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Customizing a Green Manufacturing Model for the Palestinian Plastics Industry

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Dedication

The fearful do not gain anything from life, and those seeking to combine success and relaxation will try in vain.

I dedicate my humble thesis to my sweet parents and family for providing me with unfailing support and continuous encouragement throughout my years of study and through the process of researching and writing this thesis.

Acknowledgment

I would first like to thank my thesis advisors Dr. Ahmad Al Ramahi and Dr. Yahya Saleh. The doors of Dr. Al Ramahi and Saleh office were always open whenever I ran into a trouble spot or had a question about my research or writing. They consistently allowed this thesis to be my own work, but steered me in the right direction whenever they thought I needed it.

الإقرار

أنا الموقع أدناه، مقدم الرسالة التي تحمل العنوان:

Customizing a Green Manufacturing Model for the Palestinian Plastics Industry

أقر بأن ما اشتملت عليه هذه الرسالة انما هو نتاج جهدي الخاص، باستثناء ما تمت الإشارة اليه حيثما ورد، وأن هذه الرسالة كاملة، أو أي جزء منها لم يقدم من قبل لنيل أي درجة أو لقب علمي أو بحثي لدى أي مؤسسة تعليمية أو بحثية أخرى.

Declaration

The work provided in this thesis, unless otherwise referenced, is the researcher's own work, and has not been submitted elsewhere for any other degree or qualification.

Student's name: **اسم الطالب:**

Signature: **التوقيع:**

Date: **التاريخ:**

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Abbreviations

GM	Green Manufacturing
GMS	Green Manufacturing System
PPP	Palestinian Plastic Plant
SOP's	Standard Operation Procedure
ANOVA	Analysis of Variance
HDP	High Density Polyethylene
LDP	Low Density Polyethylene

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Abstract

Interests in addressing and reducing the negative impacts on environment and human health are becoming of more importance around the globe. Different sectors adversely contribute to the severity of impacts among them is the manufacturing sector which is characterized by huge consumption of natural resources and a producer of significant amounts of solid wastes. To alleviate such negative impacts of manufacturing, industries have started adopting and employing new strategies represented by shifting to what-so-called green manufacturing (GM) in their operations to become more environmentally-friendly.

This study aims at assessing the implementation of GM practices in Palestinian Plastic Industry working in West Bank. More succinctly, based on a general model of GM in the literature, a customized model of GM in Palestinian Plastic Industry has been developed taking into consideration five main attributes associated with their corresponding indicators. Namely, environmental, resource usage, energy consumption, economic and social attributes have been used in the customized model. Relevant data has been gathered via a self-report questionnaire from a randomly-selected sample of 49 plastic factories working in West Bank. The collected data were

analyzed using SPSS statistical package where a set of descriptive and inferential statistical tests was conducted to assess the extent of implementation of GM in these industries based on a three-level scale (low, medium, high) of greenness.

The analysis revealed that most surveyed plastic factories are on a moderate degree of greenness. Thus, plastic industries stakeholders are highly-encouraged to revisit their manufacturing strategies in order to improve their greenness levels towards the highest ones. In addition, the developed five-attribute customized GM model is highly recommended to be used as an assessment tool for assessing the greenness level of an already established and running plastic factory or a new plastic factory to be established in Palestine.

Chapter One

Introduction

1.1 Overview

This chapter introduces a general background of the research title. It presents the problem statement, research objectives, research questions, research importance, research limitations, research population, research sample, the procedural concepts of the research, and it clarifies the research structure.

1.2 General Background

After the exposure of earth to global warming and contamination, such as waste from factories and car exhaust, countries have begun to think about a mechanism to preserve the environment and to put an end to this rapid environmental pollution through sophisticated scientific developments.

International and regional conferences have been held on this topic as it becomes the main subject for many governmental and private agencies, and it is expected that they will increase their initiatives in the future. Such conferences and initiatives aim to reduce the environmental damage caused by human activities, and to open the door for investment in this area. Investment in the green economy are not only designed to make money, but also to satisfy human needs and social development by preserving the environment and natural resources (Handy, 2004).

Manufacturing has negative impact on the environment, including pollution (on air, land and water), which is one of the world's biggest environmental problems, waste disposal, climate change and global warming. (First Carbon Solutions, 2015).

Bansal et al. (2012) illustrate the changes in manufacturing philosophies, which started with mass production in the 1910s, flexible manufacturing in the 1970s, mass customization in the 1990s, and the opening of the door for green manufacturing (GM) in the 2000s.

A Green Manufacturing System (GMS) addresses the many environment-related problems that arise in various industries, like energy use, emissions and solid waste. On the other hand, it has many other benefits for those industries, like saving unnecessary expenses, promoting research and design, and creating a good reputation of the industry amongst the public (Andrew, 2012).

Firms are seeking to become greener and more eco-friendly to maximize the efficient use of raw materials and to minimize waste by applying GM practices, thereby reducing costs, raising energy efficiency and providing valuable resources at a higher quality and reliability.

There are many reasons to implement GM processes in these companies; the top priorities are incentives, public pressure, future legislation, current legislation, public image, cost savings, customer demand, technology, competitiveness, organizational resources, and supply chain pressure (Mittal & Sangwan, 2014).In addition, there are five key success factors for implementing a GMS in a company: the proportion of non-toxic materials,

compliance with eco-ordinances, the proportion of biodegradable materials, environmental pollution per product, and the extent of process pollution (Chuang &Yang, 2014).

A GMS could be applied in many fields, including the stone manufacturing, dairy products, aluminum products, plastics manufacturing and other industries. Plastic raw materials are used in the manufacturing of a wide range of products, such as bags, cups, glasses, cutlery, plastic bottles, shampoos containers and toys. At the end of their lives, upon disposal, these products become harmful to the environment and human health because of their composition, unless they are effectively recycled and/or treated (Peelman et al., 2013).

Sahoo and Ali (2008) illustrate that plastics are usually classified into various types, depending on the polymeric molecules they contain and the procedure of polymerization and processing.

In the plastics industry, several materials contain oil (petrochemicals), such as coal, petroleum and other materials. In addition to oil, other materials are involved in the plastics industry including polymer, which is known to be the main component of the manufacturing in the plastics industry. The process of the plastic industry has two phases, starting with the polymerization phase; at this stage, the plastic material is broken down into grains, and the grains are then ready for the manufacturing process. The second stage is formation, which involves machines and equipment; specialized plastics factories start to take plastic materials and remodel them, either by melting or dissolving through several steps, and in the end,

heat is used to perform this task. And there are two basic ways to make plastics: molding and extrusion.

So, the plastics industry causes some damage that should not be overlooked, including damage to the environment, this certainly starts with the harmful smell that is produced during the plastic fusion, and continues even after disposal of its waste (which also carries a lot of harm to the environment) (Al-Dmoke, 2018).

1.3 GM and Sustainability

Dornfeld (2014) explains that the manufacturing process can play an important role in reducing the environmental impact while increasing the value of products by contributing to sustainability.

GM and sustainable activities are two ways to create long term cost reductions and improve efficiencies. World Commission on the Environment and Development (1987) defined sustainability as "meeting the needs of the present generation without compromising the ability of future generations to meet their own needs".

Bebbington et al. (2007) illustrate that sustainability assessment modeling offers a way to understand a project's impact. It appears to capture tacit knowledge relating to sustainable development profiles. Mendler et al. (2005) illustrate that sustainable (green) design is interdependent on man-made and natural environments; it seeks to harness natural energy flows and biological processes, eliminate reliance on fossil fuels and toxic materials, and improve resource efficiency.

Deif's (2011) shows how GM deals with sustainability in several areas, including economic and environmental aspects of the manufacturing process. Reducing energy and emissions, recycling, and using renewable materials are examples of sustainable GM activities during the manufacturing process.

1.4 Problem Statement

The plastics industry is one of the economic engines that drive the Palestinian national economy; it is comprised of a wide range of products, including plastic pipes and fittings, plastic bags and sacks, different sizes and types of plastic containers, drinking water containers, polystyrene, rubber and kitchen wear. The market share is distributed over the West Bank (66%), the Gaza Strip (15%), Jerusalem (2%) and Israel (10%). It is clear that the local market is the core of this industry (Ministry of National Economy, 2004).

Gross domestic product is 8% plastic and rubber, and the total exports are 25 million USD, while total imports are 101 million USD (Office of the Quartet Representative, 2011).

The plastics industry is a relatively important one in Palestine, with approximately 165 plastics factories, including 63 factories in the Gaza Strip, and the number of workers working in this industry exceeds 3,500. The plastics industry is distributed around the various areas of the West Bank, with a focus on plastic pipes in Hebron and Ramallah. The total number of industrial plants is 95 firms with medium and large plants

employing 950 workers, with an average of 10 workers per firm. The working labor varies from 5 to 20 workers, with an exception of 4 factories employing more than 50 workers (Plastic Palestinian Federation of Industries, 2010).

The Palestinian Chamber of Commerce and Industry (2017) indicates that the number of factories and the geographical distribution of these plants are shown in the Table 1.1.

Table 1.1: The number of factories and the geographical distribution of these plants in the West Bank.

No.	District	Number of Plastic Plants
1	Hebron	65
2	Ramallah	20
3	Bethlehem	2
4	Nablus	2
5	Tulkarm	2
6	Jenin	2
7	Qalqilya	1
8	Jericho	1

Source: The Palestinian Chamber of Commerce and Industry (2017)

The Palestinian plastics industry needs many resources, the most important is energy. Decreasing the electricity consumption rate is worth considering as electricity is a major cost component and deserves critical scrutiny to minimize it. In addition, the resources in the West Bank are limited because of the occupation's control over these resources. Training is needed for the top management in this sector, and lack of upgrading machinery and preventive maintenance are some major problems in this sector.

Environmentally, an estimated 30% of plastic waste in the Palestinian Territory is being recycled and reused for the production of plastic pipes. However, the majority of the plastic waste, over 450 ton/month, is dumped in landfills and ends up in the streets (ASCS, 2012).

Most plastics are made from petroleum or natural gas. The manufacture of plastic, as well as its destruction by incineration, pollutes air, land, and water, and exposes workers to toxic chemicals, including carcinogens. Also, plastics cause serious damage to the environment both during its manufacture and disposal, which releases a huge quantity of carbon, monoxide, dioxin, and hydrogen cyanide. Properly utilizing the industry's waste has a dual positive impact, both on the total productivity of firms and on the environment.

Therefore, the Palestinian plastics industry needs to adopt a GMS, which will have a positive impact environmentally, economically and socially.

1.5 Importance of the Research

"Going green" has become more popular trend as of late, with more and more businesses opting to make the switch. While it can certainly seem overwhelming, manufacturers who embrace sustainable practices can recognize a positive impact on their bottom line. These benefits can help boost sales, lower operating costs, and more (Dakota, 2017)

The importance of this research is to have better understanding of GM adoption and implementation on Palestinian plastic plants (PPP) and its impact on the performance of plants. Furthermore, the main purpose of this

research is to determine the key attributes that affect the implementation of GM on PPP and its impact on the performance of the plants.

1.6 Research Objectives

The main objectives for this study are:

1- Assessing the current practices and levels of GM in Palestinian plastic industry.
2- Customizing a model of GM for the Palestinian plastic industry.

1.7 Research Questions

This study will clarify the answers to the following questions:

1- What are the main attributes and corresponding indicators for GM in the Palestinian plastic industry?
2- What are the current practices in GM in the Palestinian plastic industry?
3- What is the management's level of willingness to implement GM in the Palestinian plastic industry?
4- How Palestinian Plastic Industry sustain the implementation of GM practices and the resulting improvements?

1.8 Research Population and Sample

The research population for this thesis are Palestinian Plastic Plants working in West Bank in Palestine with a random sample selected.

1.10 The Structure of the Thesis

The thesis consists of six chapters, Chapter One introduces the thesis subject and objectives of this research, Chapter two literature review and summarizes studies that address GM, Chapter Three presents the methodology that is followed in this research, Chapter Four presents the results and discussion and data collection tool which includes the questionnaire, illustrates the analytical results of research variables. Chapter five presents the Model Simulation. Chapter six gives brief conclusions on the results with a set of recommendations.

Chapter Two

Literature Review

2.1 Overview

This thesis emphasizes that GM, as a concept, is applicable in the industrial sector, with this chapter presenting a review of the literature related to GM; it is an important part of the research process as it helps to generate ideas for research. The main topics covered are green manufacturing's definition and its benefits, the various dimensions and factors of GM, the most important models and studies of GMS, and Deif's (2011) Model for GM.

2.2 Definitions of GM

GM is a method of manufacturing that minimizes waste and pollution. It slows the depletion of natural resources as well as lowering the extensive quantities of trash that enter landfills. Its emphasis is on reducing the number of components, increasing the efficient use of material, and reusing components, to help make products more efficient to build (Rehmanet al. 2013). Handfield et al. (1997) illustrate that GM is one of the most important aspects of the manufacturing process, while it is a relatively new concept in the field of the manufacturing. It is based on the approach of reducing and eliminating all waste streams associated with the design, manufacture, use and/or disposal of products and materials. Andrew (2012) defined GM in the following way:

GM can be looked at in two ways: the manufacturing of “green” products, particularly those used in renewable energy systems and clean technology equipment of all kinds, and the “greening” of manufacturing-reducing pollution and waste by minimizing natural resource use, recycling and reusing what was considered waste, and reducing emissions.

Maruthi and Rashmi (2015) define GM as a method of manufacturing that minimizes waste and pollution through product and process design, where the ultimate goal of GM is sustainability. Also, the main objective of GM is to save the environment and reduce the cost of the product (Paul et al., 2014).

According to the GAO et al. (2009), GM is a set of standards including zero potential safety problems, zero health threats for the operators and product users, zero environmental pollution, waste recycling and as much waste disposal as possible during the production process.

GM is very important for establishing eco-friendly operations within the manufacturing field. Essentially, it is the “greening” of manufacturing, in which workers use fewer natural resources, reduce pollution and waste, recycle and reuse materials, and moderate emissions in their processes (Muirhead, 2016).

2.2.1 Benefits of GM

The benefits that can be achieved from GM are very huge. From these what Dakota (2017) says about:

- Reduce costs: Manufacturing business can experience a decrease in total operating costs if green changes are planned accordingly. Solar

and wind energy, combined with energy efficient equipment and machines, can greatly reduce energy bills and utilities.

- Incentives: several utility companies offer their own incentives and rebates for green changes.
- Green Reputation = Sales: Sustainability has become a consumer interest, and your business in this area has become a major boost to reputation. Branding your company can open your business in a new consumer market and increase your overall sales.
- Become More Competitive with Government Contracts: many contracts are available to only green businesses, which will provide you with even more opportunities to grow and own.
- Impact on the Environment: just by taking your business green, you're automatically providing a great change for our future. Even its reduce the number of toxins released into the atmosphere.

Also, Bhardwaj (2015) demonstrates part of the advantages of GM include

- Does not emit anything harmful into the air
- Can bring economic benefits
- Requires less maintenance so you do not have to shell out a lot of money to operate it
- Renewable which means we will never run out
- Can slow the effects of global warming by reducing CO2 emissions

2.3 Dimensions and Factors of GM

GM has many dimensions and factors; Bansal et al. (2012) define five such dimensions, each of which has many factors: the research and design process, waste control, packaging control, manufacturing control and quality control. Rehman et al. (2016) define many factors for GM which include green design initiatives, adopting green standards, supplier management, technology innovation, GM planning, green purchasing and marketing, top management's commitment, customers focus, and process management.

Rusinko (2007) points out that the practices of GM, include reduced energy use, reduced raw materials use, and reduced solid waste, reduced emissions, recycling, the use of renewable materials, and the use of eco-friendly energy. Sezen and Cankaya (2013) illustrate that GM applications have a significant positive impact on environmental and social performance, and that eco-process innovations also have a significant positive impact on corporate sustainability.

Bebbington et al. (2007) illustrate several sustainability practices, including the conservation of resources such as sound (by checking the noise level periodically and continuing to limit its impact on workers), the optimal utilization of plant operation times and shut down upon completion of need, and the depreciation and damage to the facility due to emissions (e.g. gases and noise).

Socially, the plant provides employment and relies on human labor. Harrick (2015) shows four important practices in sustainability and GM,

including environmental practices, manufacturing practices, economic practices, and social practices. Figure 2.1 shows the four main practices of the Harrick model and the related indicators.

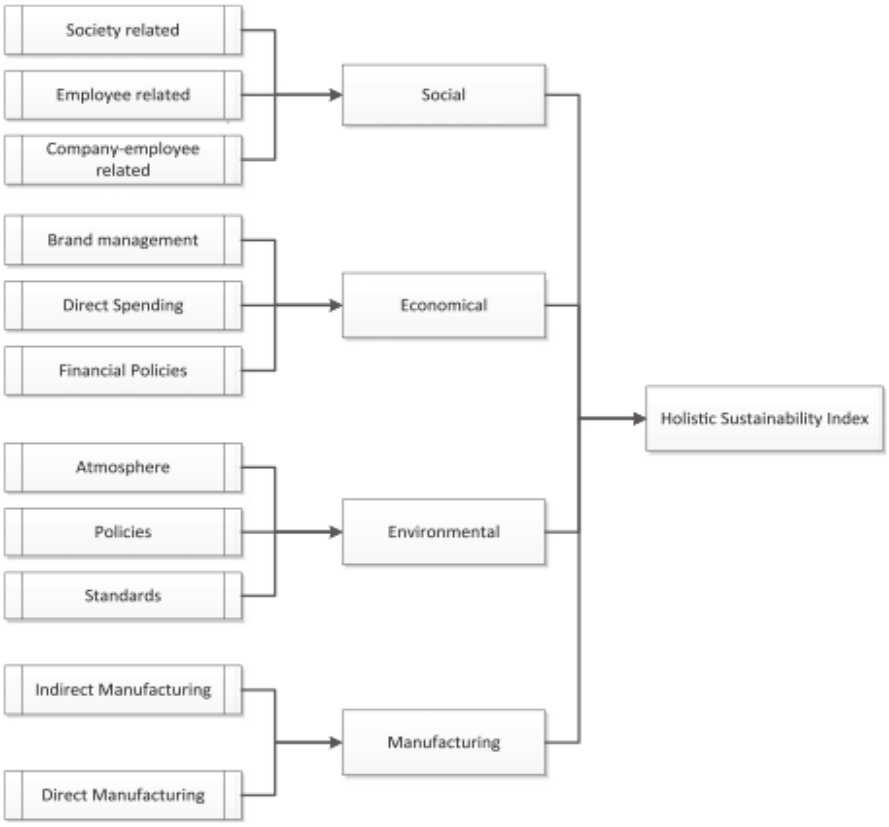

Figure 2.1: Main practices for sustainability index (Harrick, 2015)

Joung et al. (2013) define five sustainability practices, which include environmental, economic, social, technological advancement, and performance management. Each one of these practices consists of a set of indicators, as illustrated in Figure2.2.

