

The Sustainable Manufacturing Focuses and their Implications: A Case Study in the State Company for Electrical and Electronic Industries

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Abstract:

The research aims at studying the possibility of carrying out the sustainable manufacturing in the State Company for Electrical and Electronic Industries and to determine the gap between the basic focuses and the factual reality, and considering the pressure that faces the company, hence, a number of three-level dimensions have been adopted (The basic focuses concerning to the quality of the product, the level of the process and the level of the system). In order to conduct the field side of the research paper to reach the results, the checklist used as a main tool for data collection. The most prominent conclusion of the research that the general average of the researched company level of the sustainable manufacturing focuses ownership reached (0.95) out of (2) degrees and with an application rate of (0.47), therefore the gap reached (0.53) which indicates that the available level is at an intermediate level, and the most prominent recommendation is represented by the necessity of the company management hard working to implement more practices that contribute to achieve sustainable industrialization and in paying attention to rehabilitate the waste and consuming materials.

Keywords: State Company for Electrical and Electronic Industries; sustainable manufacturing; Process; Product.

JEL Classification Codes : L21, M11, Q57.

ملخص

يهدف البحث إلى دراسة إمكانية تنفيذ التصنيع المستدام في الشركة العامة للصناعات الكهربائية والإلكترونية وتحديد الفجوة بين الأهداف الأساسية والواقع، والنظر في الضغوط التي تواجه الشركة، ومن هنا تم اعتماد الأبعاد الثلاثة (المحاور الأساسية المتعلقة بجودة المنتج ومستوى العملية ومستوى النظام). ومن أجل إجراء الجانب الميداني من ورقة البحث للوصول إلى النتائج، تم استخدام قائمة المراجعة كأداة رئيسية لجمع البيانات. ومن أبرز نتائج البحث أن المعدل العام لمستوى ملكية الشركة محل الدراسة لأهداف التصنيع

المستدام بلغ (0.95) من (2) درجة وبنسبة تطبيق (0.47) وبذلك وصلت الفجوة إلى (0.53) وهي تشير إلى مستوى متوسط، وتتمثل التوصية الأبرز في ضرورة أن تعمل إدارة الشركة بجدية على تنفيذ المزيد من الممارسات التي تساهم في تحقيق التصنيع المستدام والاهتمام بإعادة تأهيل المخلفات والمواد المستهلكة.

المصطلحات المفتاحية: الشركة العامة للصناعات الكهربائية والإلكترونية ؛ التصنيع المستدام ؛ العملية ؛ المنتج.

تصنيف JEL: Q57 ؛ M11 ؛ L2.

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Introduction

In recent decades, industrial organizations face pressures and strict government legislations as a result of the pollution resulted from the expired products, as well as the need to dispose these products in this landfill in addition to the emissions and toxic gases that result from the production process, leading to environmental pollution which obliges organizations to take in consideration the environmental policies and scarcity of resources, therefore, it is imperative to conduct kindly the environmental practices which currently have become familiar in the contemporary world because of their significance in reducing the contribution of those companies to environmental pollution by reducing toxic emissions that resulted from production processes or from using them until throwing them in the landfill. The implementation of contemporary systems, including the sustainable industrialization system, can be regarded as one of the basic and important mechanisms in overcoming or reducing environmental and health concerns on the one hand and adhering to the obligations of the legal legislations related to the environment on the other hand, as well as preserving natural resources from depletion and saving in consumption energy, so the aim of the research is to investigate the implantation of the focuses of the sustainable industrialization in the State Company for Electrical and Electronic since the sustainable industrialization achieve several advantages which can consolidate the marketing status of the researched company locally and globally ;

Throughout reviewing a number of literary writings of researchers and writers in the field of manufacturing, the researcher has selected the most important fields in the productive system in which the sustainable manufacturing rely on and a checklist has been designed for compiling and analyze data to determine to what extent the researched company has implemented the focuses of the sustainable manufacturing and after completing the analysis process of the results of the research which reached a number of conclusions and recommendations whose one of the most prominent conclusion s was that the general average level of the ownership of the researched

company of the sustainable manufacturing focuses was (1.16) degrees out of (2) degrees and with an application rate of (0.58) i.e. the gap reached (0.42), and this indicates the available level is at an intermediate one in which it requires exerting much efforts to reduce the gap. As for the most prominent recommendation, it is represented by the necessity of the company hard to carry out more practices which contribute in achieving the sustainable industrialization and paying attention to rehabilitate the waste and consumed materials ;

The research paper is divided into four axes, the first of which is devoted to present the research methodology which exposes to the problem, importance, goals, and other concerned items, while the second axis to show the theoretical aspects such as concepts, the importance and bases of the subject matter, while the third axis depicts the practical side that reviewed the reality of the sustainable industrialization and determined the gap of its application. Finally, the fourth axis included the most important conclusions and recommendations reached by the research.

The first axis : Research Methodology

First: The Research Problem

Business organizations are exposed to growing environmental pressures rapidly, which poses a challenge before them in overcoming these pressures, so many organizations resort to apply practices and administrative methods which can contribute effectively in getting rid of these pressures, thus, many organizations cooperate with research centers in applying the most important of these methods and practices to confront those environmental pressures, and sustainable industrialization is considered one of the important methods nowadays in the world of industry because of the practices it contains that can consolidate the status of the organization against the environment and sustainability issues and the preservation of the natural resources in accordance to the international and local legal legislation, and throughout the field visits which are carried out by the researcher in the researched company, the research problem has been identified and expressed through the following questions:

1. Are there sustainable manufacturing focuses available in the research company?
2. What is the level of sustainable manufacturing focuses in the researched company?
3. Does the researched company apply the focuses of sustainable manufacturing?
4. What are the obstacles of implementing sustainable manufacturing focuses?

