
THE EFFECT OF GREEN QUALITY MANAGEMENT ON GREEN MANUFACTURING

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Abstract

The research seeks to identify the nature of the relationship between the two variables of the study: green quality management, represented by six dimensions (green quality performance, green quality reliability, green quality suitability, green quality durability, green quality conformity, and sustainability) and green manufacturing, represented by (the environmental management system, green purchasing, social and environmental responsibility, and energy-saving technologies in the company). Central refineries. The problem of the study stemmed from the presence of challenges facing organizations towards paying attention to the environmental aspect and the lack of awareness of it. This is what appears from the decline in the level of application of green manufacturing as a result of weak green quality management. To reach the research objectives and answer the questions raised, the research was applied to a sample of (117) officials from the general manager, department heads and their assistants, and officials of divisions and units at all levels of the company. The study relied on the descriptive analytical approach according to a questionnaire prepared for this purpose and distributed to officials at all administrative levels in the company. To reach the results, the statistical program (SPSS) was used (and the study concluded with a set of results, the most important of which is the existence of a positive, statistically significant correlation between green quality management and green manufacturing. In light of that relationship, the researcher presented a set of recommendations, the most prominent of which was the necessity of adopting the concept of green quality management and the green manufacturing system, as a means that works to reduce costs and reduce emissions and resulting carbons. Of the manufacturing operations in the researched company.

Keywords: Green quality management, green manufacturing, sustainability, environmental management system, social and environmental responsibility.

Introduction

The green revolution, transition to green environment, protecting environment, urban sustainable, green manufacturing and other related terms are considered natural phenomenon in our daily life and green quality management is regarded as one of the tools that can be used in many countries in different fields to improve organizational performance as well as companies are trying to find an easy process to follow the steps which are based on the best practices throughout benefiting from successes and experiences of other companies in order to improve jobs and improve product manufacturing which will cause a reflection in customer satisfaction and business success by deploying the function of green quality management and green manufacturing.

Thus, society generally has two kinds of interactions with the environment as a source of natural resources from one perspective and the other perspective as a dump for solid, gas and liquid waste which have damages to be depletions and cause low quantity as well as low quality of resources in the same manner unbalanced conditions of natural processes.

The studies which related to the direction of nature pollution indicate that many aspects of environmental degradation have been identified. Thus, the problem of the study emerged due to the lack of green manufacturing studies because green quality management and the study benefit appears in applying green manufacturing system as one of the modern manufacturing systems which will help most industrial companies achieve a competitive advantage as well as to achieve environmental sustainability.

The researchers in this study use the descriptive analytical approach and the most important conclusions were the company's management does not keep pace with the concept of green quality management which has negative reflection on the application of green manufacturing and the other one was raise the awareness of green quality and green manufacturing for the subject matter company due to its significant in promoting sustainable development, reduce environmental damages and reduce costs for the company.

The research was divided into methodology, previous studies, theoretical part, practical side and finally it ends with conclusions and recommendations.

2- Methodology and Previous Studies

2-1 Problem of the Study

Most of the world's countries suffer from pollution, including Iraq, due to industrial companies did not take into consideration the required standards and the specified requirements to preserve the environment from any pollution because its production processes' residues and their consequences for what is released to the environment.

For the purpose of maintaining Iraqi companies position and their market share it must produce green production which its aim to preserve the environment in accordance with the laws and regulations that adopted by the State by reviewing a number of literature review that concerned with green quality management and green production and the researchers did not find a study addressing the two variables in one study and thus the researchers motivated to discuss this topic.

Based on the aforementioned the main problem emerged to be the low level of green manufacturing application may be due to poor implementation of green quality management. and thus a set of questions were raised as follows:

- 1- Is there a relationship between green quality management and green manufacturing in Midland Refineries Company?
- 2- Is there a significant effect to maintain green quality management on sustainable manufacturing in Midland Refineries Company?

2-2 Aims of the study

- 1- Determining the nature of the relationship between green quality management and green manufacturing in Midland Refineries Company.
- 2- Determining the impact of green quality management to achieve green manufacturing.

2-3 The significant of study

- 1- To clarify intellectual foundations for green quality management and green manufacturing
- 2- To clarify the importance of green quality management in producing products that take into account established standards and environmental quality requirements.
- 3- To clarify the importance of adopting green quality management and green manufacturing in assisting the company's management in reducing costs, decrease the amount of environmental pollution rates, innovating environmentally friendly products and the optimization of natural resources, in addition to the exploitation of raw materials and energy.
- 4- To clarify the importance of applying green manufacturing system as a modern manufacturing system that helps most industrial companies achieve a competitive advantage towards environmental sustainability.
- 5- Providing a set of recommendations for decision makers in Midland Refineries Company

