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Green Operations Practices and Their Role in Achieving Environmental Sustainability Through Intelligent Quality Management (An Analytical Study of The Opinions of a Sample of Employees at the Ur General Company in Iraq)

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ABSTRACT: This study aimed to determine the impact of green operations practices in achieving environmental sustainability through intelligent quality management. The hypothetical plan was built according to the three variables of the study, in light of which the main and sub-hypotheses were developed. This study was applied and tested in the government sector of Ur General Company, affiliated with the Iraqi Ministry of Industry and Minerals. The questionnaire was used as a method to collect data from a sample of 290 individuals. The results indicated that there is a positive impact of green operations practices on environmental sustainability. Therefore, when the company conducts its operations while paying attention to the concept of the environment, it will produce green operations with many opportunities that can be developed. Based on the results that were reached, a number of recommendations were proposed, the most prominent of which was the interest in implementing green operations practices in the company sample of the study by developing all green practices that would work to reduce the environmental damage resulting from the organization's operations from polluting emissions and waste of resources and energy.

KEYWORDS: green operations practices, intelligent quality management environmental sustainability, Ur General Company in Iraq

INTRODUCTION

Diagnosing the research problem is the first and most important stage of scientific research, especially since it gives helpful indicators to obtain answers related to improving the current situation in business organizations, as it represents a situation where there is a gap between the actual level and the desired level. This section deals with clarifying the general framework of the study in terms of determining The problem, its presentation in both its cognitive and field aspects, its causes, and the most important questions that the study seeks to answer, in addition to addressing the importance of the study, the goals it seeks to achieve, and its justifications, along with presenting the general structure of the study.

1. Study Problem

1.1. The cognitive controversy of study

Environmental sustainability became a slogan for many management thinkers and forward-thinking practitioners in the early 1990s. It is unlikely that this in thought and philosophy will return to the classical economic perspective of the organization as an entity seeking to achieve profit with the continued progress and growth of industrial society, especially since the pressures exerted to increase the focus on the natural environment will not stop, and it is almost certain that this growth in Environmental awareness of organizations will continue. For example, a Miller (1998) survey of 1,000 US manufacturers found that 90% had environmental strategies and 80% believed they had environmentally friendly mechanisms and processes. Those initial efforts contributed to its introduction into the organization and manufacturing strategy, noting that there are many problems facing organizations that seek to be environmentally conscious, and these environmental issues include global, regional and local perspectives. Therefore, the responses of these organizations should be profound, strategic and directed to address the issue of environmental sustainability (Sarkis, 2001:2).

On the other hand, to ensure the survival and sustainability of organizations, it has become necessary for them to adopt green operations practices that enable them to perform their required activities in a way that reduces the environmental impact of their operations, as green operations practices include (production planning practices - product and process development - supply chain management - and post-operations Sales) contribute to enhancing the environmental performance and competitiveness of business organizations, as green operations adopt a basic approach based on managing environmental operations by integrating environmental management principles with the decision-making process to transform resources into usable and environmentally friendly products. (Nunes, Bennett, 2010:4).

The green operations strategy is the appropriate tool to guide the organization, whether industrial or service, on how to deal with environmental impacts, as there is an urgent need to know the tools that help organizations understand the problems related to their operations, whether purchasing, manufacturing, design, or logistics services, and then set specific goals. And measuring the extent of contribution to achieving environmental progress and success. This, in turn, necessitates organizations to adopt intelligent quality management tools that are based on the use of comprehensive and added technologies, including big data, artificial intelligence, robotics, distributed recording systems, and virtual and augmented reality technologies. The most important aspect of a intelligent quality management system is obtaining the necessary information from a group Huge heterogeneous data for digital production, modeling production processes and ensuring the flow of electronic documents, which allows providing high quality in the products and services provided and complying with regulations and regulatory requirements related to achieving environmental sustainability. (Chesalin et al., 2020:1).

Through the literature review and theoretical survey of many previous studies, it was revealed that there is no study or research, whether at the Arab or foreign level, that combines the variables of the current study (green operations practices, environmental sustainability, and intelligent quality management) in the same current research model, as those studies focused either On the direct relationship between green operations practices and environmental sustainability, or the direct relationship between intelligent quality management and environmental sustainability, or even dealing with green operations practices as an intermediary variable within the framework of the research model, and this indicates the existence of a knowledge gap, which prompted the researcher to determine the nature of the relationship between These variables and their interpretation.

1.2. The problem of the practical study

Iraqi industrial organizations face many difficulties and problems related to the lack of clear-cut industrial policies towards achieving sustainable development, the obsolescence of production methods that have led to low levels of production, high production costs, and a weak ability to compete with imported goods, in addition to the lack of support required for industrial projects of strategic importance, which It requires large financing, such as chemical, petrochemical, construction, and mining industries, such as sulfur and phosphate extraction, and the lack of an administratively and financially stable work environment, which limits the improvement of the level of local products.

On the other hand, industrial organizations in Iraq suffer from intense competition due to the large amount of products imported into the markets, and the lack of clear mechanisms and controls to limit it, despite the state issuing some laws to prevent the import of some products to support and protect the national product. In this context, the cable and aluminum industry is one of the important and vital industries for the national economy due to the continuous demand for it by the Ministry of Electricity. The researcher chose Ur General Company - Dhi Qar as it is the main company that has branches in most of the governorates of Iraq, as well as because of its ability to To provide a high-quality product that meets the needs of the Iraqi market despite the importation that caused a decrease in the market share of the company's products investigated (cables and aluminum), and therefore it has become necessary for the company's management to adopt modern strategies and work mechanisms to confront the challenges in this field.

Based on the field visits and unstructured personal interviews conducted by the researcher at Or Dhi Qar Company to identify the extent of the possibility of adopting correct foundations for green operations practices in order to achieve excellence in the level of environmental sustainability of the company under study, the researcher found the possibility of conducting this study in the aforementioned factory since it has operations with similar Environmental impacts related to the subject of the study, as well as the desire of the company's senior management and employees to conduct such a study to find out the extent of the impact that adopting green operations practices can have to avoid environmental impact amid the challenges and difficulties that the factory is experiencing within the current environmental changes.

In light of the above, the problem of the study can be defined as follows:

The low level of achieving environmental sustainability in the company under study is due to the failure to adopt correct green operations practices and the weakness of the tools used in the intelligent quality management system.

2. Questions of the Study

Based on the research problem identified in the previous paragraph, the study sought to answer the following questions:

1. What is the level of implementation of green operations practices in the company under study?
2. What is the level of application of the intelligent quality management system in the company under study?
3. What is the level of achieving environmental sustainability in the company under study?
4. Is there an impact of green operations practices in achieving environmental sustainability in the company under study?
5. Is there an impact of green operations practices on the intelligent quality management system in the company under study?
6. Does implementing a intelligent quality management system affect achieving environmental sustainability in the company under study?
7. Is there an impact of green operations practices in achieving environmental sustainability through the intelligent quality management system in the company under study?

3. Objectives of study

Through this study, the researcher aimed to achieve the following objectives:

1. Determine the impact of green operations practices in achieving environmental sustainability in the company under study.
2. Determine the impact of green operations practices in achieving environmental sustainability through intelligent quality management.
3. Determine the level of interest in achieving environmental sustainability in the company under study, and which indicators are of greater interest to it.
4. Determine the level of application of the intelligent quality management system in the company under study, and determine the most applied practices in the company under study?
5. Determine the impact of adopting intelligent quality management in achieving environmental sustainability.
6. Determine the awareness of officials in the company under study of the concept of green operations practices, and identify the most important foundations that facilitate their adoption.
7. Diagnosing the challenges and difficulties facing the company under study in adopting green operations practices and achieving outstanding environmental sustainability.

4. Study Hypotheses

A theoretical framework represents and details the relationships between variables, explains the theory behind these relationships, and describes the nature and direction of the relationships. A review of the literature paves the way for a good theoretical framework, which in turn provides a rationale for developing testable hypotheses. (Sekaran & Bougie, 2016:81).

