The Role of Green Manufacturing Strategies in Sustainable Development

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Abstract:
Effective use of materials is one of the potential components of a green manufacturing strategy. There are many of these strategies proposed in the literature and used in practice, with intellectual debate over what they are, what are the differences between them and how they can be used by practitioners in design and manufacturing to improve the sustainability of their products and processes. This paper reviews the literature on green manufacturing strategies that provide improved material performance. Four main strategies for green manufacturing were found; They are: waste minimization; Material efficiency, resource efficiency; and environmental efficiency. The literature was analyzed to determine the key characteristics of these sustainable manufacturing strategies and 17 characteristics were found. Then the four strategies were evaluated through the motives and obstacles to applying the practices of these strategies through a questionnaire prepared for this purpose. It was distributed to the experts and specialists in charge of the Union Company in the province of Babylon to determine the level and reality of the application of these strategies, and the research reached a set of results, the most important of which.

Keywords: *green, manufacturing, strategies, sustainable, development*

1.1 Introduction

Centuries ago, when natural resources were plentiful and labor scarce, industries struggled to find ways to increase labor efficiency by introducing diversified manufacturing strategies and technologies. Strategies ranged from functional flexibility, shift work, time and motion study, mass production, and low production, while technologies ranged from machine tools, actuators, automated devices, robots, and automated lines; All of these are designed and used to increase business productivity in order to meet customer demand. Machines must be faster, cheaper, more reliable and always available. More recently, the theme of "doing more with less", which usually means doing less labor per unit of production, has been reoriented away from increasing batch sizes, and thus improving the use of machinery, toward the revolutionary approach of "flexible" production, which emphasized making what is Required when requested by the customer. While the flexible concept attracted initial concern about its impact on reduced machine usage, the many benefits of improved lead times, reduced inventory, etc. demonstrated the value of this radical rethink**.**

incorporating green practices into their manufacturing activities. The past decade has witnessed a debate that a radical rethinking of the manufacturing system may occur again, driven by a changing world where energy and materials become less abundant and work more abundant. In contemporary business environments, characterized by environmental changes and globalization, producers are interested in achieving sustainable manufacturing practices, not only to meet their responsibility, but also to prioritize their competitive markets. As a result, as producers seek to incorporate many sustainable strategies into their manufacturing processes, green manufacturing (GM) is receiving more attention than the other approach due to its important implications for organizational performance.

In addition to influencing organizational performance, GM leads to obtain the full support of various stakeholders including customers, governmental and non-governmental organizations. GM manufacturing compensates for and balances the environmental slowdown which has become an undeniable global issue, due to population growth and current studies confirm that the ultimate goal of global strategies is to minimize and minimize environmental impact and resource consumption during the product life cycle that spans time domains. It is now a mandatory process for almost all manufacturing organizations. Among GM engines, ISO 14001 plays a vital role, because after the introduction of this certification, many industries have taken an increasing role around green strategies, and as a result, recent studies have explored cleaner production and environmental mental management practices.

1.2 The concept of green manufacturing

Researchers define green manufacturing from their own perspectives, but one of the more effective definitions, cited by several studies, is the one given by Melngk and Smith, 1996: "A system that integrates product and process design issues with those of manufacturing planning and control in a way that determines Quantifies, assesses and manages the flow of environmental waste with the aim of minimizing and ultimately minimizing environmental impact while trying to maximize resource efficiency."

Green manufacturing is part of sustainable industrialization and can be interpreted as a form of pollution prevention that integrates environmental considerations into the production of goods, the installation of environmentally friendly manufacturing processes, the conservation of energy and natural resources, as well as the reduction of negative environmental impacts (Remo, et.al, 2014).)

Green manufacturing and environmental innovation have a positive relationship with the performance of corporate sustainability (Sezen and Sibel, 2013), which consists of the environment, economy and society. Green manufacturing not only meets the requirements, but also creates a positive image in the mind of customers. There are three different aspects that must be considered in order to implement new manufacturing strategies such as green manufacturing. This provides inspiration to prioritize green manufacturing engines using environmental (ie the planet), economic (ie prosperity) and social (ie human resources) perspectives. Companies have to do their best in green innovation to build their competitiveness because of the changing state of green technology and the short life cycle of products. Unfortunately, green innovation involves a great deal of uncertainty and risk and many resources are consumed in the process. Therefore, understanding green innovation is a possible way for companies to obtain the required technologies and assistance. Through this study, green and sustainable manufacturing and environmental innovation or green innovation collectively show the impact on corporate sustainability performance. Environmental innovation is divided into four sub-parts: Environmental product innovation. ecological process innovation; green management innovation; Green technological innovation, these are very necessary for the sustainable development of the manufacturing industry due to the increasing environmental pressure.

The word "green" in green manufacturing means environmentally friendly manufacturing that must be done without affecting the environment, the living world and natural resources. One must keep in mind during production that the release of pollutants should be minimal. It is forbidden to use resources too much, because our moral responsibility towards our future generation is to give them what is their right. There are a number of international environmental regulations such as the Montreal Convention and the Kyoto Protocol, restricting the use of certain hazardous materials, electronic waste and electrical equipment.

In the early 1990s, some companies began implementing environmental policies due to the development of standards, which led to a growing concern about green manufacturing practices. GMP "Green" manufacturing is quite different from traditional manufacturing because it aims to "reduce the amount of natural resources needed to produce the final products through more energy, and materials for efficient manufacturing processes that also reduce negative externalities associated with waste and pollution." (CII, 2011) After the introduction of ISO 14001 in 1996, more companies started implementing GMP. As a result, the field of "green" manufacturing grew rapidly, and researchers began to study strategies. In addition to the driving force of the ISO 14001 standard, there are other drivers that have pressured the implementation of "green" manufacturing and these drivers of environmental processes have been explored (Agan, Acar, and Borodin, 2013) (Agan, Acar, and Borodin, 2013). And their impact on corporate performance in their analysis of SMEs.

1. 3 Methodology

The four strategies were chosen because they are the most representative in the academic and practical literature and reported to be self-acting at the level of manufacturing strategies; Terms used by individual authors, as well as terms assessed as tools, of limited scope, or as captures for all other strategies (eg material selection techniques, component design, green manufacturing) were ignored. Each strategy seems to have its own audience: waste reduction is more common in the literature. Resource efficiency is

also very popular, and environmental efficiency is common all over the world, especially in Europe; Material efficiency is emerging as a related strategy and a descriptive approach was used to analyze the literature and the opinions of researchers in this field, while on the practical side, the analytical approach was used to assess the reality of practices of applying green manufacturing strategies.

The literature search strategy for this research was developed by identifying potentially relevant databases, conferences and journals and using keywords (eg material efficiency, sustainability, waste minimization, cleaner production). This generated potential papers whose abstracts were analyzed from different perspectives.

1.4 Identify and analyze the four strategies

1- Waste Reduction Strategy

Minimal waste is often mentioned in sustainability strategies. It is recognized that a commitment to waste minimization is desirable in resource management. Waste minimization is described as "waste reduction" at source while recognizing that it is cheaper to not produce waste in the first place. It covers the minimum waste of activities aimed at reducing waste arising from: the use of raw materials and components; product loss, water consumption and effluent generation; paper and packaging; consumables for factory and office; Energy consumption for all other solids; liquid and gaseous waste; and wasted effort.

The waste hierarchy provides a framework within which the most desirable management options are identified for waste reduction (formerly waste minimization), reuse, recovery (including recycling, composting and energy recovery) and disposal (landfill and incineration without energy recovery). Waste minimum is now referred to as an outdated option compared to waste prevention (waste prevention, recovery and safe disposal) (Pongra'cz et al. 2004). Although there are different versions of the waste hierarchy, it is widely accepted that waste minimization, reduction or prevention is the first priority, while recycling has a higher priority than incineration, and landfill is the lowest priority (Moberg et al. 2005).

The basic definition of waste minimization is "reducing the quantity and hazardousness of waste produced at source" (OECD 1998). In this definition, reuse, recycling, and recovery are not included. Although this definition of waste minimization is limited only to the relevant hazardous waste.