2-4 Hypothetical Outline of the Study

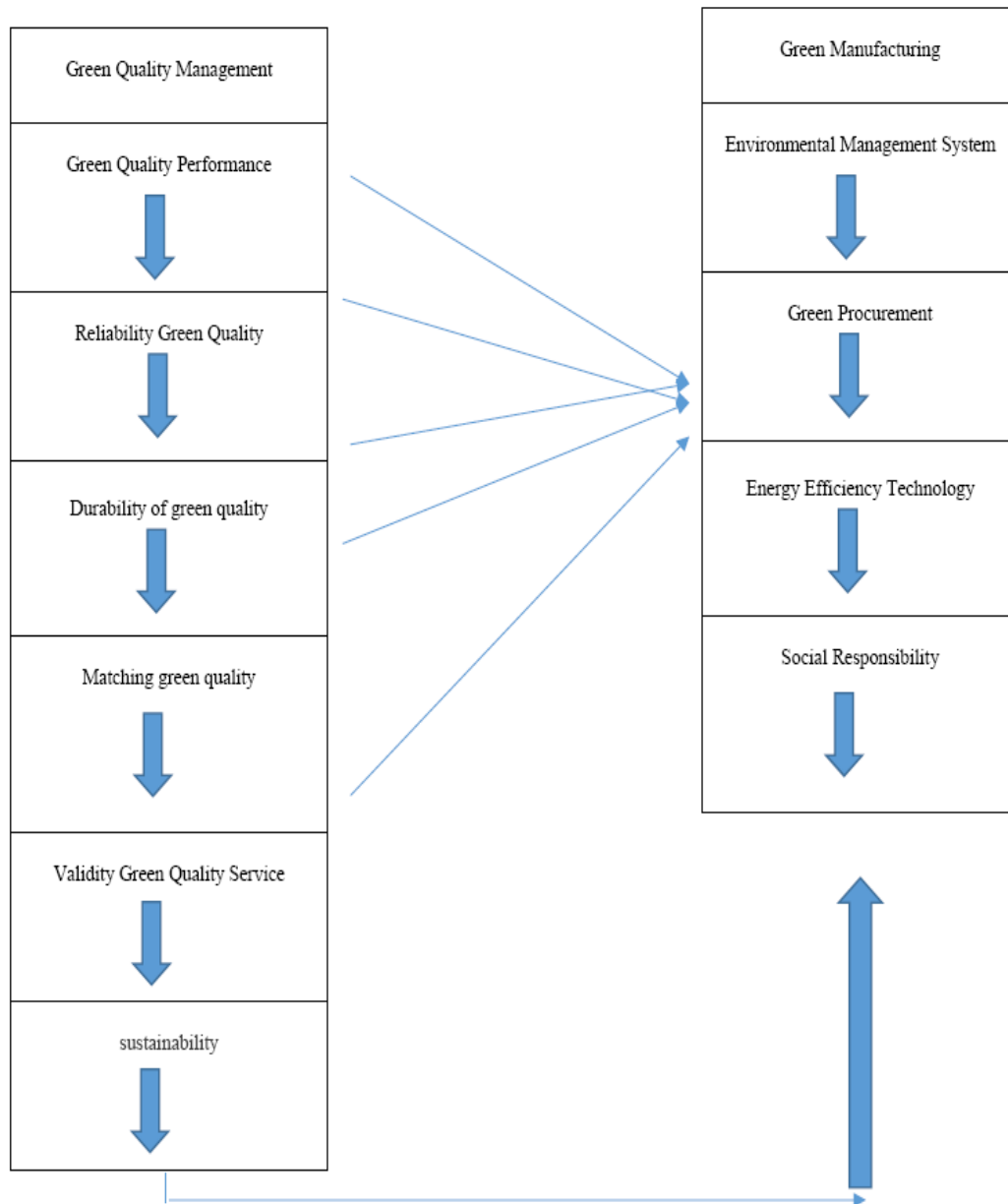


Figure (1) shows Hypothetical Outline for the variables of Study
 The resource based on researchers' information
The Effect

2-5 Study Hypotheses

2-5-1 Main hypothesis

There is a significant relationship between green quality management and green manufacturing which are gathered in Midland Refineries Company and from main hypothesis branching the sub hypotheses as following

- 1- There is a significant correlation between green quality performance and green manufacturing.

- 2- There is a significant correlation between green quality reliability and green manufacturing
- 3- There is a significant correlation between durability of green quality and green manufacturing
- 4- There is a significant correlation between matching green quality and green manufacturing
- 5- There is a significant correlation between validity of green quality and green manufacturing
- 6- There is a significant correlation between sustainability and green manufacturing

2-6 Methodology

The study adopted the descriptive analytical approach which based on the reality of investigated researches with its interpretation, diagnosis relationships, as the survey of study reached to precise conclusions and providing recommendations with reference to this approach is characterized by a holistic view due to it deals with the description of what exists taking into account its interpretation. Then, draw the conclusions and essential indicators by using description on collecting data and information in accordance with study requirements to determine the results and identifying the most prominent indicators.

2-7 Limitation of Study

The limitation of study as follows:

- 1- Scientific limitation involves the variables of study which they are quality management and green manufacturing
- 2- Place limitation which is Midland Refineries Company in Baghdad- Dora
- 3- Time limitation which is specified in accordance with date of questionnaire was distributed on 30-05-2023 and 30-07-2023 On the research samples.

2-8 Data collection methods

The following sources were relied to obtain the data and following information to complete the current study

- 1- Books, journals and university theses to accomplish the theoretical part
- 2- Internet
- 3- Arabic and English Theses and dissertations that related to the current topic

2-9 Analytical tools and statistical tools

For the purpose of analysing the data inside in the questionnaire, the researchers use the Social Science Statistical Program and test its hypothesis

- 1- Using Normality for the study variables to verify that data are distributed naturally using (Shapiro-wilt - kolmogoror.smimov)
- 2- Using Content Validity by sending the questionnaire to arbitrated experts.
- 3- Using Reliability
- 4- In order to ensure that the internal consistency of sample respondents' responses is established in terms of the resolution paragraphs using the scale Cronbach's Alpha

- 5- Using T to know the level of significant Information
- 6- Using Coefficient of Determination which explains the independent variable effect ratio in comparing with dependant variable
- 7- Using F to determine the significance of the model
- 8- Binding coefficient Coefficient of Correlation, Spearman and R Shows the strength of the relationship between the study variables overall dimensional level.
- 9- Use the test km with Bartlett's Test to conduct exploratory factor for working analysis.