Second: Research Objectives

The research seeks to achieve the following goals:

1. Studying the concept of the sustainable industrialization and the most important focuses within the concept.
2. Diagnosing the actual reality of the bases of the sustainable industrialization.
3. Determining the gap between the focuses of the sustainable manufacturing in the researched company.
4. Determining the most important obstacles and challenges that stand against implementing the sustainable industrial focuses.
5. Presenting a study to contribute in reinforcing the company's attitude towards environmental issues and its own legislations.

Third: The Importance of Research Paper

The importance of the research paper includes the following points:

- 1- Presenting a study that contributes in preserving the environment, natural resources and individuals.
- 2- The study's contribution lies in consolidating the competitive capability of the researched company because of the characteristics of the subject matter concerning the economic, social and environmental levels.
- 3- Contributing to support the decision-maker through the conceptual framework of the subject of the sustainable industrialization and the focuses it contains.

Fourth: The Research Hypothesis

The main hypothesis of the research represents the answer to the research questions, is as follows: « An acceptable level of sustainable manufacturing focus is available in the State Company for Electrical and Electronic Industries in a manner that contributes to it in preserving the environment and meeting the needs of customers »

Fifth: The Research Tool

In order to compile the required data to accomplish the research, a checklist is used as a basic tool, and the checklist was created by relying on a number of sources that touched on the subject of the sustainable industrialization (Lu et al., 2010) (Vimal and Vinodh, 2013: 214) (Kishawy et al., 2018) (Masoumik et al., 2015), and the researcher used the Triple Likert scale (fully applied 2, partially applied 1, not applied 0) for the purpose of converting data into the body of the list into quantitative expressions and then obtaining more accurate results.

Sixth: Methods of Analysis

In order to conduct an analysis of the data which are collected by using the checklist, a number of statistical methods and methods are used, as it is used the frequency distribution, percentage, arithmetic mean and hypothetical mean rate in order to determine the level of availability for each item out of the items of the sustainable manufacturing practices in the checklist and then to identify the gap which can be explained as follows (Sharif, 2008:163).

1. Result = (Frequency x Weight)
2. Average = [(Total Frequency x Weight)/(Total Frequency)]
3. The percentage of application = [(Total of Frequencies × Weight)/((Total of Frequencies x 2)]
4. Hypothetical Average Rate = [(Percentage × Average)/(Result)]
5. Gap = (1- The percentage of application)

Seventh: The Research Community and Its Sample

The research has been conducted in the state companies for electrical and electronic industries which are linked to the Ministry of Industry and Minerals, and a brief summary can be shown about them as follows:

The establishment of the State Company for Electrical and Electronic Industries dates back to 1967, but it was officially opened on (28/4/1967) in the governorate of Baghdad, Al-Waziriya neighbourhood on the part of the Al-Karkh. The researched company which strives for presenting its services to its customers deals with the industrial side and provide the local market with various electrical equipment and apparatuses..

In keeping with development, aiming at facing competition, in 2016, the State Company for Electrical and Electronic Industries was merged with the General Ezz Company which is linked to the Ministry of Industry and Minerals and was established in 1997. The target was providing the local market with different electronic apparatuses. The merged company is called "the State Company for Electrical and Electronic Industries" after the decision of amalgamation.

The Second axis: The Theoretical Side

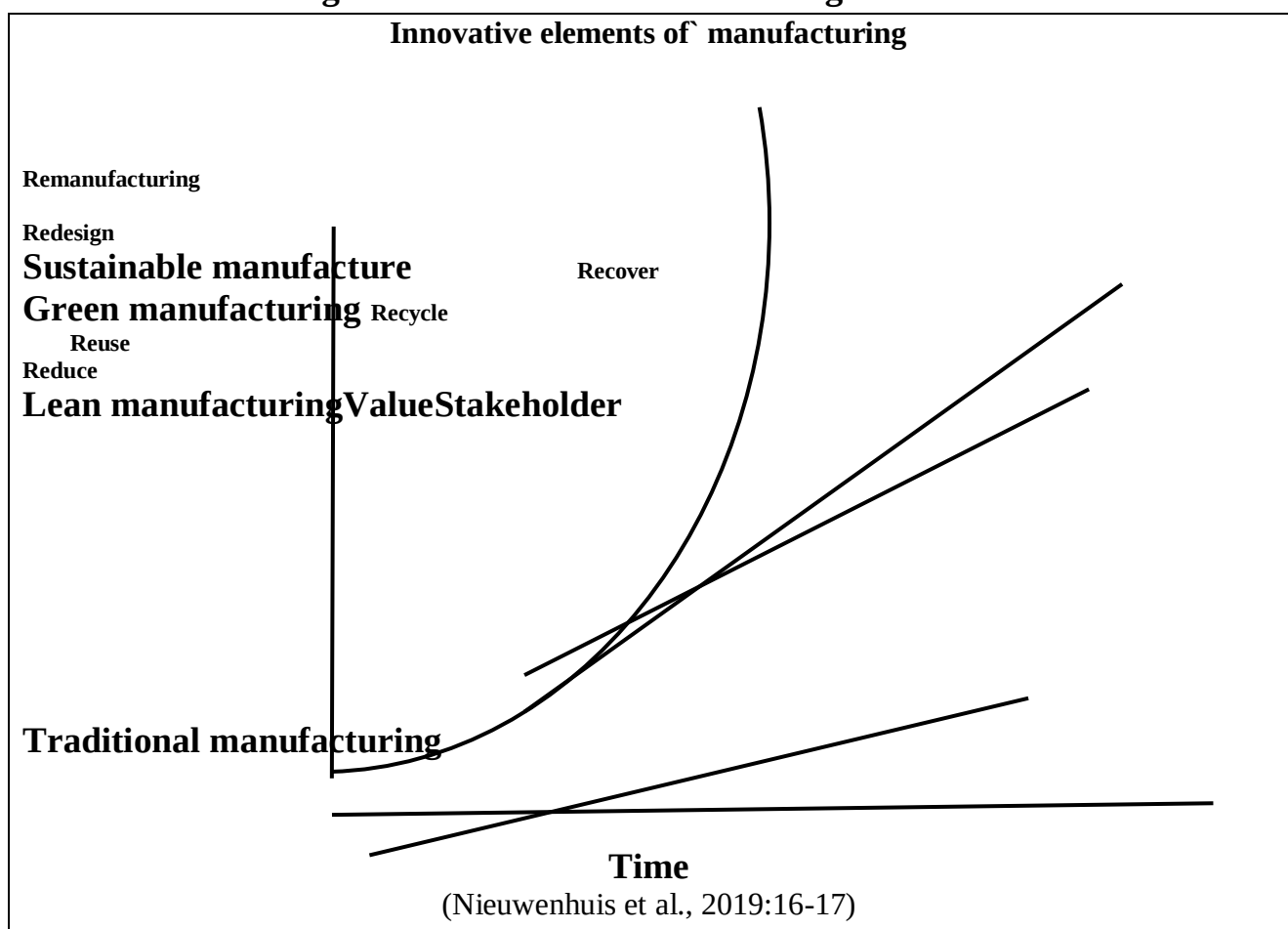
First: The Emergence and Development of the Concept of Sustainable Industrialization