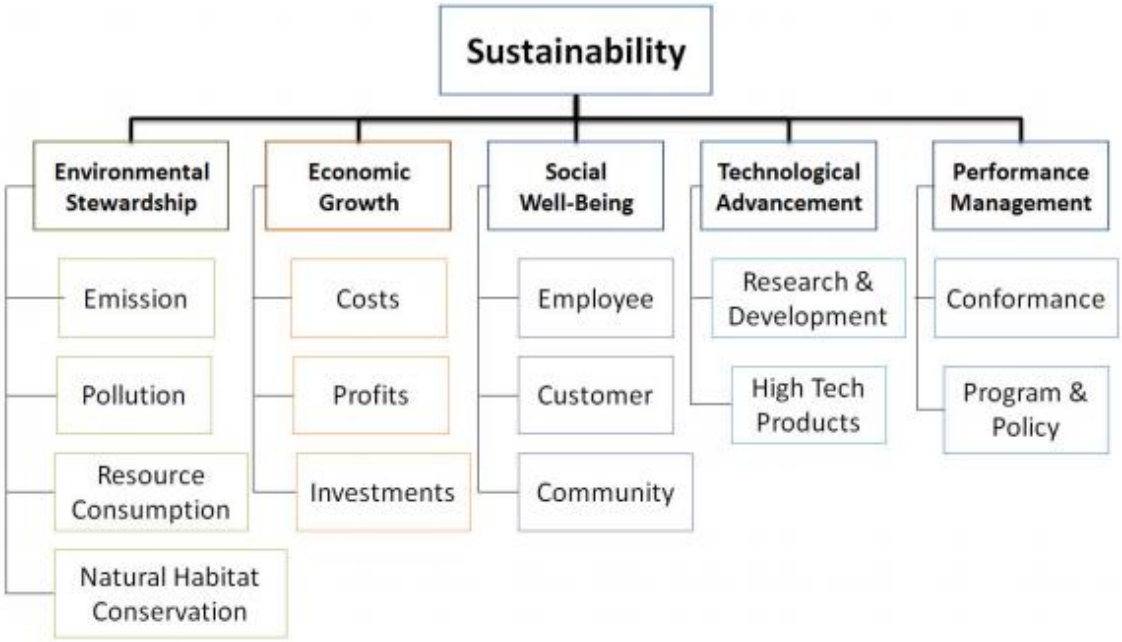

Figure 2.2: Sustainability practices' structure containing the five main dimensions (Joung et al., 2013)

The study also showed that the most effective practices on GM are environmental practices.

Tan et al. (2015) illustrate four main sustainability practices including environmental protection, economic growth, social, and performance management. These practices include the 40 indicators commonly used for manufacturing enterprises. Velva and Ellenbecker (2001) define the six main aspects of sustainable production: energy and material use, the natural environment, social and community development, economic performance, workers, and products.

Ghinmine & Sangotra (2015) identify the factors that helps to implement the GM in the industry include environmental policy, customer awareness, training and employee involvement, green distribution, green design, green

purchasing, and top management commitment, the most important and impact factor on the GM was environmental policy.

2.4 Models and Studies of Green Manufacturing

There are many GM models being applied in many companies, and from these, a Model Chaung and Yang (2014) proposed a way to evaluate GMS performance and to identify the key success factors of its real-world implementation. This model contains a three-dimensional assessment with strategic subjects based on the manufacturing stages to evaluate the manufacturer's green performance. The proposed three dimensions are green design (including green product design, research and design of raw materials, and the research and design process), green-manufacturing processes (including the use of raw material, the manufacturing process legitimacy, quality control, waste minimization and recycling, and manufacturing facilities), and green packaging (including the proportion of reusable packaging, integration of eco-marks into packaging design, packaging simplification, etc.…).

Qingsong et al. (2010) established evaluation index system of GM using life cycle theory and the "pressure - state – response" model. The index system is the 3-tier indicator system, a total of 39 sub-indicators, including 17 environmental attributes index, 8 energy property index, 7 resource properties index and 7 economic attributes index. Life cycle theory commonly used in the study of environmental index system. It has some

theoretical and practical significance to build GM index system based on life cycle theory and combined with pressure-state-response concept model. Wu et al. (2015) established implementation of GM strategic decisions evaluation model to comprehensive evaluate the GM level by establishing judgment matrix. The results from this study, Source control is more in line with the strategic decision making.

Tilina et al. (2015) presented a model that will integrate the GM concept at the organizational level based on the practices identified in the Romanian manufacturing companies at the operational level in the context of sustainable development. The study has shown that the implementation of GM in the manufacturing organizations is not that easy, because it is hampered by different barriers. Starting from this point the purpose of this research was to elaborate a model for helping the Romanians manufacturing enterprises to develop eco-innovative production systems with the purpose of greening their products and processes while reducing the impact of their activities.

Maruthi & Rashmi (2014) focuses on achieving GM by using various techniques that has impact on reduction in waste and environmental pollution. These techniques are:

- Lean Manufacturing include: Just in Time, Kanban, Zero defects, The 5s philosophy, Poka-Yoke, and Lean Line Design (quality, flexibility, …etc.)

- Zero Emission concepts can contribute: to creation of more effective technology, new production process, and Conservation and recycling of natural resources (waste into energy).
- ISO 14000 & ISO 14001: ISO 14000 standards, demonstrate sound environmental management practices and are able to prevent environmental disasters, correcting environmental problems, environmental performance evaluation, environmental labeling and life-cycle assessment.

  The ISO 14001 standard is the most important standard within the ISO 14000 series, it's based on the Plan-Check-Do-Review-Improve cycle.

Deif (2011) defines a model for GM which works by assessing the level of the greenness and then improving the level of greenness to make manufacturing companies more eco-efficient. The Model is introduced in the next section.

2.5 Deif's (2011) Model for GM

The model of Deif's contains four main layers shown by figure2.3: the first layer is the performance assessment layer to assess the current situation at companies by various means; the second layer is GM planning, which identifies potential factors for green improvements; the third layer is improving the status of the identified potential factors (indicators) using various tools; and the final layer is the monitoring and sustaining of these improvements using a range of techniques.

Salem and Deif's (2014) define most generic attributes for green manufacturing, which are the environment, resources, energy, and the economy; for each attribute a set of sustainable production indicators.

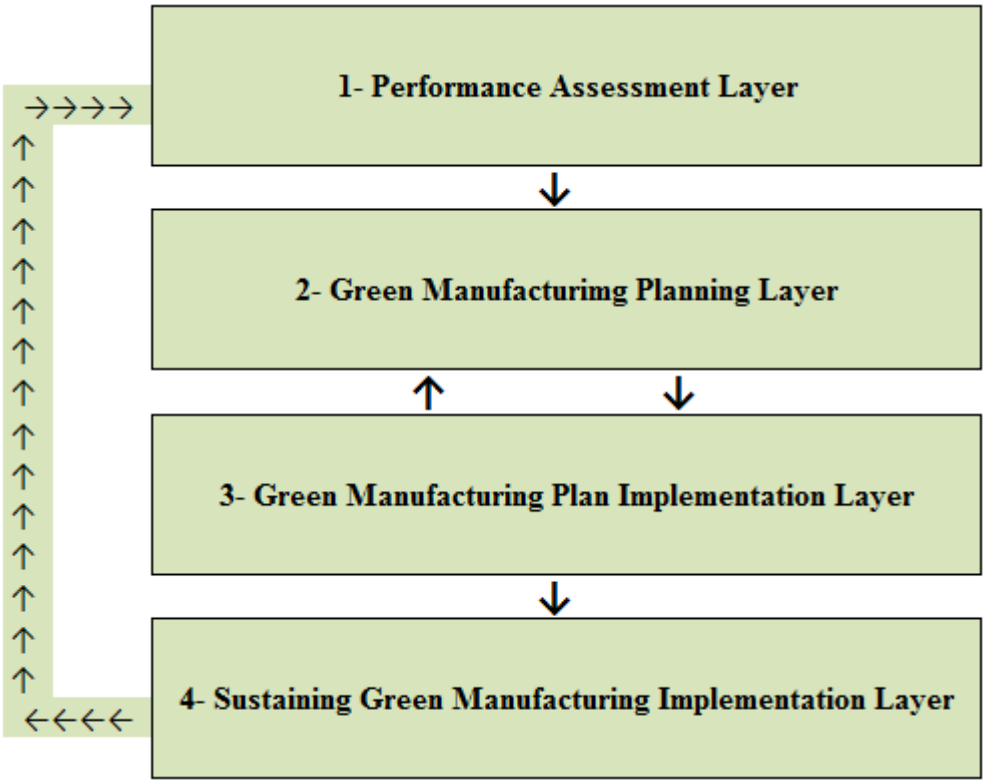

Figure 2.3: Deif's GMS Model (2011)

Based on Deif's model, we have structured a customized model for GM for the Palestinian plastics industry by defining the four main Deif's attributes, with the addition of a fifth, the social attribute, which we define as a key attribute in our model with some practices. Table 2.1 shows the main attributes of the Deif's model, illustrating them and the related indicators.

To adapt Deif's model, we grouped a large number of sustainability indicators into appropriate categories and subcategories. The categorization

provides a reasonable structure to integrate all the possible indicators that show the level of greenness in the industry.

Table 2.1: Generic Attributes for Green Manufacturing (Deif, 2014)

No.	Attributes	Indicators
1	Environment	Solid waste, waste water, air quality, disposal rate industrial emissions…etc.
2	Resources	Material scrap rate, utilization of raw material, natural resources consumption, resources productivity the REs rates (Reuse, Reduce, Repair, Recycle, Recover, Remanufacture, …. etc.
3	Energy	Fuel productivity, electricity efficiency, energy utilization rate, solar energy usage, renewable energy usage …. etc.
4	Economy	Return on environment investment, environmental penalties cost rate, environmental expenses, …etc.

In addition, social attribute was added to the attributes with some practices such as Public awareness, social responsibility, employee's protection responsibility, customer satisfaction…. etc.

2.5.1 The Justification for Choosing Deif's Model

Deif's GMS model was adopted to be applied at this research in the Palestinian plastic industry, because it is a clear model, it is applicable to the most industries, including plastics, the application steps and tools used are understandable, uncomplicated, and can be applied through this study.

Chapter Three

Methodology

3.1 Overview

This chapter provides the research methods used to conduct this research. It explores the definition, approaches and strategy of research. It also shows sample size and sampling techniques. Moreover, it clarified the research model and explains the reasons for choosing this model. It also provides the criteria for the selected research tools and finally discusses the statistical analysis methods used in this research.

3.2 Research Strategy

Research strategy is the general plan of how one will go about answering the research questions. Usually the researchers use different strategies such as experiment, case study, and survey (Saunders et al., 2009).

In this research, the survey approach was selected, the justification for this selection is the research questions mentioned in chapter 1

3.3 Research Tool

A self-administered questionnaire was designed to collect data related to research topic.

3.4 Questionnaire

Questionnaire is a common expression used to describe the mechanism used to collect the research data by asking respondents to answer the same predefined questions (Saunders et al., 2009). Closed questions method is used in the questionnaire designing in this research. This method allows the respondents to give quick and accurate answers to achieve the desired research purposes.

The structure of the questionnaire was as follows:

1. Questionnaire cover page: which contains the questionnaire objective, Duration of filling the questionnaire, a message of thanks and appreciation for the cooperation of respondents with a promise to keep confidential data, and personal information about the researcher.
2. The first section of the questionnaire related to the general information of the plants such as the location, raw material used, number of employees, number of engineers, year established.
3. In the second section, the questions are developed to evaluate GM practices (environment, resources, energy, economic, and social) using a four-point scale rating. They are: "0" There is no "1" Few, "2"Medium, "3" High.
4. In the third section, the questions are related to the process of planning and improving the plants with GM practices.
5. Finally, section four, includes quantitative questions regarding certain practices of the plant.

6. Then an open-ended question was placed at the end of the questionnaire to give a chance for respondents to talk about any information not covered in the questionnaire on the subject of study adequately.

English version of the questionnaire is designed and reviewed carefully more than one time. After that the questionnaire is translated into Arabic because it is the mother tongue of respondents. Then it is tested by pilot test on some plants. Finally, it is reviewed by the supervisors and the necessary adjustments are made to ensure getting the correct results and the vocalizations used are understandable to all.

The whole Questionnaire (English and Arabic) will be presented in Appendix 2, and 3 in this thesis

3.5 The Proposed Conceptual Model

Based on the previous discussions about the models and the dimensions related to GM (chapter 2), the most important factors that affect GM implementation are identified. The GM model of Deif's (2011) was customized and applied on the PPP results in four stages as explained in chapter 2 figure 2.3. The best model (Deif's) that fit the needs and current situation of PPP was customized, the hierarchy of the model was set, and the indicators were defined and categorized according to the sustainability of the five attributes (Environment, Energy, Economy, Resource and Social).

3.6 Sampling Technique

Sampling is the operation that is carried out by the researcher in order to choose the right elements to be studied (Sekaran, 2006).

3.6.1 Study Population

Population is the overall group of elements that the researcher is seeking to study (Sekaran, 2006). In this research the medium and large Plastic Plants in Palestine specifically West Bank are selected to be the research population. Small factories have been excluded, because they are very small plants where practices related to GM are not applied

3.6.2 Study Sample

Sample is a partial set from the research population. In this research, random sample is used

3.6.3 Sample Size

There are various techniques that control the selection of the sample size according to Sekaran (2006), such as:

- The needed confidence level: This determines the trust scale of the ability of selected data features to represent the population features.
- The tolerable error margin: the precision of sample estimates.
- The population sizes
- The required analysis types

Several ways can be used to calculate the required sample size. In this research, the population size is 95 Plants in West Bank. The required confidence level is 95% and the required confidence interval is 0.1. The suitable formula according to Daniel and Cross (2013) is then as follows:

$$n = (Nz^2pq) / ((d^2 (N - 1)) + (z^2pq)) \ldots\ldots\ldots\ldots (1)$$

Where:

n = the sample size.

Z = is the abscissa of the normal curve which interrupts an area α at the tails (1 - α equals the required confidence level) (Israel, 1992). In this research z= 1.96 for 95% confidence level.

p = the population ratio that have the required characteristic (probability of selecting an element). To give a better estimate of p, let it equal 0.5 as this value will give the largest possible value for n (Daniel and Cross, 2013).

q = (1-p) and this means that q=0.5

d = the required confidence interval. In this research, 0.1 has been adopted.

N = the total population for the research.

So, using equation (1):

n= 48.01, we used n= 49 Plants.

3.7 Quality Standards for the Research Tool

After collecting data and completing its filling, the researcher needs to measure the accuracy and the actuality of the used research tool. The aim is to ensure the fineness of measures and to decrease the potency of obtaining wrong answers (Saunders et al., 2009, Sekaran, 2006).

3.7.1 Reliability

Reliability means the consistency and the constancy of the data that is collected using the research tool (Saunders et al., 2009).

Various techniques can be used to measure the inner consistency of the questionnaire. The famous and most used one is Cronbach's alpha. When the value of the Cronbach's alpha more the 70%, this is mean that we have high consistency of the data to get the required answers from the questions.

Cronbach's Alpha test is used to measure internal consistency using SPSS program, reliability Analysis. We have measured the internal consistency for each practice: for Environmental, Economy, Resources and Energy practice indicators, Cronbach's Alpha was more than 0.70; for the Energy practice indicators it is less than 0.70. Many factors can affect this result, and one of them is the number of crosschecked statements. Table 3.1 shows these results:

Table 3.1: Reliability Statistic – Cronbach's Alpha

Attributes	Cronbach's Alpha
Environment	.942
Resources	.702
Energy	.605
Economy	.836
Social	.767

- **Cronbach's Alpha Formula:**

Tavakol and Dennick (2011) defined a formula for Cronbach's alpha is:

$$\alpha = \frac{N \cdot \bar{c}}{\bar{v} + (N-1) \cdot \bar{c}}$$

Where:

N: The number of items

c̄: Average covariance between item-pairs

v̄: Average variance.

- **SPSS Steps:**

It was adopted SPSS program to calculate the Cronbach's Alpha. Often calculate alpha in SPSS or similar software. In SPSS, the steps are (Tavakol and Dennick, 2011):

Step 1: Click "Analyze," then click "Scale" and then click "Reliability Analysis."

Step 2: Transfer your variables (q1 to q5) into "Items,". The model default should be set as "Alpha."

Step 3: Click "Statistics" in the dialog box.

Step 4: Select "Item," "Scale," and "Scale if item deleted" in the box description. Choose "Correlation" in the inter-item box.

Step 5: Click "Continue" and then click "OK".

3.7.2 Validity

In this research, different methods are used to measure the validity of the questionnaire, these methods are:

- The questionnaire is revised with the supervisor more than once to verify its ability to achieve its purpose and to make sure from the simplicity and clarity of statements. Also, it is reviewed by seven specialists' arbitrators in this field (which was adopted in this research) (see Table 1 in Appendix 1).
- After filing data to SPSS, the validity was checked to be sure from the consistency of the questionnaire.

3.8 Distribution of the Questionnaire

In this research, the proportional stratified random sample is adopted to collect data from the Plants in West Bank. When distribution, fifty-four questionnaires were distributed to ensure a high rate of response and thus obtain the required sample size. At last, forty-nine of them were restored and five were refused to fill in the questionnaire. Based on the above, the response rate of the questionnaire equals to 90.7%.

The questionnaire was tested through Pilot Test on some plants, including the Royal Plant, modifications were made to some questions and other questions were also deleted and others are added.

3.9 Analysis Methods

The analysis methods which were used in this research are:

1- Cronbach's Alpha: to test the reliability of the questionnaire.
2- Frequency distributions: Using tables and pie charts to view the frequency and percent for each one of the demographic variables.
3- Descriptive statistics: It is used to describe (and compare) variables numerically.
4- Analysis of Variance (ANOVA): ANOVA will be used to find out where is the difference, specifically where are the groups in which the difference appears.

Chapter Four

Results and Discussion

4.1 Overview

This chapter discusses the research results and findings of analysis for the data collected via questionnaires. It discusses the results of descriptive statistics, statistical differences between respondents, hypotheses testing, and the suitable GM implementation model.

4.2 Performance Assessment Stage (Stage 1 of the Deif's Model)

In this stage, the data was collected from plastic plants using a structured assessment tool, as shown in Appendices 2 and 3. The assessment tool was judged by experts in the field, who approved the comprehensiveness of the questions.

The assessment criteria covered five main attributes: Energy, Resources, Environment, Economy, and Social. For each attribute a set of indicators were identified to collectively measure the level of greenness. Results from the assessment will help firms to focus more on specific areas for improvement with regards to sustainability. Indices provide a more straightforward conclusion on the level of sustainability because they rely on weight-based mathematical methods to aggregate many indicators into a single score.