2-10 Previous Studies

The following are Arabic and Foreign studies about the study variables in table no (1)

The researcher and the year	Al-Jaddri 2022
Study Title	Product life cycle costs and green quality management and their impact on improving the competitive advantage of Iraqi economic units
Problem of Study	What is the impact of both product life cycle costs and green quality management in improving competitive advantage
Aim of Study	To explain the impact of product life cycle cost and green quality management under the strategic entry point for cost management in improving the organization's competitive position
Society and Sample Study	State Company for Automotive & Equipment / Battery manufacturer in Baghdad as a sample study
Curriculum and study tool	Deductive curriculum and field living
The main findings	The results showed that the green product life cycle cost technique exceeds the control limits of the traditional system, they analyses product costs throughout the life cycle and from a holistic perspective. The application of the product's life cycle cost techniques and green quality management have been found to reduce costs, improve environmental performance and take into account the optimum utilization of scarce resources and energy, thereby improving the competitiveness of the economic unit.
Similarities	The two studies are concerned with the concept of green quality.
Differences	Difference in field side and the size sample
Field of Utilization	Providing Theoretical part for the variable of Green Quality Management
Researcher and Year	(Ranjan & Jha), 2019
Study Title	Pricing and coordination strategies of a dual-channel supply chain considering green quality and sales effort
Problem of Study	How to develop a specific model for the quantity of economic production
Aim of Study	Developing a specific model for the quantity of economic production while integrating the costs associated with GQP production, as well as validating the proposed model with numerical example and can be adjusted or expanded to probability, random and hazardous inventory models
Society and Sample Study	DCSC industrial company in India
Curriculum and study tool	Analytical descriptive curriculum and use of questionnaire as a main tool for the study
The main findings	The results showed that the central model gives the best supply chain for professionals, so the central decision helps to achieve the economic goal, and the green quality of the product is high in the cooperation model which is necessary and useful from the environmental perspective
Similarities	The two studies deals with the concept of green quality, and adopted the analytical descriptive curriculum as a study curriculum
Differences	Difference in field side and the size sample
Field of Utilization	Promoting the theoretical part for the variable of Green Quality Management and knowing the statistical methods which used in the analysis process

Researcher and year	(kushwaha& Talib), 2020
Study Title	Ranking of Barriers to Green Manufacturing Implementation in SMEs Using Best- WORST Method
Problem of Study	Modern industrialization and natural resource consumption pose challenges to people as a form of resource waste and environmental degradation
Aim of study	Identify barriers to green manufacturing in SMEs for in selected companies whether they are small or medium company
Society and Sample Study	Selected small and medium companies in Delhi
Curriculum and study tool	Case study curriculum and use of checklists as main tool for study
The main findings	The results of the study showed that the lack of new technology facilities and processes, the lack of experts in relation to new technology, the lack of training programmes , the high cost of primary capital for the implementation of the global management programme, and the weakness of legislation are the first five obstacles that lead to difficulties in implementation green manufacturing in SMEs while the least significant remarkable barrier is insufficient and understandable information
Similarities	The two studies deals with the concept of green manufacturing
Differences	Difference in field side, the size sample and the difference in the method of statistical analysis
Field of Utilization	Prompting theoretical part
Researcher and year	Hasan (2019).
Study Title	The Integration between Lean Production and Green Manufacturing and Its Impact on Project Success Exploration study at The Oil Projects Company
Study problem	Achievement the requirements of agile production and green manufacturing, availability of project success factors, and determination of how the impact of the availability of agile production and green manufacturing requirements on the success of project in a field in eastern Baghdad
Aim of study	Measuring the achievement of agile production and green manufacturing requirements in the project and the impact of their availability on the project's success
Society and Sample Study	Oil projects company selected field in east Baghdad for developing and made rehabilitation for a sample include 120 engineers, technicians and administrators
Society and Sample Study	The descriptive analytical approach and adopting the questionnaire as the main tool for the study
The main findings	There is Interest in project management in providing the requirements of agile production and green manufacturing in the completion of the project of development and rehabilitation the field which is located in east Baghdad, and the existence of a correlation and impact between the requirements of agile production and green manufacturing and the success of the project
Similarities	The two studies deals with the concept of green manufacturing and both adopted the analytical descriptive curriculum as a study curriculum
Differences	Difference in field side and the size sample
Field of Utilization	Prompting theoretical part that concerned with the variable of green manufacturing and knowing the statistical methods used in the analysis

3- Theoretical Part

The Concept and definition of green quality management

Green quality management works to promote sustainable consumption and production patterns which means patterns that have efficient in using resources and energy as well as low, non-polluting and safe waste which produce products can be controlled of responsibly throughout life cycle which involve to deal with green quality management for covering the preparation

of specific industries to be in line with all industries which work constantly to improve the productivity of their resources and their environmental performance as it seeks to establish green industries that provide environmental goods and services artificially for instance Waste, recycling, renewable energy techniques and environmental analytical and advisory services whereas greening as industry becomes as a Key to competitiveness and economic as well as sustainable growth.

As a result, the resource inputs represent an important production cost for industries, improving efficiency gives industries a leading advantage to the organization(1) and the Green Quality Management is considered process of providing products that have value in its use and meets green safety requirements due to green safety is the first function that determines the product quality as well as It leads to all production and operation activities for all the economic unit to the path that meets the requirements of green safety .

2] The philosophy of the green environment is a strategic objective for the organization, integrating green environmental protection functions into production management and the production process of economic unit products, taking into account organizations' interests and environmental needs meeting customers' green needs, enhancing customer and community satisfaction through a harmonious, unified and environmentally sound management system (2) and the philosophy of green management applies throughout product life cycle stages which means the design of product related to many standards of research , i.e. product design, R&D, technical support, procurement, production, processing, marketing, logistics, consumption, recycling, and all the elements pay attention to the benefits of economic and environmental unity, thereby improving economic units' sustainable environmental competitiveness (3).

Green quality management has been defined as the way to create green products that are harmonious and environmentally friendly based on traditional overall quality, in order to meet customers' green demand, taking into account the needs of society, resources and the environment, customer satisfaction, social development, environmental protection, energy conservation and other aspects of satisfaction, and that these factors are consistent among themselves (4).

3-1-1 The significant of green quality management

The following refer to the significant of green quality management as follows :(5)

1- Green quality management participates in the state of environmental quality through its positives in various areas of interest in spatial planning as well as aesthetic, ecological, quality of work life and environmental factors affecting urban space.

2- Green quality management contributes to the equilibrium of the ecosystem and thus educates the organizations' green infrastructure.

And No (6) added the following:

3- Green quality management contributes to focus on reliability, flexibility and efficiency in inventory models emphasizing high quality products.

4- The Green Quality management determines the customer's desires in accordance with its preferred standards then changing into technology to know information about the level of importance to those need.