(Rosen, 2012) and (Pathak et al., 2017) point out that the sustainable industrialization is a part of a larger concept which is represented by the sustainable

development that dates back to the early 1980s in a response to the growing awareness and concern for the environmental impact on economic growth and global extension in business and trade. The subject of sustainable industrialization has been submitted at the United Nations Conference on Environment and Development in Rio de Janeiro as a guide to help companies and governments move towards sustainable development (Rosen, 2012: 159) (Pathak et al., 2017: 22), and in the same context both (Haapala et al., 2011) confirm that the sustainable industrialization is an integral part of a sustainable society, so a balance must be struck between environmental performance and socio-economic goals (Haapala et al., 2011: 3).

(Kishawy et al., 2018), Badurdeen, Jawahir, 2017: 21) indicate that the emergence and development of the concept of the sustainable industrialization has passed through several generations called (traditional manufacturing, agile manufacturing, green manufacturing until reaching the most developed stage which is the sustainable industrialization). Figure 1 shows the development stages of the sustainable industrialization:

Figure 1. Sustainable Manufacturing Evolution



It is noted from Figure (1) that the entrance to the 6R) added three new updated elements to the traditional entrance (3R) and these elements are (re-coverage, re-

design, recycling) (Kishawy et al., 2018: 3) and as a consequence the sustainable industrialization became to include (6R).

Second: the definition of sustainable industrialization

(Moldavska, 2016) indicated that the concept of the sustainable industrialization has received a very great attention by industrial researchers, and at the same time it was noted that the process of transition to sustainable industrialization is still limited and this attributes to the challenges of the interface of transformation processes that were preventing this from being achieved, and a number of researchers and writers have presented a number of definitions to the concept of the sustainable manufacturing, but there is no unified definition agreed upon, as Garetti and Taisch, 2012) defined the sustainable industrialization as "the expression of the capability to smartly use of the natural resources in production through forming products and solutions and the credit is to the new technology, regulatory measures, coherent social behaviours and the ability to meet social, economic and environmental goals so as to achieve environmental conservation while continuing to improve the quality of life "(Moldavska, 2016: 413), while Barletta et al., 2018) defines the sustainable industrialization as "A group of processes that minimize the negative impact on the environment and conserve energy and natural resources, workers, society and consumers economically" (Barletta et al., 2018: 242), while (Pa Thak et al., 2017) indicates that the US Department of Commerce defines the sustainable industrialization as "the formation of industrial products that use processes with minimal negative impact on the environment whit conserving energy and natural resources and preserving workers, societies, consumers and the economic situation", either Lowell Center for Sustainable Production (which expresses sustainable manufacturing with sustainable production and defines it as "the production of goods and services using processes and systems bearing the following characteristics (non-pollution, energy conservation and natural resources, economic viability, safe and healthy for workers, society and consumers (Pathak et al, 2017: 22).

(Haapala et al., 2011) believes that the sustainable industrialization can be defined as "the design of industrial and human systems in a form that ensures that the human utilization of natural resources and their cycles do not lead to the low quality of life due to losses in future economic opportunities or to the harmful impacts on social conditions, mankind health and environment." Human and the environment " (Haapala et al., 2011:3), and (Badurdeen, Jawahir, 2017) has pointed out that several definitions of the concept of the sustainable industrialization have been received recently, but the most comprehensive definition of the concept of it can be regarded

as "the expression of levels of product and process." And systems that should demonstrate reducing the negative impact on the environment, saving energy, resources' efficiency, generating the minimum amount of waste, providing operational safety, and improving employee health while maintaining or improving product and process quality along the life-cycle of costs and benefits " (Badurdeen, Jawahir, 2017: 20-21).