The term "waste reduction" is arguably the most obvious of the four strategies, with an emphasis on reducing the worst types of polluting waste. However, some authors refer to waste minimization as a different version of waste prevention, indicating the level of challenge in creating a common language for the emerging fields of sustainable manufacturing and sustainable engineering. The term 'waste reduction' is preferred and used in the UK while in the US the term 'waste reduction' is often replaced by 'pollution prevention' (Levin 1990), Freeman et al. 1992) Waste minimization, due to its simple and straightforward goal of waste minimization, is a first step for organizations implementing a broader and more sophisticated environmental strategy (Clelland, et al. 2000). van Weenen, J.C., 1990) grouped the terms waste prevention, waste avoidance, waste reduction, pollution abatement, pollution prevention and recycling as having similar strategies. All of these strategies are concerned with waste (the cause) and pollution (the problems or consequences)

In previous studies, GM was called environmentally conscious manufacturing (EMS); Reijnders, L., 1998) discussed the challenges and obstacles of EMS with other interesting insights such as life cycle analysis (LCA) and design guidance. Chang (1999) has incorporated a life-cycle and life-cycle cost approach into a quality function deployment for GM improvement as shown in an example of engine filters. Discuss Reich-Weiser et al. (2013) GM metrics across multiple considerations, including environmental, social, and economic metrics. Rao (2011) explored the GM advantage in managing risks such as technological, regulatory, financial, and situational risks. Mittal (2013) and Sangwan (2013) developed a model and explored the effective barrier to environmentally conscious industrialization/GM using statistical analysis (Structural Equation Modeling)

2. Material Efficiency Strategy

Efficiency is the ratio of the outputs to the inputs of any system. Thus, material efficiency can be stated as "the ratio of output of products to input of raw materials". (Worrell et al. 1997) explained material

efficiency as being similar to energy efficiency whereby improving material efficiency is described as reducing the consumption of raw materials without significantly affecting the service or function of the product. In a broader definition, this has been extended by Worrell et al. As "reducing the consumption of raw materials without affecting the level of human activities qualitatively". Male (von Weizsa¨ cker et al. 1997) in their book The Fourth Factor: Double Wealth, Halve Resource Use, they argue that we can use resources at least four times as effectively as we currently do. (Hawken et al. 2000) in their book "Natural Capitalism: The Coming Industrial Revolution" indicates that we will observe the birth of a new type of industrial revolution that emphasizes the efficient use of resources including material resources, suggested (Young et al. 1994) the need for an economy Materialistic as effective as the next efficiency revolution, claiming that it will require more than technological improvements alone, and calling for a change in culture and morals. Material efficiency as described here is echoed in later sections and is arguably a key component of other sustainability strategies such as resource efficiency and environmental efficiency.

In the literature, the authors found relatively few studies on physical efficiency or physical productivity. Most of the studies that mentioned material efficiency did so as part of other strategies such as energy efficiency, resource efficiency and environmental efficiency.

The materials efficiency strategy is defined as “the quantity of raw materials needed to perform a specific function.” Improving the efficiency of materials allows achieving the same function but reducing the quantity of materials” (Worrell et al. 1997). As defined by the Glossary of EEA (EEA 2006) an indicator of the output or added value generated for each unit of materials used materials used to achieve functional performance, which can be compared to the concept of material efficiency presented by (Worrell, 1995) which is concerned with the maximum use of inputs. To achieve material efficiency, it is clear that dematerialization, as well as other procedures, should be practiced. Material efficiency and energy efficiency are always linked together, some definitions of materials efficiency are given first as similar concepts applied to different things - materials and energy. Second, it is usually said that actions to reduce one resource will also reduce another. Improving material efficiency usually saves energy in not producing and transporting those materials. Whereas, improvement in energy efficiency reduces consumption of materials and other primary resources (Worrell 1995, Worrell et al. 1997). Again it is said that material efficiency is an essential strategy in all sustainable strategies. Energy efficiency is an area that is attracting a lot of research.

3.Efficient use of resources Strategy

The UK government actively promotes resource efficiency as part of its government policy for sustainable development (Foxon 2000).. Resource efficiency is a strategy that “strives to effectively use and reduce the flow and consumption of resources derived from nature” (Schmidt-Bleek 1996). Resource efficiency, also called resource productivity, has received a lot of attention lately because it focuses on managing resources as a whole rather than being limited to a single phase of a resource's life, such as waste minimization and pollution prevention that focuses on waste (the cause) and its polluting impact. The resource efficiency strategy itself is defined as concerned with a broader range of impacts on the environment including reducing waste generation, using fewer resources and using resources and production and extraction processes that have a lower environmental impact. Schmidt- Bleek (1995)) points out that resource extraction is the most important reason, because all the materials that are taken up in the economy sooner or later end up as emissions and waste. Thus, reducing the costs of environmental damage requires reducing emissions and reducing the flow of resources derived from nature.

Resource productivity and efficiency are among the terms used and often suggested as specific indicators of the efficiency of the entire economy [OECD as mentioned in (EEA 1998)]. Emphasizing national resources consumed versus economic value added can give a very rough calculation of conversion efficiency at the nation-state level, but it is seen as more challenging for individual firms or manufacturers. While ensuring resource efficiency and resource production is introduced at the state level, the concepts are still advocated as being relevant and useful for industrial organizations. The authors' analysis shows that many authors consider the ability to easily and accurately measure something as important in "operational" the concept or strategy, which the concept of resource efficiency finds

difficult. Some authors or organizations have been selective in their terminology and used either resource efficiency (Foxon 2000) or resource productivity (eg Pearce 2001 and Schmidt-Bleek 1995), while some refer to both resource efficiency and resource productivity and sometimes use them interchangeably (eg von Weizsa).¨cker et al. 1997, Commission of European Communities 2003) and others use and distinguish between both terms [eg Dahlstro¨and Ekins, 2005).
At the national policy level, resource efficiency and resource productivity can be defined as the efficiency with which energy and materials are used throughout the economy, ie the value added per unit of resource input. (Thomas and Iles 2004)

Pearce (2001), (Hawkins and Shaw 2004) suggested a variety of means to make the use of natural resources more efficient by:
• Reducing wasteful use of resources;
• Adopting technological change that raises the efficiency of a certain resource unit;
• substituting other inputs, such as labor, with natural resources, so that output remains the same but resource use is reduced;
• Recycle materials so that the "same" unit of resources is used multiple times;
• Replacing one supplier with another. If the focus is on environmental pollution, one ton of one substance may pollute less than one ton of another substance.

4. Environmental Efficiency

An environmental efficiency strategy is explained as “having a business link to sustainability”. The concept of environmental efficiency was used by Schaltegger and Sturm in 1990 (Schaltegger and Burrit 2000). The strategy is concerned with increasing economic development while striving to reduce environmental impact, and it is not a new strategy since it has been around since the 1970s (Ehrenfeld 2005 Cote et al. 2006). This concept was popularized mainly at the United Nations Conference on Environment and Development (UNCED) Summit) in Rio in 1992 by changing course, then the World Business Council for Sustainable Development adopted the strategy and launched it worldwide and since then has marketed environmental efficiency as a central business strategy for achieving corporate progress toward sustainability and has helped it to be adopted by many companies, first in Europe and Latin America, then in other countries (WBCSD 2000a). The WBCSD describes environmental efficiency as “achieved through the provision of competitively priced goods and services that meet human needs and bring quality to life, while reducing environmental impacts and resource intensity progressively throughout the life cycle, to a level at least consistent with the estimated carrying capacity of the Earth.” Environmental efficiency can be broadly defined as the production, delivery and use of goods and services at competitive prices, along with the achievement of environmental and social goals. Improving “environmental efficiency” defined as “maximum value addition with minimal use of resources and minimal pollution.” (Welford, 1997)
It is argued that 'efficiency' measures in environmental efficiency carry more than one perspective. "The cross-efficiency between the economic and environmental dimension - ecological economic efficiency - is the ratio between changes in value in the added environmental impact and the added economic value. Ecological economic efficiency is often referred to as eco-efficiency proposed" (Schaltegge and Burrit 2000) proposed the following equation to measure efficiency environmental.

$$\text{eco} - \text{efficiency} \sim \frac{\text{value added}}{\text{environmental impact added}}$$

Based on the above equation, the environmental efficiency is improved by reducing the environmental impact while maintaining or increasing the monetary value added. Given its breadth, this strategy is said to appeal to higher levels of administration and government in policy and decision-making. The following figure shows the four green manufacturing strategies.