Based on the above and based on the theoretical foundations, the hypotheses can be formulated as follows:

H_1 : There is a significant effect of green operations practices on environmental sustainability.

From this main hypothesis, four sub-hypotheses emerge:

H_1a : There is a significant effect of green manufacturing on environmental sustainability.

H_1b : There is a significant effect of green design on environmental sustainability.

H_1c :There is a significant effect of green purchasing on environmental sustainability.

H_1d :There is a significant effect of the green supply chain on environmental sustainability.

H_1e :There is a significant effect of green buildings on environmental sustainability.

H2 :There is a significant effect of green operations practices on intelligent quality management.

From this main hypothesis, four sub-hypotheses emerge:

H2a : There is a significant effect of green manufacturing on intelligent quality management.

H2b :There is a significant effect of green design on intelligent quality management.

H2c :There is a significant effect of green purchasing on intelligent quality management.

H2d :There is a significant effect of the green supply chain on intelligent quality management.

H2e :There is a significant influence of green buildings on intelligent quality management.

H3 :There is a significant impact of intelligent quality management on environmental sustainability.

From this main hypothesis, four sub-hypotheses emerge:

H3a :There is a significant effect of the Process Data Exchange Module on environmental sustainability.

H3b :There is a significant effect of the Algorithm of iterative Process Mining on environmental sustainability.

H3c :There is a significant effect of Backward Quality Tracking Module on environmental sustainability.

H3e: There is a significant effect of Front Quality Improvement Module on environmental sustainability.

H4: There is a significant impact of green operations practices on environmental sustainability through intelligent quality management.

From this main hypothesis, four sub-hypotheses emerge:

H4a :There is a significant effect of green operations practices on environmental sustainability through the Process Data Exchange Module.

H4b: There is a significant effect of green operations practices on environmental sustainability through the the Algorithm of iterative Process Mining.

H4c: There is a significant effect of green operations practices on environmental sustainability through Backward Quality Tracking Module.

H4d :There is a significant effect of green process practices on environmental sustainability through the Front Quality Improvement Module.

5. Study Justification

There are a group of justifications that prompted the researcher to choose the topic of his study, the most prominent of which are:

1-The importance of applying the intelligent quality management system in the industrial environment, especially since it involves a set of intensive knowledge activities for continuous improvement and enhancing business performance within organizations through the use of objective observations, standardizing the use of knowledge, achieving alignment with regulatory standards and implementing guidelines to ensure the achievement of the highest levels. Quality of the products provided (Ansari, Seidenberg, 2011: 152), This is what motivated the researcher to study and adopt a intelligent quality management system in the Iraqi environment in order to discover defects and deviations in the manufacturing process and correct them in the appropriate manner and time.

2- The importance of green operations practices for industrial organizations in enhancing environmental performance, as green practices include production planning, product and process development, supply chain management, and after-sales operations, contribute to reducing expenses, increasing the efficiency of resource use, and reducing environmental risks, in addition to enhancing competitiveness For organizations (Nunes, Bennett, 2010:4).

3-Environmental sustainability is one of the important priorities for business organizations at the present time, especially in the industrial sector, where environmental issues have raised great controversy about the corrective measures that must be taken to prevent environmental degradation. Therefore, creating a sustainable environment necessarily requires the implementation of a strategic plan that includes biological or biological solutions. Green, and in this context it was necessary to benefit from green operations practices to achieve environmental sustainability in Iraqi industrial organizations (Arora et al., 2018:11).

4- Adopting the foundations of green operations and the intelligent quality management system to achieve excellence from an environmental standpoint, and trying to provide some solutions to the problems and challenges with an environmental impact that obstruct the work of Or Dhi Qar Company in adopting the requirements of green operations to achieve a high level of environmental sustainability through the application of the intelligent quality management system.

6. Importance of study

The researcher divided the importance of his study into theoretical importance and practical importance as follows:

6.1. Theoretical importance:

A - Discussing the intellectual and philosophical debate regarding the variables of the study in terms of content and intellectual aspects, and the findings of researchers in this field.

B - Presenting philosophical and intellectual theoretical concepts about the variables of the study and researching them in-depth for the purpose of benefiting from them in bridging the knowledge gap.

C - The scarcity of previous studies that addressed the relationship between green operations practices and environmental sustainability with the presence of intelligent quality management, as the current study focused on the Iraqi industrial environment, and the extent to which reality can be improved by measuring the requirements of continuous improvement in order to respond to environmental requirements.

D - The study focused on presenting an intellectual proposal concerned with modernity with regard to green operations, intelligent quality management, and environmental sustainability, which are among the topics that writers and researchers have addressed in terms of their variables individually or linked to other variables.

E - The possibility of adopting this study to conduct future studies in different sectors, and provide senior management with information about the importance of green operations practices, and how to achieve sustainable environmental sustainability through a intelligent quality management system.

6.2. Practical importance:

A- Focusing on environmental aspects to achieve a competitive advantage for organizations by achieving environmental sustainability and reducing costs.

B- Increase awareness of the environment, reduce waste, and recycle materials for later use.

C - Delving into a field of research related to the industrial sector through the variables of the current study to address contemporary problems that have not been addressed by other researchers to the best of the researcher's knowledge.

D- Benefiting from the results and recommendations of the study to address similar problems in other companies affiliated with the Ministry of Industry.

E - Understanding the nature of the relationship between the study variables (green operations practices and environmental sustainability through intelligent quality management) in the researched company, where the reason lies in choosing the study population due to the role it plays in the Iraqi economy and the ability to achieve practical addition in the industrial sector.

F- Addressing a realistic problem and analyzing and describing its variables based on statistical methods and scientific standards.

J - Knowing the levels of application of green operations, and the extent to which the researched company possesses intelligent quality management in order to reach distinct levels of environmental sustainability.

K - Taking advantage of the nature of the relationship that exists between the variables of the study (green operations, intelligent quality management, and environmental sustainability) in improving the environmental performance of the company under study, and increasing its level of awareness in a way that reflects positively on its environmental performance.

7. Contributions of Study

1- The researcher dealt with a research model that included three variables: (green operations practices - environmental sustainability - intelligent quality management) to fill the knowledge gap in previous literature, as these variables had not been tested in a single model previously, to the best of the researcher's knowledge.

2- Testing the relationship between green operations practices and environmental sustainability through the presence of intelligent quality management as an intermediary variable.

3- Employing a scientific methodology to achieve the objectives of the study by diagnosing a realistic problem suffered by industrial organizations in general and Ur Dhi Qar Company in particular, and working to adapt several metrics from foreign studies to measure the variables studied in a way that is compatible with the Iraqi manufacturing environment.

4- Benefiting from the previous literature that was reviewed to explain the causal relationship between the variables of the study, where institutional theory was employed to determine the nature of the relationship between green operations practices, intelligent quality management, and environmental sustainability, which emphasizes that the behavior of industrial organizations is affected by the regulatory environment, especially since those organizations It must align its operations with the rules and standards of leading organizations in order to obtain the necessary support and avoid risks associated with the complex environment.

5- Arriving at a research model that tests the relationship between the study variables within the practical framework, using structural modeling equations (SEM).

8. Study methodology and used tools

The researcher adopted the descriptive analytical method, which focuses on collecting facts relevant to a particular phenomenon, while providing a detailed description of the case being investigated in order to arrive at a set of recommendations related to the phenomenon or situation under study. The nature of the study also required the use of statistical methods, as the method used helps in Deep and comprehensive analysis of all data and information obtained for the purpose of testing hypotheses.

In order to achieve the objectives of the study, a number of tools were used to collect data, as follows:

1. The theoretical aspect: The researcher relied on the contributions of researchers and specialists, which are represented by books, dissertations, dissertations, and periodicals, as well as websites to collect data related to the theoretical aspect.