Third: The Importance of Sustainable Manufacturing:

Although the sustainable industrialization occupies an important role in the pursuit of sustainable production and sustainable development, it takes into account the environmental impacts of the product which are largely determined during the design phase as is in the case of the cost of the product in which the decision is made during the completion of product design in (70 %) to (80%) of the total costs, so it is better to make design decisions that facilitate the sustainable manufacturing. Haapala et al., 2011: 3), and in the same context, the (Vimal and Vinodh, 2013: 214) indicate that implementing sustainable industrialization can or will improve the green image of the organization, its workforce, and the wider community. Moreover, (Vimal and Vinodh, 2013:214), (Kishawy et al., 2018: 3) indicate that through adding the three elements: (re-coverage, redesign, and recycling) to the stages of the development of manufacturing that led to the emergence of the concept of sustainable manufacturing will achieve for us (conservation on natural resources, energy, cost reduction and waste) (Kishawy et al., 2018: 3).

Fourth: Success Factors for Implementing Sustainability

(Rosen, 2012) has presented a number of factors that could have an effective role in the success of implementing the sustainable industrialization in the industrial organizations which can be explained by as following: (Rosen, 2012: 161-162)

1. Information: The quality and quantity of information needed to conduct the evaluation is very important and a good example is the knowing of the quantity and type of metal used by the process, and the quantity and type of pollutants released that contribute to the evaluation of the extent of the achievement of the sustainable industrialization. However, this information may not always be readily available and may be available sometimes and at other times difficult if not impossible to obtain.

2. Administration and Culture: The treatment of the environmental supervision efforts which is carried out by specialized managements rather than dealing entirely with management may lead to an inconsistent application of the sustainability and discouraging the development of a trend towards a culture of sustainability in the organization, so sustainability issues need special treatment.

3. Procedures: To achieve the goals of sustainability need to take into consideration the sustainability issues effectively by the workers when making decision, since there are a very large number of variables that have an impact when making decision, and when the decision makers and employees are not provided with the necessary methodologies and procedures to ensure that the organization's sustainability goals and strategies are applied in an efficient, effective, stability and strength may cause a problem for the measures of implementing the sustainability in industrialization. (Rosen, 2012: 161-162).

Fifth: The Focuses of Sustainable Manufacturing

Authors and researchers disagree in dealing with the mechanism for classifying the focuses of the sustainable industrialization in terms of formality, but in terms of content and essence they agree, as both (Vimal and Vinodh, 2013) remark that sustainability can be achieved in industrial companies by targeting improvement in three directions which are represented by (raw materials, product and manufacturing process) (Vimal and Vinodh, 2013: 214), while (Kishawy et al., 2018) and (Lu et al., 2010) indicate that the concept of the sustainable industrialization is categorized into three levels through their interaction with each other to achieve the sustainable manufacturing and the following is an explanation of this (Kishawy et al., 2018: 1-2) (Lu et al., 2010: 1).

1- **Classification at the product level:** (Kishawy et al., 2018) (Lu et al., 2010) indicates that this classification takes care of focusing on the perspective of the sustainable industrialization through the entrance of (6R), which includes (Recycling, Recovery reuse, Redesign, Recycle, Reducing), so, theoretically, closed-loop models and multiple life-cycle models are achieved for us (Kishawy et al., 2018: 1-2) (Lu et al., 2010: 1), and both (Badurdeen, Jawahir, 2017) with (Kishawy et al., 2018) that sustainable manufacturing practices which represent the contemporary era of industrialization can be expressed by the elements of (6 R) by adopting the closed-loop methodology and the total life cycle is based on the flow of materials with the comprehensive concentration on the levels of the product, process and system. (Badurdeen, Jawahir, 2017: 20-21) Here is a brief explanation of elements (6R):

A- Recycling refers to applying more chemical processes to one of the components where the raw material is usable for another purpose (Rosenthal et al., 2016: 318), Recycling achieves three benefits, they are: (reducing demand for new resources, reducing transportation costs and production capacity costs and using waste that would have been lost in landfills (Sadi et al., 2012: 939).

B-Recover or Restore is the process of recovering units or entire parts of users or previous operations (Rosenthal et al., 2016: 318).

C- Reuse is the use of the same materials in construction more than once, including using the materials again for the same job. (Sadi et al., 2012: 939) or is the process of completely reusing parts or components without altering the parts or making a very slight change in them. (Rosenthal et al., 2016: 318).

D- Recycling refers to transforming the life cycle and closing material loops, and there is a great deal of potential for developing processes to support product / material recovery and reuse, and this includes recycling technologies for plastics and the recycling of more complex components, and researchers emphasized new entrances and increased levels of recycling and recycling. They drive development, product design changes, increased use of reverse logistics, and possibly even reimagining the entire product life cycle (Haapala et al., 2011: 14).

E-Recycling refers to transform the life cycle and close the material loops, and there is a great deal of potential for developing processes to support product / material recovery and reuse, and this includes recycling techniques for plastics and the recycling of more complex components, researchers stressed to new entrances and increasing levels For recycling and remanufacturing leads to a push in the development process, changes in product design, increased use of reverse logistics, and possibly even re-imagining the entire product life cycle (Haapala et al., 2011: 14).

F-Reduction is the most effective and efficient way to manage waste, which can not only reduce waste generation, but also reduce the cost of waste transportation (Sadi et al., 2012: 938).

2. Classification at the process level: Classification at the process level includes reducing energy consumption, reducing risks, and reducing toxic waste through the optimal use of the technological process associated with the methodology for effective process planning, and it is expected that sustainable manufacturing process can achieve (energy consumption reduction, removal Reducing waste, improving product durability, eliminating health risks and eliminating toxic waste, high manufacturing quality).