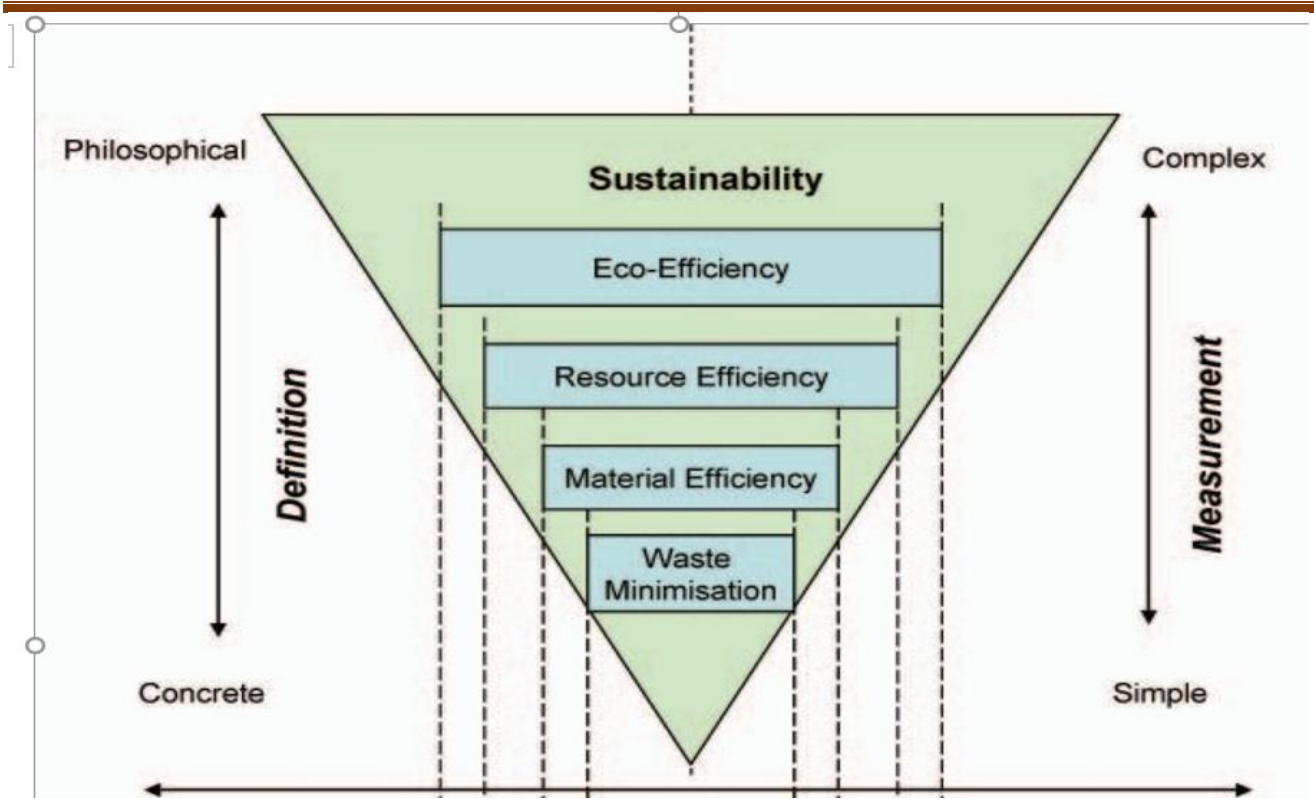

Figure 1. The hierarchy of sustainable strategy preference

Salwa H. Abdul Rashid , Stephen Evans & Philip Longhurst "A comparison of four sustainable manufacturing strategies" International Journal of Sustainable Engineering, 04 Nov 2008

1.5 Drivers of green manufacturing

After reviewing the literature, it was found that the focus of many researchers is the general concept of green manufacturing only and not on the drivers of green manufacturing. Only a few researchers have demonstrated an interest in the motivations, barriers, and stresses of EMS/GM. But motives put a fair effect on GM and various studies have identified in the past

(Niki, ET.AL, 2013) Number of Green Manufacturing Drivers. According to the servey literature there are seventeen drivers of green industrialization. Current and future legislation (D1), incentives (D2), customer demands (D3), employee demands (D4), cost saving (D5), green (D6), green innovation (D7), internal motivation (D8), pressure year (D9), competitiveness (D10), supply chain requirements (D11), corporate image (D12), shareholders (D13), senior management commitment (D14), market orientation (D15), technology (D16), organizational resources (D17). These drivers have a particular priority over green manufacturing (Varinder and Kuldip, 2014).

The effect of the driving factors is to focus on efficiency, and (Payman and Cory, 2013) and focus on performance.

1.6 Obstacles to green manufacturing

The impediments to green manufacturing are just as important as the drivers. Obstacles or barriers are the criteria that hinder the implementation of green manufacturing in this industry. In the study it was found that there are 12 common barriers [6] to green industrialization among them spreading lack of awareness/information “in the language of insufficient information about current technological options and limited access to information. The barriers are weak legislation, low enforcement (B1), and insufficient future legislation Certain (B2), low overall pressure (B3), high short-term costs (B4), uncertain benefits (B5), low customer demand (B6), trade-offs (B7), impairment (B8), management commitment (B9) Lack of organizational resources (B10), technological risks (B11), and lack of awareness/information (B12) (Rohit, et.al, 2015).

(Raja, et.al, 2014)

1.7 Environmental innovation

It is processes of innovation towards sustainable development of new products and services that provide customers and business with value but significantly reduce environmental impact (Javier, ET.AL, 2010) and are able to attract businesses, politicians, unions, associations, clients, private families, employees, etc. According to, (R. Kemp), and P.Pearson, 2008), "Environmental innovation is the manufacturing, integration/product development, manufacturing process, service/management/business technology new to an organization (development or adoption) that, throughout its life cycle, leads to the reduction of environmental risks and pollution and other negative effects of resource use (including energy use) compared to related alternatives." The drivers of environmental innovation can be divided into two groups, one being intrinsic drivers (organizational capabilities, technological capabilities, corporate social responsibility) and the other being extrinsic drivers i.e. green customer demands, pressures Competition, Environmental Regulations, gives the idea of performance drivers for green innovation and has a positive impact on the performance of environmental innovation (environmental applications, energy reduction and waste reduction). Li has four main components. Environmental product innovation, environmental process innovation, green management innovation, and green technology innovation (Ming-Lang Tseng, Fei-hsin Huang, 2012). Environmental product innovation is strategic innovation to obtain new alternative competitiveness for green products, understanding customer needs as well as evaluating the technical, economic, environmental and commercial feasibility of products. Innovation in environmental processes can be understood in terms of the level of knowledge and uncertainty related to the ratios of return to risk with the improvement of existing processes and the development of new ones and also through recycling, reuse, remanufacturing of materials and life cycle assessment. Green management innovation is proposed.

The company's ability to prepare green projects and assemble green projects with appropriate programming and resource allocation such as redefining operations and production processes to ensure internal efficiency that can help implement GSCM and redesign and improve the product or service to acquire new environmental standards or trends. Thus, the company must be able to evaluate and establish an environmental management system. Green technological innovation is modern technologies that are very effective to implement environmental innovation in the green and sustainable development of products, such as green products.

1.8 Sustainable Development

Sustainable development, as defined from the famous report of the UN World Commission on Environment and Development in 1987, is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987). One potential key to the pursuit of sustainable development is sustainable manufacturing (Rosen and Kishawy 2012). The manufacturing sector has a strong influence on sustainability due to the inherent high volume of resource consumption, and the increasing number of new products introduced annually that require relatively high levels of energy, consumables and waste. The manufacturing processes and the resulting products have an immediate negative impact on society.

Efforts addressing sustainable manufacturing today can be divided into two main groups: (1) management, and (2) design and engineering. Sustainable manufacturing management includes a systems approach, such as environmental collaboration in the supply chain (Zilani
2012), et al., Product Life Cycle Assessment (2010, et al., Heijungs, Environmental Design (Rosen and Kishawy, 2012), Environmental Procurement 2012), et al., (Zailani), etc. Design and engineering efforts in sustainable manufacturing include technologies and approaches that address materials, energy, and waste (Despeisse, et al., 2013;). (Yuan, et al, 2012) However, these two approaches nowadays separate themselves from the company's competitive strategies. The link between these approaches and the internal and external functions of manufacturing in creating competitive advantages remains unclear.

One of the enabling factors towards sustainable industrialization is the presence of stakeholder interests. Sustainability is only achieved when the interests of different stakeholders such as government, customers, suppliers, society, competitors, shareholders, employees and consumers are considered.

1.9 Case Study (Etihad Company)

The main objective of the research is to assess the reality and requirements of green manufacturing strategies through the efficient use of energy (water and other resources). maintaining health and

improving employee productivity; Reducing waste, pollution and environmental degradation. It also tries to avoid introducing chemicals into the environment or soil, and to set up an effluent treatment plant (ETP) to make the water free of harmful pollutants released into the environment. In the company they try to provide natural lighting and ventilation through the sky and wind tunnels are being developed to provide a natural air cooling system. According to this, a proportion of the factory area is used for agriculture and green space. The company's waste can be recycled and utilized.