After collecting the data, a customized scoring scale was developed to rank plastic facilities into one of three possible greenness levels, with each level

is described by a color according to the Deif's Model: black (low greenness), brown (medium greenness), and gray (high greenness). Figure 4.1 shows the three levels:

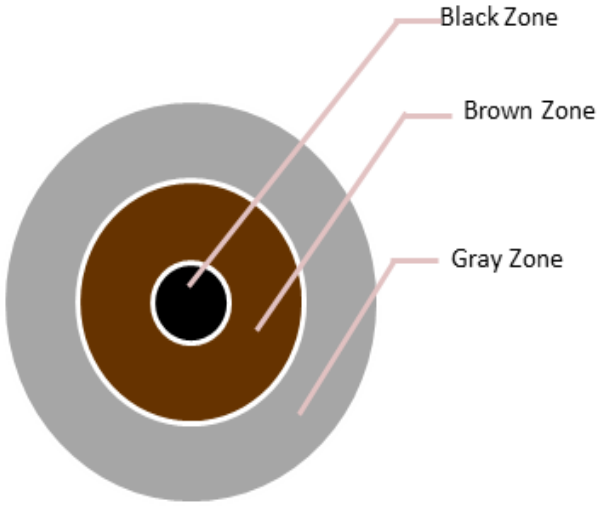

Figure 4.1: Greenness levels

As shown in the figure above, the worst of three levels to rank sustainability for the plastics industry is the Black Zone, with a score ranging, the level of each item is determined by the following formula: (highest point in Likert scale − lowest point in Likert scale) / (the number of the levels used). By applied the previous formula (3-1) / (3) = 0.67, the ranges are 1 to 1.67, in this zone (Black Zone) all the greenness indicators are very low. The next is the Brown Zone (1.68 to 2.33) which is the middle level. The last level is the best, which is the Gray Zone where the greenness indicator is the highest for all attributes (2.34 to 3). Table 4.1 shows Rank of the practices and relevant quantitative result

Table 4.1: Rank of the practices and relevant quantitative result

Zone	Quantitative Result	Frequency
Black	**1.00-1.66**	**Low (L)**
Brown	**1.67-2.33**	**Medium (M)**
Grey	**2.34-3.00**	**High (H)**

To go into deeper detail about the indicators, the following sections will separately brief each indicator as follows:

4.2.1 Environmental Attribute

A set of sub indicators have been identified to assess the most common practices in PPP that directly affect the environment negatively, mainly gas emissions, solid waste and wastewater.

The most significant impact of the plastics industry is the solid waste from the manufacturing process and products. The main practices to minimize the negative environmental impact on water, soil and air are:

- Recycling manufacturing process scrap.
- Coordinating between plastic firms and customers to collect and recycle products.
- Using eco-friendly materials.
- Solid waste practices (gathering, separation and recycling).
- Using gas filters to minimize the hazardous emissions.
- Controlling wastewater contaminants.
- Controlling water quality.

4.2.2 Resources Attribute

Resources practices include using the resources in a more efficient and sustainable way, either by minimizing the material scrap rate, the utilization of raw materials, natural resources consumption, or through resource productivity. Recycled materials should be used in materials that are normally used for manufacturing, such as plastic tables and chairs. We also concentrate on material reuse, using renewable resources such as rainwater.

The following statements were the indicators for the practices that have been measured:

- Replacing some materials with eco-friendly materials.
- Using recycled materials as an input in the manufacturing process.
- Following a system for monitoring and controlling resources in warehouses to protect chemicals from damage or leakage.
- Collecting rainwater in reservoirs for use in the manufacturing process and / or sanitary facilities.
- Using treated wastewater in irrigation.
- Re-using treated water in the plant, either in the manufacturing process, in the sanitary plant or at other facilities.

4.2.3 Energy Attribute

Energy related practices are all about using clean energy resources, either renewable or by minimizing the energy loss. The following were the main attributes that are included in the indicators:

- Optimal utilization of energy in terms of machine running times and idle times.
- Using clean energy sources (e.g. solar or wind).
- Using modern energy conservation techniques (like LEDs).
- Applying Standard operating procedures(SOPs)to contribute to the rationalization of energy consumption by employees.

Additional beneficial energy preservation practices include:

- The periodic maintenance of lighting and the periodic replacement of lamps.
- Following the principles of the optimum utilization of energy resources through the design of the plant building (e.g. lighting, ventilation, insulation, etc.).

4.2.4 Economy Attribute

By adopting planned economic practices, it is easier to understand the new concept, where Hami (2015) summarizes that instead of acting on well-intentioned impulses or reacting to external pressure, firms should clearly define and grasp economic opportunities gained from being environmentally friendly and socially responsible.

The following economic indicators presented in our model measure the short term and long-term impact of economical practices:

- Whether the factory does not have to pay fines resulting from violations of environmental standards.
- The plant achieving financial returns as a result of environmental investment, such as the use of alternative energy, waste recycling, wastewater reuse and the use of modern technology.
- Enhancing the role of the plant in environmental conservation and its use of GM practices in promoting its brand.
- A plan is drawn up to study potential risks and identify mitigation measures.
- Investment in other practices related to GM, including periodic maintenance and training in the application of GM practices.

4.2.5 Social Attribute

To ensure full sustainability for the manufacturing process, it is worthwhile to examine the social attribute through indicators that have an explicit social orientation, such as the firms' social responsibility, emergency preventive measures, awareness campaigns about plastics risks and wastes, workers' rights, customer satisfaction, and the atmosphere of the working environment.

A set of indicators was defined under this attribute to estimate the social impact of GM processes in plastic manufacturing plants. These indicators cover different sectors as follows:

a.Environmental-social responsibility includes:

- Allocates a budget for social responsibility activities (e.g. environmental education, environmental conservation, etc.).
- Awareness campaigns and guidance on the effects of the disposal of products and the harm to the environment.
- Pays attention to the area surrounding the plant in relation to agriculture and the environment.
- The existence of special instructions on the labels of finished products to preserve the environment.
- Providing new job opportunities and relying on the local workforce in different operations.

b. Customer related attributes include:

- Avoiding certain types of products because of their negative effects on the environment due to manufacturing waste or materials in the manufacturing process.
- Preference in dealing with qualified suppliers based on their compliance with environmental standards or following a specific environmental policy (such as ISO certification).
- Customers are satisfied with your products in terms of their compliance with GM standards and conditions compared to other competitors (in terms of recyclability, eco- friendliness, etc.).

c.Worker related social attributes include:

- Having specific environmental procedures and practices for the preservation of the environment within a documented and

generalized set of instructions at the plant, regarding a responsibility for preserving the environment.

- Providing the means for personal protection and fire protection.
- The plant has gas or chemical safety measures.

4.3 Demographic Factors Analysis

The following sections present the results based on the survey, the indicators for each practice and a general evaluation of GM practices in the PPP.

The diagnostic survey was conducted to study the general practices in GM in the Palestinian plastics industry, Figure 4.2 shows the distribution by geographical area. One can note that the southern area of the West Bank (Bethlehem and Hebron) has the majority of plastic plants, especially the Hebron governorate as shown in Figure 4.3, because it is an industrial city that contains most of the plastic plants in the West Bank.

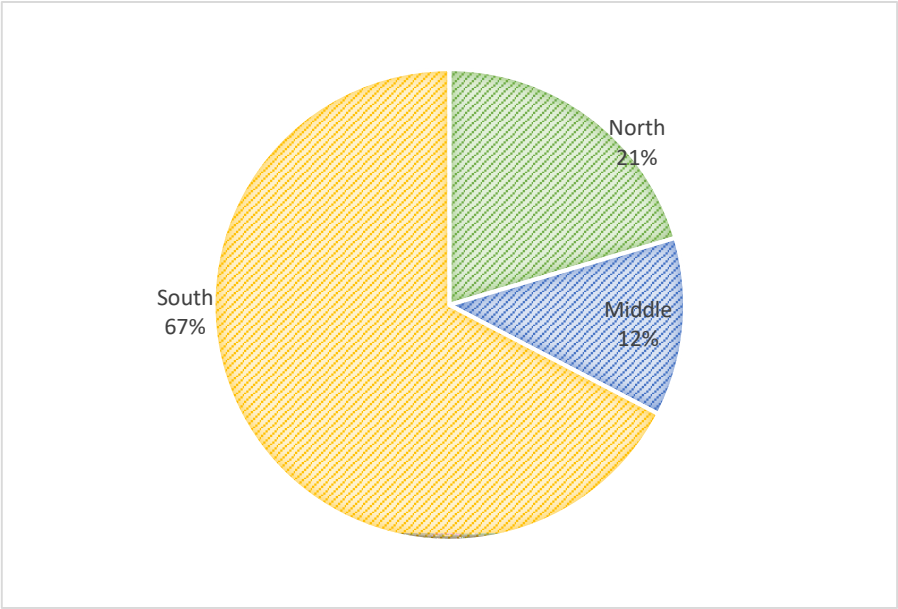

Figure 4.2: Sample distribution based on geographical location.

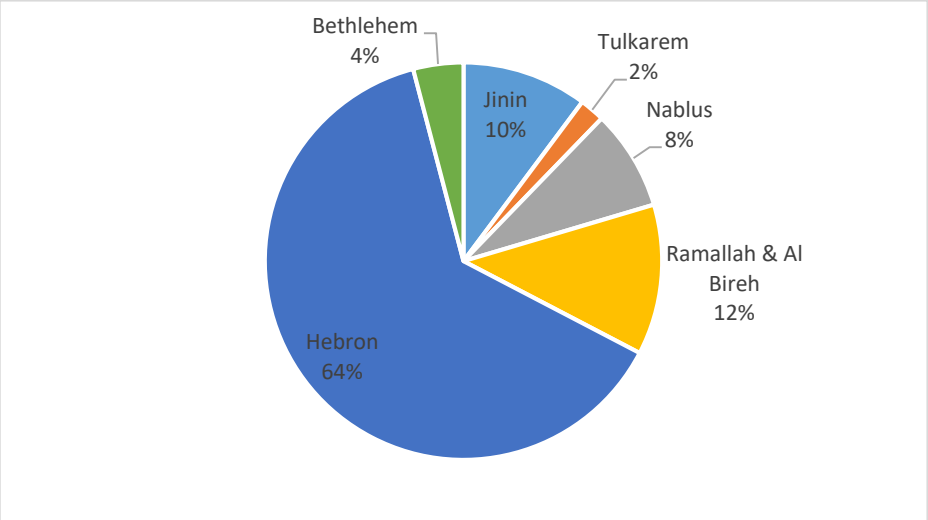

Figure 4.3: Sample distribution based on governorate

According to the survey results, the following sections summarize the results of the plants covered in the thesis.

4.3.1 Establishment Year and Classification in the Ministry of National Economy

Figure 4.4 shows that the establishment years of the plastics plants in the West Bank which were included in the study.

There were 37.5% established during the years 1990-1999, 29.2% between 2000-2009, while 27.1% were established between the years 2010-2017, and 6.3% of the sample were established prior to 1990, between 1970-1989.

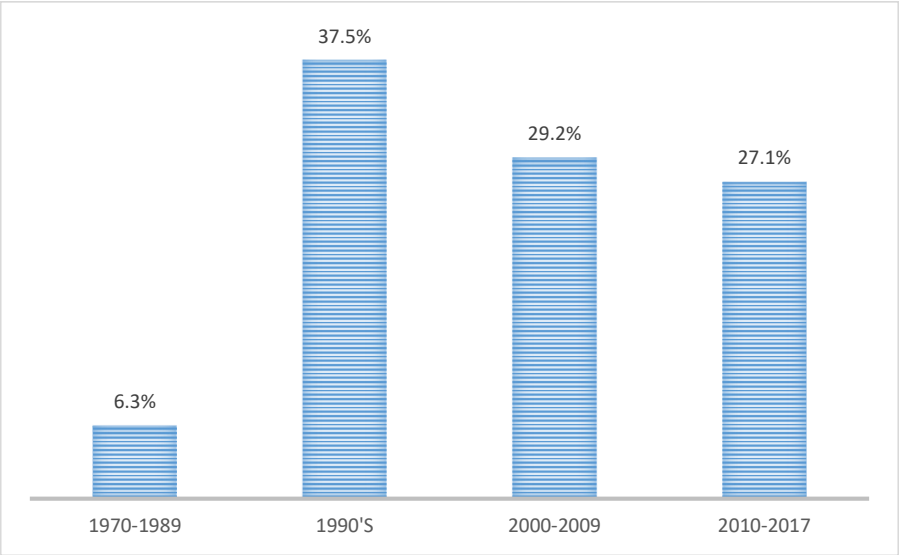

Figure 4.4: Establishment years of the plastics plants in the West Bank

It is noted from previous results that most of the years of establishment plants have been recent, due to the modern and sophisticated modern technology involved in the plastics industry

For the registration of factories in the Ministry of National Economy, the majority (48%) were registered as a private partnership company, 35% as an ordinary limited company, and 17% as an ordinary general company.

It is noted from previous results that most companies are registered as private partnership companies, because the majority of the plants in the west bank are registered under a private partnership company.

4.3.2 Membership in Palestinian industry unions

According to the Palestinian industry unions, there found that 77% of the plastic plants are members of the Palestinian Plastic Industries Union and 2% belong to the Palestinian Chemical Industries Union. On the other hand, 21% of the sample does not belong to any union yet.

It is noted from the previous results that most of the companies are registered in the Palestinian Plastic Industries Union, because the location of these companies in Hebron and the Palestinian Plastic Industries Union is also located in Hebron.

4.3.3 Numbers of employees and engineers at plastics Plants

The number of employees was taken into consideration; our target was medium and large plants. The results show that the majority of the plastic factories (65.3%)have 10-49 employees, Plants with more than 50 employees and workers represent 16.3% of the sample. Figure 4.5 shows the results for number of employees and engineers at plastics plants

Regarding the number of engineers in these plastic plants, 44.9% of the plants have 1-2 engineers, 12.2% have 3-5 engineers and 4.1% more than 5 engineers. On the other hand, 38.8% of the sample do not have any engineers yet.

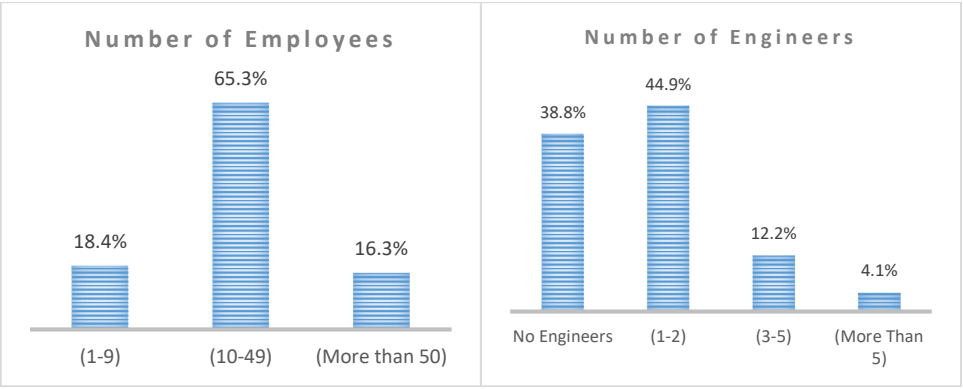

Figure 4.5: Numbers of employees and engineers at plastics plants.

The results indicated that the number of employees ranged between 10-49% by 65%, which is the largest percentage, because the sample was selected for companies classified as medium and large companies. Regarding to the number of engineers, it is noted that the number of engineers was 1-2, due to the need of these medium and large plants to at least one engineer to perform the tasks required of him in his field.

4.3.4 Quality Certifications and daily work in the plastic plants

The survey results show that 76% of the plastics plants do not have any quality certificates, which means that they do not comply with international or local environmental specifications and standards. On the other hand, 14% of plastics plants have the Palestinian Standards (PS) certificate, 12% have the ISO 9000 certificate and 2% have the ISO14000 certificate. Note that some plants have more than one ISO and PS certificate.

It is noted from the previous results that most companies with 76% do not have any type of quality certificates, because the lack of awareness of the importance and benefits of these certificates in plants, which was one of the problems in the lack of knowledge and application of GM practices in plants.

For the daily work in the plastic plants, 20% of these plants only work in the morning in one shift, 37% work in two shifts, and 43% of the plastic firms work in three shifts in a day. The following figure 4.6 shows these results

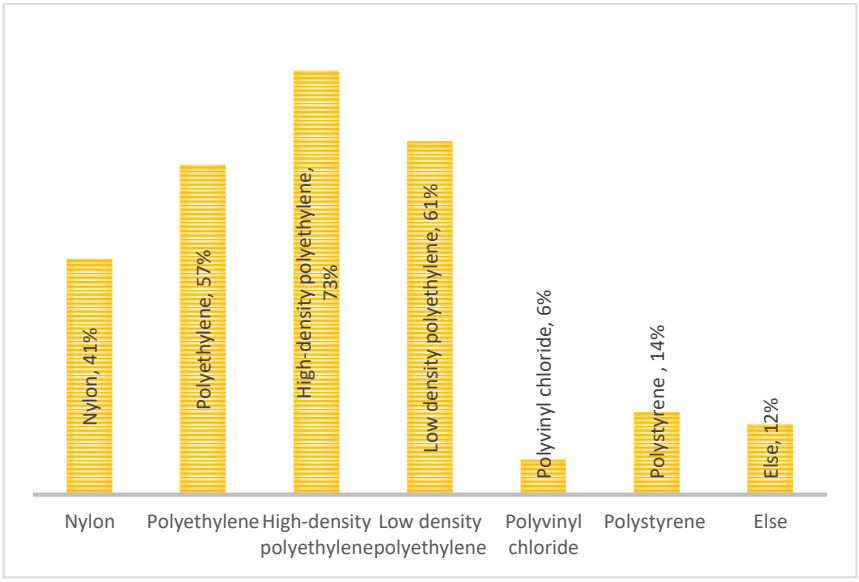

Figure 4.7: The plastics industry's raw material usage in West Bank

It is noted from previous results that the percentage use of Polyethylene, HDP, and LDP is higher, because it is involved in the manufacture of most plastic products.

4.4 GM Attributes and Practices

In this section, the results for each attribute are presented, evaluating each practice under each attribute, and presenting the final indicator according to the current status.

4.4.1Environmental Practices Assessment

Seventeen environmental practices have been identified to measure the extent that plastic plants consider preservation of water, air and soil resources.