3. Classification at the system level: This classification indicates that through the use of an efficient supply chain system taking into account the stages of the life cycle that are intended (before manufacturing, during manufacturing and use, and after use), this level can be achieved by providing an effective sustainable system (Kishawy et al., 2018: 2). (Masoumik et al., 2015) indicates that external pressures

from customers, competitors, societies and the media are forcing organizations to work increasingly towards integrating environmental measures into their business, including the entire supply chain of raw materials and the supply of materials for use in production. It extends to reverse logistics services and from the practices that it undertakes are (using environmentally friendly raw materials that can be renewed for use in the production of new products, replacing hazardous and contaminated materials with safer materials, selecting suppliers according to environmental standards, cooperating with suppliers for planning and implementing initiatives that are not Harmful to the environment, improving production processes to reduce or reduce energy consumption, reduce emissions from toxic substances (Masoumik et al., 2015: 670-675), and Nieuwenhuis et al., 2019) indicate that most of the research conducted in The field of sustainable supply chain focused on the most effective practices in achieving environmental and social performance with suppliers without compromising profitability, and studies have shown that the relationships of the current supply chain are a major method of business L To influence the sustainability of products and services. (Nieuwenhuis et al., 2019: 16-17).

The third axis : The practical side

This axis deals with the field side of the research which includes displaying check lists of the basic focuses with their three levels of the (product, process and system level, which may be through an analysis of its results reach and determine the availability or ownership of the research company for sustainable manufacturing as follows:

First: The main basics of the sustainable industrialization at the product level

The practices which is included within this base that include (recycling, recovery, reuse, re-design, remanufacturing, reducing) indicate that mechanisms can contribute largely in achieving sustainable industrialization within its location in the production processes of the company, as it is through its contribution to achieving balance Between the environment and production requirements on the one hand and meeting the needs of customers on the other hand, it works to reduce environmental pollution to a minimum and provide appropriate products to customers with advantages that increase the competitiveness of the company as well as to reduce or reduce energy consumption, and questions related to this anchor were identified through the aforementioned practices that will be Display them in the examination list shown in Table 1 as follows:

Table (1) the check list of sustainable manufacturing at the product level

	Items	Search metrics		
		Fully applied	Partially applied	Not Applicable
	First: Recycling			
1	The company is carrying out treatments on the components of the products used for use in new areas of production.		✓	
2	The company is devising new methods to treat components of damaged products.		✓	
3	The company collects the ingredients used by customers for recycling			✓
4	The company is working on using the waste and consumed components and not disposing them as waste.	✓		
5	The company's products are designed in such a way that they can be recycled		✓	
	Second: Recovery			
6	The company is tackling the ability to return entire units of products to second use			✓
7	The company works to provide equipment and cadres that have the ability to treat damaged or used units for renewal		✓	
8	The company's products are designed so that they can be recovered after their use is completed	✓		
	Third: Reuse			
9	The company is working on using some materials more than once for the same job		✓	
10	The company uses the whole parts or components without changing them or making a very slight change			✓
11	The company designs its products to be able to reuse it again after consuming it		✓	
	Fourth: Redesign			
12	The company is redesigning products to increase the life expectancy of the product.		✓	
13	The company is working to reduce the number of parts used in the installation of products through a redesign.			✓
14	The company is simplifying the processes after use through a redesign.		✓	
	Fifth: Recycling			

15	The company is working to recycle the used or damaged products and return them to service again.		✓	
16	The company is developing its capabilities in the area of product recovery operations for reuse			✓
17	The company has human capabilities and equipment that can recycle used products	✓		
18	The company is increasing the use of reverse logistics and reimagining the product life cycle		✓	
	Sixth: Reduction			
19	The company works to reduce the number of parts or components of the products it provides		✓	
20	The company achieves cost savings by reducing waste generated.	✓		
21	The company's products are designed to include the fewest parts and components		✓	
22	The company works to avoid using rare raw materials		✓	
	Weights	2	1	0
	frequencies	4	13	5
	Result	8	13	0
	Average	0.95		
	The percentage of application	0.47		
	Hypothetical Average Rate	0.02		
	Gap	0.53		

According to Table (1), it becomes obvious to us that the sub-practices of the sustainable industrialization at the product level have achieved different results, as it is noted that paragraph (4) within recycling has achieved the highest degree (2) out of (44) and with an application rate of (0.05) which is a ratio Higher than the hypothetical mean average of (0.02), which indicates that the company uses some of the waste and components consumed in the production process and not put it as waste, and also achieved paragraph (8) within recovery at the highest degree of (2) out of (44) and with an application rate of (0.05) which is higher than the hypothetical mean average of (0.02), which indicates that the company is keen that the design of its products be in a manner that can recover the products after the completion of their use, and it is also noted that paragraph (17) obtained the highest degree, as it exceeded (2) Out of (44) and the application rate for it reached (0.05), which is higher than the hypothetical mean average of (0.02). This indicates that the researched company possesses human capabilities and equipment that can recycle used products, and it is also noted that paragraph (20) has the highest degree It reached (2) out of (44)

with an application rate of (0.05) which is higher than the average The hypothesis of (0.02) indicates that the company has achieved a reduction in costs by reducing the waste generated.