2. The applied aspect: The researcher relied on a number of sources to collect data related to the applied aspect, as follows:

A - Personal interviews: The researcher conducted a number of unstructured personal interviews with (the general manager, department managers, division officials, and engineers) at Or Dhi Qar Company, in order to know their opinions regarding the variables of the study.

B- Documents, records and reports of the Ur General Company, Dhi Qar.

C - Questionnaire form: The researcher adopted the design of the questionnaire form as an appropriate tool for collecting data, and adopted its results as an input for statistical analyses, and as a summary of what he presented (Sekaran & Bougie, 2016:63-69) regarding measuring the studied variables.

The questionnaire was composed of two parts: the first part includes personal information relevant to the study sample, while the second part includes the main variables of the study, the independent variable (green operations practices), which included sub-dimensions represented by (green manufacturing, green design, green purchasing, green supply chain, Green buildings), the intermediate variable (intelligent quality management), which in turn included sub-dimensions represented by (the process data exchange unit, the reverse quality tracking unit, the forward quality improvement unit, the interconnected process mining algorithm), and the dependent variable (environmental sustainability), which also included dimensions Sub-categories: (waste management, rationalization of water consumption, air emissions, use of renewable energy sources, rationalization of resource consumption). Table (1) shows the study standards and the Resources relied upon

Table (1): Study standards and References

sequence	The main variables	Dimensions	Paragraphs	References
1	Green operations practices	Green manufacturing	10	Nunes& Bennett ,2008(، Nunes,2011)Al Sheyadi,2014)(MUTHEKE,2016 Liu etal ,2017 Al-Ghwayeen&) Abdallah,2018
		Green design	7	
		Green purchase	10	
		Green supply chain	9	
		Green buildings	5	
2	Intelligent quality management	Process Data Exchange Module	5	Alhassani ,2021
		Algorithm of iterative Process Mining	5	
		Forward Quality Optimization Module	5	
		Backward Quality Tracking Module	4	
3	Environmental sustainability	Waste management	9	Cook, etal.,2017 Tseng et al ,2019 Green etal.,2019 Gupta & Gupta.,2020 Cantele & Cassia ,2020 Kumar& Chaudhary,2021 Ferreira etal.,2023 Shamsuzzaman et al.,2023 Ismail et al.,2023 Sarango-Lalangui et al.,2023 Alshuwaikhat et al., 2023 Chen et al.,2023 Lin & Zhai, 2023
		Rationalization of water consumption	12	
		Air emissions	11	
		Use of renewable energy sources	10	
		Rationalization of resource consumption	9	

9. Theoretical Study Diagram

The hypothetical diagram of the study aims to clarify the relevant relationships between the main and sub-variables, as the dimensions for each variable were chosen based on previous surveys and literature on green operations practices, intelligent quality management, and environmental sustainability. This diagram in Figure (1) represents a set of relationships related to the variables of the study. As follows:

1. The independent variable (green operations practices): It was measured through the following dimensions (green manufacturing, green design, green purchasing, green supply chain, green buildings).
2. The intermediate variable (intelligent quality management): It was measured through the following dimensions (process exchange unit, reverse quality tracking unit, forward quality improvement unit, interconnected process mining algorithm).
3. The dependent variable (environmental sustainability): It was measured through the following dimensions (waste management, rationalization of water consumption, air emissions, use of renewable energy sources, rationalization of resource consumption).

The following figure shows the hypothetical plan of the study:

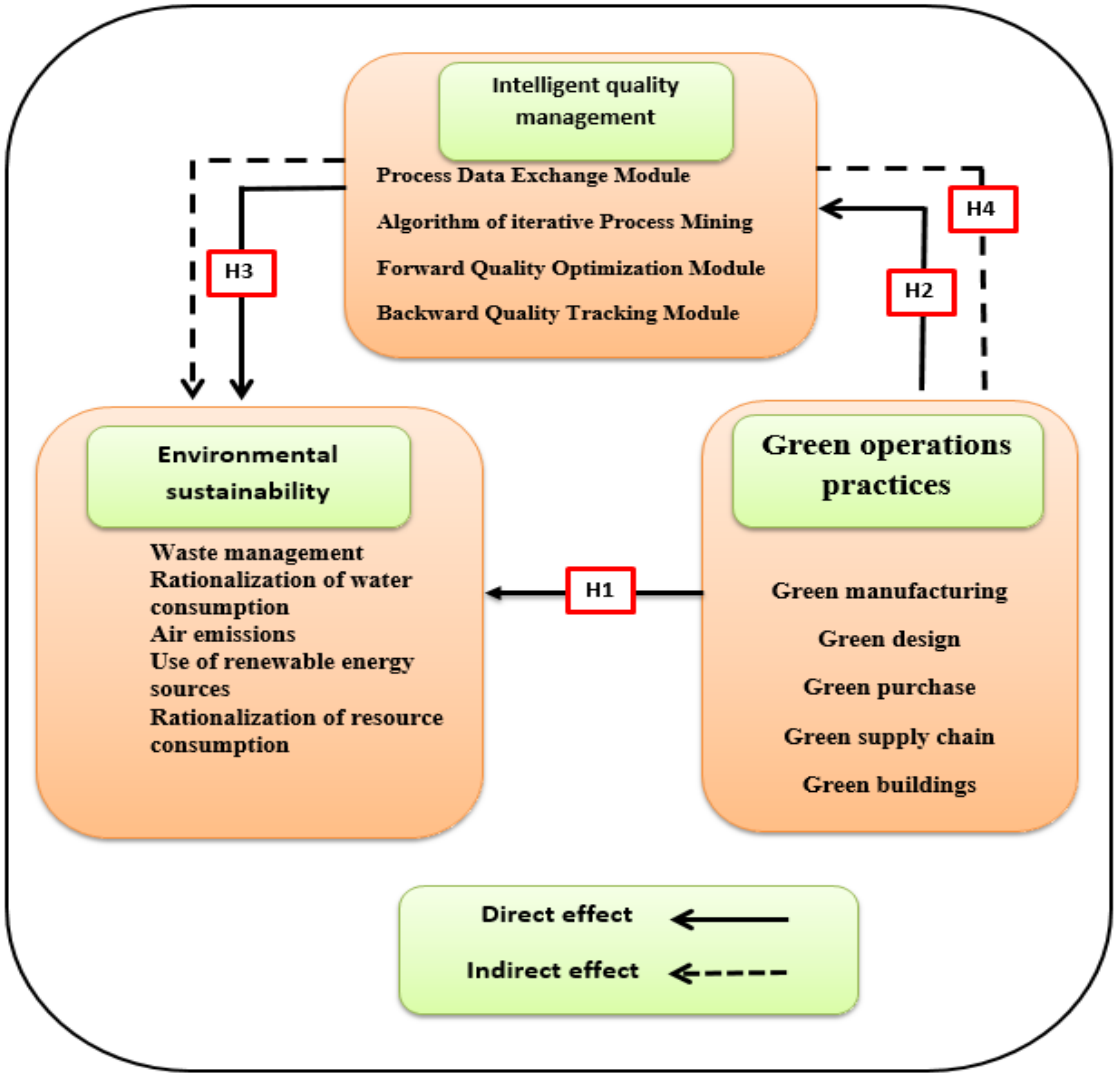

Figure (1) Hypothetical diagram of the study: prepared by the researcher

10. Study Limits

1- Cognitive limits: The study is one of the contemporary research contributions in the field of production and operations management, which includes green operations, intelligent quality management, and environmental sustainability.
2- Human limits: The human limits are represented by the employees of the researched company.
3- Spatial limits: The study was applied in the Ur General Company in Dhi Qar.
Time limits: The time limits for the study extend from 1/1/2023 to 18/6/2024.