Here will be highlighted these practices by dividing them according to their major impact on a specific element of the environment:

1- Impact on the Soil

Firstly, to measure the impact on the soil, practices related to the recycling and the use of materials were evaluated to show that some general practices been adopted by all plants, such as producing recyclable products; all PPP said that their products are, overall, recyclable, whether they practice recycling or not. The average rating is 2.49, which is according to Table 4.2, is a very good indicator for our study as it means that plastic products might be recycled one way or another, now or in the future. Another good point was that all of PPP are trying to reduce the percentage of waste produced during manufacturing by adopting the best designs and processes; the average rating for this action is 2.4, which is also considered in the Gray Zone in our model. Then avoiding as much as possible the use of extremely harmful materials in the manufacturing process has an average rating of1.96, which is considered in the Brown Level (medium greenness).

For other practices which affect the soil, 73% of the PPP practice waste classification with an average rating of 2.0, which is considered as medium greenness in the Brown Zone. For using recyclable packaging material, 69% of the PPP agreed that they use such kinds of materials, with an average rating of 1.94, which is almost medium and also in the Brown Zone.

For collaboration between PPP and their customers in waste recycling practice, 63% of plants said that they do collaborate (to a low, medium or high extent), with average rating of2.1 which is in the Brown Zone.

Finally, for the last adoptable practice which directly affects the soil, 45% of the PPP showed that they use environmentally friendly materials in the manufacturing process, with an average rating of 1.77 which is a medium score in the Brown Zone.

Table 4.2 describes each action under the environmental practice affecting the soil, the level of PPP practicing plants and the PPP weighted average.

Table 4.2: Environmental Practices index and Overall Rank – Soil preservation actions

#	Environmental practices – Soil Preservation	Practicing plants %	L (1)	M (2)	H (3)	Weighted Average	Overall Rank
Q1	Recycling manufacturing process wastes inside the plant or in collaboration with external body	95.9%	19.1%	21.3%	59.6%	2.40	High
Q2	The collaboration between the firm and customers in waste recycling	62.5%	26.7%	36.7%	36.7%	2.10	Medium
Q3	Waste categorization before disposal	72.9%	40.0%	20.0%	40.0%	2.00	Medium
Q4	Avoid using material classified as sever harmful raw material	95.9%	29.8%	44.7%	25.5%	1.96	Medium
Q5	The final products are recyclable	100%	10.2%	30.6%	59.2%	2.49	High
Q6	Reducing the percentage of wastes produced during manufacturing by adapting best design and process	97.9%	8.5%	31.9%	59.6%	2.51	High
Q16	Using recyclable material for packaging	68.8%	39.4%	27.3%	33.3%	1.94	Medium
Q17	Using Environmentally friendly materials such as BPA, recyclable materials…)	44.9%	45.5%	36.4%	18.2%	1.73	Medium

Sample calculation for the first practice (Q1):

- Total number of the plants (n)= 49
- Total plants practicing this practice (P)= 47

Total plants practiced in Low level (L)= 9

The percentage of the plants practiced in Low level,

(L)/(P), (9) / (47) =19.1%

Total plants practiced in a Medium (M)= 10

The percentage of the plants practiced in Medium level

(10) / (47) = 21.3%

Total plants practiced in a High level (H)= 28

The percentage of the plants practiced in High level

(28) / (47) = 59.6%

Weighted Average = (1*(L) + 2*(M) + 3* (H)) / (P)

= (1*(9) + 2*(10) + 3* (28) / (47) = 2.40 (High)

In the assessment, plants were required to estimate the percentage of recyclable products, the waste from the production process and the percentage of recyclable packing materials. Table4.3 shows the estimated percentage which indicates high rates of recyclable products. The mean is 76.78%, while the lowest rate of recyclable packing materials was 36.75%. On the other hand, the percentage of waste from production that cannot be re-used ranges from 0 to 20%, which should be take into consideration in the process design. While for the number of annual water quality inspections was very low at most plants, the maximum rate was 12, i.e. one

per month; the mean value was 1.04, i.e. only once per year. Table 4.3 shows the results:

Table 4.3: descriptive analysis for environmental practices - Soil preservation actions

Practice	Mean	Std. Deviation
Proportion of recyclable products in the factory to total products	76.78	25.99
The percentage of waste from the production process that cannot be used	6.60	5.04
Percentage of recyclable packing materials	36.75	36.74
Number of annual inspections of water quality in the plant	1.04	2.94

Noted that the mean and the std. deviation for the percentage of recyclable packing materials practice are similar, because there is a high variability in the answers for this practice.

2- Impact on the Air

For environmental practices that are related to protecting the air quality from pollution, there is a general lack in adopting these practices. For example, only 30.6% of the PPP use filters to minimize polluted emissions, with an average rating of 1.6, which is considered a low score in the Black Zone of our model. On the other hand, 51% of the PPP considered emissions from their vehicles as a pollutant and used filters and vehicle maintenance to minimize the emissions; this practice has an average rating of 1.8, which is considered a medium score in the Gray Zone.

For monitoring the air quality in the working environment, 42.9% of the PPP took this action; with an average rating of 1.57 which is considered a

low rating, and according to our model is located in the Black Zone. Similarly, 49% of the most plants said that air monitoring tests were normally performed by external bodies, with an average rating for this practice of 1.46, which is also considered as low and in the Black Zone. Table 4.4 summarizes these results:

Table 4.4: Environmental Practices index and Overall Rank – Air quality

#	Environmental practices – air quality	Practicing plants %	L (1)	M (2)	H (3)	Weighted Average	Overall Rank
Q8	Use filters to reduce the emissions of the manufacturing process.	30.6%	46.7%	46.7%	6.7%	1.60	Low
Q9	Carry out periodic tests for the air quality in the plant	42.9%	52.4%	38.1%	9.5%	1.57	Low
Q10	Visits from official bodies to monitor and measure air quality in the plant	49.0%	58.3%	37.5%	4.2%	1.46	Low
Q11	Adapting and Distributing guidance for drivers about the use of diesel and filters/ cars maintenance	51.0%	48.0%	24.0%	28.0%	1.80	Medium

3- Impact on the Water

The third part of environmental practices was related to water quality and wastewater disposal. Most activities performed by the PPP show a lack of internal or external control over water quality or wastewater disposal. Only 18.4% of PPP say they conduct an initial treatment for the wastewater before disposal, and the average rating was very low at 1.33, which is also

in the Black Zone. For water quality control, 36.7% of the PPP internally monitor the water quality, with an average rating of 1.73, which is considered as a medium score in the Brown Zone of our model.

Only 24.5% say that external bodies perform periodic checks on water quality, with an average rating 1.5; this is also considered a low score and is in the Black Zone.

In terms of wastewater control, 20.4% of the PPP say they test the wastewater before disposing it into the public sewage system, with a low average rating of 1.5. Also 18.4% say these tests are implemented by an external body, with an average rating of1.78 which is considered as a medium score in the Brown Zone. The details results are shown in Table 4.5.

Table 4.5: Environmental Practices index and Overall Rank – Water quality and wastewater control.

#	Environmental activities– water and wastewater control	Practicing plants %	L (1)	M (2)	H (3)	Weighted Average	Overall Rank
Q7	Wastewater treatment before disposal	18.4%	66.7%	33.3%	0.0%	1.33	Low
Q12	Monitor water quality internally	36.7%	44.4%	33.3%	22.2%	1.78	Medium
Q13	Monitor water quality by external bodies	24.5%	66.7%	16.7%	16.7%	1.50	Low
Q14	Monitoring wastewater internally	20.4%	60.0%	30.0%	10.0%	1.50	Low
Q15	Monitoring wastewater by external bodies	18.4%	44.4%	33.3%	22.2%	1.35	Low

4.4.1.1 Environmental Practices Indicator

According to the previous evaluation, environmental practices at PPP are the most important practices considered in calculating the environmental indicator. 10 practices were selected from 17 practices according to the literature and experts that are direct impact on the environmental index. The results are linked to our model (Deif, 2011) to diagnose the current situation for the plastics industry relative to GM practices.

The following figure 4.8 shows the main practices included in calculating the environmental indicator, taking into consideration the weightings and practicing of each practice by the plants. The weighted average for the indicator is 2.08 and according to the Deif's model, it is considered in the Gray Zone.

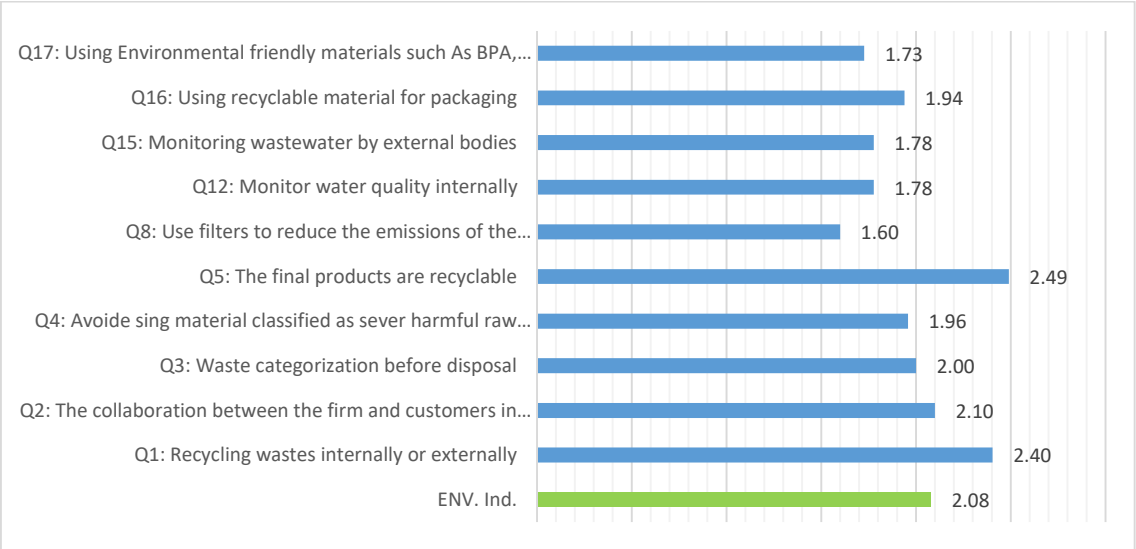

Figure 4.8: Environmental practices indicator

Sample calculation:

To calculate the Environmental Index, we must calculate the relative weight and relative rate.

- Relative weight for the first practice (Q1) = (P=47) / (total number of plants that practiced all practices of the environmental attribute=305) = 15.41 %
- Relative rate for the first practice (Q1) = (Weighted Average=2.4) * (Relative weight= 15.41%) = 0.37

By summation all relative rate for all practices (10 practices) (0.37+……), the total will be 2.08, which is the indicator of the Environmental Index at middle level (Brown Color).

Figure 4.8 shows the practices that directly affect the environmental indicator. The lowest ratings relate to using filters to control emissions in the manufacturing process, and using environmentally friendly materials and monitoring wastewater and water quality.

This is due to lack of awareness and knowledge about the effects of these practices on the environment. If plants work on these issues the result will positively affect the environment and a significant increase in the indicator would be noticed.

Also, laws and regulations, specifications required, and economic cost for these practices impact on the Environmental Index.

4.4.2Resources Practices Assessment

For practices relating to resource use and conservation, a set of practices have been categorized; these measure the use of raw materials, storage and conservation recycling, the replacement of non-eco-friendly substances with eco-friendly materials, the use of renewable materials to preserve resources and reusing the resources in different operations (such as treated wastewater for agricultural use).

Table 4.6 summarizes the results for resources practices:

Table 4.6: Resources Practices index and Overall Rank

#	Resources activities	Practicing plants %	L (1)	M (2)	H (3)	Weighted Average	Overall Rank
Q18	Replacing some material with eco-friendly material	57%	53.6%	28.6%	17.9%	1.64	Low
Q19	Using recycled material as an input in the manufacturing process	92%	22.2%	40.0%	37.8%	2.16	Medium
Q20	Follow a system for monitoring & controlling resources in warehouses to protect chemicals from damage or leakage	90%	25.0%	36.4%	38.6%	2.14	Medium
Q21	Rainwater is collected in reservoirs for the use in the manufacturing process and / or sanitary facilities	29%	42.9%	28.6%	28.6%	1.86	Medium
Q22	Using treated wastewater in irrigation	12%	50.0%	33.3%	16.7%	1.67	Medium
Q23	The treated wastewater is re-used in the plant either in the manufacturing process or in the sanitary plant or other facilities	16%	50.0%	25.0%	25.0%	1.75	Medium

The results show that the most applied practice in this sector is using recycled material as an input in the manufacturing process, with 92% of PPP adopting this practice in their work procedures; this practice has an average rating 2.16, which is considered a medium score in the Brown Zone of the Deif's Model. After that comes the activity of using a control system to monitor the warehouses for raw material from loss or spoilage; this is practiced by 90% of the PPP, with average rating 2.14, also considered a medium score in the Brown Zone. Thirdly, comes the activity of replacing some harmful raw materials with eco-friendly raw materials; this activity is practiced by 57% of the PPP, with an average rating 1.64 which is considered low and in the Black Zone. Therefore, this practice needs a lot of work to be improved and developed. Then, 29% of PPP harvest rainwater to be used in the manufacturing process or inside the plastic plants, practice with an average rating of 1.86; this is also considered a medium rating. Finally, reusing the treated wastewater (in irrigation or inside the factory) is only practiced by 16% of plants, with average rating 1.75.

4.4.2.1 Resources Practices Indicator

The resources indicator calculated based on the practices average ratings, is 1.98, which is considered as a medium result. This indicator is currently in the Brown Zone according to the Deif's model. This outcome can be improved through more attention to concentrated on treating wastewater for irrigation or use inside the factory. Figure 4.9 show the results:

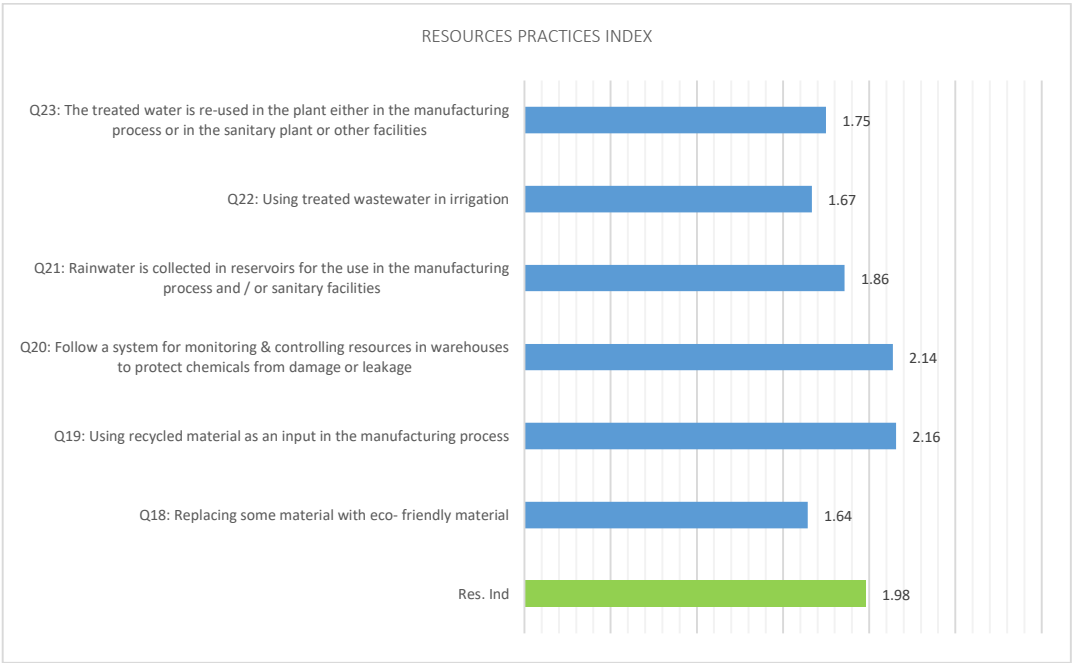

Figure 4.9: Resources practices indicator

As with environmental practices, during the assessment it was required for the PPP to estimate the percentage of resources (materials and water) that are recycled; the table shows that in some plants they depend mainly on recycled raw materials (98%), which is considered a GM practices; on the other hand, some plants have no recycled raw materials or treated water, which is considered the worst scenario in GM. Table 4.7 shows the results:

Table 4.7: Descriptive analysis for some resource's practices in PPP

Resources practices	**Mean**	**Std. Deviation**
Percentage of materials in the production process which is from the previous recycling process	34.06	32.45
Percentage of water used in the plant resulting from rainwater harvesting or waste water treatment	6.70	19.22
Percentage of treated water used for irrigation	1.02	7.14
Percentage of treated water used for manufacturing purposes or in sanitary facilities	3.26	12.31

It is noted from the previous results that the rate for these practices are very low, due to many reasons, most importantly the lack of knowledge and importance of such sources that contribute to the production process, which also reduce the cost on the plant, and economic cost for some resources maybe one reason that didn't applied some practices in the plants

4.4.3Energy Practices Assessment

The third practices defined in this thesis are energy practices that are related to GM. This evaluation includes several practices to understand the current practices and situation in PPP. Table 4.8 shows the detailed results per practice with the average rating:

Table 4.8: Energy Practices index and Overall Rank

#	Energy activities	Practicing plants %	L	M	H	AVG.	Overall Rank
Q24	Optimal utilization of energy in terms of machine running times and idle time	92%	2.2%	13.3%	84.4%	2.82	High
Q25	Use clean energy sources (solar / wind)	14%	28.6%	57.1%	14.3%	1.86	Medium
Q26	Using developed energy conservation techniques (like LED)	83%	12.5%	40.0%	47.5%	2.35	High
Q27	Periodic maintenance of lighting and periodic replacement of lamps	100%	4.1%	20.4%	75.5%	2.71	High
Q28	Maintaining the principles of optimum utilization of energy resources through the design of the plant building (lighting / ventilation / insulation ...)	90%	29.5%	43.2%	27.3%	1.98	Medium
Q29	Application of SOPs to contribute to the rationalization of energy consumption by employees	71%	47.1%	20.6%	32.4%	1.85	Medium

The results show that the best rating was for the periodic maintenance of lighting and the periodic replacement of lamps. The average rating was 2.71, which is considered a high score in the Gray Zone.