As long as the following items (5,2,1) are concerned, they have got (1) a degree out of (44) degrees, and with an application rate of (0.02) for each paragraph, which is equal to the hypothetical mean average of (0.02), and this ratio is considered fairly acceptable What is indicative of a partial application by the company of recycling practices, as the company sometimes performs treatments on some of the components used and is usually recycled to be used in new products such as discharging Freon gas and maintaining it for second use instead of putting it in the air and causing damage to the environment, in addition to the company's pursuit of Finding new methods to deal with components of damaged products. As for paragraph (7), it has obtained (1) degree out of (44) degrees and with an application rate of (0.02), which is also equal to the hypothetical mean average of (0.02), which indicates the pursuit of The company provides equipment and cadres that have the ability to process damaged or used units to renew and use them secondly. As for paragraphs ((11.9), it also obtained (1) a degree out of (44) and with an application rate of (0.02) which is equal to the average rate. The hypothesis is (0.02) and the percentage of application of these paragraphs indicates that the company's orientation take advantage of the use of materials and components for more than one job and take that into consideration when designing products. Paragraphs (13,12) obtained (1) a degree out of (44) with an application rate of (0.02) which is equal to the hypothetical mean average of (0.02) And this application percentage indicates that the company takes into account when designing the products to increase their life as well as to simplify the processes after use, and paragraphs (18.15) obtained (1) degree out of (44) degrees with an application rate of (0.02) which is equal to The hypothetical mean average rate of (0.02), which indicates the generation of a perception in the company about the life cycle of the product through its endeavor to benefit from reverse logistic services, as well as the company's desire to recycle some of the consumed or damaged products to return them to service secondly, while paragraphs (22,21) have occurred on (1) a degree out of (44) degrees and with an application rate of (0.02) which is equal to the hypothetical average justice of (0.02) and this percentage indicates the company's orientation towards its products being the lowest number of parts and components and avoiding the use of rare raw materials.

It is also noticed in the table (1) that paragraph (3) occurred, as it obtained (0) a degree out of (44), meaning no failure indicating that the company did not collect the used components from customers for recycling, and also paragraph (6) obtained (0) A

degree out of (44) degrees, and this indicates that the company does not have the ability to return complete units of production after processing it. As for paragraph (10), it also obtained (0) degrees out of (44) degrees which indicates that no parts or components are used completely without change in it or by making a very slight change, and paragraph (13) obtained (0) degrees out of (44) degrees, which indicates that the company did not reduce the number of parts used to install the products through re-design, either of paragraph (16) It also obtained (0) degrees out of (44) degrees, and this indicates that the company has not developed its capabilities in the field of product recovery operations for reuse.

According to what has been already mentioned above and by looking at Table (1), it becomes clear to us that the general rate of application of practices related to the sustainable manufacturing at the product level has reached (0.95) and with an application rate of (0.48) which indicates a gap in the application of these practices amounted to (0.52) which means that the company's endeavor towards achieving sustainable industrialization through these practices was somewhat acceptable at an average level, and it is required from it to make more efforts towards raising the application rate.

Second: The main pillars of sustainable industrialization at the process level

The sustainable manufacturing aims at the level of the process to reduce energy consumption and reduce the damage and waste that can be caused to the environment, whether by using newer technology or improving current production processes, so achieving this level can enhance the achievement of sustainable industrialization, and for the purpose of determining the level of sustainable industrialization at the level of science in The researched company, the checklist was used and obtained the results presented in Table (2) as follows:

Table (2) the check list of sustainable manufacturing at the process level

	Items	Search metrics		
		Fully applied	Partially applied	Not Applicable
1	The company works to reduce energy consumption used in production processes.	✓		
2	The company develops its performance to secure work and reduce risks.		✓	
3	The company works to reduce toxic waste that pose environmental risks	✓		
4	The company is reusing some materials a second time, as they may cause toxic waste.		✓	

5	The company works on the optimal and effective use of technological processes that are related to the process methodology.		✓	
6	The company continues to provide products with high durability.	✓		
7	The company's products have characteristics and advantages to become of high quality	✓		
8	The company designs its products in a way that reduces the consumption of raw materials		✓	
9	The company designs its products in a way that reduces energy consumption		✓	
	Weights	2	1	0
	frequencies	4	5	0
	Result	8	5	0
	Average	1.44		
	The percentage of application	0.72		
	Hypothetical Average Rate	0.08		
	Gap	0.28		

According to what has been resulted in Table (2), it is clear to us that paragraph (1) has the highest degree, as it has reached (2) out of (18) degrees, i.e. an application rate of (0.11) approximately, which is a good percentage and is higher than the hypothetical mean average of (0.08) It indicates the company's tendency to reduce energy consumption used in production processes in order to reduce costs and environmental pollution, as well as paragraph (3) obtained the highest degree, as it reached (2) out of (18) degrees and with an application rate of (0.11) which is higher than The average mean rate, and this percentage indicates the company's work to reduce toxic waste that causes environmental risks.

The company is working to reduce toxic waste that causes environmental risks, and as mentioned in paragraphs (7.6), the highest degree reached (2) out of (18) degrees and with an application rate of (0.11), which indicates that the company maintains to provide products that have durability High and has good properties.

As for paragraph (2), it obtained (1) a degree out of (18), with an application rate of approximately (0.06), which is acceptable at an average level, because the hypothetical average rate is (0.08), and this application rate indicates that the company is working on Development of its performance in a manner that secures its work and can reduce risks. Paragraph (4) also obtained (1) a degree out of (18) degrees and with an application rate of (0.06) approximately at an average level of being less than the hypothetical mean average of (0.08) which indicates The company sometimes tries to reuse some materials a second time to avoid the toxic waste that

these substances cause. Paragraph (5) obtained (1) a degree out of (18) degrees and with an application rate of (0.06) which is acceptable at an average level because it is less than the hypothetical average rate, and this indicates that the company sometimes works on the optimal and effective use of technological processes that are linked systematically the operation. It is also noticed from Table (2) that paragraphs (9,8) obtain (1) degrees for each paragraph out of (18) degrees and with an application rate of (0.06) at an average level of being less than the assumed average average, and this ratio indicates that the company has a trend Designing its products in a way that reduces consumption of raw materials as well as reduces energy consumption.