3-1-2 Aims of Green Quality Management

1- Green Quality Management aims to achieve environmental efficiency in the product life cycle including design, raw material selection, process improvement, pollution prevention, treatment, after-sales services, recycling and waste treatment.

No (7) and (8) refer to the aims of Green Quality Management as follows:

1- Most companies are currently seeking a competitive advantage over other companies, which depends heavily on the company's ability to be environmentally effective and apply green quality management methods.

2- Green products not only meet marketing demand and cost-effectiveness, but must meet environmental objectives such as resource and energy conservation and reducing the environmental burden to integrate customers' needs into product concepts and product planning.

3- It works to identify and eliminate bottlenecks to increase business performance, as well as work on the mission of protecting the environment to motivate organizations to follow optimal environmental management.

4- The development of green products and production aimed at reducing the environmental impact of manufactured goods. many guidance and evaluation methods have been developed for the process of evaluating green products using the company's green quality tools.

3.1.3 Dimensions of green quality management

1- Reliability of green quality which is referred by no (9) can be the tendency of a product to perform continuously over a useful design period. A subfield has emerged in quality management called reliability management due to the importance of this role as well as to build probability theory on quality.

2- Green Quality Performance which can be defined as a set of basic operational characteristics of the product that meet customers' needs (10)

3- Validity of green quality service which indicates the possibility of repairing the product quickly and efficiently when there is a problem with its use as well as the availability of special and low-cost spare tools.

4- Durability of green quality which means the amount of benefit that the customer gets from the product during the productive life and before disposing of it or replacing it.

5- Sustainability can be defined as the ability to sustain present and future life, life on Earth and the future of Earth [11]

3-2 Green manufacturing

green manufacturing is Process or system that has little or no impact on the environment and this is in accordance with a definition proposed by the U.S. Department of Commerce (12) Green manufacturing is defined as a manufacturing method and process that comprehensively takes into account environmental impact and resource efficiency within the premise of ensuring a product's function and quality by using technological innovation and system improvement (13). and it promotes sustainable manufacturing by producing sustainable products that pave the way for product safety and community security to ensure a sustainable

environment, reduce negative impacts, preserve energy and natural resources, and to be safe for employees, communities and consumers (14)

The concept of green manufacturing differs from sustainability due to the latter is considered more inclusive than the term green manufacturing to include ideas of agile manufacturing, overall quality management and social responsibility as well as green manufacturing (15) further, relatively modern manufacturing system which seeks to design, manufacture and packaging green products using inherently inadequate materials and using technology with minimal energy (16).

3-2-1 Aims of Green manufacturing

The aim of the administration is not only to achieve economic benefits but also to pursue environmental protection, energy conservation and emissions reduction, which not only has economic performance but also includes the corporate green growth goal [17 and the following some of the green manufacturing goals

- 1- Facilitating the recycling process.
- 2- Assessment the equipment design and select material for environment
- 3- Assessment the environmental impact for manufacturing processes and product design
- 4- Increase the effectiveness of waste collection systems.

3.2.2 Dimensions of green manufacturing

1- Environmental Management System (EMS) is a management tool that develops policies and procedures on environmental issues and enables continuous improvement, with a view to achieving sustainable development [18].

2- Social and environmental responsibility which is considered for Corporate social and environmental responsibility and it is one of those issues that will never disappear from societies around the world, corporate strategies will continue to include CSR issues, social, economic and environmental challenges will continue to affect the world's economies.

3- Green procurement which means Integrating environmental considerations into procurement policies and selecting suppliers, the decision to purchase or green supply affects the green supply chain through the process of purchase of recyclables [19].

4- energy saving is understood as the implementation of legal, regulatory, scientific, productive, technical and economic procedures aimed at effective use (20).

4- practical part

First: Questionnaire data tests

1- Testing validity and reliability using Cronbach's alpha coefficient

it Cronbach's alpha coefficient is one of the most common stabilizers in previous studies and is used to assess the internal consistency of sample responses in terms of resolution paragraphs, The value of alpha-kronbach is positive, ranging from 0 to 1, and there is a consensus by the writers that the acceptable value is greater or equal to (0.70), Through the results of the Questionnaire, it is specified its sincerity and consistency in the variable of green quality management and green manufacturing.

Table No (2) Cronbach's alpha coefficient for the reliability and validity of the questionnaire scale

Variables	Alfa	Kronbach Value A	Constant Factor $\sqrt{\alpha} =$	Paragraph NO
Green quality performance		0.741	0.861	5
Reliability of green quality		0.778	0.882	4
Validity of Green Quality Service		0.756	0.869	4
Matching green quality		0.730	0.854	4
Durability of green quality		0.779	0.883	3
sustainability		0.747	0.864	4
Green Quality Management		0.907	0.952	24
environmental management system		0.780	0.883	6
green procurement		0.763	0.873	5
social and environmental responsibility		0.754	0.868	5
green manufacturing		0.748	0.865	4
Total		0.917	0.958	20

The resource prepared by researchers by using SPSS-24 programme Using SPSS-24, the results obtained in Table 1 show that all Alfa Kronbach value results are acceptable because they are greater than 0.70 for the variable Green Quality Management and its dimensions likewise green manufacturing, and the total value of this metric is (0.954) According to this high value, it is clear to us that the questionnaire is honest and constant in its variables.

2- Natural Distribution Test

The natural distribution test determines the mechanism of data, and it is conducted using several statistical tests and it is important for the Kulmkrov Smirnov test, the Shapiro Wolx test and the blog results in the following table

Table no (2) for Natural Data Distribution Test

variables	Test value Kolmogorov smirnov	significance level.	Test value Shapiro – wilk	significance level. Sig
Green Quality Management	0.044	0.199	0.984	0.183
Green manufacturing	0.053	0.200	0.987	0.333

Source: Prepared by researchers using SPSS-24

It is clear from the results of the previous table that the value of the significance level (Sig.) is greater than 0.05 for both tests and for both variables studied, and therefore this indicates that the data is distributed normally

Multicollinearity test between study variables: Multicollinearity

Multicollinearity is a statistical phenomenon that represents the presence of a close connection between the independent variables in the regression model. Its goal is to avoid a strong, high correlation between the variables, which leads to the occurrence of the problem of multicollinearity, as one of the variables should be eliminated when analyzing because a high correlation indicates that they measure the same thing because the effect between them is not known, as they are both measured by the same thing. One of the most commonly used measures to determine multicollinearity is the Variance Inflation Factor and the Tolerance value, which must be greater than or equal to the value of (0.10), and the inverse of the inflation factor the variance is less than or equal to (10) in order to determine that there is no multicollinearity problem.