In order to assess the extent to which the green manufacturing strategies are applied in Al-Etihad Company through the motives (motivators) and constraints (obstacles), a questionnaire consisting of two parts was designed, the first part was devoted to the motives, while the second part dealt with the obstacles to the application of green manufacturing strategies to achieve sustainable development. And based on a group of literature presented in Table (1-1) and Table (1-2), as well as interviews that were conducted with officials in the company. And as follows:

1. 9. 1 interview

The first interviewee: He is a production manager in the company. A question was answered about the existence of practices for implementing green manufacturing strategies, and his answer was that these practices are among the priorities of the company's decisions and that they are subject to the ISO 14001 system and that the company is subject to a visit by the ISO organization SNOPA, in addition to that, the company is subject to For the periodic inspection of the environment committees on a weekly basis to ensure the company's commitment to these strategies, preserving the environment and preventing pollution, and a question about the responsibility of these practices was, the answer was that this is the responsibility of the quality department in the company through a set of organizational, logistical, environmental, social and other procedures and motives.

The second interrogator: As for the second interrogator, he was asked about the procedures and practices of treating harmful and polluting wastes to the environment, and his answer was that the wastes resulting from the manufacturing processes, which include 9 stages before storage and packaging, are often liquid materials accompanying the production processes that include (the dissolution stage of raw materials extracted from Sugar cane imported from Brazil or India, the second stage: treatment or carbonization by adding chemicals, the third stage filters through filtering the liquid through special fabrics, the fourth stage is nonisip (ionic reaction) to remove the color, then the fifth evaporators: a heat exchange between steam Water and juice, then the sixth cookers, then separators (centrifuges), then dryers, then coolers) He explained that there is a special unit for treating waste to remove harmful substances and gases before dumping them into a river called sewage. He also mentioned that the company's production capacity is 4,000 tons per day, with three working meals, and the number of workers is approximately 4,000 workers, and that it covers local consumption at the country level, and that the sugar product is supported by the local product support law, which confirms the ban on importing. He stated that the company means great attention to environmental conditions by providing natural lighting, ventilation, and continuous cleaning operations, increasing green spaces and afforestation.

1. 9.2 Analysis of strategies that stimulate the implementation of green manufacturing practices in the company

It is clear from Table (1-1) the paragraphs of the questionnaire that include the motives for practices related to green manufacturing strategies, which include a set of main dimensions distributed among experts and those responsible for green manufacturing. The 30 questionnaires are valid for analysis, as follows:

A- Logistic motives: Table (1-1) shows the first dimension of motives, which includes four paragraphs through the mean and standard deviation, which shows the extent of the dispersion of the answer by the respondents, as the average answer for the first strategy was; Waste reduction strategy for the sum of the four paragraphs was 3.287, with a standard deviation of 0.895, and this indicates the agreement of the sample members about the necessity of taking these matters into consideration in the waste reduction strategy. As for the resource efficiency strategy, the average was 3.317 with a standard deviation of 0.862, which reflects the agreement of the sample members about these items, and the first item achieved the highest average of 3.600, and the rest of the items were close to each other. While the resource efficiency strategy achieved a general average of 3.283, and the dispersion was somewhat larger through the standard deviation of 0.941. The second paragraph was distinguished; (Environmental labeling'

mandatory regulation imposed by the local government (such as hazardous and toxic regulation) GMP) with the highest average score of 3.533, which indicates the agreement of the respondents on this paragraph; In addition, the average of the overall environmental efficiency strategy was 3.267, with a standard deviation of 0.962, and the highest average in the second paragraph was 3.500, which means the most agreement by the respondents.

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The analysis was also at the level of the four strategies for this dimension. The general average of these strategies was 3.289, with a deviation of 0.016, and this indicates the convergence of the opinions of the sample individuals about these strategies, but the second strategy was more focused by the respondents. As for the arrangement of these strategies and for each paragraph, the paragraph was occupied The second and fourth strategy The third is the resource efficiency strategy. And the first and third paragraphs of the second strategy.

B- Organizational pattern: Table (1-1) shows the second dimension (pattern), which includes two paragraphs through the mean and standard deviation, which shows the extent of the dispersion of the answer by the respondent, as the average answer for the first strategy was; Waste reduction strategy for the sum of the four paragraphs 3.250 and standard deviation of 0.807, and this indicates the agreement of the sample members about the necessity of taking these matters into consideration in the waste reduction strategy. The item (self-directed organization and easy to facilitate GMP) achieved the highest average of 3.400 with a deviation of 0.770, which indicates that this paragraph is more in agreement in the opinions of the sample members

As for the resource efficiency strategy, the average was 3.417, with a standard deviation of 0.604, which reflects the agreement of the sample members about these items. The second paragraph achieved the highest average of 3.567, while the resource efficiency strategy achieved a general average of 3.350, and the dispersion was somewhat larger through the standard deviation of 0.808. second paragraph; achieving the highest average of 3.567, and this indicates the agreement of the respondents on this paragraph; In addition, the overall environmental strategy averaged 3.267, with a standard deviation of 0.761, and the highest average in the second paragraph was 3.458, which means the most agreement by the respondents.

The analysis was also on the level of the four strategies for this dimension. The general average of these strategies was 3.321, with a deviation of 0.069, and this indicates the convergence of the opinions of the sample individuals about these strategies, but the second strategy was more focused by the respondents. As for the arrangement of these strategies and for each paragraph, the first paragraph was occupied The second strategy is the resource efficiency strategy. The second paragraph, the third strategy, is the resource efficiency strategy.

C- Organizational commitment: Table (1-1) shows the third dimension of motives, which includes ten paragraphs through the mean and standard deviation, which shows the extent of the dispersion of the answer by the respondents, as the average answer for the first strategy was; Waste minimization strategy for the total of the ten items 3.250 with standard deviation of 0.807. This indicates the agreement of the sample members about the necessity of taking these matters into consideration in the waste minimization strategy. As for the resource efficiency strategy, the average was 3.417, with a standard deviation of 0.604, which reflects the agreement of the sample members on these paragraphs, and the tenth paragraph achieved the highest average of 3.600, and the rest of the paragraphs were close to each other. While the resource efficiency strategy achieved a general average of 3.350, and the dispersion was somewhat larger through the standard deviation of 0.808. The eighth paragraph (internal organizational capabilities to support good manufacturing practices) was characterized by achieving the highest average of 3.600, and this indicates the agreement of the respondents about this paragraph; In addition, the average of the overall environmental efficiency strategy was 3.267, with a standard deviation of 0.761, and the highest average in the sixteenth paragraph was 3.667, which means the most agreement by the respondents.

The analysis was on the level of the four strategies for this dimension. The general average of these strategies was 3.321, with a deviation of 0.074, and this indicates the convergence of the opinions of the sample individuals about these strategies, but the second strategy was more focused by the respondents. As for the arrangement of these strategies and for each paragraph, the paragraph was occupied The

eleventh) The first strategy, which is the strategy of waste reduction, and the rest of the paragraphs were close to each other, and the (twelfth) paragraph occupied the second strategy, which is the resource efficiency strategy, and the seventh paragraph occupied the third strategy, and the sixteenth paragraph occupied the fourth strategy, which is the environmental efficiency strategy.

D- Business environment: Table (1-1) shows the fourth dimension of motives, which includes six paragraphs through the mean and standard deviation, which shows the extent of the dispersion of the answer by the respondents, as the average answer for the first strategy was; Waste reduction strategy for the sum of the six items 3.503 with a standard deviation of 0.644, and this indicates the agreement of the sample members about the need to take these matters into consideration in the waste reduction strategy. As for the resource efficiency strategy, the average was 3.393, with a standard deviation of 0.707, which reflects the agreement of the sample members on these items. The second paragraph achieved the highest average of 3.233, and the rest of the items were close to each other. While the resource efficiency strategy achieved a general average of 3.397, and the dispersion was somewhat larger through the standard deviation of 0.700. The eighteenth paragraph (a professional network to support good manufacturing practices) was characterized by achieving the highest average of 3.300, and this indicates the agreement of the respondents about this paragraph; In addition, the average of the overall environmental efficiency strategy was 3.393, with a standard deviation of 0.727, and the highest average in the eighteenth paragraph was 3.233, which means the most agreement by the respondents.