11. Study population and sample

The study sample was chosen from employees of the Ur General Company affiliated with the Iraqi Ministry of Industry and Minerals, and (12) departments of the company were chosen as a population for the study because of their relationship to the topic of the thesis, which is located in Dhi Qar Governorate. The justification for choosing this company is:

1. The strategic role it plays in the Iraqi economy
2. A company that has a vision and policy of quality, environment, health and occupational safety.
3. Enhancing the industrial sector's ability to provide the best services
4. The industrial sector suffers from administrative and technical problems in this field
5. The industrial sector suffers from a decline in the quality of the products provided

As for the study sample, it was represented by (297) individuals from the study population of (1288) individuals, based on the table provided by (Sekaran & Bougie 2016:315), which includes the above sample size for the study population located between (1200-1300) and Table No. (1). It explains the details of the study population and sample and my agencies:

Table 1: Details of the study population and the questionnaires distributed, retrieved, and analyzed

sequence	Targeted UR company divisions	Study population	questionnaire distributed	questionnaires retrieved		questionnaires analyzed	
1	Planning Department	20	5	5		5	
2	Commercial department	40	9	9		9	
3	Quality Management and ISO Department	7	2	2		2	
4	Building Maintenance and Industrial Services Department	25	6	6		6	
5	Safety and Engineering Inspection Department	17	4	4		4	
6	Information Center Department	19	4	4		4	
7	Cable factories	579	133	128		128	
8	Aluminum factories	406	94	92		92	
9	Quality control department	140	32	32		32	
10	Research and development department	5	1	1		1	
11	Marketing department	23	5	5		5	
12	Technical department	7	2	2		2	
The Total		1288	297	290	%97.6	290	%97.6

Theoretical Framework

1. Green operations concept:

The definitions that address the concept of green operations have varied, and their content sometimes differed depending on the school to which the researcher belongs, or the economic sector in which it is applied. Below are some definitions by a number of researchers as follows:

Table (2): The concept of green operations

(wong et al, 2012:283)	All environmental practices that are product and process oriented to reduce the harm of products and supply chain processes to natural resources.
(Martinez, 2013: 35)	It is to cover the environmental impacts of the organization's work, products and facilities, eliminate waste and emissions, achieve the maximum efficiency and effectiveness of its resources, and reduce practices that may negatively affect future generations' benefit from environmental resources.
(Kariuki, 2014:2)	These are processes whose main purpose is to produce products that are closely linked to recycling and reuse at the end of the product's life.
(Sheikh, 2014: 14)	It is the use of the organization's resources and special capabilities in order to deliver a product in the most efficient and effective way, by achieving integration between operations to achieve sustainability.
(Skibinska & Kott, 2015: 220-221)	It is another concept of sustainable development that is based on three pillars, represented by society, environment and economy, but the difference appears that green operations are a single concept based on the organization, while sustainable development is directed to society.
(Liu et al, 2017: 185)	It is the integration of environmental considerations into operations management through analysis of the organization's strategic strategies.
(Liu et al, 2019: 31)	Refers to the systematic consideration of the design process regarding environmental improvement over the life cycle of a product, and includes both resource conservation, use of recycled materials, and minimal energy consumption product design.

Reference: Prepared by the researcher based on previous literature

From the above, it can be said that green operations are not limited to a productive executive situation related to the final product, but rather a way of thinking that concerns not only senior management, but also all employees and human resources in the organization, through which they take environmental protection as a major criterion in rationalizing the decision-making process. At the administrative and operational levels and in all stages of the organization's work, taking all steps and procedures that end with achieving the set environmental goals.

2. Green Operations steps:

The process of an organization's transition to green operations goes through a set of stages, which can be arranged as follows (Hraiga et al, 2023:92-93):

1. Inspection of processes with green characteristics:

At this stage, it is ensured that the main characteristics that must characterize the processes are available, so that they are green processes that achieve the goals desired for their adoption. These characteristics can be defined as follows:

- Necessary: meaning that the process that is adopted will lead to adding value to the product, contribute to achieving economic value for the organization, and are consistent with the legal and regulatory requirements for environmental protection.
- Efficiency: It means implementing green operations in the best and most appropriate way, using the best tools, techniques and resources.
- Effectiveness: means ensuring that these processes will lead to achieving the set goals in terms of reducing pollution and reducing waste.
- Flexibility: It means the ability to modify operations in order to respond to changes and developments, whether at the internal level of the organization or the external environment. Thus, operations are more flexible the faster they respond to government legislative requirements related to the environment, for example.

- Measurability: This means the possibility of achieving control and verifying the success and validity of the application of these processes and the extent of their impact on the environment at each stage of implementation.

Here, at this stage, processes that meet the characteristics of green science are tested, and processes that do not meet the specified conditions and standards are reported.

1. Integration of operations with environmental dimensions:

At this stage, it is necessary to verify the integration between the process on the one hand, and the environmental requirements on the other hand, and this requires a clear and sufficient knowledge and understanding of all the operations adopted by the organization, and the involvement of environmental dimensions in every activity of the operations, by adopting an appropriate methodology that It includes a set of measures and mechanisms according to the following:

- Dividing processes into phases and sequential activities.
- Apply environmental dimensions at every stage.

2. Green process re-engineering:

This stage involves conducting a comprehensive analysis of each process and dividing it into smaller partial processes, then studying the environmental impact of each process separately, studying the importance of this activity at the level of performance in the organization, and ensuring the possibility of reformulating and designing the process in alternative ways that achieve greater efficiency. It results in less pollution, waste and energy.

Ultimately, this stage requires redesigning and restructuring operations, which means difficulties related to the nature of operations, difficulty in finding the appropriate alternative to achieve the environmental standard, and compensating for the economic and social impact in the event that it is not possible to develop and modify the process.

3. Feedback:

At this stage, performance is monitored, and continuous improvement is carried out in terms of monitoring emissions resulting from each process, and comparing them to the target standard values, to ensure the effectiveness and efficiency of the process.

From the above, it can be said that the process of transitioning to green operations is the other side of the process of re-engineering green operations, which is based in essence on adopting the environmental concept and environmental issues in the process of redesigning and building operations in the organization in order to achieve its goals in light of protecting the environment and environmental objectives.

3. Green Operations Practices:

Organizations can adopt green operations practices by making simple or fundamental changes, with the aim of saving energy and resources used, which results in the adoption of environmentally friendly operations, or investment in renewable energies and other operations (Sheikh, 2014: 28), Academics differed in classifying and defining these practices, but in most studies they were dealt with through five main practices:

- **Green design.**
- **Green purchasing.**
- **Green manufacturing.**
- **Green supply chains.**
- **Green buildings**

✓ Green design: It is the process of controlling the product's life cycle process to achieve maximum efficiency of resource use, protect the environment, reduce pollution, maximize value and reduce costs, as green design does not focus only on humans, but also on nature, by achieving harmony and coexistence between them (Yuan, Tang, 2021: 1)

In another definition, it is defined as the process of replacing a substance or process that is likely to have a dangerous impact on the environment with another that is less dangerous (Amemba et al, 2013:53).

Green design is based on the principle of reducing, reusing and recycling. It is not only based on reducing energy consumption and reducing harmful emissions, but also emphasizes the importance of facilitating sorting, reusing and recycling products (He, 2016: 258). Green design means looking at the environmental impact. Throughout the design process in order to achieve sustainability, the entire product life cycle is taken into account (Rosen, Kishawy, 2012: 164)

- Green purchasing concept:

Green purchasing is defined as a set of activities that include reducing, reusing, and recycling resources in the purchasing process, and sourcing a selection of products and services that reduce environmental impact (Amemba et al, 2013:53).

- Green manufacturing:

The first official appearance of the concept of green manufacturing occurred at the end of the sixties, by relying on mechanisms and methods that help reduce pollution and harmful emissions from factories and companies, by applying the end-of-pipe mechanism, which is used to treat pollution in the final stages of the production process as a form of compliance with environmental regulations (Xie et al, 2022: 3), and with the beginning of the 1980s, the shift began to mechanisms for preventing pollution instead of treating it, which was called the term "cleaner production techniques," and eventually the term green manufacturing was proposed by the United Nations for the first time in 1989.