Based on what was mentioned in Table (2) and through the answers in the examination list about the application of sustainable manufacturing at the process level, the results indicate that the company obtained a rate of (1.44), and the application rate reached (0.72) which is a positive percentage and indicates a degree above the average in the application Practices of applying sustainable manufacturing at the process level, and this ratio supports the company's orientation towards those practices that protect the environment on the one hand and in products that meet the needs of customers on the other hand.

Third: The main Focuses of the sustainable industrialization at the system level

Achieving sustainable industrialization at the system level is associated with broader and more comprehensive practices, as it is associated with the supply chain from obtaining raw materials through production processes to delivery of products to customers, as it is concerned with making all the facilities associated with this chain environment friendly while meeting the needs of customers in full In order to determine the extent of the researched company's application of sustainable manufacturing at the system level, the data in the checklist presented in Table (3) was analyzed as follows:

Table (3) the check list of sustainable manufacturing at the system level

	Items	Search metrics		
		Fully applied	Partially applied	Not Applicable
1	The company is interested in achieving a balance between its activities and the environment that surrounds it.	✓		
2	The company takes into account the scarcity of natural resources that go into manufacturing its products.		✓	

3	The company has a working mechanism by which to face the possible economic crises.		✓	
4	There is coordination between the company and government agencies regarding supporting the company's activity and protecting its products.		✓	
5	The company is heading towards increasing the consumption of renewable energy in production processes.		✓	
6	There is a tendency from the company to take into account and improve the standard of living for working individuals.			✓
7	There is interest from the company in using advanced technology by following developments in the industry	✓		
8	The company works on treating the water used in production before putting it up, as well as reducing its consumption.	✓		
9	It takes the company into account when selecting suppliers with an environmental focus.		✓	
10	The company works to reduce costs associated with production processes such as (labor cost, energy use cost, by-product processing cost)		✓	
11	The company is interested in involving customers in designing environmentally friendly products.			✓
12	The company works to reduce noise inside and outside the company.		✓	
	Weights	2	1	0
	frequencies	3	7	2
	Result	6	7	0
	Average	1.08		
	The percentage of application	0.54		
	Hypothetical Average Rate	0.05		
	Gap	0.46		

By looking at Table (3), it becomes clear to us that paragraphs (8,7,1) have the highest score of (2) out of (24) degrees, with an application rate of (0.08) approximately, which is higher than the hypothetical average mean of (0.05). This ratio is attributed to the research company's interest in achieving a balance between its activities and the environment surrounding it, and the company's endeavor to use advanced technology through the introduction of modern machines and equipment to introduce new products, in addition to the company's treatment of water used in

production in more than one filtering stage before its launch as well as reducing Its consumption.

As for the paragraphs (12,10,9,5,4,3,2), each one of them has obtained (1) a degree out of (24) degrees and with an application rate of (0.04) for each paragraph and it is at an intermediate level although it is just below The hypothetical mean average rate of (0.05), and this ratio indicates that the company sometimes takes into account the scarcity of natural resources that are involved in production operations, and has simple working mechanisms to address economic crises, as well as an average coordination between the company and government agencies about supporting the company's activity and protecting its products, In addition to the company's tendency to increase the consumption of renewable energy in production processes at a simple rate, it was also noted that the company's endeavor is to select suppliers who have an observance of environmental aspects, as well as the company's work to reduce noise inside and outside the company and reduce the costs associated with production operations such as (labor cost, Energy use cost, secondary product processing cost)

It is also noted from Table (3) that paragraphs (11.6) obtain a (0) degree out of (24) degrees and that result indicates the lack of interest of the researched company in involving customers in designing environmentally friendly products, as well as the company's inability to pay greater attention to the standard of living of working individuals.

Table (3) shows that after analyzing the results of the checklist on the level of sustainable industrialization at the system level, the company obtained a rate of (1.08), and the application percentage reached (0.54), which is somewhat acceptable and indicates the search company's pursuit of sustainable manufacturing at the system level at the level of Average.

Fourth: The overall presentation of the results of the examination list related to determining the level of application of sustainable manufacturing.

In order to determine the extent of application of sustainable manufacturing in the General Company for Electrical and Electronic Industries, and to determine the application rate and the gap between the actual reality and the required level, and for the purpose of presenting the treatment mechanisms that can contribute to reducing the gap, in this paragraph the contribution of each major focal point to achieving sustainable industrialization will be determined and then determined The overall level of the contribution of the pillars combined, and Table (4) shows the results related to the checklist for determining the level of sustainable manufacturing as follows:

By looking at the results in Table (4) obtained from the checklists of the main pillars of sustainable industrialization, the following results can be reached:

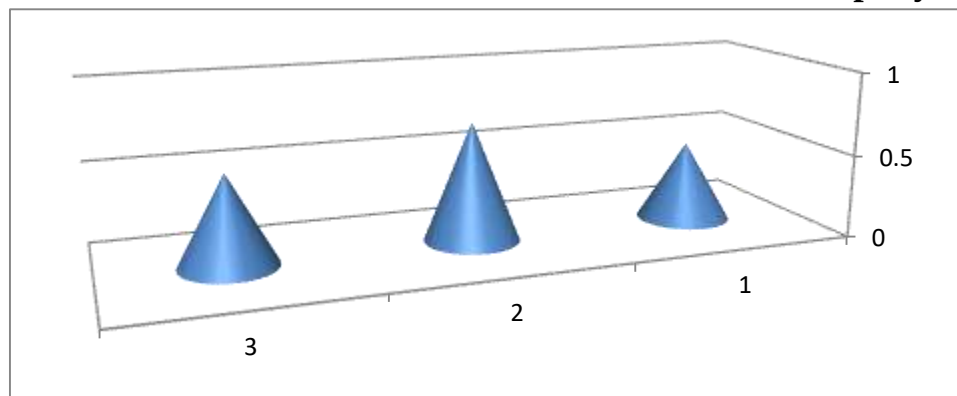
1. Achieving the basic focuses of the sustainable industrialization at the product level with a general average of (0.95) and with an application rate of (0.48), which indicates having an average level of sustainable industrialization foundations at the product level and this is what appears through the gap that reached (0.52), which requires The company should do more to reduce the gap by focusing on practices that achieve this ;