The analysis was also at the level of the four strategies for this dimension. The general average of these strategies reached 3.422, with a deviation of 0.042, and this indicates the convergence of the opinions of the sample individuals about these strategies, but the first strategy was more focused by the respondents. As for the arrangement of these strategies and for each paragraph, the paragraph was occupied Seventeen The first strategy is a waste reduction strategy. While the eighteenth paragraph occupied the third strategy, and the twenty-second paragraph occupied the second strategy, which is the resource efficiency strategy.

E- Community effects: Table (1-1) shows the fifth dimension of motives, which includes four paragraphs through the mean and standard deviation, which shows the extent of the dispersion of the answer by the respondents, as the average answer for the first strategy was; Waste minimization strategy for the sum of the four paragraphs 3.011 with a standard deviation of 0.760 and this indicates the agreement of the sample members about the necessity of taking these matters into consideration in the waste minimization strategy. As for the resource efficiency strategy, the average was 3.928, with a standard deviation of 0.931, which reflects the agreement of the sample members on these items. The twenty-fifth paragraph achieved the highest average of 3.067, and the rest of the items were close to each other. While the resource efficiency strategy achieved a general average of 3.972, and the dispersion was somewhat larger through the standard deviation of 0.913. The twenty-sixth paragraph was distinguished; Social and cultural responsibility towards green practices with higher achievement
An average of 3.033, which indicates the agreement of the respondents on this paragraph; In addition, the average of the overall environmental efficiency strategy was 2.883 with a standard deviation of 0.997, and the highest average in the twenty-sixth paragraph was 2.867, which means the most agreement by the respondents.
The analysis was also at the level of the four strategies for this dimension. The general average of these strategies was 2.949, with a deviation of 0.063, and this indicates the convergence of the opinions of the sample individuals about these strategies, but the first strategy was more focused by the respondents. As for the arrangement of these strategies and for each paragraph, the paragraph was occupied Twenty-sixth The first strategy is a waste reduction strategy. The twenty-fifth paragraph occupied the second strategy, while the twenty-third paragraph occupied the fourth strategy.
F- Financial incentives: Table (1-1) shows the sixth dimension of motives, which includes two paragraphs through the mean and standard deviation, which shows the extent of the dispersion of the answer by the respondents, as the average answer for the first strategy; Waste reduction strategy for the sum of the two paragraphs 2.483 with a standard deviation of 1.159, and this indicates the agreement of

the sample members about the necessity of taking these matters into consideration in the waste reduction strategy. As for the resource efficiency strategy, the average was 2.517, with a standard deviation of 1.226, which reflects the agreement of the sample members about these items, and the second item achieved the highest average of 2,933, and the rest of the items were close to each other. While the resource efficiency strategy achieved a general average of 2.567, and the dispersion was somewhat larger, with a standard deviation of 1.247. The twenty-eighth paragraph was distinguished; (Organizational belief in cost reduction) by achieving the highest average of 3.033, and this indicates the agreement of the respondents on this paragraph; In addition, the average of the overall environmental efficiency strategy was 2.433, with a standard deviation of 1.131, and the highest average in the twenty-eighth paragraph was 2.900, which means the most agreement by the respondents.

.

The analysis was also on the level of the four strategies for this dimension. The general average of these strategies reached 2,500, with a deviation of 0.050, and this indicates the convergence of the opinions of the sample individuals about these strategies, but the third strategy was more focused by the respondents. As for the arrangement of these strategies and for each paragraph, the paragraph was occupied Twenty-eighth The first strategy is a waste reduction strategy. And the twenty-seventh paragraph has occupied the second strategy.

G- Creativity: Table (1-1) shows the seventh dimension of motives, which includes seven paragraphs through the mean and standard deviation, which shows the extent of the dispersion of the answer by the respondents, as the average answer for the first strategy was; Waste reduction strategy for the sum of the seven paragraphs 3.543 with a standard deviation of 0.660 and this indicates the agreement of the sample members about the necessity of taking these matters into consideration in the waste reduction strategy. As for the resource efficiency strategy, the average was 3.571, with a standard deviation of 0.629, which reflects the agreement of the sample members about these items. The thirty-fourth item achieved the highest average of 3.867, and the rest of the items were close to each other. While the resource efficiency strategy achieved a general average of 3.467, and the dispersion was somewhat larger through the standard deviation of 0.770. The thirty-second paragraph (improving the company's image through GMP) was characterized by achieving the highest average of 3.767, and this indicates the agreement of the respondents about this paragraph; In addition, the overall environmental efficiency strategy averaged 3.510 with a standard deviation of 0.721, and the highest average in the thirty-fourth paragraph was 3.800, which means the most agreement by the respondents.

.

The analysis was also at the level of the four strategies for this dimension. The general average of these strategies was 3.523, with a deviation of 2.780, and this indicates the convergence of the opinions of the sample individuals about these strategies, but the second strategy was more focused by the respondents. As for the arrangement of these strategies and for each paragraph, the paragraph was occupied The thirty-first strategy occupied the strategy of waste reduction, while the thirty-fourth paragraph occupied the second strategy, and the thirty-third paragraph occupied the third strategy, which is the resource efficiency strategy.

Table (1-1) Analysis of the drivers of green manufacturing strategies practices

NO	Motivation	Waste minimization strategy		Material efficiency strategy		Resource efficiency strategy		Environmental efficiency strategy		Overall strategy		
	A - logistical motives	mean	S.D	mean	S.D	mean	S.D	mean	S.D	MEAN	S.D	RANG
1	Establishing voluntary GMP standards and regulations	3.483	0.688	3.600	0.563	3.200	0.761	3.333	0.922	3.404	0.203	2
2	Environmental labeling' mandatory regulation imposed by	3.433	0.971	3.300	0.877	3.533	0.776	3.500	0.777	3.442	0.111	3

3	Local government (such as dangerous and toxic regulation) GMP	3.067	1.048	3.300	1.179	3.033	1.299	3.133	1.306	3.133	0.129	2
4	Mandatory or voluntary corporate social responsibility paid by the authorities for GMP	3.167	0.874	3.067	0.828	3.367	0.928	3.100	0.845	3.175	0.150	3
	overall average	3.287	0.895	3.317	0.862	3.283	0.941	3.267	0.962	3.289	0.016	
	b- organizational style											
5	The type of organizational culture supportive of GMP	3.100	0.845	3.267	0.640	3.133	0.937	3.233	0.728	3.183	0.074	2
6	Self-directed organization and easy to facilitate GMP	3.400	0.770	3.567	0.568	3.567	0.679	3.300	0.794	3.458	0.083	3
	C. GMP Regulatory Compliance											
7	Owner's values or employees' aspirations towards GMP	3.433	0.626	3.200	0.887	3.467	0.681	3.100	0.923	3.300	0.069	3
8	Internal organizational capabilities to support manufacturing practices the good	3.667	0.844	3.467	0.681	3.600	0.675	3.500	0.731	3.558	0.129	1
9	Sustainable internal efforts towards GMP	3.600	0.563	3.400	0.814	3.500	0.682	3.467	0.629	3.492	0.084	1
10	Awareness within the organization's management of GMP	3.433	0.935	3.600	0.855	3.533	0.860	3.433	0.935	3.500	0.082	2
11	Awareness of the impact of GMP throughout the organization	3.700	0.466	3.600	0.563	3.533	0.571	3.533	0.730	3.592	0.069	1
12	Good community and employee relations support GMP	3.433	0.817	3.533	0.507	3.233	0.626	3.500	0.630	3.425	0.079	2
13	environmental knowledge	3.300	0.466	3.167	0.648	3.233	0.679	3.367	0.615	3.267	0.150	4
14	Availability of comprehensive training and education in GMP	3.300	0.596	3.100	0.759	3.200	0.664	2.967	0.850	3.142	0.054	1
15	GMP education is part of organizational training	3.533	0.571	3.400	0.724	3.167	0.874	3.400	0.621	3.375	0.082	1
16	Availability of GMP . information	3.633	0.556	3.467	0.629	3.500	0.682	3.667	0.606	3.567	0.182	4
	overall average	3.250	0.807	3.417	0.604	3.350	0.808	3.267	0.761	3.321	0.074	
	D-Business environment											
17	The commitment of various business stakeholders to	3.433	0.504	3.133	0.819	3.200	0.805	2.933	0.980	3.175	0.054	1
18	Good Manufacturing Practices	3.167	0.592	3.233	0.898	3.300	0.915	3.233	1.006	3.233	0.132	3
19	Professional Good Manufacturing Practice Support Network	3.133	0.507	3.067	0.740	3.167	0.834	3.000	0.830	3.092	0.064	3
20	New market opportunities towards GMP	3.200	0.887	3.167	0.986	3.167	0.950	3.067	1.015	3.150	0.047	1
21	Competitor pressures towards GMP	2.667	1.028	2.400	1.070	2.467	1.074	2.533	1.042	2.517	0.017	1
22	Industry Sector Initiatives for GMP	2.467	1.042	2.567	1.073	2.533	0.900	2.533	1.106	2.525	0.115	2
	overall average	3.503	0.644	3.393	0.707	3.397	0.700	3.393	0.727	3.422	0.042	
	E-Social Influences											
23	Public awareness of green initiatives	2.200	1.095	2.100	1.094	2.167	1.053	2.367	1.066	2.208	0.034	4
24	Customer demand for green products/processes	2.667	0.884	2.567	1.006	2.433	0.971	2.500	0.974	2.542	0.042	1
25	Customer collaboration towards green initiatives	2.733	0.907	3.033	0.890	2.933	0.691	2.800	0.887	2.875	0.113	2