(Zakaria, 2018:5) defined green manufacturing as the application of one or more environmental and chemical sciences, environmental monitoring and information technology, for monitoring and modeling with the intention of preserving the environment and natural resources, and reducing the negative effects of industrial processes.

While (Haleem et al. 2023:2) defined it as a manufacturing method that reduces environmental consequences and disasters through the use of innovative production methods, which lead to reducing and recycling waste.

- Green buildings:

Green buildings are defined as buildings designed with care and respect for nature and the ecosystem, so as to reduce the side effects of human activity on the environment in terms of resources, materials and processes (Xiong, 2015: 7).

(Hou et al., 2023:2) believes that green construction has become an inevitable trend in the development of the building and construction industry, and its major role in alleviating the pressure resulting from the consumption of resources and energy, and high rates of pollution by achieving green development.

- Green supply chains

The concept of green supply chains appeared for the first time in 1999, as an expanded supply chain that takes into account the environmental aspects, effects of the product, and its shelf life. It can be defined as applying the principles of sustainable development when dealing with the supply chain. Green logistics management includes both the processes of improving roads and reducing Fuel consumption, reducing emissions, and maximizing the volume of transported goods

(Noiki et al, 2023:2)

It is also defined as the organization's plans regarding purchasing operations, in which environmental issues and supply chain management are combined in order to improve the environmental performance of suppliers and customers (Shamimul et al, 2017: 15). It is a network of suppliers, manufacturing, assembly, distribution, and logistical facilities that constitute the material purchasing function. And the conversion of materials into semi-finished goods and finished goods, in addition to the process of distributing materials and products (Jasina et al, 2023: 1188), so the green supply chain is responsible for scheduling and controlling the processes of purchasing, production, inventory, and delivering products to customers.

The concept of intelligent quality management :

The concept of intelligent quality management (IQM) is an introduction to integrating information through quality management practices in the database, where decisions are made based on facts related to quality based on data mining techniques and knowledge discovery in the database, and comprehensive quality management practices are the basis for the quality management system. Intelligent, which is based on the assumption that learning skills and knowledge improve dynamically during the iteration of the quality management process through the assistance of the knowledge management component (Gerlich & Gottschalk, 2019: 43).

On the other hand, intelligent quality management is a repetitive process consisting of intensive knowledge activities to continuously improve and enhance business performance within the organization. These activities are classified into two types of categories, the first: includes previous knowledge management activities (such as knowledge acquisition, scoping, and evaluation), and the second: activities Subsequent to knowledge management (such as analyzing objective feedback and reasoning), as completing the implementation of these activities is the primary success factor for intelligent quality management (IQM) (Ansari et al., 2011: 152)

Writers and researchers have addressed the concept of intelligent quality management through many definitions and viewpoints that agree in some aspects and differ in other aspects. The following table shows some of the definitions related to intelligent quality management:

Table 3: The concept of intelligent quality management

Westgard et al.,) (2003:1	The quality control process is statistically and fully automated, where repeated measurements are used to control internal processes, monitor measurement variation and indicate abnormal deviations, and then apply pattern recognition algorithms to determine the type of error and take appropriate corrective actions.
(Wang, 2009:1)	Develop an intelligent system to capture quality audit data from various processes during manufacturing, where meaningful patterns and knowledge are discovered for future improvement
(Lau et al., 2009: 1802)	The ability to develop an intelligent system to identify quality audit data from different processes, discover knowledge aimed at improvement, and determine the relationship between process features and quality features or final results through data mining and artificial intelligence techniques.
(Xu et al., 2018: 443)	A system that relies on unified, modular entities to detect current and previous quality errors and take immediate measures to find out their causes and address them with the aim of laying the foundation for building the subsequent quality knowledge base.
(Gerlich & Gottschalk, 2019: 21)	An introduction to adopting data mining technology and discovering knowledge in databases, and integrating the information collected from quality management practices into a primary database with assisted decision making based on data mining.
Kima & Ryu, 2020:) (382	The statistical control process based on the use of historical data and its analysis with artificial intelligence techniques, with the aim of preventing the production of defective products in the future and facilitating the innovation process in value chains by maximizing the use of field information.
Somasundaram et) (al., 2020: 439	The system designed to detect quality problems early to take proactive measures in order to produce products conforming to quality standards in various branches and departments of the organization
Shafique et al., 2015:) (1312	Various data mining techniques to predict behavior and trends that allow experts to make more accurate decisions based on knowledge

Reference: Prepared by the researcher based on previous literatur

The importance of intelligent quality management:

Based on the algorithms used by the intelligent quality management system to mine quality control data and discover the knowledge required to perform continuous improvement on processes and products, there are a group of factors that confirm the importance of this system, the most important of which are embodied in the following: (Madavi, et al., (2012: 74) (Abraham & Suganthi, 2013: 307) (Oztemel, 2020: 14)):

1-The intelligent quality management system provides the necessary facilities for internal operations to occur efficiently and effectively, which leads to achieving customer satisfaction and improving the level of profitability.

2-The intelligent quality management system identifies the reasons for the occurrence of problems, errors and defects in manufacturing and production, where proactive measures are taken to prevent process failure and reach the level of superior quality.

3- Benefit from analyzes and observations related to the organization's operations in order to raise the level of quality and achieve continuous improvement.

4- Intelligent quality management is designed on the basis of continuous improvement of internal processes related to quality control, which leads to high-quality products at the lowest possible cost.

5-The intelligent quality management system relies on historical data, which contributes to early detection of quality problems and enhancing the organization's activities related to the design and production process.
6- The intelligent quality management system improves the organization's ability to control operations effectively and adapt to changing customer requirements, which helps in reaching meaningful cognitive patterns.
7-The intelligent quality management system works to achieve competitive advantages for the organization in private industries.

The objectives of intelligent quality management system:

By implementing a intelligent quality management system, organizations aim to achieve a set of goals, the most important of which is: (Ansari et al., 2011: 153) (Xu et al., 2018: 442):
1-Create a database that can be referred to when any quality-related problems occur in the future.
2- Achieving a comprehensive understanding of the types of errors and defects that occur in product parts during the stages of the production process by using the available data to extract a matrix of the relationship between the types of errors and quality problems.
3-Using time series data related to quality and analyzing it based on intelligent statistical programs with the aim of identifying the causes of deviations and addressing them.
4- Achieving high coordination between all administrative levels in the organization, which contributes to making the right decisions the first time.
5- Reducing the time and cost related to causal analysis of quality problems, as the data analysis process is based on a digital fishbone diagram that provides real and reliable reasons for quality management practices.
6- Providing the required knowledge to employees responsible for addressing problems, given that the intelligent quality management system is linked to artificial intelligence, so it contributes to solving problems through the question-answering system.
7- Increasing the organization's operational efficiency by continuously improving processes and reducing recurring errors in the production process.
8- Utilizing knowledge management techniques to provide high-quality performance inputs and obtain final outputs for continuous improvement.

Therefore, it can be said that the primary goal of the transformation process for a intelligent quality management system in business organizations is to define the application scenario that describes the target state of the system, identify the value-hosting activities (which determine the causes of deviations and methods for addressing them), and document the technical and organizational conditions and requirements using artificial intelligence techniques, leading to Improving the quality of final performance through the use of knowledge-intensive activities, objective feedback analysis, and systematic reasoning.

The concept of environmental sustainability:

Environmental sustainability is one of the advanced concepts for which many conferences, seminars and workshops were held in many local, international and international forums, all of which emphasized protecting the environment and finding ways, means and tools to reduce the depletion of natural resources as a result of irresponsible practices that caused significant environmental damage such as social pollutants. Economic, health and environmental.