Table No. (3) Multicollinearity test among study variables

Independent variables	Multicollinearity coefficients	
	Contrast inflation factor VIF	The value of tolerance
Green quality performance	2.229	0.449
Green quality reliability	2.017	0.496
Validity of green quality service	1.824	0.548
Matching green quality	2.241	0.446
Green quality durability	1.582	0.632
Sustainability	2.150	0.465

Source: Prepared by researchers using SPSS-24.

From Table No. (3), the results of the variance inflation factor (VIF) values for the independent variables are considered acceptable because they are less than (10), and the tolerance values for the independent variables were found to be greater than (0.10). This indicates that there is no problem in Multicollinearity.

4- Exploratory factor analysis

An exploratory factor analysis was conducted, which is used to reduce the number of items. The researcher relied on the Kaiser Meyer Olkin (KMO) test so that the study sample would be sufficient to conduct the analysis, and its value must be greater than or equal to (0.50), and the Bartlett's Test of Sphericity) In order for the relationship between variables to be statistically acceptable, the critical value must be less than (0.05).

Table No. (4): Results of the exploratory factor analysis of the dimensions of green quality management

Dimensions	items	KMO	Critical value C.R	Bartlett's Test Sig.	Suitable for the study sample items	Did the items achieve it? Convergence validity
Green quality performance	Q1	0.766	112.829	0.000	0.642	YES
	Q2				0.676	YES
	Q3				0.719	YES
	Q4				0.736	YES
	Q5				0.725	YES
	Q6				0.670	YES
Green quality reliability	Q1	0.733	65.521	0.000	0.704	YES
	Q2				0.714	YES
	Q3				0.784	YES
	Q4				0.723	YES
	Q5				0.720	YES
Validity of green quality service	Q1	0.693	4.5686	0.000	0.785	YES
	Q2				0.579	YES
	Q3				0.550	YES
	Q4				0.791	YES
	Q5				0.755	YES
Matching green quality	Q1	0.636	65.867	0.000	0.729	YES
	Q2				0.693	YES
	Q3				0.813	YES
	Q4				0.705	YES
Green quality durability	Q1	5950.	34.458	0.000	0.668	YES
	Q2				0.752	YES
	Q3				0.716	YES
Sustainability	Q1	0.677	60.256	0.000	0.660	YES
	Q2				0.642	YES
	Q3				0.676	YES
	Q4				0.719	YES

Source: Prepared by researchers using SPSS-24.

It is clear from the table above that the value of (KMO) for all dimensions of the independent variable (green quality management) is greater than the value of (0.50), while the values of (Bartlett's Test) for the dimensions of the independent variable were less than the moral value of (0.05), while the critical value represents the level Significance, meaning that the results achieved proportionality to the study sample for all items with values higher than the standard limit of (0.50), and thus exploratory factor analysis was achieved for all values of the dimensions of the independent variable.

Table No. (5): Results of exploratory factor analysis of green manufacturing dimensions

Dimensions	items	KMO	Critical value C.R	Bartlett's Test Sig.	Suitable for the study sample items	Did the items achieve it? Convergence validity
Environmental management system	Q1	0.820	162.758	0.000	0.646	YES
	Q2				0.716	YES
	Q3				0.743	YES
	Q4				0.692	YES
	Q5				0.626	YES
	Q6				0.735	YES
Green purchase	Q1	0.579	92.918	0.000	0.560	YES
	Q2				0.635	YES
	Q3				0.688	YES
	Q4				0.679	YES
	Q5				0.700	YES
Social and environmental responsibility	Q1	0.694	141.919	0.000	0.668	YES
	Q2				0.700	YES
	Q3				0.713	YES
	Q4				0.775	YES
	Q5				0.684	YES
Environment-saving technologies	Q1	0.627	71.719	0.000	0.623	YES
	Q2				0.688	YES
	Q3				0.764	YES
	Q4				0.720	YES

Source: Prepared by researchers using SPSS.

The table above shows that the value of (KMO) for all dimensions of the dependent variable (green manufacturing) is greater than the value of (0.50), while the values of (Bartlett's Test) for the dimensions of the dependent variable were less than the moral value of (0.05), while the critical value represents the level Significance, meaning that the results achieved proportionality to the study sample for all items with values higher than the standard limit of (0.50), and thus exploratory factor analysis was achieved for all values of the dimensions of the dependent variable.

4.3 Testing the study hypotheses

Table (6) shows the results of the Pearson test, which tested the first main hypothesis, which is that there is a significant relationship between the dimensions of green quality management and the dimensions of green manufacturing individually and in aggregate.

Table No. (6) Pearson correlation coefficient matrix between the dimensions of green quality management and green manufacturing at the aggregate and individual levels

Dimensions		Environmental management system	Green purchase	Social and environmental responsibility	Energy saving technologies	Green manufacturing
Green quality performance	Pearson Correlation	0.656**	0.700**	0.649**	0.618**	0.897**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000
Green quality reliability	Pearson Correlation	0.706**	0.727**	.658**	0.673**	0.901**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000
Validity of green quality service	Pearson Correlation	0.712**	0.759**	0.658**	0.653**	0.940**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000
Matching green quality	Pearson Correlation	0.763**	0.799**	0.660**	0.670**	0.891**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000
Green quality durability	Pearson Correlation	0.448**	0.497**	0.399**	0.417**	0.898**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000
Sustainability	Pearson Correlation	0.664**	0.717**	0.797**	0.608**	0.897**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000
Green quality management	Pearson Correlation	0.825**	0.877**	0.796**	0.760**	0.897**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000

Source: Prepared by the researcher based on the SPSS program

** The correlation is statistically significant at the level (0.01)

Table (6) shows the presence of a strong, positive correlation between the dimensions of green quality management and green manufacturing in general (**0.897), which is significant at the level of significance (0.01). It reflects that green quality management is considered an essential factor in the company's ability to achieve green manufacturing up to Achieving sustainability.