26	Social and cultural responsibility towards practices	3.167	0.834	3.067	0.691	3.033	0.718	2.867	0.819	3.033	0.126	1
	overall average	3.011	0.760	2.928	0.931	2.972	0.913	2.883	0.997	2.949	0.063	
	F-financial incentives											
27	Financial incentives (punishments and subsidies) from	2.000	1.509	2.100	1.583	2.100	1.494	1.967	1.377	2.042	.029	2
28	Government for GMP	2.967	0.809	2.933	0.868	3.033	0.999	2.900	0.885	2.958	0.050	1
	overall average	2.483	1.159	2.517	1.226	2.567	1.247	2.433	1.131	2.500	0.050	
	g- creativity											
29	comprehensive intervention programmes	3.033	0.890	3.367	0.669	3.233	0.568	3.200	0.610	3.208	0.041	2
30	Organizational belief in innovation opportunities from	3.433	0.728	3.400	0.675	3.300	0.915	3.300	0.837	3.358	0.137	1
31	through GMP	3.733	0.583	3.700	0.794	3.567	0.774	3.733	0.450	3.683	0.069	1
32	Better competitiveness through best practices	3.600	0.855	3.833	0.379	3.767	0.430	3.500	1.106	3.675	0.088	2
33	good manufacturing	3.533	0.571	3.400	0.814	3.567	0.728	3.467	0.776	3.492	0.100	3
34	Improving corporate image through GMP	3.833	0.379	3.867	0.346	3.433	0.935	3.800	0.407	3.733	2.067	2
35	Desire to promote environmentally benign products	3.633	0.615	3.433	0.728	3.400	1.037	3.567	0.858	3.508	3.238	1
	overall average	3.543	0.660	3.571	0.629	3.467	0.770	3.510	0.721	3.523	2.780	

1.9.3. Analysis of obstacles to implementing green manufacturing practices in the company that affect sustainability

It is clear from Table (1-2) the paragraphs of the questionnaire that includes the obstacles to practices related to green manufacturing strategies, which includes a set of main dimensions distributed among experts and those responsible for green manufacturing, which are 30 questionnaires that are valid for analysis, as follows:

A- Organizational: Table (1-2) shows the first dimension of obstacles, which includes ten paragraphs through the mean and standard deviation, which shows the extent of the dispersion of the answer by the respondents, as the average answer for the first strategy was; Waste reduction strategy for the total of the ten paragraphs was 0.763 with a standard deviation of 1.004, and this indicates the weak agreement of the sample members about the necessity of taking these matters into consideration in the waste reduction strategy. As for the resource efficiency strategy, the average was 0.803 with a standard deviation of 1.093, which reflects the weak agreement of the sample members on these items, and the sixth item achieved the highest average of 1,267, and the rest of the items were close to each other. Whereas, the resource efficiency strategy achieved a general average of 0.780, and the dispersion was somewhat larger through the standard deviation of 1.041. The sixth paragraph (supervision of products / processes for GMP) was characterized by achieving the highest average of 1.467, and this indicates the disagreement of the respondents about this paragraph; In addition, the average of the overall environmental efficiency strategy was 0.833 with a standard deviation of 1.102, and the highest average in the sixth paragraph was 1.367, which means the most agreement by the respondents

.

The analysis was also at the level of the four strategies for this dimension. The general average of these strategies was 0.795, with a deviation of 0.016, which indicates the convergence of the opinions of the sample individuals about these strategies, but the fourth strategy (the environmental efficiency strategy) was more focused by the respondents. As for the arrangement of these strategies For each paragraph, the

sixth paragraph occupied the first strategy, which is the strategy to reduce waste. The fifth paragraph occupied the second strategy, the ninth paragraph occupied the third strategy (the resource efficiency strategy), and finally the fifth paragraph occupied the fourth strategy.

B- Environmental knowledge: Table (1-2) shows the second dimension of obstacles, which is environmental knowledge, which includes four paragraphs through the mean and standard deviation, which shows the extent of the dispersion of the answer by the respondents, as the average answer for the first strategy was; Waste reduction strategy for the sum of the four paragraphs 0.858 with a standard deviation of 1.174, and this indicates the weak agreement of the sample members about the need to take into consideration these matters in the waste reduction strategy. As for the resource efficiency strategy, the average was 0.758, with a standard deviation of 1.156, which reflects the weak agreement of the sample members about these items. The twelfth paragraph achieved the highest average of 0,900, and the rest of the items were close to each other. Whereas, the resource efficiency strategy achieved a general average of 0.683, and the dispersion was somewhat larger through the standard deviation of 1.006. The thirteenth paragraph (no access to external technical support GMP) was characterized by achieving the highest average of 0.800, and this indicates the weak agreement of the respondents on this paragraph; In addition, the average of the overall environmental efficiency strategy was 0.708, with a standard deviation of 1.106, and the highest average in the eleventh paragraph was 0.733, which means the weakest agreement among the respondents.

.

The analysis was also at the level of the four strategies for this dimension. The general average of these strategies was 0.752, with a deviation of 0.083, and this indicates the lack of agreement between the opinions of the sample individuals about these strategies, but the first strategy (the waste reduction strategy) was more focused by the respondents. These strategies and for each paragraph, the thirteenth paragraph occupied the first strategy, which is the strategy to reduce waste. The twelfth paragraph occupied the second strategy.

C- Business environment: Table (1-2) shows the third dimension of obstacles, which includes eleven paragraphs through the mean and standard deviation, which shows the extent of the dispersion of the answer by the respondents, as the average answer for the first strategy was; Waste reduction strategy for the total of the eleven paragraphs was 0.936 with a standard deviation of 1.065, and this indicates the agreement of the sample members about the necessity of taking these matters into consideration in the waste reduction strategy. As for the resource efficiency strategy, the average was 1.006, with a standard deviation of 1.079, which reflects the agreement of the sample members about these items, and the sixteenth paragraph achieved the highest average of 1.333, and the rest of the items were close to each other. While the resource efficiency strategy achieved a general average of 0.967, and the dispersion was somewhat larger through the standard deviation of 1.050. The twenty-first paragraph (a limited set of technological competencies in the GMP) was characterized by achieving the highest average of 1.267, and this indicates the agreement of the respondents on this paragraph; On that, the average of the overall environmental efficiency strategy was 0.933, with a standard deviation of 0.999, and the highest average in the sixteenth paragraph was 1.233, which means the most agreement by the respondents.

.

The analysis was also on the level of the four strategies for this dimension. The general average of these strategies was 0.961, with a deviation of 0.029, and this indicates the convergence of the opinions of the sample individuals about these strategies, but the second strategy (the material efficiency strategy) was more focused by the respondents. As for the arrangement of these Strategies and for each paragraph, the sixth paragraph occupied the first strategy, which is the strategy to reduce waste. The fifteenth paragraph occupied the second strategy, the twenty-first paragraph occupied the third strategy (the resource efficiency strategy), and finally the nineteenth paragraph occupied the fourth strategy.