2. The main focuses which have been achieved at the process level have reached a general rate of (1.44) and with an application rate of (0.72), and this ratio indicates the achievement of a good level of sustainable manufacturing practices at the level of the process and this is confirmed by the gap that reached (0.28), but it requires The company is continuing with those efforts that have achieved this level in order to reduce the gap further, by diagnosing the weaknesses that led to that gap.

3. The main focuses of the sustainable industrialization achieved at the system level, a general average of (1.08), with an application rate of approximately (0.54). This ratio indicates the achievement of an average level of sustainable industrial foundations at the system level and with a gap of (0.46), which indicates the need for greater efforts In order to achieve sustainable industrialization by focusing on the weaknesses that led to it;

The following figure (2) shows a diagram of the three basic foundations for the extent of application of sustainable industrialization in the researched company, as the horizontal axis of it shows the basic foundations for sustainable industrialization represented by the numbers from (1) to (3), and the number (1) represents the basic foundations on The level of the product, which achieved an application rate of (0.48) that appears in the vertical axis, and No. (2) shows the basic foundations for sustainable manufacturing at the level of the process, which reached the application rate (0.72) that is clear in the vertical axis, while the number (3) reflects the foundations of manufacturing System-wide sustainable development in which the application percentage (0.54) shown by the vertical axis is shown.

figure (2) diagram of the three basic foundations for the extent of application of sustainable industrialization in the researched company



Fourth Axis : Conclusions and recommendations

First: Conclusions

- Achieving sustainable manufacturing practices at the product level with an application rate of (0.48), which means a gap of (0.52), as achieving practices (recycling, recovery, reuse, re-design, recycling, reduction) were in varying proportions and at a level Average ;
- The company recycles some of the waste and components consumed in the production process and do not put it as waste ;
- The company is keen on that the design of its products be in a way that can be recovered after its completion ;
- The research company possesses human capabilities and equipment that can recycle used products ;
- There are simple efforts made by the company sometimes to make treatments on some of the components used and recycle them to be used in new products such as discharging Freon gas and maintaining it for reuse second instead of putting it in the air and causing damage to the environment, as well as the endeavor of the company to find out new methods to treat the components of impaired products ;
- The endeavor of the company to have equipment and staffs that have the ability to treat damaged or used units for their renewal and second use ;
- The company is directed to benefit from the use of materials and components for more than one job, and this is taken into consideration when designing products ;
- The company has not developed its capabilities in the field of product recovery operations for reuse ;

- Achieving the pillars of the application of sustainable industrialization at the process level, a rate of (1.44), and with an application rate of (0.72) which is a good percentage and indicates a degree above the mean in the application of the pillars of sustainable industrialization application at the process level ;
- The company should work to reduce the energy consumption used in production processes in order to reduce costs and environmental pollution, as well as reduce toxic waste that causes environmental risks ;
- The company works to develop its performance in a way that secures its work and can reduce risks, as it sometimes tries to reuse some materials again to avoid the toxic waste that these substances cause ;
- The company sometimes works to optimize and efficiently use the technological processes that are related to the process methodology ;
- Achieving the foundations of sustainable industrialization at the system level, with a rate of (1.08) and with an application rate of (0.54), which means that the gap reached (0.46), so it can be said that practices at this system level have a medium contribution to achieving sustainable industrialization ;
- Achieving a balance between the company's activities and the surrounding environment, and supporting that through its endeavor to use advanced technology ;
- The company's treatment of some waste before it is released to the environment, such as treating the water used in production in more than one filtering stage before it is released, in addition to reducing its consumption ;
- The company sometimes takes into consideration the scarcity of natural resources that go into production processes, and has simple working mechanisms to deal with economic crises;
- The company endeavors to choose the suppliers who have an observance of the environmental aspects, as well as the company's work to reduce the noise inside and outside the company and reduce the costs associated with production operations such as (labor cost, energy use cost, the cost of processing secondary products.

Second: Recommendations

- Paying more attention to the pillars of sustainable industrialization because of its great role in preserving the environment from pollution on the one hand and providing safe products at the lowest costs that meet the needs of customers ;
- Opening units engaged in re-dismantling of consumed products for re-use of some valid parts or components ;

- Recycling some of the consumed parts and using them as renewed components or raw materials in manufacturing new products ;
- Treating all forms of waste that appear during production operations and not dumping it in the environment or throwing it in the landfill ;
- Simplifying the product design and reducing the components that go into its manufacture, while ensuring that there is a possibility to reuse some parts or components after consuming the products and the end of their useful life ;
- The trend towards significantly reducing energy consumption by redesigning production processes and taking into account the amount of energy consumption of new equipment.
- The trend towards using renewable energy in production processes ;
- Developing product design and focusing on the use of renewable energy in its operation.
- Focusing attention on reducing costs, waste, toxic waste and energy consumption, starting from preparing raw materials to delivering products to customers ;
- Involving customers in designing products and directing them towards the economic use of products ;
- Increasing interest in workers and involving them in developing production processes, developing product design and handling waste and consumed products.

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