4.3.1 There is a strong positive correlation at the level (0.01) between the sub variable green quality performance and the dimensions of green manufacturing (environmental management system, green purchasing, social and environmental responsibility, energy-saving technologies), as the highest correlation value was (0.897) between quality performance green and green manufacturing.

4.3.2 There is a strong, positive correlation at the level (0.01) between the sub variable green quality reliability and the dimensions of green manufacturing (environmental management system, green purchasing, social and environmental responsibility, energy-saving technologies), as the highest correlation value was (0.901) between the reliability green quality and green manufacturing.

4.3.3 There is a strong, positive correlation at the level (0.01) between the sub variable of green quality service validity and the dimensions of green manufacturing (environmental management system, green purchasing, social and environmental responsibility, energy-saving technologies), as the highest correlation value was (0.940) Between the validity of green quality service and green manufacturing.

4.3.4 There is a strong positive correlation at the level (0.01) between the sub-variable green quality compliance and the dimensions of green manufacturing (environmental management

system, green purchasing, social and environmental responsibility, energy-saving technologies), as the highest correlation value was (0.891) between Matching green quality with green manufacturing

4.3.5 There is a strong, positive correlation at the level (0.01) between the sub variable of green quality durability and the dimensions of green manufacturing (environmental management system, green purchasing, social and environmental responsibility, energy-saving technologies), as the highest correlation value was (0.898) between durability green quality and green manufacturing.

4.3.6 There is a strong positive correlation at the level (0.01) between the sub variable sustainability and the dimensions of green manufacturing (environmental management system, green purchasing, social and environmental responsibility, energy-saving technologies), as the highest correlation value was (0.897) between sustainability and green manufacturing.

Based on the previous correlations, this leads to accepting the first main hypothesis that: There is a significant relationship between green quality management (green quality performance, green quality reliability, green quality suitability, green quality conformity, green quality durability, and sustainability) and green manufacturing individually and .combined

5- Testing the hypotheses of the effect of the independent variable (green quality management) and its dimensions on the dependent variable (green manufacturing)

It is required to test the main and subsidiary effect hypotheses to determine the strength of the effect of the independent variable on the dependent variable, by applying some statistical methods represented by the regression (effect) coefficient (β), and the coefficient of determination (R^2), which explains the percentage of effect of the independent variable on the dependent variable, and comparing the value of (F) Calculated with its tabular value to indicate acceptance or non-acceptance of the hypothesis.

The impact of green quality performance on green manufacturing and its dimensions

Table No. (7) Results of the impact of green quality performance on green manufacturing and its dimensions

Independent variable	Dependent variable	The determination Factor R^2	The decline (impact) β	Fixed limit α	Calculated t value	Calculated F value	indication level P	Level of relationship
Green quality management X	Environmental management system	0.618	0.685	1.207	**9.326	**114.563	0.000	High morale
	Green purchase	0.561	0.730	1.002	**10.519	**86.975	0.000	High morale
	Social and environmental responsibility	0.623	0.732	0.988	**9.147	**110.645	0.000	High morale
	Energy saving technologies	0.564	0.656	1.286	**8.431	**83.667	0.000	High morale
	Green manufacturing	0.594	0.701	1.121	**11.207	**71.086	0.000	High morale
Influence relationship		The validity of the first sub-hypothesis with high significance at the 99% confidence level.						

**Significant value represents confidence (99%)

Source: Prepared by the researcher using SPSS-24

Table No. (7) shows a test of the effect of green quality performance on green manufacturing and its dimensions. The results show the value of the coefficient of determination (R²) of (0.594), and this indicates the percentage of contribution of green quality performance of (59.4%) to changes in green manufacturing, or the remaining percentage (40.6%) is due to unknown factors that did not appear in the model, and any increase in the value of green quality performance by one unit leads to an increase in green manufacturing, which was represented by the regression coefficient (β) by (0.701) The calculated (t) value (11.207) was greater than the tabulated value of (2.326) at a significance level of (0.01), and the calculated (F) value (125.607) indicates that it is greater than the tabulated value of (6.85) at a significance level of (0.01). With a confidence level of (99%), it is also clear that green quality performance has a significant impact on all dimensions of green manufacturing, as is clear in the results of the previous table.

Thus, the first sub-hypothesis is accepted, which is (there is a significant effect on green .quality performance in green manufacturing)

The effect of green quality reliability on green manufacturing and its dimensions.2

Table No. (8): Results of the impact of lean equipment on green manufacturing and its dimensions

Independent variable	Dependent variable	The determination Factor R ²	The decline (impact) β	Fixed limit α	Calculated t value	Calculated F value	indication level P	Level of relationship
Green quality management X	Environmental management system	0.605	0.677	1.226	**10.703	**114.563	0.000	High morale
	Green purchase	0.524	0.696	1.118	**11.339	**128.583	0.000	High morale
	Social and environmental responsibility	0.539	0.680	1.163	**9.360	**87.609	0.000	High morale
	Energy saving technologies	0.572	0.657	1.278	**9.743	**94.971	0.000	High morale
	Green manufacturing	0.533	0.677	1.197	**12.562	**157.793	0.000	High morale
Influence relationship		The validity of the second sub-hypothesis with high significance at the 99% confidence level.						

**Significant value represents confidence (99%)

Source: Prepared by the researcher using SPSS-24

Table No. (8) shows a test of the effect of green quality reliability on green manufacturing and its dimensions. The results show the value of the coefficient of determination (R²) of (0.533), and this indicates the percentage of contribution of green quality performance of (53.3%) to changes in green manufacturing, or the remaining percentage (46.7%) is due to unknown factors that did not appear in the model, and any increase in the green quality reliability value by one unit leads to an increase in green manufacturing, which was represented by the regression coefficient (β) by (0.677), The calculated (t) value (12.562) was greater than the

tabulated value of (2.326) at a significance level of (0.01), and the calculated (F) value (157.793) indicates that it is greater than the tabulated value of (6.85) at a significance level of (0.01). With a confidence level of (99%), it is also clear that the reliability of green quality has a significant impact on all dimensions of green manufacturing, as is clear in the results of the previous table.