Then comes the optimal utilization of energy in terms of machine running times and idle times, as practiced by 92% of the factories; the average rating is 2.82, which is also considered a high score in the Gray Zone.

highest rating for optimal utilization of energy in terms of machine running times and idle times and using developed energy conservation techniques (like LEDs). 4 practices were selected from 6 practices according to the literature and experts that are direct impact on the energy index. Figure 4.10 summarizes the results used for the indicator:

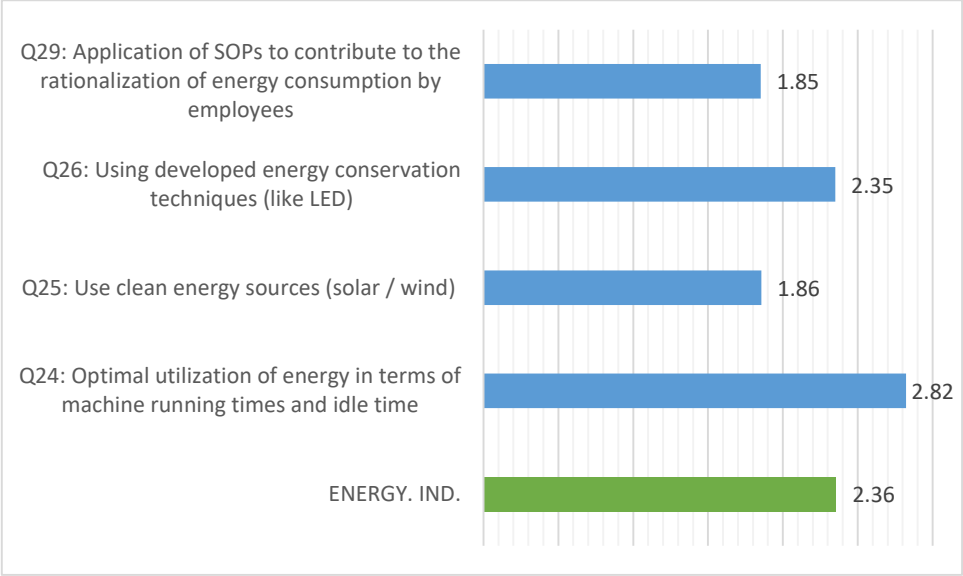

Figure 4.10: Energy practices indicator

It is noted from the previous results that the energy index was in the high classification, due to several reasons, the most important of which is the knowledge and the great awareness of these practices in factories, and the cost acceptable to apply most of these practices

Table 4.9 shows results for the two main indicators in energy practices. We can see that the level of clean energy usage is very low in PPP, as the maximum percentage is 50% of the total energy used and the mean is only 3.81 On the other hand, the percentage of energy-saving lighting at a much a higher level than clean energy usage, as sometimes it reaches 100% of the lights used in the plant.

Table 4.9: Descriptive analysis for some energy practices in PPP

Indicators	Mean	Std. Deviation
The percentage of clean energy used (i.e. solar) from the total energy used in the plant	3.81	11.53
Percentage of lights from energy saving types (like LED)	52.31	38.88

It is noted that the percentage of clean energy used (i.e., solar energy) of the total energy used in the plant is very low for several reasons, the most important of which is the high cost of these technologies, the lack of knowledge and experience, the Israeli occupation, which imposes laws including not using such technologies in plants.

4.4.4 Economic Practices Assessment

For the economic practices, five main practices were determined to have an impact on GM, in terms of obtaining financial returns from GM: the use of recycled materials, investment in alternative energy, the promotion of plant products as environmentally friendly, a prepared emergency plan and compliance with environmental legislation (if any).

The details of the results for this attribute are shown in the Table 4.10.

Table 4.10: Economic Practices index and Overall Rank

#	Economic activities	Practicing plants %	L	M	H	AVG.	Overall Rank
Q30	The factory did not have to pay fines resulting from violations of environmental standards	100%	0.0%	6.1%	93.9%	2.94	High
Q31	The plant achieves financial returns as a result of investment in environmental aspects such as the use of alternative energy, waste recycling, wastewater reuse and the use of modern technology	61%	63.3%	23.3%	13.3%	1.50	Low
Q32	Enhance the role of the plant in environmental conservation and its use of GM practices in promoting its brand	55%	55.6%	25.9%	18.5%	1.63	Low
Q33	A plan is drawn up to study potential risks and identify mitigation measures	96%	36.2%	42.6%	21.3%	1.85	Medium
Q34	Investment in other practices related to green manufacturing, including periodic maintenance and training in the application of GM practices	43%	57.1%	33.3%	9.5%	1.52	Low

From the survey results, it is noted that the highest-rated activity is not paying fines as a result of environmental violations, with an average rating 2.94, which is a very high score in the Gray Zone. It should be noted here that this does not mean compliance with all environmental legislation, but that the law is not enforced as required by all local authorities. Next, implementing a plan to study the potential risks and determining measures to reduce them is adopted by 95% of the plants, and the rating of this

practice, 1.85, is considered medium and in the Brown Zone. It should be noted here that the majority of the plants that are implementing a risk plan to study the potential risks are those plants that follow a system of international standards or of PS.

For other practices associated with financial returns due to GM practices, such as the use of alternative energy, waste recycling, wastewater reuse and the use of modern technology, 61% of the sample indicate that they follow some of these mechanisms, but their evaluation is low, at 1.5, because there is no standard system or procedure to see the results of these achievements.

The enhancement of the role of the plant in preserving the environment and the use of GM practices in brand promotion has been applied by 55% of PPP factories, with an average rating of 1.63, which is considered a low score in the Black Zone.

Investing in other GM-related practices and training on the application of GM practices was the lowest rated economic practice, applied by only 43% of the PPP sample with an average rating of 1.52.

4.4.4.1 Economic practices indicator

Figure 4.11 summarizes the results of the economic practices and their indicator.

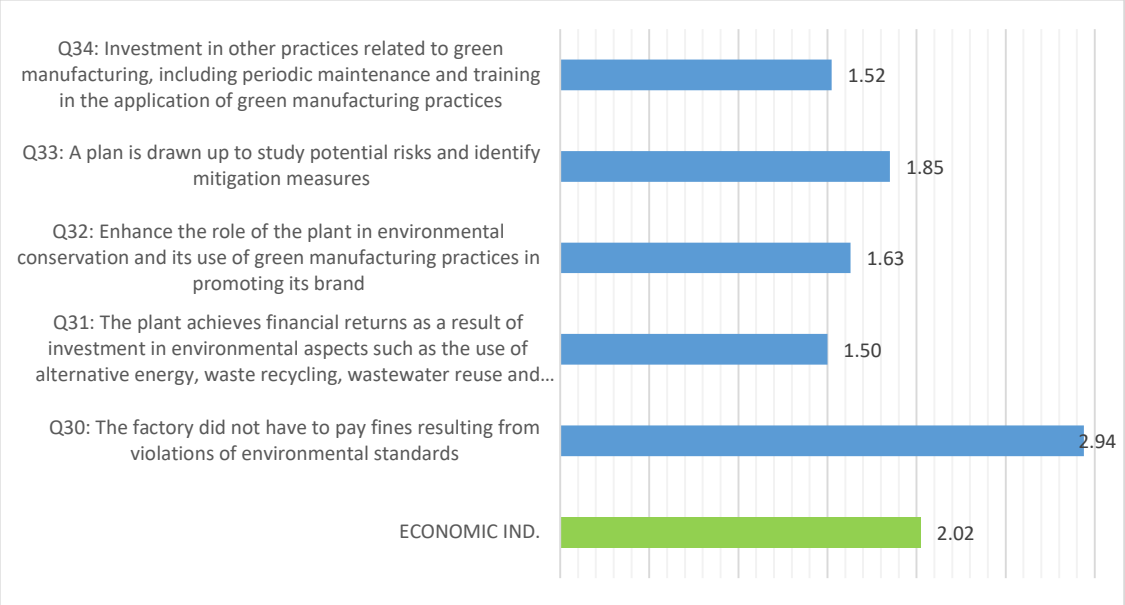

Figure 4.11: Economic practices indicator

For one of the economic practices, the PPP estimated the quantitative value of the rate of return on investment as a result of environmental practices. From the Table 4.11, it is clear that the rate of return is high for a few plants, with the rate reaching 85%, while the mean value for all plants is 13.7%.

Table 4.11: Descriptive analysis for some economic practices in PPP

Practice	Mean	Std. Deviation
Rate of return on investment as a result of investment in environmental aspects such as the use of alternative energy, waste recycling or reuse of wastewater and the use of modern technology	13.70	23.92

It is noted here that the rate of return on investment due to investment in environmental aspects such as the use of alternative energy, waste recycling or reuse of wastewater and the use of modern technology is very low, because of the high cost and low awareness and knowledge of these activities.

4.4.5Social Practices Assessment

The fifth and final practices are the social practices towards green manufacturing. Several related practices were evaluated at plastic plants in the West Bank, focusing on issues related to increasing social awareness of the negative impact of the production process or waste on the environment. These include allocating a budget for socially and environmentally responsible activities, giving attention to the plant's employees in terms of providing a healthy working environment and monitoring their health through periodic inspections, focusing on products that meet basic requirements but also that enhance environmental protection measures in terms of chemical safety precautions, and caring for the plant's surrounding environment. Table 4.12 details these social practices relating to green manufacturing.

Table 4.12: Social Practices index and Overall Rank

#	Social Practices	Practicing plants %	L	M	H	AVG.	Overall Rank
Q35	Allocates a budget for social responsibility activities (environmental education, environmental conservation, etc.)	35%	58.8%	29.4%	11.8%	1.53	Low
Q36	The existence of special instructions to preserve the environment on the labels of finished products	54%	50.0%	30.8%	19.2%	1.69	Medium
Q37	The existence of special instructions on the risk of the constituent materials of the product or the residues of the product on the environment / origin / source / etc.	59%	44.8%	37.9%	17.2%	1.72	Medium

#	Social Practices	Practicing plants %	L	M	H	AVG.	Overall Rank
Q38	The plant sets its own environmental procedures and practices for the preservation of the environment within a documented and generalized instructions at the plant in the sense of responsibility for preserving the environment	73%	52.8%	33.3%	13.9%	1.61	Low
Q39	Awareness campaigns and guidance on the effects of disposal of products and harm the environment	32%	26.7%	53.3%	20.0%	1.93	Medium
Q40	To donate / volunteer to sponsor projects that contribute to the preservation of the environment	49%	75.0%	16.7%	8.3%	1.33	Low
Q41	Conduct periodic medical tests for workers in the factory	63%	64.5%	25.8%	9.7%	1.45	Low
Q42	Check the noise level periodically and working to limit its impact on the workers	75%	63.9%	16.7%	19.4%	1.56	Low
Q43	The factory works to provide new job opportunities and rely on the local workforce in different operations	100%	4.1%	40.8%	55.1%	2.51	High
Q44	The core products of the factory meet the urgent need of society (a basic need and not an accessory(	100%	8.2%	22.4%	69.4%	2.61	High
Q45	The plant takes the appropriate measures and the appropriate design of the workplace in order to provide a healthy and suitable working environment for the safety of employees in the course of their work	100%	14.3%	51.0%	34.7%	2.20	Medium
Q46	Provide means for personal protection and fire protection	100%	4.1%	8.2%	87.8%	2.84	High
Q47	The factory has safety measures against gases or	37%	16.7%	27.8%	55.6%	2.39	High

#	Social Practices	Practicing plants %	L	M	H	AVG.	Overall Rank
	chemicals						
Q48	Pay attention to the surrounding area of the plant in relation to agriculture and the environment	71%	54.3%	25.7%	20.0%	1.66	Low
Q49	Preference is given to dealing with qualified suppliers based on their compliance with environmental standards or following a specific environmental policy (such as ISO certification)	82%	42.5%	30.0%	27.5%	1.85	Medium
Q50	Your customers are satisfied with your products in terms of their compliance with GM standards and conditions compared to other competitors (in terms of recyclability, eco- friendly ... etc.)	92%	20.0%	22.2%	57.8%	2.38	High
Q51	Avoiding certain types of products because of their negative effects on the environment from manufacturing waste or materials in the manufacturing process	78%	18.4%	39.5%	42.1%	2.24	Medium

The best social practices relating to GM was the provision of personal protection means for workers against fires and firefighting; this was provided in all factories and has an average rating 2.84, which is considered as high score in the Gray Zone. Products that meet the basic needs and are not mostly accessories has an average score of 2.61, which is also high score, and then comes annually providing new job opportunities with an average rating of 2.51, which is also a high score. Taking appropriate action and a properly designed workplace to provide a healthy

working environment that ensures general staff safety has an average rating of 2.2, which is a medium score

After that comes the satisfaction of the factory's customers with the products in terms of compliance with GM standards; with an average rating of 2.18, this practice is applied by 92% of the PPP.

As for an interest in collaborating with suppliers who are committed to environmental standards or who follow a specific environmental policy in terms of obtaining quality certificates, specifically environmental, 82% of plants have this interest, with an average rating of 1.85. For socially responsible commitments by avoiding producing products with a harmful impact on the environment, this is adapted by 78% of the plants, with an average rating of 1.85. For respecting the environment surrounding the plant, for example with regards to agriculture, 71% of PPP adopted this principle, with a low average rating 1.66.

In general, 73% of plastic plants adopt specific environmental procedures and practices, and the average rating for the application of these standards is 1.61, which is considered a low evaluation in the Black Zone in the Deif’s Model.

Then comes checking the noise level in the factory as a responsibility towards the workers, which is adopted by 75% of the PPP but also at a low rating of1.56.

In terms of their responsibility towards the factory workers, 63% of the PPP carried out periodic inspections, but the average rating is considered to be low, at 1.45.

For the least adopted socially-oriented practices, only 35% of the plants allocate a budget for social responsibility activities, such as environmental education, with an average rating of 1.53. For conducting awareness campaigns and guidance on the effects of disposal of products on the environment, this is adopted by 32%, with an average rating of 1.33. Also, 49% of PPP say that they volunteer for projects to preserve the environment, but also at a low average rating 1.33.

Regarding their commitment to alert customers by labeling the hazard of the materials or the final product residues, 54% of the plants in our sample adopt this practice, with a medium average rate of 1.69.

In terms of adding labels to the product about preserving the environment when disposed of the product, this is adopted by 59% with an average rating of 1.72.

4.4.5.1 Social Practices Indicator

To summarize, the general result for the five practices is around 2.00. 11 practices were selected from 17 practices according to the literature and experts that are direct impact on the social index as shown in figure 4.12, the highest ratings are for providing the means for personal protection, because that they are important means that must be applied in plant, and providing job opportunities and relying on the local workforce, because plants need lots manpower to work in the industry.

While the lowest ratings are for allocating a budget towards social responsibilities for environmental preservation, because of the limited awareness of the practice and the costs involved

Figure 4.12 summarizes the results of the social practices and their indicator.

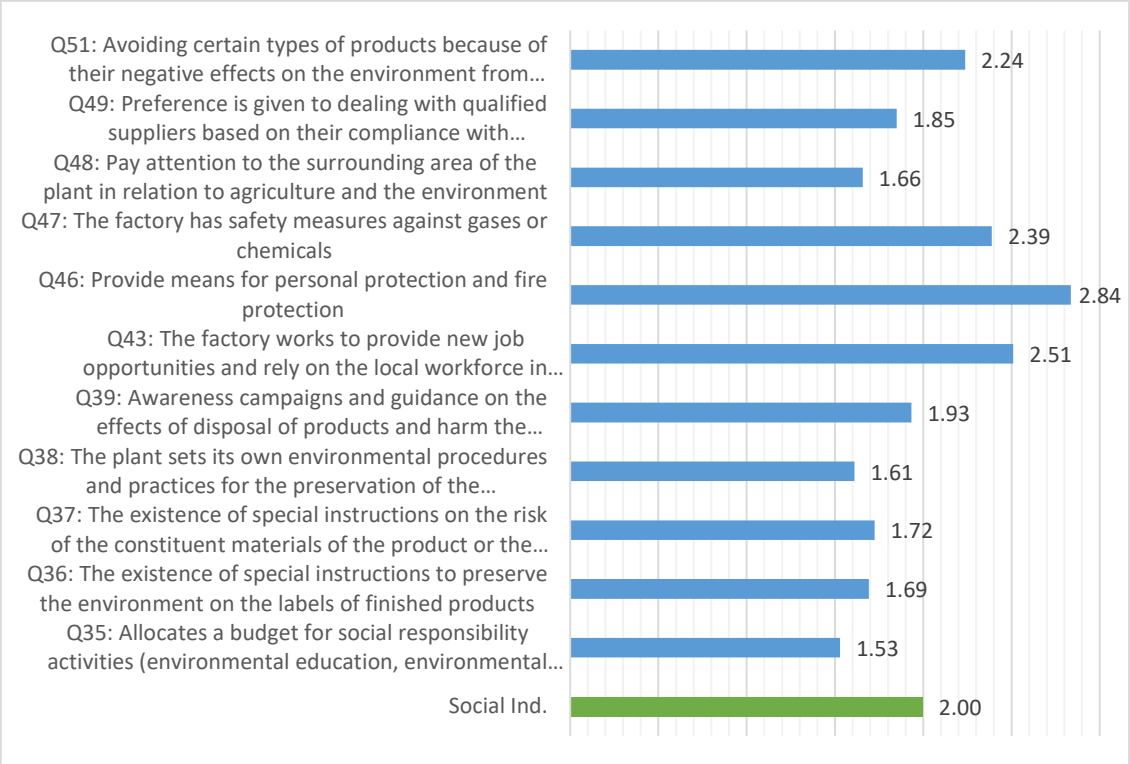

Figure 4.12: Social practices indicator

According to the quantitative estimates for some practices indicating that awareness campaigns for preservation of the environment are very rare, as the maximum number was 6times per year for some plants while the mean value is 0.30 times per year, as most plants didn't implement such campaigns. For annual sponsored projects for environmental conservation, the maximum number was 3 times while the mean value was 0.22.For the

number of conferences and sessions related to GM, 7 times was the maximum per year while most plants attend such sessions once yearly, so the mean value for the whole sample was 1.5.For workers' rights and the number of annual medical tests, the maximum number was 3 times per year, while most plants didn’t take this into consideration as a social practice, this is due to the lack of awareness about the importance of these practices and resulting positive impact on the plants.

The number of accidents due to fires in the factory annually was very low, which is a very good indicator, and the maximum number was 1 per year. While the mean value was 0.20 for gas leakage this was a little bit higher, with the maximum at 2 times per year and a mean value of 0.29, these are excellent indicators

The annual budget for social responsibility activities reached 125,000NIS for some plants who are committed to GM, while a lot of plants did not allocate a budget for this issue, and so the mean value was 6063 NIS.

The number of annual sponsorships or donations to projects that contribute to the preservation of the environment was very low for most plants, with a mean value of 0.41 times and a maximum of 3 times.

The maximum number of qualified suppliers committed to environmental standards was 9, and the mean value was 2.44, which is a good indicator.