D- Organization/Government: Table (1-2) shows the fourth dimension of obstacles, which includes three paragraphs through the mean and standard deviation, which shows the extent of the dispersion of the answer by the respondents, as the average answer for the first strategy was; Waste reduction strategy for the total of the three paragraphs is 1.133 with a standard deviation of 1.054, and this indicates the weak agreement of the sample members about the necessity of taking these matters into consideration in the waste reduction strategy. As for the resource efficiency strategy, the average was 1.056, with a

standard deviation of 1.028, which reflects the weak agreement of the sample members on these items, and the twenty-seventh item achieved the highest average of 1,200, and the rest of the items were close to each other. While the resource efficiency strategy achieved a general average of 1.022, and the dispersion was somewhat larger through the standard deviation of 1.076. The twenty-sixth paragraph (the absence of environmental implementation of GMP) was characterized by achieving the highest average of 1.067, and this indicates the weak agreement of the respondents on this paragraph; In addition, the average of the overall environmental efficiency strategy was 1.189, with a standard deviation of 1.116, and the highest average in the twenty-seventh paragraph was 1.267, which means the most agreement by the respondents.

.

The analysis was also at the level of the four strategies for this dimension. The general average of these strategies was 1.100, with a deviation of 0.069, and this indicates the convergence of the opinions of the sample individuals about these strategies, but the fourth strategy (the environmental efficiency strategy) was more focused by the respondents. As for the arrangement of these strategies For each paragraph, the twenty-eighth paragraph occupied the first strategy, which is the strategy to reduce waste. The twenty-seventh paragraph occupied the second strategy.

Table (1-2) Obstacles that prevent the implementation of good manufacturing practices in the company

Put the value of the evaluation that you see fit to develop the strategy in the company for each paragraph:

NO	Constraint (constraint)	Waste minimization strategy		Material efficiency strategy		Resource efficiency strategy		Environmental efficiency strategy		Overall strategy		
	A-Regulatory	mean	S.D	mean	S.D	mean	S.D	mean	S.D	MEAN	S.D	RANG
1	Weak organizational structure to support good manufacturing practices	0.567	1.135	0.400	0.770	0.467	0.973	0.533	0.973	0.492	0.069	1
2	No GMP support enabled	0.433	0.935	0.600	1.276	0.600	1.221	0.600	1.003	0.558	0.083	2
3	Senior internal policy delaying implementation of GMP decisions f	0.800	1.215	0.700	1.119	0.600	0.855	0.767	1.251	0.717	0.096	1
4	Management has a high resistance to GMP	0.667	1.184	0.667	1.124	0.567	1.006	0.700	1.236	0.650	0.058	4
5	Difficulties in converting positive GMP attitudes into actions	0.900	0.662	1.167	1.177	1.000	0.830	1.167	1.020	1.058	0.111	2 , 4
6	Supervising Products/Processes for GMP	1.600	1.102	1.267	0.785	1.467	1.008	1.367	1.033	1.425	0.137	1
7	Great reluctance to convert traditional practices to GMP	0.867	1.137	0.933	1.230	0.800	1.031	1.067	1.285	0.917	0.064	4
8	Limited resources affecting the organization Ability to adopt new GMP practices	0.633	0.809	0.933	1.337	0.767	1.073	0.800	1.157	0.783	0.123	2
9	Perception of the site "out of liability" to GMP	0.667	0.959	0.667	0.959	0.833	1.464	0.567	0.898	0.68	0.0	3

										3	96	
10	undeveloped GMP organizational culture	0.500	0.900	0.700	1.149	0.700	0.952	0.767	1.165	0.667	0.1000	4
	overall average	0.763	1.004	0.803	1.093	0.780	1.041	0.833	1.102	0.795	0.0166	
	B-Environmental knowledge											
11	Existence of attitude and perception issues regarding green manufacturing practices	0.833	1.392	0.633	1.033	0.567	1.006	0.733	1.202	0.692	0.1266	1
12	GMP . lack of knowledge	0.800	1.157	0.900	1.213	0.733	1.081	0.700	0.988	0.783	0.0779	2
13	No access to external GMP technical support	0.867	0.973	0.667	1.061	0.800	1.126	0.733	1.112	0.767	0.0844	1
14	Difficulties in obtaining GMP information for potential improvements	0.933	1.172	0.833	1.315	0.633	0.809	0.667	1.124	0.767	0.1500	1
	overall average	0.858	1.174	0.758	1.156	0.683	1.006	0.708	1.106	0.752	0.0833	
	c- business environment											
15	Weak market positions for GMP products/processes	0.867	0.507	1.300	1.088	1.067	0.980	1.100	0.845	1.083	0.1777	2
16	GMP tool, business condition measurements and verification procedures are aimed primarily at large companies	1.300	1.088	1.333	1.093	1.200	0.887	1.233	0.935	1.267	0.0699	1
17	No effect on GMP strategic adjustment	1.067	1.112	1.033	0.809	0.900	0.845	0.867	0.860	0.967	0.0888	1
18	Efficiency against changes in SMEs	0.833	1.289	0.933	1.143	0.933	1.202	0.933	1.202	0.908	0.0500	2 . 3 ,4
19	Lack of market preferences/demands for products/processes based on GMPs	0.967	0.928	0.900	0.960	0.933	1.202	1.133	1.332	0.983	0.0277	4
20	Lack of flexibility to switch to GMP	1.133	1.074	1.133	0.973	1.133	0.900	0.933	0.583	1.083	0.0000	
21	Limited set of technological competencies in GMP	0.900	1.322	1.067	1.230	1.267	1.285	1.067	1.112	1.075	0.1777	3
22	Lack of Innovative Capabilities in Good Manufacturing Practices	1.100	1.125	1.167	1.315	1.033	1.189	0.833	0.747	1.03	0.0	2

										3	64	
23	Lack of flexibility in the manufacturing process regarding implementation of good manufacturing practices	0.733	1.143	0.767	1.006	0.700	0.952	0.800	1.243	0.750	0.0032	4
24	Lack of GMP Technological Capabilities	0.667	1.184	0.633	1.129	0.767	1.278	0.500	0.938	0.642	0.0069	3
25	Lack of human resource capacity in the area of good manufacturing practices	0.733	0.944	0.800	1.126	0.700	0.837	0.867	1.196	0.775	0.0047	4
	overall average	0.936	1.065	1.006	1.079	0.967	1.050	0.933	0.999	0.961	0.0029	
	D-Regulation/Government											
26	Lack of environmental implementation of GMP	1.067	0.944	1.100	0.885	1.067	1.172	1.167	1.020	1.100	0.0017	4
27	Lack of support and guidance from regulators on GMP	1.133	0.973	1.200	1.157	1.033	0.928	1.267	1.048	1.158	0.008	4
28	Lack of GMP training/consulting courses provided by the government	1.200	1.243	0.867	1.042	0.967	1.129	1.133	1.279	1.042	0.1410.00	1
	overall average	1.133	1.054	1.056	1.028	1.022	1.076	1.189	1.116	1.100	0.006	

1.10. 1 Conclusions

1) Through the results, we conclude that the company is constantly working on developing a sustainable manufacturing strategy and designing a sustainability program based on a priority consideration of the green manufacturing strategy and sustainable manufacturing areas within its short and long-term plans.

2) It was also found through the research that the company worked on developing a framework to guide decision makers in developing a green manufacturing strategy with related issues, such as company size, competitive priority, strategic response and stakeholder interests.

3) It can be concluded that the company is applying green manufacturing practices through its application of international standards such as ISO 14001 as well as local standards through continuous field visits by the competent committees.

4) It was found from the results of the research that the company has a special unit for waste treatment to remove harmful substances and gases before putting them into the river water.

5) The conclusion reached that the second strategy; The material efficiency strategy was more focused by the consensus of the interviewed sample through the daily practices of the company regarding the two dimensions of the motives, namely the logistical motives and the organizational style.

6) The results showed that with regard to the third dimension, organizational commitment, the opinions of the sample about the strategy varied according to the different paragraphs related to the dimension, which reflects the overall importance of these paragraphs that embody these strategies and that enhance sustainability.

7) The conclusion from the two dimensions, the business environment and community influences, is that the first strategy achieved the waste minimization strategy in the first place.

8) The third strategy; The financial resources efficiency strategy ranked first in the financial incentives dimension. The second strategy was also ranked first with regard to the dimension of creativity.
9) The conclusion that was reached from analyzing the obstacles of green manufacturing strategies practices and at the level of the four strategies, the disagreement of the sample opinions about the obstacles that prevent these practices and for all the four dimensions through the weak averages, despite the little dispersion in the answer, which confirms that these obstacles do not affect these Strategies and thus have little impact on sustainability.
10) The final conclusion reached by the research from the interviews that were conducted and the questionnaire that was distributed is that the company pays great attention to green manufacturing strategies and that it continues to apply them and within the methodologies of its daily operations. As for the obstacles, it was found that there are hardly any obstacles that the company faces that prevent the application of these practices, and this, if anything, indicates the company's capabilities, culture and responsibility towards society.