Thus, the first sub-hypothesis is accepted, which is (There is a significant effect of green quality reliability in green manufacturing

The effect of the validity of green quality service in green manufacturing and its dimensions

Table No. (9) The effect of green quality service validity on green manufacturing and its dimensions

Independent variable	Dependent variable	The determination Factor R ²	The decline (impact) β	Fixed limit α	Calculated t value	Calculated F value	indication level P	Level of relationship
Green quality management X	Environmental management system	0.572	0.561	1.680	**9.105	**82.896	0.000	High morale
	Green purchase	0.634	0.604	1.483	**10.447	**109.135	0.000	High morale
	Social and environmental responsibility	0.518	0.556	1.647	**7.930	**62.884	0.000	High morale
	Energy saving technologies	0.524	0.538	1.743	**8.228	**67.696	0.000	High morale
	Green manufacturing	0.630	0.565	1.638	**10.544	**111.173	0.000	High morale
Influence relationship		The validity of the third sub-hypothesis with high significance at the 99% confidence level.						

**Significant value represents confidence (99%)

Source: Prepared by the researcher using SPSS-24

Table No. (9) shows a test of the effect of the validity of the green quality service on green manufacturing and its dimensions. The results show the value of the coefficient of determination (R²) of (0.630), and this indicates the contribution of the validity of the green quality service by (63%) to changes in green manufacturing, or either the percentage The remaining (47%) is due to unknown factors that did not appear in the model, and any increase in the validity value of green quality service by one unit leads to an increase in green manufacturing, which was represented by the regression coefficient (β) by (0.565), The calculated (t) value (10.544) was greater than the tabulated value of (2.326) at a significance level of (0.01), and the calculated (F) value (111.173) indicates that it is greater than the tabulated value of (6.85) at a significance level of (0.01). With a confidence level of (99%), it is also clear that the validity of green quality service has a significant impact on all dimensions of green manufacturing, as is clear in the results of the previous table.

Thus, the second sub-hypothesis is accepted, which is (There is a significant effect of the validity of green quality service in green manufacturing

The effect of green quality conformity on green manufacturing and its dimensions

Table No. (10): Results of the effect of green quality conformity on green manufacturing and its dimensions

Independent variable	Dependent variable	The determination Factor R ²	The decline (impact) β	Fixed limit α	Calculated t value	Calculated F value	indication level P	Level of relationship
Green quality management X	Environmental management system	0.585	**126.35	**11.24	1.167	0.701	0.000	High morale
	Green purchase	0.570	**143.76	**11.99	1.053	0.721	0.000	High morale
	Social and environmental responsibility	0.591	**87.33	**9.35	1.168	0.686	0.000	High morale
	Energy saving technologies	0.506	**75.87	**8.71	1.431	0.623	0.000	High morale
	Green manufacturing	0.567	**155.79	**12.48	1.205	0.683	0.000	High morale
Influence relationship		The validity of the fourth sub-hypothesis with high significance at the 99% confidence level.						

**Significant value represents confidence (99%)

Source: Prepared by the researcher using SPSS-24

Table No. (10) shows a test of the impact of green quality conformity performance on green manufacturing and its dimensions. The results show the value of the coefficient of determination (R²) of (0.567), and this indicates the percentage of contribution of green quality conformity at (56.7%) in changes in green manufacturing, or the remaining percentage. (43.3%) is due to unknown factors that did not appear in the model, and any increase in the value of green quality compliance by one unit leads to an increase in green manufacturing, which was represented by the regression coefficient (β) by (0.683), The calculated (t) value (12.48) was greater than the tabulated value of (2.326) at a significance level of (0.01), and the calculated (F) value (155.79) indicates that it is greater than the tabulated value of (6.85) at a significance level of (0.01). With a confidence level of (99%), it is also clear that conforming to green quality has a significant effect on all dimensions of green manufacturing, as is clear in the results of the previous table.

Thus, the first sub-hypothesis is accepted, which is (There is a significant effect of green quality conformity in green manufacturing

The effect of green quality durability on green manufacturing and its dimensions

Table No. (11): Results of the impact of green quality durability on green manufacturing and its dimensions

Independent variable	Dependent variable	The determination Factor R ²	The decline (impact) β	Fixed limit α	Calculated t value	Calculated F value	indication level P	Level of relationship
Green quality management X	Environmental management system	0.578	0.507	1.912	**6.759	**45.679	0.000	High morale
	Green purchase	0.624	0.560	1.686	**7.811	**61.016	0.000	High morale
	Social and environmental responsibility	0.523	0.465	2.012	**5.448	**29.678	0.000	High morale
	Energy saving technologies	0.576	0.472	2.018	**5.970	**35.675	0.000	High morale
	Green manufacturing	0.542	0.501	1.907	**7.371	**54.338	0.000	High morale
Influence relationship		The fifth sub-hypothesis is valid with high significance at the 99% confidence level.						

**Significant value represents confidence (99%)

Source: Prepared by the researcher using SPSS-24

Table No. (11) shows a test of the effect of green quality durability on green manufacturing and its dimensions. The results show the value of the coefficient of determination (R²) of (0.542), and this indicates the percentage contribution of green quality performance of (54.2%) to changes in green manufacturing, or the remaining percentage (45.8%) is due to unknown factors that did not appear in the model, and any increase in the green quality durability value by one unit leads to an increase in green manufacturing, which was represented by the regression coefficient (β) by (0.501), The calculated (t) value (7.371) was greater than the tabulated value of (2.326) at a significance level of (0.01), and the calculated (F) value (54.338) indicates that it is greater than the tabulated value of (6.85) at a significance level of (0.01). With a confidence level of (99%), it is also clear that the durability of green quality has a significant impact on all dimensions of green manufacturing, as is clear in the results of the previous table.