The number of new annual jobs provided by the plant to the community was 40, as a maximum value, and a mean value of 10. Table 4.13summarizes the previous results:

Table 4.13: Descriptive analysis for some economic practices in PPP

Practices	Mean	Std. Deviation
Number of annual awareness campaigns implemented regarding the preservation of the environment and the effects of disposal of products on the environment	0.29	1.04
Number of projects sponsored annually for environmental conservation	0.21	0.65
Number of sessions / conferences that were held or attended annually on clean / GM or conservation of environmental resources	0.88	1.53
Number of times workers were examined medically per year	0.72	0.76
The number of accidents due to fires in the factory annually	0.04	0.19
The number of accidents due to leakage of gas or toxic substances annually	0.04	0.28
The percentage of green area surrounding the plant (which belongs to the plant land) to the total area	6.69	11.60
Annual budget for social responsibility activities in NIS	6063.82	21555.94
The number of annual sponsorships or donations to projects contribute to the preservation of the environment	0.40	0.81
Number of qualified suppliers committed to environmental standards who have an environmental policy or are ISO certified to the total number of suppliers in the plant	2.44	1.81
Number of new annual jobs provided by the plant to the community	10.15	9.62

4.4.6 GM Indicator

The previous results on the five main attributes, that together form GM model, are illustrated in Figure 4.13. According to the results shown below, it is clear that the current situation for PPP is within the Brown Zone, which is considered as a medium rating. Only the energy practices are in the beginning of the Gray Zone, which means it has a better rating than the other attributes. The lowest rating was for the resource's practices, which at

1.98 is very close to the Black Zone. Then comes economic practices at 2.02, the social practices at 2.017, and the environmental practices at 2.08, which are all in the Brown Zone. Actions should be taken by the PPP in order to move towards the Gray Zone; this will be achieved by implementing some steps for each practice.

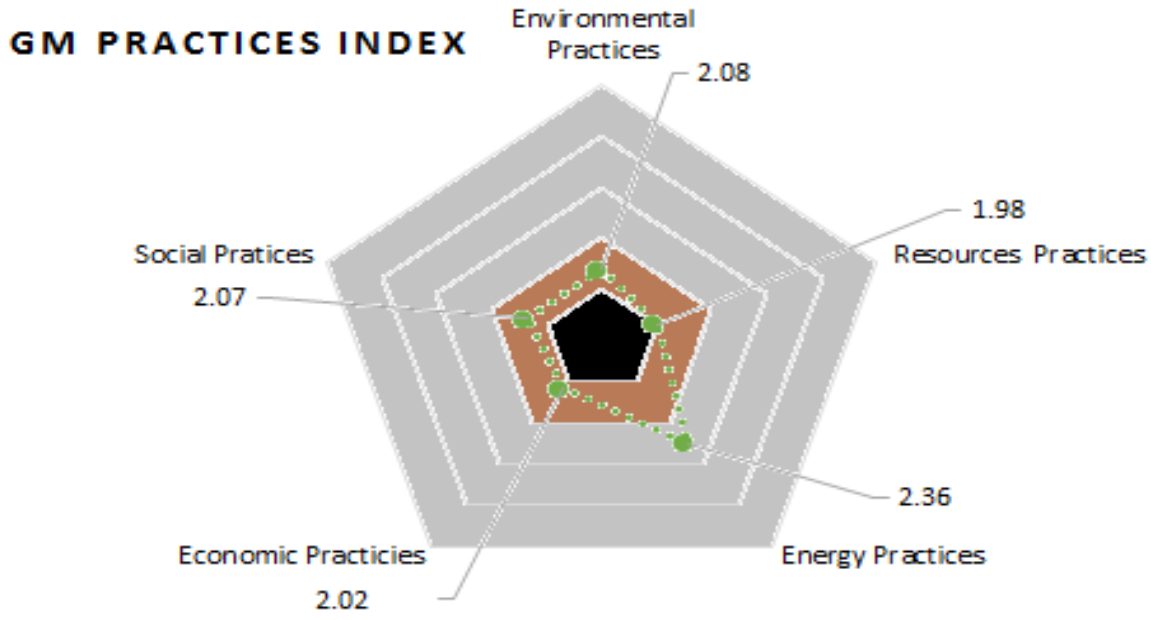

Figure 4.13: GM practices in PPP.

4.5 General Comparison between PPP

Using the results for each attribute, a comparison of the current situation across the whole sample was done in order to see the differences between plants in the West Bank. These results are represented in five different forms, each one showing the results of a specific practice (Environmental, Resources, Economic, Energy, and Social).

Using Figures 4.14 to 4.18, we choose Plant 1, the Royal Plastic Plant in Hebron, as benchmark for our work as it adopts environmental policies and

works with international standards and specifications. Plants 1-33 are in the southern West Bank, then 34-39 are in the middle of West Bank plants (34-39), and 40-49 are in the north.