Researchers and academics have addressed the concept of environmental sustainability through many definitions and viewpoints that all agree and emphasize the necessity of protecting the environment by controlling the overexploitation of natural resources. The following table shows some of the definitions that have addressed this concept:

Table (4): The concept of environmental sustainability

(Ekins et al., 2003: 166)	Preserving important environmental functions, and maintaining the ability of capital to provide those functions. This concept also includes two important aspects: (the specific functions that must be focused on, and the level that ensures their preservation in the long term)
(Sutton, 2004;9)	Achieving balance in environmental, economic and social issues, and integrating programs and procedures based on participation and consultation with stakeholders and members of the human community, with the aim of preserving natural resources and the integrity of the ecosystem.
(Attah, 2010:6)	Factors and practices that contribute to maintaining environmental quality in the long term

(Morelli, 2011:6)	A basic condition for balance, flexibility and interconnectedness that allows meeting the needs of human society, and working to continue renewing the services necessary to meet those needs, while preserving the quality of nature and ecosystems.
(Wu & Wu, 2012:67)	Meeting the needs of present generations without compromising the ability of subsequent generations to meet their needs
(Cai et al., 2013:492)	The ability to reduce the negative impacts and maximize the positive impacts of human behavior on the environment through designing, producing, applying, operating and disposing of products in a manner that is not harmful to the environment.
(Yuan, 2013:177)	Make the decision to mitigate the negative impacts and effects of human activities and then take action towards using limited resources in a fair and equitable manner for both present and future generations.
Hecker & Hornung,) (2015:9	A concept that focuses on two important elements: the input element through preserving the raw materials used and not allowing the use of unsuitable materials in order to control the outputs of the production process, and the output element through the ability to be aware of the waste resulting from manufacturing processes.
(Klarin, 2018:76)	A concept that includes three basic elements: development (economic and social in line with environmental constraints), needs (redistribution of resources to ensure the quality of community life) and future generations (the possibility of using resources in the long term to ensure the necessary quality of life for future generations)
Skripnuk et al.,) (2019:4	The ability of the environment to continue and continue to function properly, and to reduce environmental degradation or pollution to a minimum, meaning that nature is able to renew the environmental balance, as this is achieved by integrating environmental considerations when planning development so as not to cause damage to natural capital.
(Boeske, 2023:3)	Commitment to activities and actions related to the integration of social and environmental concerns into daily work, with individuals being aware of the choices that affect the achievement of balance in social, environmental and economic systems, and being aware of their roles in preserving and optimally exploiting natural resources.
Charfeddine & Umlai,) (2023: 3	Controlling human behaviors that can help conserve natural resources to allow future generations to have a safe lifestyle similar to or better than that of current generations, which at its core involves protecting natural capital

Reference: Prepared by the researcher based on previous literature

Based on the previous definitions of the concept of environmental sustainability that researchers addressed, it can be said that environmental sustainability is one of the basic dimensions of sustainable development, which aims to meet the needs of current generations without compromising the ability of future generations to meet their needs. It refers to the ability to maintain balance, flexibility and stability in systems. It also aims to ensure the responsible use of natural resources, preserve biodiversity, reduce emissions and waste management, mitigate negative impacts on the environment, and limit resource depletion and environmental degradation. In other words, preserving natural resources and environmental balance is preserving the basic elements and components for the survival of human society, and using limited resources fairly and equitably.

The importance of environmental sustainability:

Environmental sustainability combines economic growth and environmental protection in a way that means investing in saving resources and preserving natural capital while achieving benefits from developing technologies and sustainable production. Many researchers in the field of environmental sustainability have indicated that protecting the environment and achieving stability in ecosystems plays an important role. In achieving business sustainability, environmental sustainability should have a long-term

perspective, taking into account the development of business systems, and the need to be flexible and adaptable, with constant attention to local and global conditions and the preservation of natural resources and biodiversity (Stojanovic et al., 2018:2).

Environmental sustainability has gained increasing importance over time, especially in light of the scarcity of resources, the damage that threatens the ecosystem, and the choices that affect living organisms, natural resources, and the climate. Therefore, environmental sustainability is a solution to increasing environmental problems by focusing on resource allocation and taking into account physical limits. Vitality, social and value systems, and focus on compliance with regulations and procedures related to environmental safety, as well as being a prerequisite for achieving long-term economic growth (Younis, Muhammad, 2017:2).

Environmental sustainability practices guarantee the ability of future generations to meet their needs, and are necessary for their survival and continuity. They support the health of human society by keeping the air clean, as well as water and soil, as their exposure to pollutants leads to many diseases, neurological disorders, malnutrition, displacement and migration, as many individuals are forced to Leaving their homes and communities due to environmental disasters such as drought, floods, fires, and lack of resources, and therefore achieving environmental sustainability is a prerequisite for preserving biodiversity, mitigating climate change, and reducing gas emissions, the source of which are human activities (Morelli, 2011:2).

The importance of environmental sustainability can be highlighted through the following points (Rebitzer et al., 2004:713):

1- Achieving positive interaction between human society and the components of the environment to ensure its sustainability.

2-Effective use of natural wealth and resources in a way that ensures the preservation of the environment.

3- Ensuring that the needs of current and future generations are met while finding less extravagant and wasteful ways.

4- Waste recycling as a tool to protect the environment.

5- Preserving natural resources represented by water, air, forests, land and biological diversity, which are necessary to ensure the sustainability of human life.

6- Achieving environmental efficiency that leads to value creation, enhancing quality of life, improving the quality of goods and services, sustainable consumption, development, and safety of operations and distribution.

7- Organizations contribute to preserving the integrity of the vital environment by reducing resource consumption and reducing the generation of waste and pollution, which leads to enhancing the reputation of those organizations and reaching optimization. In the use of raw materials, energy and water, and the possibility of renewing environmentally friendly products.

The relationship between green operations practices and environmental sustainability through intelligent quality management:

Green supply chain management focuses on eliminating or minimizing waste, including energy, chemicals, emissions, or solid waste. Therefore, it develops integrated and effective strategies to achieve goals and gain market share while adopting innovative solutions to reduce environmental risks and improve environmental efficiency. On the other hand, total quality management practices directly affect the performance of the green supply chain by developing a philosophy of continuous improvement and developing defect-free products while maintaining quality standards in products and services. Considering that total quality management focuses on human resources, leadership, and customer desires, it is An important and decisive factor for evaluating environmental performance, and therefore there is a positive role for total quality management in improving sustainable performance, that is, green operations practices and total quality management are important precedents for environmental sustainability (Jermsittiparsert et al., 2019:34,39).

According to the study of Shen, Zhang, 2023:2) digital transformation is the starting point for promoting intelligent manufacturing (IM) with regard to the path to achieving information management, as intelligent manufacturing depends on cloud computing, big data applications, artificial intelligence, and the study of technology-based manufacturing, as it aims To achieve network cooperation, mass customization and service-oriented transformation, and address bottlenecks in research and development, management and production, thus contributing to addressing problems related to environmental sustainability.

The study by (Hassan, Jaaron 2021:4) confirms that green practices mediate the relationship between total quality management and sustainable performance, as quality management allows through its practices to comply with the demands of stakeholders regarding improving their environmental footprint and thus satisfying the customer and gaining a competitive advantage, and the shift to sustainability The environment through Total Quality Management practices helps organizations compete more effectively by reducing costs in the long term, increasing investor interest, and improving the quality of processes and products. On the other hand, Total Quality Management practices enhance green innovation capabilities through its focus on rationalizing resource consumption and reducing waste. In addition, implementing green practices encourages organizational learning, develops internal competencies, and improves organizational effectiveness. All of these factors contribute to improving the financial and operational performance of organizations, allowing for the achievement of environmental sustainability.

The study by Zaid, Sleimi, 2021:2,5 explains the relationship between green practices, intelligent quality management, and environmental sustainability through a number of the following basic points:

- The purpose of total quality management is continuous progress in operational activities to achieve growth in sales and production with higher levels of satisfaction among customers and stakeholders. The scope of quality management has also been expanded to include the inclusion of social responsibility and environmental policies, as the focus of quality management is on continuous improvement and development of products. Services constitute an important priority for environmental sustainability.
- Total Quality Management practices are applied by organizations to promote the adoption of green practices through their active and effective participation in responding to customer requirements for a healthier and cleaner environment. In the same context, Total Quality Management aims to ensure the effectiveness of rapid delivery of products with high efficiency, which is an important requirement. For environmental sustainability to reduce waste.
- Green supply chain management refers to the integration of environmental concerns into all supply chain activities from material sourcing and selection and product design to delivery, so green practices constitute an important precedence for environmental sustainability.