Thus, the first sub-hypothesis is accepted, which is (there is a significant effect of green quality durability in green manufacturing

The impact of sustainability on green manufacturing and its dimensions – 1

Independent variable	Dependent variable	The determination Factor R ²	The decline (impact) β	Fixed limit α	Calculated t value	Calculated F value	indication level P	Level of relationship
Green quality management X	Environmental management system	0.603	0.668	1.285	**9.524	**90.71	0.000	High morale
	Green purchase	0.561	0.722	1.055	**11.033	**121.72	0.000	High morale
	Social and environmental responsibility	6300.	0.865	0.515	**14.169	**200.76	0.000	High morale
	Energy saving technologies	130.5	0.624	1.428	**8.207	**67.36.	0.000	High morale
	Green manufacturing	0.584	0.719	1.071	**12.917	**166.84	0.000	High morale
Influence relationship		The validity of the second main hypothesis with high significance at the 99% confidence level.						

Table No. (12): Results of the impact of sustainability in green manufacturing and its dimensions

**Significant value represents confidence (99%)

Source: Prepared by the researcher using SPSS-24

Table No. (12) shows a test of the impact of sustainability on green manufacturing and its dimensions. The results show the value of the coefficient of determination (R²) of (0.584), and this indicates the contribution of sustainability by (58.4%) to green manufacturing changes, and the remaining percentage (41.6%) is due to unknown factors that did not appear in the model, any increase in the value of sustainability by one unit leads to an increase in green manufacturing, which was represented by the regression coefficient (β) by (0.719), The calculated (t) value (12.917) was greater than the tabulated value of (2.326) at a significance level of (0.01), and the calculated (F) value (166.84) indicates that it is greater than the tabulated value of (6.85) at a significance level of (0.01). With a confidence level of (99%), it is also clear that sustainability has a significant impact on all dimensions of green manufacturing, as is clear in the results of the previous table.

Thus, the first sub-hypothesis is accepted, which is (there is a significant effect of sustainability in green manufacturing

7-The impact of green quality management on green manufacturing and its dimensions

Table No. (13): Results of the impact of green quality management on green manufacturing and its dimensions

Independent variable	Dependent variable	The determination Factor R ²	The decline (impact) β	Fixed limit α	Calculated t value	Calculated F value	indication level P	Level of relationship
Green quality management X	Environmental management system	0.694	1.015	0.024	**16.009	**72.256	0.000	High morale
	Green purchase	0.781	1.077	0.242	**20.151	**406.08	0.000	High morale
	Social and environmental responsibility	0.672	1.057	0.182	**14.422	**207.98	0.000	High morale
	Energy saving technologies	0.569	0.954	0.224	**12.785	**163.45	0.000	High morale
	Green manufacturing	0.821	1.026	0.044	**22.635	**512.32	0.000	High morale
Influence relationship		The validity of the second main hypothesis with high significance at the 99% confidence level.						

**Significant value represents confidence (99%)

Source: Prepared by the researcher using SPSS-24

Table No. (13) shows a test of the effect of green quality management on green manufacturing and its dimensions. The results show the value of the coefficient of determination (R²) of (0.821), and this indicates the contribution of green quality management by (82.1%) to the changes that occur in green manufacturing. The remaining percentage (17.9%) is due to unknown factors that did not appear in the model. Any increase in the value of green quality management by one unit leads to an increase in green manufacturing, which was represented by the regression coefficient (β) by (1.026), and the calculated (t) value (22.635) was greater than the tabulated value of (2.326) at a significance level of (0.01), and the calculated (F) value (512.32) indicates that it is greater than the tabulated value of (6.85) at a significance level of (0.01) with a confidence level of (99%). It is also clear that green quality management in general has a significant impact on all dimensions of green manufacturing, as is clear in the results of the previous table.

Thus, the second main hypothesis is accepted, which is (there is a significant effect of green quality management in green manufacturing).

Conclusions and recommendations of the study

Conclusions

1. It is clear from the results that the measures used to measure the study variables represented by (green quality performance, green manufacturing) achieved good levels of confirmatory construct validity, and this indicates the accuracy of constructing these measures and matching them with the data collected from the study sample
2. The availability of green manufacturing in the research sample company is highly related to the performance of their operations, as the results show that the strongest correlation is between the dimensions of green quality management and green manufacturing. This indicates that there is a significant correlation between the dimensions of green quality management and the green manufacturing variable at the level of the company in the research sample, and this reflects that green quality management is considered an essential factor in the company's access to achieving green manufacturing.
3. The statistical results showed that there is a significant correlation between the sub-dimensions of the green quality management variable and the green manufacturing variable, and this reflects that the dimensions of green quality management are considered an essential factor in the company's achievement of sustainability.
4. The statistical results showed the existence of a significant relationship of influence for the independent variable (green quality management) in green manufacturing. This explains the interest of the study sample company in implementing green manufacturing because it contributes to the production of environmentally friendly products.
5. The statistical results showed that there is a significant relationship of influence between the sub-dimensions of the green quality management variable and the green manufacturing variable, which indicates that the application of these dimensions necessarily leads to achieving green manufacturing.

Recommendations

1. The necessity of investing in the relationship and positive influence between green quality management practices and green manufacturing through the researched company developing a plan to benefit from those practices and activities that are concerned with the environmental aspect.
2. Urging the company to pay attention to producing green products that are free of environmental damage and do not permanently harm the consumer
3. The need for the researched company to pay attention to finding ways and providing capabilities to dispose of industrial waste in a safe manner and away from citizens' residential sites.
4. Urging the company to adopt the views of green quality management and green manufacturing in all their dimensions and to implement them clearly. This requires implementation support by the company's senior management in order to obtain the best results.
5. Increasing the investment of the researched company in green technologies and tools, as they are the basis for reducing emissions and negative impacts on the environment, especially since industrial companies are experiencing a new type of competition based on

environmental reputation and achieving environmental sustainability, and this requires the management of the research sample company to adopt it.

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