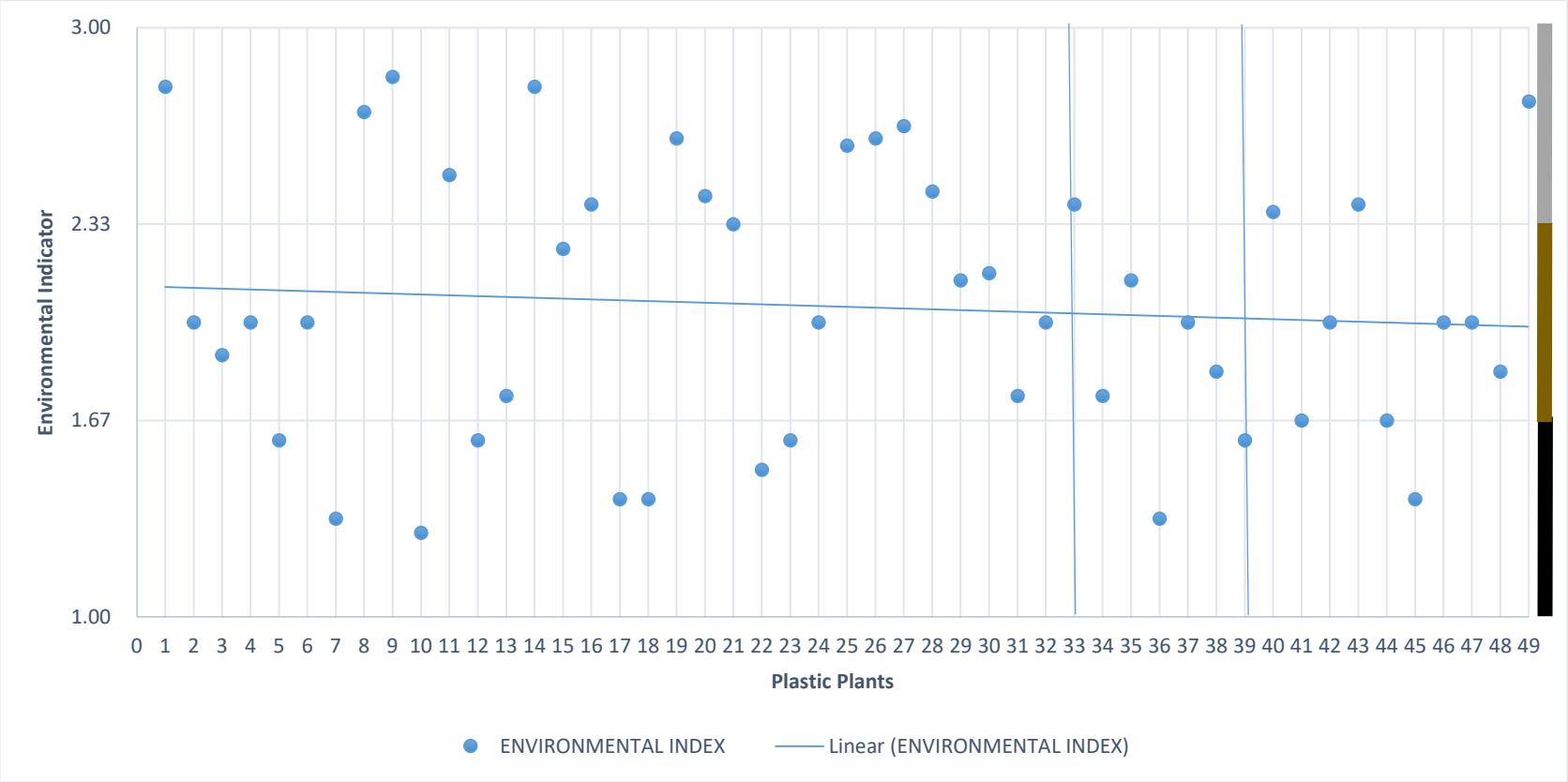

Figure 4.14: Environmental Indicator in Palestinian Plastic Plants Sample

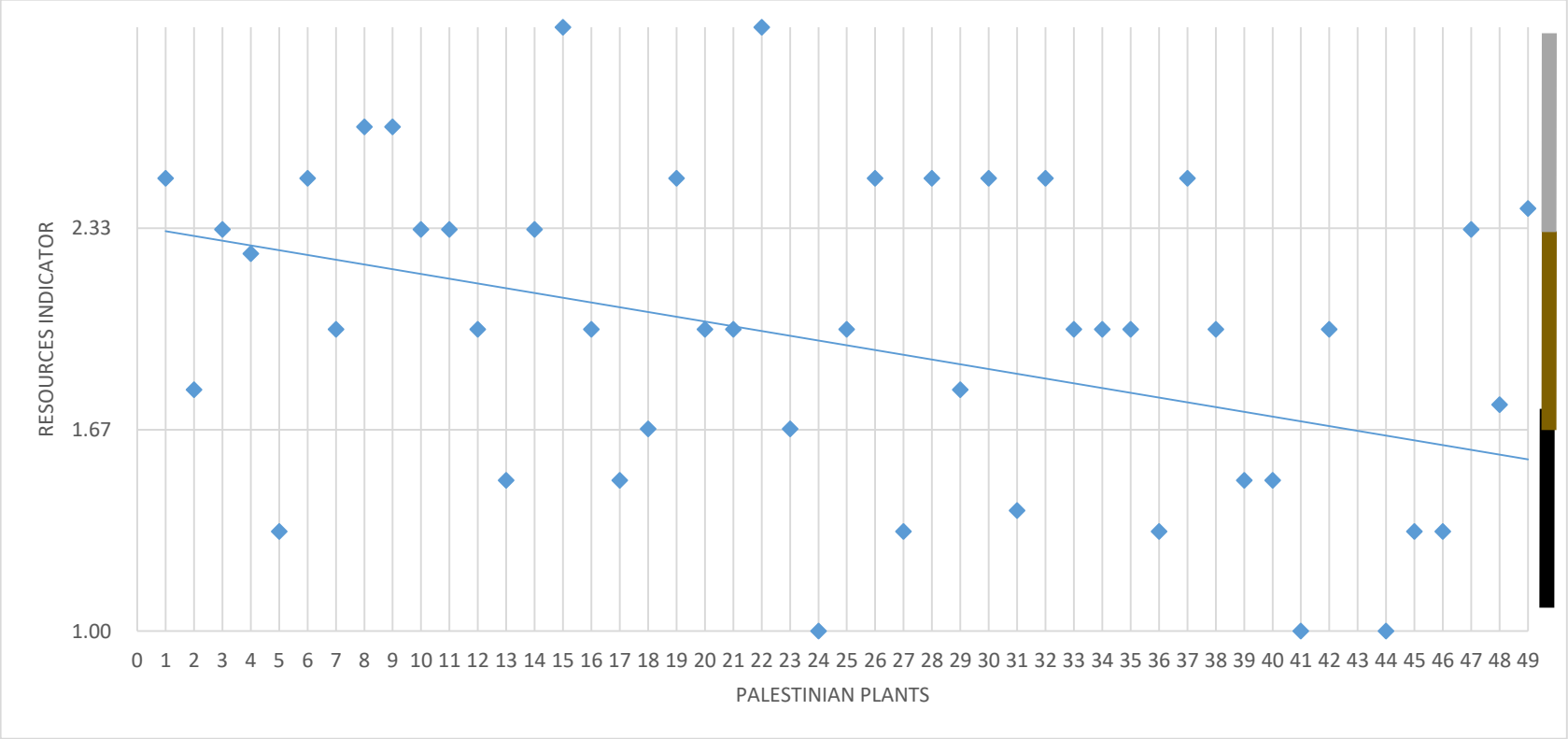

Figure 4.15: Resources Indicator in Palestinian Plastic Plants Sample

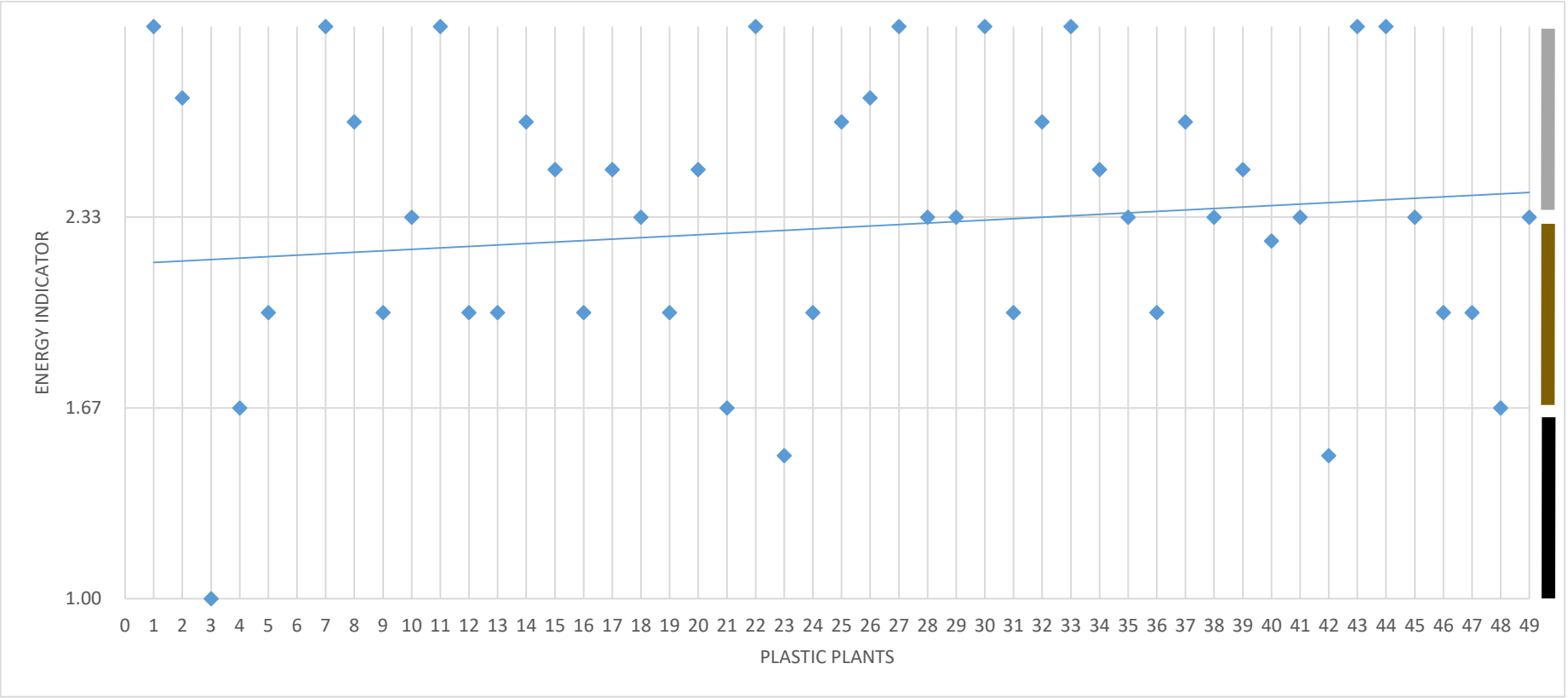

Figure 4.16: Energy Indicator in Palestinian Plastic Plants Sample

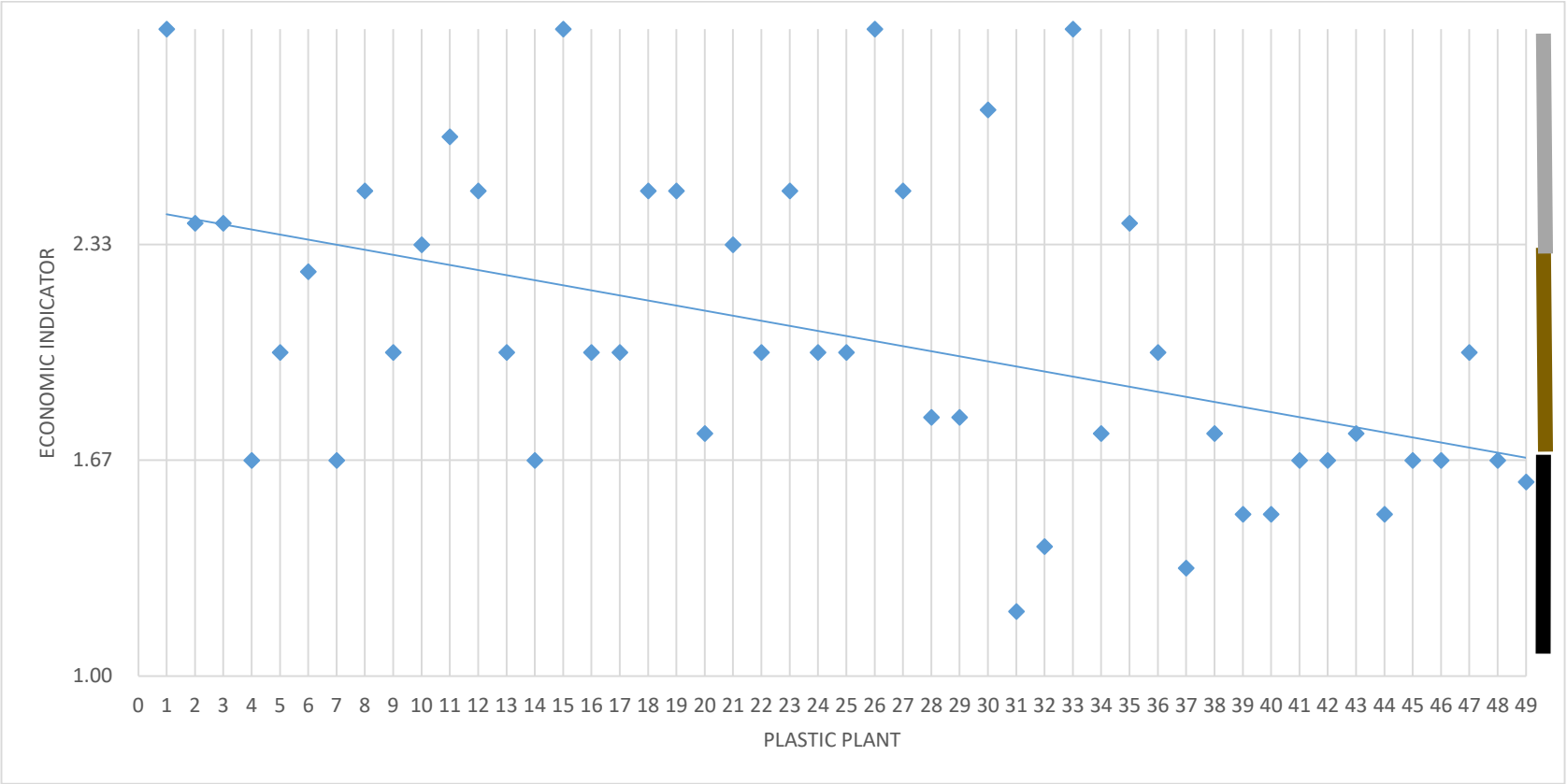

Figure 4.17: Economic Indicator in Palestinian Plastic Plants Sample

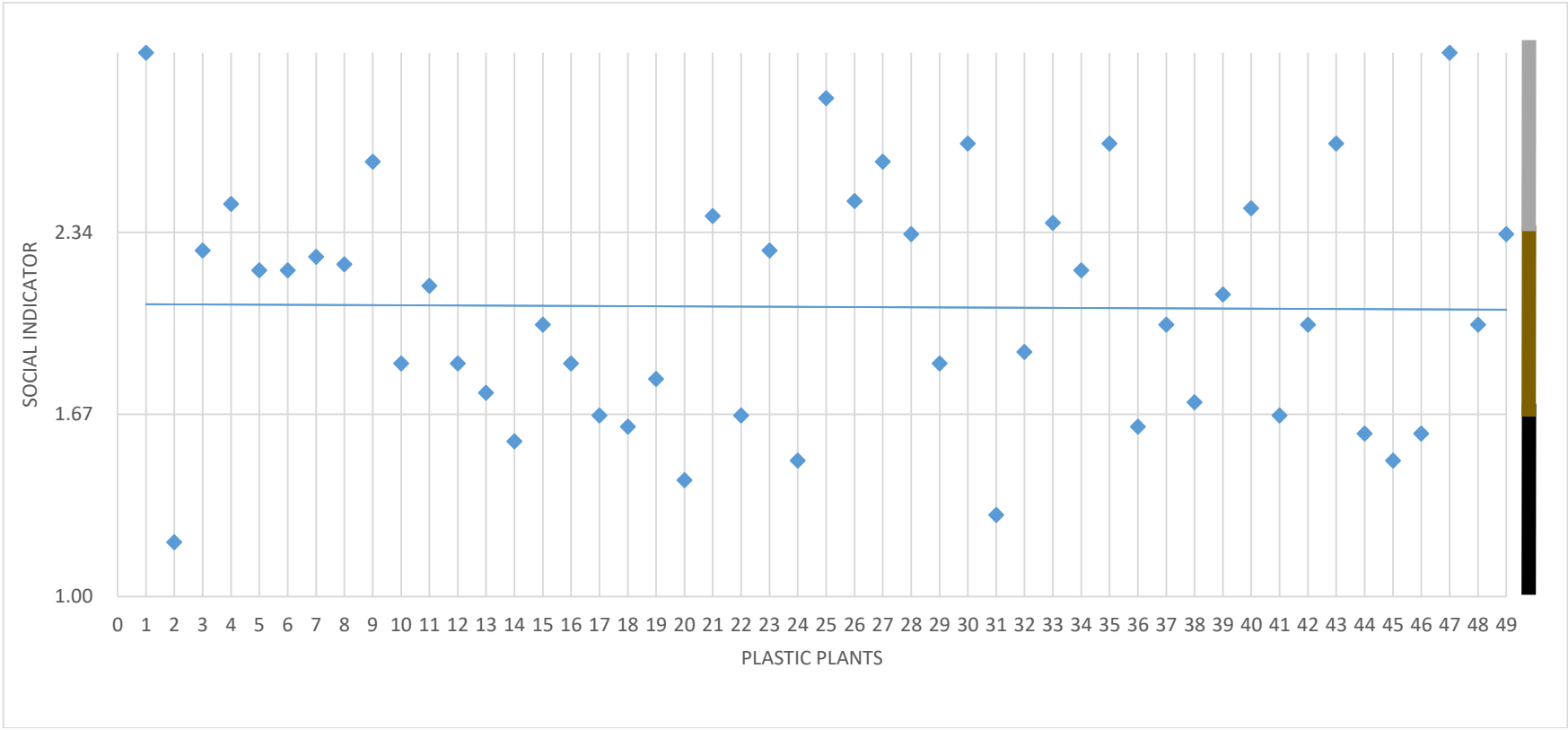

Figure 4.18: Social Indicator in Palestinian Plastic Plants Sample

4.6 GM Planning Stage (Stage 2 of Deif's Model):

In this stage, and after the initial diagnosis of the current situation in PPP, the plan identifies potential factors (indicators) for level improvement across different attributes. The identification of potential indicators is based on the scoring result (zone color), and such a structure will help plastic plants to identify weaknesses and areas for improvement to gradually move from one greenness level to the next. The developed plan will include qualitative and/or quantitative actions.

The reference for the plants will be the Royal Plastic Plant (Plant 1) in the diagnosis study, which was chosen as the national benchmark. The final list of practices was selected as assessment tool, used to diagnose the plant's current situation.

The tool was prepared using a simple Excel sheet, showing all the indicators for each attribute, automatically calculating the scores per attribute and for all attribute. After the assessment, the tool highlights the top priority issues to be improved.

The tool consists of two sheets:

1. A self-assessment tool, including all proposed indicators per attribute, with a summery table for the latest evaluation, which is automatically represented on the graph to show the results. Table 4.14 shows Rank of the practices and relevant quantitative result.

Table 4.14 Rank of the practices and relevant quantitative result

Zone	Quantitative Result	Frequency
Not Applied	**0-0.74**	**Not Applied**
Black	**0.75-1.49**	**Low (L)**
Brown	**1.50-2.24**	**Medium (M)**
Grey	**2.25-3.00**	**High (H)**

2. A GM progress sheet, in this sheet the plant can see the progress in the greenness level at least 3 times for 3 different dates.

   Table 4.14 shows an example from the self-assessment tool. After evaluating the current situation in the plant for each practice in the status columns, the plant's management will prioritize the actions towards GM according to the improvement priority column.

Table 4.15: Self-assessment tool example – Environmental section

#	Sector	Practices	Status				EVALUATION	Improvement Priority
			High	Mid	Low	Not Applied	(1-3)	
1	**Environmental**	Recycling wastes internally or externally				X	0	Top Priority
2		The collaboration between the firm and customers in waste recycling				X	0	Top Priority
3		Waste categorization before disposal			X		1.0	High Priority
4		Avoid Using material classified as sever harmful raw material				X	0	Top Priority
5		The final products are recyclable				X	0	Top Priority
6		Use filters to reduce the emissions of the manufacturing process.			X		1.0	High Priority
7		Monitor water quality internally			X		1.0	High Priority
8		Monitoring wastewater by external bodies				X	0	Top Priority
9		Using recyclable material for packaging	X				3.0	Low Priority
10		Using Environmentally friendly materials such as BPA, recyclable materials…)		x			2.0	Medium Priority

The whole template is presented in Appendix 4 in this thesis

Where:

0: Top Priority

1: High Priority

2: Medium Priority

3: low Priority

4.7 GM Plan Implementation stage (Stage 3 of the Deif's Model):

In this stage, the objective is to define a "to-do-list", to help the plastic plants continuously improve their greenness level by applying a list of actions used in the assessment stage and linking them with the zones (colors) which were defined in our model.

This "to-do-list" is an Excel data sheet, designed after the field visits and meeting the plant representatives who summarized the current practices to implement and sustain GM in their plant, such as in the Royal Plastic Plant in the Hebron governorate, which is ranked as number one according to environmental standards. The greenness level will be improved by implementing the relevant actions identified in this stage; such actions may include process control, recycling, housekeeping, compliance with regulations, adopting new techniques, etc.…, the whole actions will be presented in Appendix 5 in this thesis.

An Excel sheet is prepared to define the proposed actions for each indicator, to be used as guidelines for the plastic plant in order to make it easier for the staff to use as an internal improvement tool. These practices where taken as an input from experts in the field, especially from our benchmark, the Royal Plastic Plant; these practices will help the plants to execute their activities in a more organized matter.

In order to develop the GMS in any plant, the figure 4.19 represents the logical sequence for the improvement sequence in any plant;

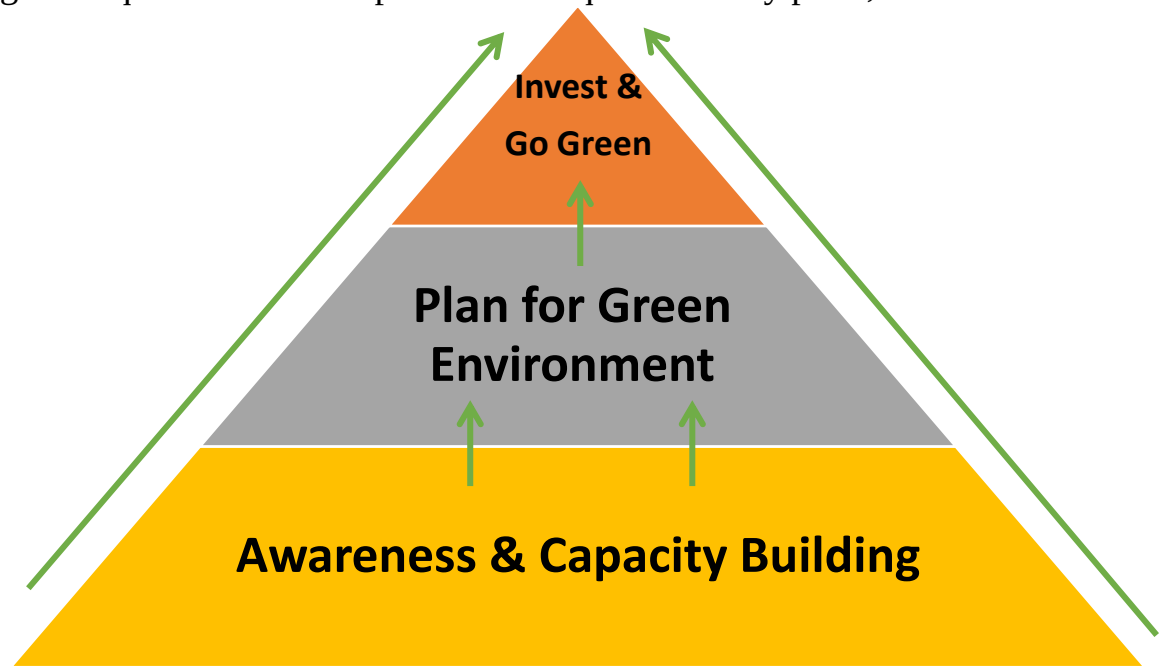

Figure 4.19: Logical Sequence for the Improvement Sequence of GM

The figure contains 3 main levels to develop from level to level, these levels are:

A- Awareness and Capacity building level: this stage will be the base line, this is through investment in Human Resources by raising their awareness and building their capacity in GM concepts and practices, which is classified under the economic practices in our model, logically, it is considered the first step for change and sustainable improvement. When the plant has its own staff aware and ready to lead the process it will be easier to start the change internally and reflect it on the plant's outputs and surrounding environment. Later on, the staff will start the improvement in the practices according to the

prioritization show in the self-assessment tool, these practices are shown in the table 4.16.

Table 4.16: Practices of GM for Awareness and Capacity building level

Attribute	Practices
Economic	Investment in practices related to green manufacturing, including periodic maintenance and training in the application of GM practices
Social	The plant sets its own environmental procedures and practices for the preservation of the environment within a documented and generalized instructions at the plant in the sense of responsibility for preserving the environment
Social	The existence of special instructions on the risk of the constituent materials of the product or the residues of the product on the environment / origin / source / etc
Social	Awareness campaigns and guidance on the effects of disposal of products and harm the environment
Social	Pay attention to the surrounding area of the plant in relation to agriculture and the environment
Resources	Follow a system for monitoring & controlling resources in warehouses to protect chemicals from damage or leakage
Energy	Application of SOPs to contribute to the rationalization of energy consumption by employees
Social	The existence of special instructions to preserve the environment on the labels of finished products
Environment	Waste categorization before disposal
Energy	Optimal utilization of energy in terms of machine running times and idle time

B- Plan for green environment: After working on the previous practices, the plant is ready to move and improve the second group of practices as the concept is already adapted and enhanced through work procedures and environmental policies, these practices are shown in the table 4.17.

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Table 4.17: Practices of GM for the Plan for green environment level

Attribute	Practices
Economic	A plan is drawn up to study potential risks and identify mitigation measures
Social	The factory has safety measures against gases or chemicals
Environment	Monitor water quality internally
Environment	Monitoring wastewater by external bodies
Social	Preference is given to dealing with qualified suppliers based on their compliance with environmental standards or following a specific environmental policy (such as ISO certification)

C- Invest and Go Green: This is the third level of improvement, it depends on the financial capacity of the plant and according to its budget, the plant can invest in one or more of the practices illustrated in the table 4.18

Table 4.18: Practices of GM for the Invest and Go Green level

Attribute	Practices
Environment	Recycling wastes internally or externally
Environment	The collaboration between the firm and customers in waste recycling
Environment	Avoid Using material classified as sever harmful raw material
Environment	Use filters to reduce the emissions of the manufacturing process.
Environment	Using recyclable material for packaging
Environment	Using Environmentally friendly materials such as BPA, recyclable materials…)
Resources	Replacing some material with eco- friendly material
Resources	Using recycled material as an input in the manufacturing process
Resources	Rainwater is collected in reservoirs for the use in the manufacturing process and / or sanitary facilities
Resources	Using treated wastewater in irrigation
Resources	The treated water is re-used in the plant either in the manufacturing process or in the sanitary plant or other facilities
Energy	Use clean energy sources (solar / wind)
Energy	Using developed energy conservation techniques (like LED)
Economic	The plant achieves financial returns as a result of investment in environmental aspects such as the use of alternative energy, waste recycling, wastewater reuse and the use of modern technology
Economic	Enhance the role of the plant in environmental conservation and its use of green manufacturing practices in promoting its brand
Social	Allocates a budget for social responsibility activities (environmental education, environmental conservation, etc.)
Social	The factory works to provide new job opportunities and rely on the local workforce in different operations
Social	Provide means for personal protection and fire protection
Social	Avoiding certain types of products because of their negative effects on the environment from manufacturing waste or materials in the manufacturing process
Economic	The factory did not have to pay fines resulting from violations of environmental standards
Environment	The final products are recyclable

4.8 Sustaining GM implementation stage (Stage 4 of the Deif's Model)

In this stage, the implementation and improvement of GM will be monitored and sustained through various techniques including Greener Manufacturing Polices and Guidelines, Continuous GM Measurement and the proposed self-assessment tool.

4.9 Planning and Development status in PPP in relation to GM Practices

The study included a general assessment of the planning and development practices in plastic plants to see their vision for the future and development relative to GM.

4.9.1 Quality of Plastic Products

The plastic plants evaluated the quality of their products for the last three years in comparison with local competitors. According to their evaluation, 71% of them see that their products over the last three years are higher quality than their competitors, while 29% agreed that they are at a medium level compared with other competitors. Figure 4.20 illustrates this result.

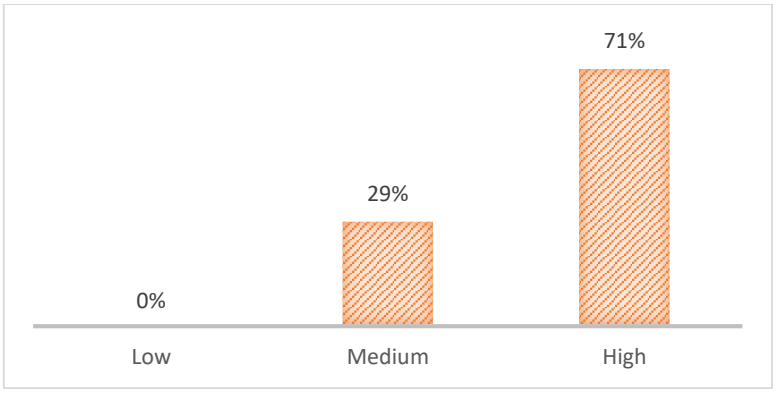

Figure4.20: Quality of products in comparison with competitors

4.9.2 Participation in workshops and conferences related to planning, production development and production processes

As for plastic factories' development of manufacturing through participation in workshops and conferences related to the development of production and the production process, 33% have relatively low participation and 24% do not participate in any of these workshops. Only 14% are highly participatory in development activities while29% are at a medium level, as shown in Figure 4.21, due to lack of awareness about the importance of these activities.

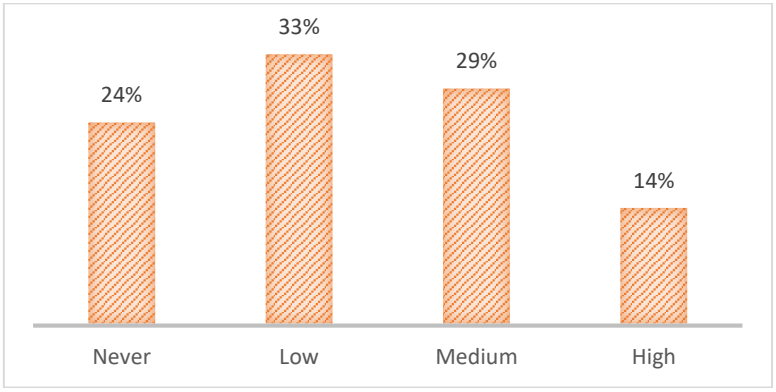

Figure 4.21: Participating in International and National Conferences and workshops for Manufacturing Process Development

4.9.3 Application of governmental legislation system for the protection of the environment

Regarding to compliance of plastic plants in the West Bank with local legislation and laws; the results showed that 57% of the sample are very committed to this legislation, while 33% are committed to it in an average manner, 2% are committed to it slightly, and 8% admitted that they never commit to these legislations. Figure 4.22 shows the previous results.

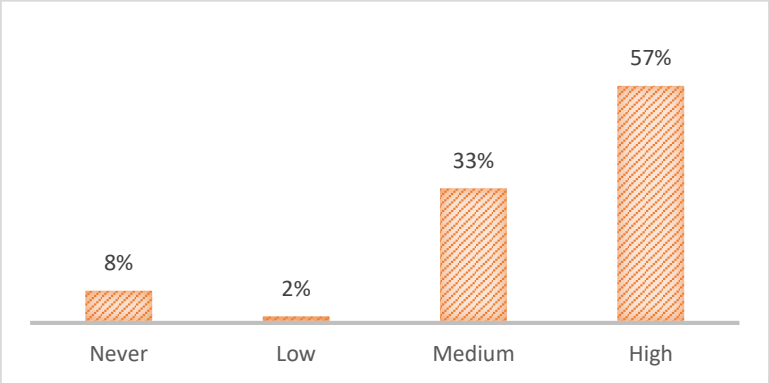

Figure 4.22: Application of governmental legislation

It is noted that the largest proportion was the category who applied government legislation with rank High by 57%, because of the government's sanctions on plants that do not comply with this legislation

4.9.4 Relying on research and development in designing and launching new products for the market

Regarding the plants' future vision based on research and development in the design and introduction of new products for the market, the results showed that 33% of the sample depends on this strategy, 31% depends

somewhat on this strategy, while 16% of the PPP admitted that they don't depend on research and development very much. Also, 20% of PPP have not conducted any studies or research. These results are illustrated in Figure 4.23.