1. 10. 2 Recommendations

1) The necessity of continuing to focus on decisions related to green design and manufacturing that are responsive to sustainable development and contribute to raising awareness of environmental protection for design and promoting sustainable capable development of the manufacturing industry.
2) Work to develop and develop the skills of manufacturing managers and designers who have a way of thinking systematically about solving sustainable manufacturing problems.
3) Working on continuing the necessary research into current practices and results, and evaluating the benefits achieved and the conditions under which they were achieved, both at the individual level and at the product life cycle level. This will help guide future manufacturing practices as well as future research into those tools and technologies that may support sustainable manufacturing sectors.
4) The necessity of working to monitor the practice of the four strategies through more necessary research in understanding the interaction between the objective, scope and measurement of green manufacturing and sustainable development strategies, with the aim of developing techniques and measurement tools that facilitate the implementation of the strategies.
5) Working on establishing waste recycling systems, benefiting from them for different purposes, and reducing their harmful effects on the environment, thus contributing to sustainable development.
6) The company's management should work on the expansion strategy by entering into other industrial fields, according to its capabilities, to contribute to supporting the national economy, providing job opportunities and reducing unemployment.

References

i. Brundtland, G. H. (1987). Report of the world commission on environment and development: Our common future. Oxford, UK: Oxford University Press.
ii. Clelland, I.J., Dean, T.J. and Douglas, T.J.,(2000). Stepping towards sustainable business: an evaluation of waste International Journal of Sustainable Engineering 227 minimization practices in US manufacturing. Interfaces, 30 (3), 107–124.
iii. Cote, R., Booth, A. and Louis, B., (2006). Eco-efficiency and SMEs in Nova Scotia, Canada. Journal of Cleaner Production, 14 (6–7), 542–550.
iv. Dahlstro¨m, K. and Ekins, P., (2005). Eco-efficiency trends in the UK steel and aluminium industries: differences between resource efficiency and resource productivity. Journal of Industrial Ecology, 9 (4), 171–188.
v. Despeisse, M., M. R. Oates, and P. D. Ball. (2012). “Sustainable Manufacturing Tactics and Cross-functional Factory Modeling.” Journal of Cleaner Production 42: 31–41.
vi. Ehrenfeld, J.R., (2005). Eco-efficiency: philosophy, theory and tools. Journal of Industrial Ecology, 9 (4), 6–8.
vii. Foxon, T.J., (2000). Resource efficiency and service provision. Energy and Environment, 11 (5), 587.
viii. Freeman, H., et al., (1992). Industrial pollution prevention: a critical review. Journal of the Air and Waste Management Association, 42 (5), 618–656.

ix. Hawken, P., Lovins, A.B. and Lovins, L.H., (2000). Natural capitalism: the next industrial revolution. London: Earthscan Publications Ltd.

x. Hawkins, R.G.P. and Shaw, H.S., (2004). The practical guide to waste management law. London: Thomas Telford Publishing.

xi. Heijungs, R., Huppes, G., and Guinee, J.B. (2010). Life Cycle Assessment and Sustainability Analysis of Products, Materials and Technologies: Toward a Scientific Framework for Sustainability Life Cycle Analysis. Polymer Degradation and Stability, 95(3): 422-428.

xii. Javier Carrillo-Hermosilla, Pablo del Rio, Totti Konnola,(2010) Diversity of eco-innovations: Reflections from selected case studies, Journal of Cleaner Production, 18, pp.1073-1083.

xiii. Levin, M.H., (1990). Implementing pollution prevention: incentives and irrationalities. Journal of the Air and Waste Management Association, 40 (9), 1227–1231.

xiv. Ming-Lang Tseng, Fei-hsin Huang, (2012) Anthony SF Chiu, Performance drivers of green innovation under incomplete information, Social and Behavioral Sciences, 40, pp.234 – 250.

xv. Moberg, A., et al., (2005). Life cycle assessment of energy from solid waste – part 2: land filling

xvi. Niki Bey, Michael Z. Hauschild, Tim C. McAloone, (2013) Drivers and barriers for implementation of environmental strategies in manufacturing companies, CIRP Annals-Manufacturing Technology, 62, pp.43-46.

xvii. OECD. (1998). Waste minimisation profiles of OECD member countries. France: Organisation for Economic Co-operation and Development.

xviii. Payman Ahi and Cory Searcy, (2013) A comparative literature analysis of definitions for green and sustainable supply chain management, Journal of Cleaner Production, 52, 2013, pp.329-341.

xix. Pearce, D., (2001). Measuring resource productivity, Paper to DTI/Green Alliance Conference, February 2001, London.

xx. Pongra´cz, E., Phillips, P.S. and Keiski, R.L., (2004). From waste minimization to resources use optimization: definitions and legislative background. Proceedings of the waste minimization and resources use optimization conference, 10 June, Oulu. Oulu: University of Oulu Press, 11–20.

xxi. R. Kemp, and P.Pearson,(2008) Final report of the project Measuring Eco- Innovation.

xxii. Raja Ariffin Raja Ghazilla1 , Novita Sakundarini1 , Salwa Hanim Abdul-Rashid1,(2015)" Drivers and barriers analysis for green manufacturing practices in Malaysian SMEs: A Preliminary Findings,"ScienceDirect 12th Global Conference on Sustainable Manufacturing, Procedia CIRP 26 ,658 – 663.

xxiii. Reijnders, L., (1998). The Factor X debate: setting targets for eco-efficiency. Journal of Industrial Ecology, 2 (1), 13–21.

xxiv. Rohit Kumar Gupta, Rajesh Purohit, R.S. Rana, Shelar Dipak, Ashutosh Mishra, (2015) "A Review On Green And Sustainable Manufacturing & Their Impact on Social, Economical , Environmental Prospects", International Journal on Applications in Science, Engineering & Technology Volume.1, Issue.1, pp.8-12 www.ijaset.org 8

xxv. Rosen, A., & Kishawy, H. (2012). Sustainable manufacturing and design: Concepts, practices and needs. Sustainability, 4(2), 154-174.

xxvi. Salwa H. Abdul Rashid , Stephen Evans & Philip Longhurst,(2008) "A comparison of four sustainable manufacturing strategies" International Journal of Sustainable Engineering, 04 Nov 2008.

xxvii. Schaltegger, S. and Burrit, R.L., (2000). Contemporary environmental accounting – issues, concepts and practice. Sheffield: Greenleaf Publishing.

xxviii. Schmidt-Bleek, F., (1995). Increasing resource productivity on the way to sustainability. Industry and Environment, 18 (4), 8–12.

xxix. Schmidt-Bleek, F., (1996). Factor 10: making sustainability accountable – putting resource productivity into praxis[online], Factor 10 Institute, Carnoules. Available from: http:// www.factor10-institute.org/pdf/F10REPORT.pdf [Accessed 18 August 2006].

xxx. Thomas, R. and Iles, A., (2004). IPPC and resource efficiency: a review of progress. Bristol: Environment Agency.

xxxi. van Weenen, J.C., (1990). Waste prevention: theory and practice, Thesis (PhD), Technische Universiteit Delft.

xxxii. Varinder Kumar Mittal and Kuldip Singh Sangwan, Prioritizing Barriers to Green, (2014) Manufacturing: Environmental, Social and Economic Perspectives, Procedia CIRP, 17, pp.559 – 564.

xxxiii. von Weizsa¨cker, E., Lovins, A.B. and Lovins, L.H., (1997). Factor four: doubling wealth, halving resource use. London: Earthscan Publications Limited.

xxxiv. Worrell, E., (1995). An approach for analysing the potential for material efficiency improvement. Resources, Conservation and Recycling, 13 (3), 215–232.

xxxv. Worrell, E., et al., (1997). Potentials and policy implications of energy and material efficiency improvement. New York: United Nations Publications.

xxxvi. Young, J.E., Sachs, A. and Ayres, E., (1994). The next efficiency revolution: creating a sustainable materials economy. Washington: Worldwatch Institute.

xxxvii. Yuan, C., Zhai, Q., & Dornfeld, D. (2012). A three dimensional system approach for environmentally sustainable manufacturing. CIRP Annals-Manufacturing Technology, 61(1), 39-42.

xxxviii. Zailani, S., Jeyaraman, K., Vengadasan, G., & Premkumar, R. (2012). Sustainable supply chain management (SSCM) in Malaysia: Asurvey. International Journal of Production Economics, 140(1), 330-340.