Procedural framework

1. Evaluation of the measurement model

This study used PLS-SEM (Hair et al., 2017) to evaluate the theoretical model using SMARTPLS software. PLS-SEM uses factor analysis and multiple regression to evaluate the model as well as test the mediation model. The goal of using a measurement model is to evaluate the reliability and validity of observed and unobserved variables (Ho, 2013).

Table (5) displays the validity and reliability of all research variables. Construct validity attests to the extent to which the results obtained from the scale are consistent with the theories around which the test was designed (Sekaran & Bougie, 2016). In line with Hair et al. (2018), item norm saturations can be used to confirm the construct validity of the measurement model. This study used a critical value for loadings of 0.7 as an acceptable value (Hair et al., 2018). Table (5) shows that all items that measure a particular construct load highly on this construct, which confirms the validity of the construct.

In addition, Cronbach's alpha and composite reliability (CR) were used to verify internal consistency. Table 5 shows that Cronbach's alpha and CR for all constructs were greater than 0.70. Therefore, Cronbach's alpha and CR indicated that the scales were reasonably stable and indicated that all latent construct values exceeded the minimum acceptable limit of 0.70. To check the convergent validity of the variables, the average variance extracted (AVE) was calculated for each latent construct (Fornell & Larcker, 1981). Latent constructs should account for less than 50% of the observed variable variance in the model. Thus, this indicates that the AVE for all constructs should be higher than 0.5 (Hair et al., 2018). Table (5) also shows that all AVE values were more than 0.5, so the convergent validity of this study model was confirmed.

Table (5) Validity and reliability of the measures

Variables	Number of paragraphs	Normative saturations	Cronbach's Alpha	AVE	CR
Green manufacturing	10	0.854-0.764	0.795	0.556	0.799
Green design	7	0.851-0.734	0.733	0.523	0.787
Green purchase	10	0.878-0.771	0.798	0.598	0.812
Green supply chain	9	0.902-0.733	0.765	0.602	0.786
Green buildings	5	0.886-0.705	0.752	0.539	0.780
Process Data Exchange Module	5	0.872-0.771	0.893	0.539	0.834
Algorithm of iterative process mining	5	0.798-0.743	0.723	0.510	0.782
Backward Quality Tracking Module	5	0.821-0.744	0.798	0.567	0.834
Forward Quality Optimization Module	4	0.782-0.703	0.702	0.534	0.732
Waste management	9	0.883-0.723	0.785	0.569	0.790
Rationalization of water consumption	12	0.910-0.784	0.743	0.543	0.789
Air emissions	11	0.853-0.732	0.712	0.523	0.758
Use of renewable energy sources	10	0.834-0.732	0.723	0.533	0.798

Rationalization of resource consumption	9	0.794-0.721	0.743	0.524	0.778

References : SMARTPLS

Table 6 displays the discriminant validity results. The Heterotrait-Monotrait (HTMT) ratio of correlations (Henseler et al., 2015) is used to evaluate discriminant validity. The HTMT criterion is an estimate of the true correlation between two constructs if they were measured perfectly. High HTMT values indicate a problem with discriminant validity. An HTMT value higher than 0.90 indicates a lack of discriminant validity. When constructs are more conceptually distinct, a lower, more conservative threshold value of 0.85 is suggested (Henseler et al., 2015). This study found that the HTMT values for all latent variables are less than 0.85, which confirms discriminant validity.

Table (6) Discriminant validity of variables through HTML

	GM	GD	GP	GS	GB	PDEM	AIPM	BQTM	FQOM	WM	RW	AE	UR	RR
GM	0.788													
GD	0.035	0.606												
GP	0.245	0.441	0.557											
GS	0.132	0.063	0.240	0.817										
GB	0.393	0.341	0.014	0.646	0.688									
PDEM	0.261	0.043	0.052	0.674	0.550	0.732								
AIPM	0.019	0.128	0.065	0.037	0.145	0.184	0.640							
BQTM	0.068	0.121	0.190	0.113	0.138	0.189	0.725	0.775						
FQOM	0.300	0.185	0.133	0.404	0.720	0.722	0.097	0.467	0.821					
WM	0.258	0.007	0.149	0.410	0.605	0.663	0.074	0.532	0.828	0.752				
RW	0.044	0.059	0.478	0.270	0.137	0.444	0.315	0.665	0.278	0.566	0.750			
AE	0.582	0.085	0.162	0.057	0.449	0.178	0.453	0.493	0.493	0.509	0.359	0.770		
UR	0.258	0.241	0.215	0.210	0.687	0.282	0.492	0.363	0.556	0.421	0.207	0.692	0.543	
RR	0.450	0.025	0.287	0.072	0.307	0.266	0.077	0.104	0.574	0.295	0.098	0.427	0.490	0.543

2. Descriptive statistics and correlation

Table (7) shows the description of the variables through the arithmetic mean, standard deviation, and correlation coefficients between the variables. The results indicate that the arithmetic means exceeded the hypothesized arithmetic mean (3), with a superiority to the green design dimension. As for correlations, most of the relationships were statistically significant and positive, which initially supports the study hypotheses.

Table 7 Description of variables and correlation coefficient

	Mean	S.D	GM	GD	GP	GS	GB	GOP	IQM	ES
GM	3.752	0.500	1							
GD	4.064	0.498	.707**	1						
GP	3.796	0.662	.336**	.708**	1					
GS	3.507	0.379	.261**	.328**	.744**	1				
GB	3.475	0.324	.227**	.426**	.321**	.257**	1			
GOP	3.719	0.360	.693**	.880**	.872**	.694**	.534**	1		
IQM	3.737	0.485	.468**	0.107	.344**	.170**	.198**	0.098	1	
ES	3.435	0.385	.276**	.345**	.251**	.304**	.555**	.429**	.299**	1
**. Correlation is significant at the 0.01 level (2-tailed).										

3. Evaluation of the structural model

The next step was to measure the results of the structural model. This included validation of the predictive validity of the model and relationships between variables. The coefficient of determination (R2), path coefficient (β value), values of T statistics, and VIF are the basic criteria for evaluating the structural model.

Table (8) VIF values for multicollinearity test

Variables	VIF
GM	1.800
GD	1.101
GP	1.149
GS	1.288
GB	1.229
PDEM	1.065
AIPM	2.309
BQTM	1.415
FQOM	2.295
WM	1.178
RW	2.390
AE	1.710
UR	1.960
RR	2.172

First, the VIF values in Table 8 reveal the absence of multicollinearity. Significant multicollinearity is absent if the VIF values are less than 5, and the VIF values range from (1.065 to 2.390). Table () also shows the results of testing the main and subsidiary relationships.

Table (9) Evaluation of the structural model

Path	β	SE	T value	P value	R^2
Green operations practices → Intelligent quality management	0.543	0.037	14.552	**0.000**	0.334
Green operations practices → Environmental sustainability	0.154	0.033	4.435	**0.001**	0.645
Intelligent quality management → Environmental sustainability	0.345	0.043	8.509	**0.000**	
Green operations practices → Intelligent quality management → Environmental sustainability	0.187	0.039	5.654	**0.000**	
Green manufacturing → Intelligent quality management	0.596	0.061	17.414	**0.000**	0.446
Green design → Intelligent quality management	0.809	0.095	8.291	**0.000**	
Green purchasing → Intelligent quality management	0.222	0.072	2.224	**0.009**	
Green supply chain → Intelligent quality management	0.492	0.090	2.737	**0.007**	
Green buildings → Intelligent quality management	0.060	0.062	1.461	0.145	
Green manufacturing → Environmental sustainability	2720.	0.064	.2972	**7000.**	0.745
Green design → Environmental sustainability	0.321	0.105	2.196	**0.029**	
Green purchasing → Environmental sustainability	0.361	0.080	2.610	**0.010**	
Green supply chain → Environmental sustainability	0.368	0.096	4.087	**0.000**	
Green buildings → Environmental sustainability	0.462	0.065	7.889	**0.000**	
Intelligent quality management → Environmental sustainability	0.345	0.045	4.841	**0.000**	
Green manufacturing → Intelligent quality management → Environmental sustainability	0.200	0.057	3.492	**0.000**	
Green design → Intelligent quality management → Environmental sustainability	0.271	0.045	5.962	**0.000**	

Green purchasing → Intelligent quality management → Environmental sustainability	770.0	830.0	.1262	**0.021**	
Green supply chain → Intelligent quality management → Environmental sustainability	0.165	0.057	2.878	**0.005**	
Green buildings → Intelligent quality management → Environmental sustainability	0.020	0.056	0.360	0.654	

From Table (9) above the following is evident:

1. There is a positive and direct effect of green operations practices on environmental sustainability at a significant level (H1: β = 0.154; P < 0.01).
2. There is a positive and direct effect of green operations practices on intelligent quality management at a significant level (H2: β = 0.543; P < 0.01).
3. There is a positive and direct effect of intelligent quality management on environmental sustainability at a significant level (H3: β = 0.345; P < 0.01).
4. There is a positive and indirect effect of green operations practices on environmental sustainability through intelligent quality management at a significant level (H4: β = 0.187; P < 0.01).
5. The study model explains 64.5% of the change occurring in environmental sustainability, and 33.4% of the change occurring in intelligent quality management.
6. There is a positive and direct effect of green manufacturing on environmental sustainability at a significant level (H1a: β = 0.227; P < 0.01).
7. There is a positive and direct effect of green design on environmental sustainability at a significant level (H1b: β = 0.321; P < 0.05).
8. There is a positive and direct effect of green purchasing on environmental sustainability at a significant level (H1c: β = 0.361; P < 0.01).
9. There is a positive and direct effect of the green supply chain on environmental sustainability at a significant level (H1d: β = 0.368; P < 0.01).
10. There is a positive and direct effect of green buildings on environmental sustainability at a significant level (H1d: β = 0.462; P < 0.01).
11. There is a positive and direct effect of green manufacturing on intelligent quality management at a significant level (H2a: β = 0.596; P < 0.01).
12. There is a positive and direct effect of green design on intelligent quality management at a significant level (H2b: β = 0.809; P < 0.01).
13. There is a positive and direct effect of green purchasing on intelligent quality management at a significant level (H2c: β = 0.222; P < 0.01).
14. There is a positive and direct effect of the green supply chain on intelligent quality management at a significant level (H2d: β = 0.492; P < 0.01).
15. There is no positive and direct effect of green buildings on intelligent quality management at a significant level (H2e: β = 0.060; P > 0.05).
16. There is a positive and indirect effect of green manufacturing on environmental sustainability through intelligent quality management at a significant level (H4a: β = 0.200; P < 0.01).
17. There is a positive and indirect effect of green design on environmental sustainability through intelligent quality management at a significant level (H4b: β = 0.271; P < 0.01).
18. There is a positive and indirect effect of green purchasing on environmental sustainability through intelligent quality management at a significant level (H4c: β = 0.077; P < 0.05).
19. There is a positive and indirect effect of the green supply chain on environmental sustainability through intelligent quality management at a significant level (H4d: β = 0.165; P < 0.01).
20. There is no positive and indirect effect of green buildings on environmental sustainability through intelligent quality management at a significant level (H4e: β = 0.020; P > 0.05).

CONCLUSIONS AND RECOMMENDATIONS

1. Conclusions: Based on the results reached through data analysis, the conclusions reached will be presented as follows:

1. The results of the study showed that green operations practices have a positive impact on environmental sustainability. Therefore, when a company conducts its operations while paying attention to the concept of the environment, it will produce green operations with many opportunities that can be developed.
2. The results of the study showed that green operations practices have a positive impact on intelligent quality management. Companies that apply green operations concepts will work to improve quality in any case.
3. The results of the study showed that intelligent quality management has a positive impact on environmental sustainability
4. The results showed a positive and indirect effect of green operations practices on environmental sustainability through intelligent quality management.
5. Using PLS-SEM, the study found that intelligent quality management plays a pivotal role in the relationship between green operations practices and environmental sustainability.
6. The results of the study showed a positive and direct influence relationship between the dimensions of green operations practices (green design, green purchasing, green supply chain and green buildings) on environmental sustainability.
7. The results of the study showed a positive and direct influence relationship between the dimensions of green operations practices (green manufacturing, green design, green supply chain) in intelligent quality management.
8. The results of the study showed a positive and indirect effect of the dimensions of green operations practices (green manufacturing, green design, green supply chain) on environmental sustainability through intelligent quality management.
9. Implementing green operations practices and investing in innovating a process or product to reduce the effects of environmental degradation contributes to achieving environmental sustainability in the organization.
10. The sample company can improve environmental sustainability by using the company's facilities in an environmentally friendly manner and organizing green manufacturing processes, green design, and a green supply chain system. As such, the company will have environmentally friendly images that can attract the attention of consumers who care about the environment.
11. There is a scarcity of studies that have addressed the existence of a relationship between the study variables (green operations practices, intelligent quality management, environmental sustainability), as these variables have not been dealt with before in a single model and the causal relationships of these variables have been tested.
12. Identifying the types of green operations practices helps organizations how to employ their resources and develop their green practices to adopt these practices to reduce the harmful environmental impact resulting from their operations and products and improve the image and reputation of the organization in society.

2. Recommendations: In light of the results of testing the study hypotheses and adopting the highest conclusions, we can recommend the following:

1. The necessity of holding training courses and workshops and holding seminars and lectures by the training departments of the research society company for the purpose of increasing the awareness of department managers on how to apply green operations practices (especially green design, green purchasing, green supply chain and green buildings) with the aim of achieving environmental sustainability.
2. Enhancing interest in consulting all department managers in the surveyed company when it comes to decisions about green design, green purchasing, green supply chain and green buildings because this enhances the optimal achievement of environmental sustainability.
3. Paying attention to implementing green operations practices in the company sample of the study by developing all green practices that would work to reduce the environmental damage resulting from the organization’s operations from polluting emissions and waste of resources and energy.
4. Conducting an analytical study of the performance of the company’s departments under investigation and evaluating performance levels using modern assessment tools to determine strengths and weaknesses and identify opportunities and risks facing each department.
5. Urging department managers and engineers to design products in a way that allows for reuse, recycling and recovery in order to achieve environmental sustainability.

6. Paying greater attention to the green purchasing strategy, through the company's selection of suppliers according to their commitment to environmental standards, following up on environmental audit procedures for their internal management, and following up on the evaluation of environmentally friendly practices by suppliers in order to achieve common goals of improving environmental performance.
7. Viewing excellence and proposals as investments and not as burdens on the budget of the ministry or institution, and providing appropriate means and tools to ensure the success of their adoption.
8. This study proposes to develop a model that can examine corporate roles that influence environmental sustainability performance in terms of (e.g. quality of life, recycling, renewable energy use). and social responsibility measures (such as corporate social responsibility).
9. Emphasis on the adoption of a intelligent quality management system by the company, as it is the most advanced stage, in order to keep pace with the changes occurring in information technology brought about by the emergence of the fourth industry, and to enhance continuous improvement processes within organizations.
10. It is necessary to focus on implementing intelligent quality management by managers in the company, due to the emergence of its importance as a mediating role in strengthening the relationship between green operations practices and environmental sustainability.
11. This study suggests that the company studied should implement the ISO 14001 standard for the purpose of reducing or eliminating environmental pollution and achieving optimal environmental sustainability.
12. It is essential that green building certification is used for both production sites and non-manufacturing facilities.

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