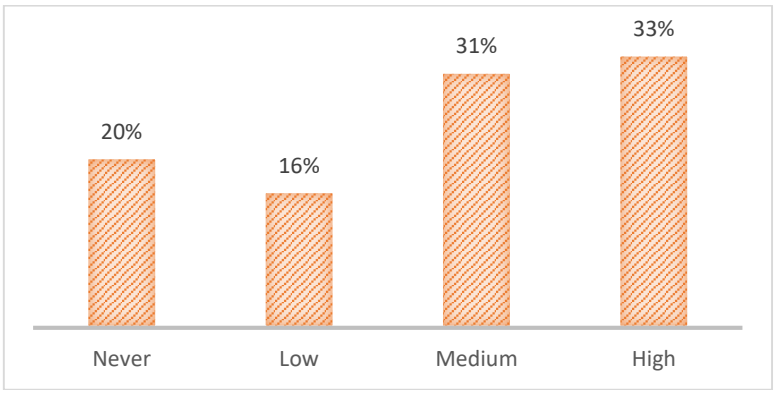

Figure 4.23: Relying on research and development for future product planning

4.9.5 Awareness level of the principles of GM between the owners or managers of the plants

As for awareness and knowledge about the principles of GM, the results showed that the knowledge is very low in this area with 33% having no idea about GM practices and 27% knowing little, this is due to lack of knowledge and awareness of the principles of GM and its positive effects on factories, while 40% showed that their knowledge was high or medium. Figure 4.24 illustrates these results.

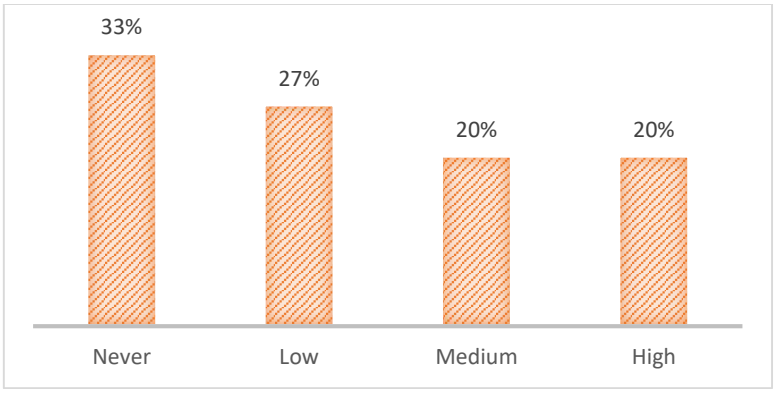

Figure 4.24: Awareness levels of GM principles.

4.9.6 Adopting GM practices based on awareness of its positive effects

Based on the current knowledge about the principle of GM, the top management was asked about the willingness to adapt these practices based on the awareness of its positive impact internally and on the externally. The results showed that 45% did not apply any of the principles of GM, and 24% apply it in a little manner. Note that these answers are based on their current knowledge and awareness about the GM principles and impact. On the other hand, 30% Showed that they applied what they knew either in a high manner or somehow. These percentages are considered medium to low and indicate the lack of knowledge and application of green environmental practices in plastic plants in the West Bank and these results clarifies the weaknesses in adapting some practices that were evaluated previously. Figure 4.25 shows these results.

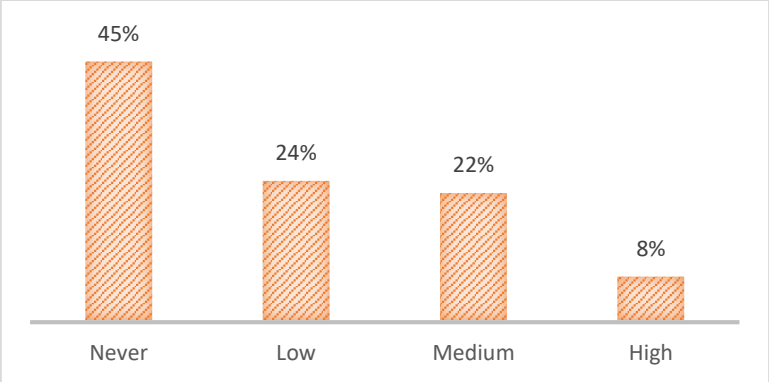

Figure 4.25: Adopting GM practices by the PPP.

4.9.7 The willingness to invest in the principle of GM

The top management of the PPP were asked about their willingness to adopt and invest in GM principle and practices; the results of the study showed that 31% of these plants do not want to adopt the principles of GM, while 24% expressed a low willingness to know more and adopt these principles. On the other hand, 22% of respondents expressed a high willingness and 22% expresses a moderate willingness. That is, 44% of the sample showed a good willingness to adopt GM principles. This ratio is relatively good since the impact of these principles is not tangible on the ground in many plants, the recommendation here is to increase awareness of the positive effects of GM on factories. Figure 4.26 shows these results.

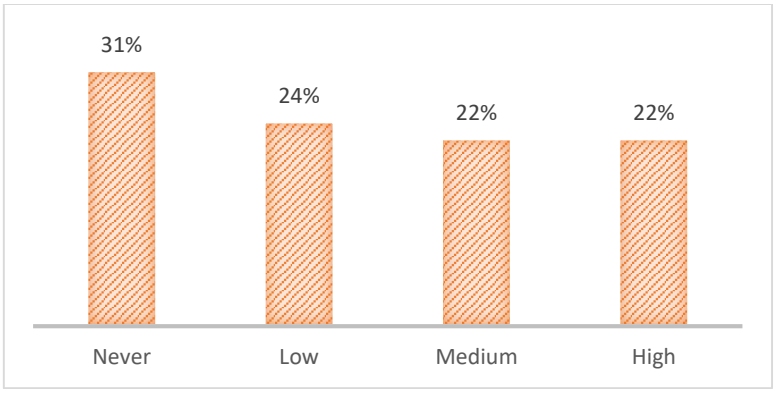

Figure 4.26: The willingness to invest and adopt the principles of GM.

4.9.8 Availability of human resources to implement GM practices

Looking at the readiness of PPP to adopt the principles of GM (in terms of the human resources and skills), the results showed that 20% have a high readiness and 27% have a medium readiness to adopt this concept, while 20% indicated that their readiness is low and 33% they did not have the skills to apply GM principles, This is also due to lack of knowledge and experience in the field of GM, and the lack of highly qualified human resources to implement these practices in plants. Figure 4.27 shows these results.

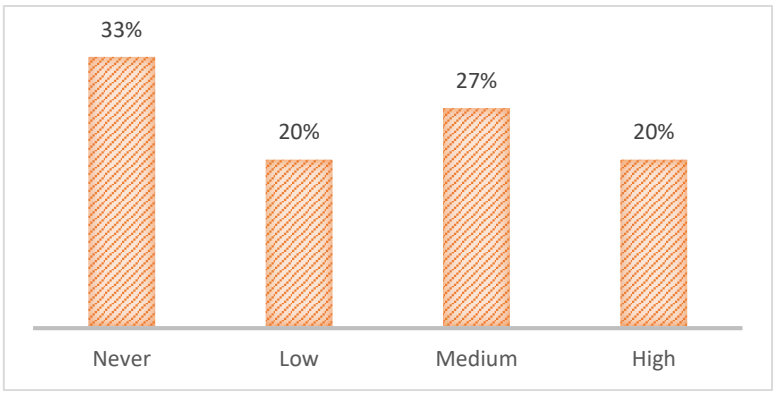

Figure 4.27: Availability of human resources to implement GM practices.

4.9.9 Availability of financial resources to implement GM practices

For the financial readiness of PPP to adopt the principles of GM, the results showed that 16% have a high readiness and 27% have a medium readiness to invest in this area. On the other hand, 33% indicated that their readiness is low and 24% indicated that they didn't have the financial resources to enable them to apply GM principles, this is due to the high cost required by some GM practices. Figure 4.28 shows these results.

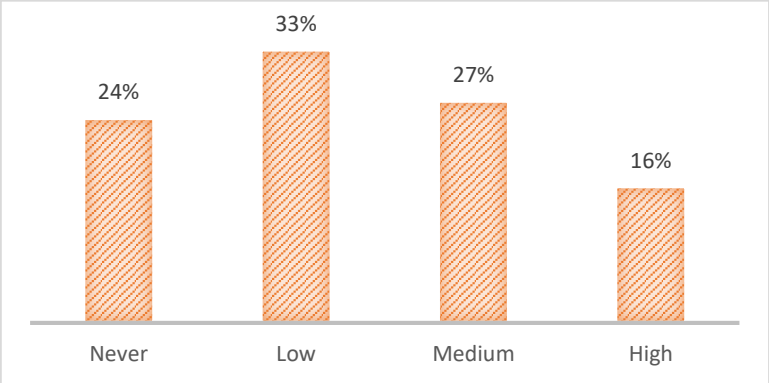

Figure 4.28: Availability of financial resources to implement GM practices

4.9.10 Contribution of GM practices to increasing market share

For the market share impact, the results indicated that 39% expected a normal increase, 29% expected a significant increase, due to their awareness of the importance of applying such practices in their plants, and 27% expected a low increase while 6% said that there would be no effect, due to the lack of awareness of the positive effects of these practices on the increase of market share. Figure 4.29 illustrates these results.

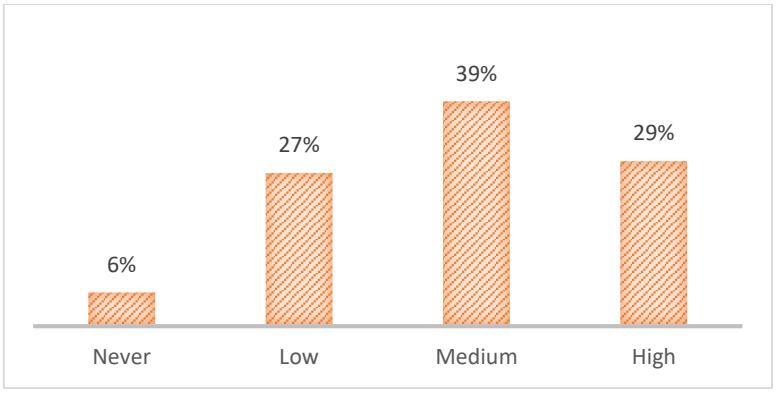

Figure 4.29: The expected effect of GM practices on the market share of the plant.

4.9.11 Contribution of GM practices to reducing the cost of production

In terms of reducing production costs, the belief was higher as 51% strongly believed that this principle will reduce production costs, 39% somewhat believed that adopting this principle will reduce the production costs, also due to their awareness of the importance of applying such practices in their plants, 8% had a low estimation of the impact and 2% said that there will be no change, also due to the lack of awareness of the positive effects of these practices on the reduce production costs. Figure 4.30 illustrates the results.

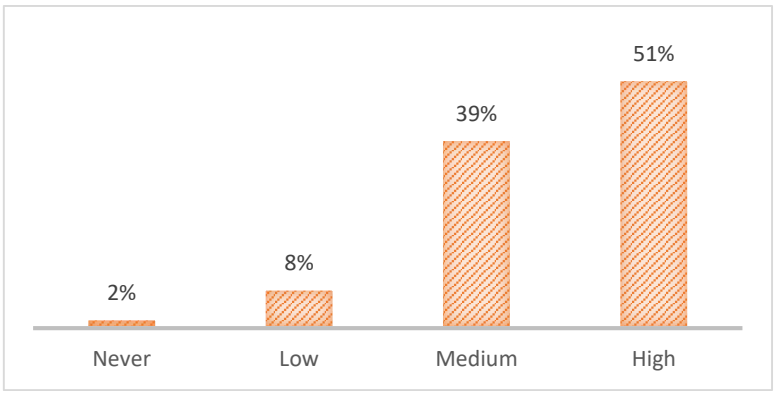

Figure4.30: The expected effect of GM practices on decreasing production costs.

4.9.12 Give tax exemption with GM practice as encouraging incentives from the government

As for the plants' expectations of the government encouraging incentives for those committed to the principles of green processing, the results showed that 55% did not expect anything from the government, due to the laws imposed by the government on plants in various industries, 22% said there may be some incentives, 14% think the encouragement will be high and 8% have a moderate expectation. Figure 4.31 illustrates these results. The recommendation here is to invite the government and donors to support this sector to help it move towards GM.

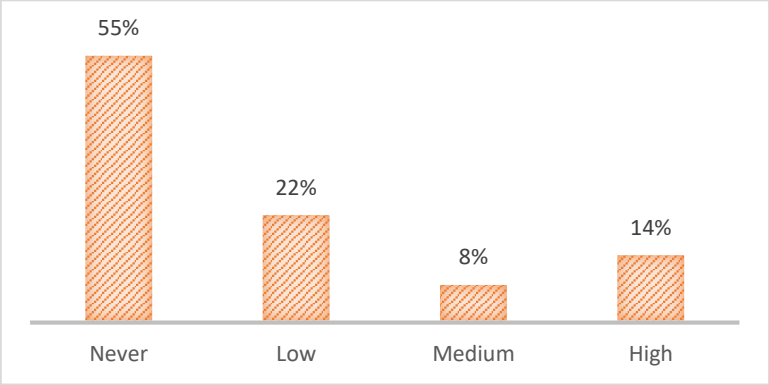

Figure 4.31: Expectations of government incentives for GM application.

4.10 Hypotheses Tests

4.10.1 Analysis of Variance – ANOVA

In the hypothesis analysis for GM indicators in the PPP, their relationship with several factors was studied as follows:

1. **Geographical Area**

   For the correlation between the geographical area (north, middle and south of the West Bank) and the general GM indicator, the following Hypotheses were made:

   - Null Hypothesis: there are no differences between the communities in the north, middle, and south, in terms of GM practices.
   - Alternative Hypothesis: there are at least two unequal communities.

   From Table 4.19 one can note that the significance=0.67, which is greater than 0.05, so we will accept the Null Hypothesis which indicates that all communities have an equal mean, and that if there is any difference it has no statistical significance.

Table 4.19: ANOVA test for graphical area

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.512	2	.256	2.864	.067
Within Groups	4.115	46	.089		
Total	4.628	48			

2. **The Number of Employees**

   For the correlation between the number of employees in the plastic plants and General GM Indicator, the following two assumptions were made:

   - Null Hypothesis: there are no differences between the employee's groups in terms of GM practices,

- Alternative Hypothesis: there are at least two unequal means of employee's groups.

From Table 4.20 one can note that the sig=0.566, which is greater than 0.05, so we will accept the Null Hypothesis which indicates that all ranges have equal means, and if there is any difference it has no statistical significance.

Table 4.20: ANOVA test for the number of employees

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.113	2	.056	.576	.566
Within Groups	4.515	46	.098		
Total	4.628	48			

3. The Number of Engineers

To see the correlation between the number of engineers in the plastic plants and the GM indicator the following two assumptions were made:

- Null Hypothesis: there are no differences between the averages of different engineer's groups in the plant in terms of GM practices.
- Alternative Hypothesis: there are at least two unequal engineer's groups.

Table 4.21: ANOVA test for the number of engineers

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.902	3	.301	3.631	.020
Within Groups	3.726	45	.083		
Total	4.628	48	.301		

From Table 4.21 one can note that the sig=0.02, which is less than 0.05, so we will reject the Null Hypothesis, which indicates that all groups have equal ranges, and we accept the Alternative Hypothesis, which indicates that at least two ranges have different means and that these differences are statistically significant.

We can see in Table 4.22 that as the number of engineers increases, it positively increases the GM index.

Table 4.22: Multiple Comparisons for the number of engineers

Number of Eng. (I)	Number of Eng. (J)	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
No Eng.	(1-2)	-.10391-	.09012	1.000	-.3526-	.1448
	(3-5)	-.36291-	.13475	.059	-.7348-	.0090
	(More than 5)	-.48909-	.21391	.162	-1.0795-	.1013
(1-2)	No Eng.	.10391	.09012	1.000	-.1448-	.3526
	(3-5)	-.25900-	.13253	.341	-.6248-	.1068
	(More than 5)	-.38518-	.21252	.460	-.9717-	.2014
(3-5)	No Eng.	.36291	.13475	.059	-.0090-	.7348
	(1-2)	.25900	.13253	.341	-.1068-	.6248
	(More than 5)	-.12618-	.23495	1.000	-.7746-	.5223
(More than 5)	No Eng.	.48909	.21391	.162	-.1013-	1.0795
	(1-2)	.38518	.21252	.460	-.2014-	.9717
	(3-5)	.12618	.23495	1.000	-.5223-	.7746

- All significance level for all groups are greater than 0.05, and all confidence intervals for all pairs of means (lower bound –upper bound)

all include zero, which indicates that the differences are not statistically significant.

4. **Establishment Year**

To see the correlation between the GM indicator and establishment year of the plastic plants, the following two assumptions were made.

- Null Hypothesis: there are no differences between the ranges of establishment year and GM practices.
- Alternative Hypothesis: there are at least two unequal ranges of years with the terms of GM practices

From Table 4.23 one can note that the sig=0.220, which is greater than 0.05, so we will accept the Null Hypothesis which indicates that all groups have equal means, and if there is any difference it has no statistical significance.

Table 4.23: ANOVA test for establishment year

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.411	3	.137	1.529	.220
Within Groups	3.946	44	.090		
Total	4.357	47			

5. **The registration type in the MONE**

To see the correlation between the GM indicator and registration type in the Ministry of National Economy for the plastic plants the following two assumptions were made.

- Null Hypothesis: there are no differences between the means of different registration type with the GM practices.
- Alternative Hypothesis: there are at least two unequal registration type in terms of GM practices.

From Table 4.24 one can note that the sig=0.162, which is greater than 0.05, so we will accept the Null Hypothesis which indicates that all groups have equal mean, and if there is any difference it has no statistical significance.

Table 4.24: ANOVA test for registration type in the MONE

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.350	2	.175	1.894	.162
Within Groups	4.152	45	.092		
Total	4.501	47			

6. Working Time (shifts) in the PPP

To see the correlation between the GM indicator and working hours in the PPP, the following two assumptions were made:

- Null Hypothesis: there are no differences between the means of different working shifts in terms of GM practices.
- Alternative Hypothesis: there are at least two unequal means of the working shifts in terms of GM practices.

From Table 4.25 one can note that the sig=0.014 which is less than 0.05, so we will reject the Null Hypothesis, which indicates that all groups have equal mean, and we will accept the Alternative Hypothesis, which

indicates that at least two groups have different means and that these differences are statistically significant.

Table 4.25: ANOVA test for working time (shifts) in PPP

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.786	2	.393	4.704	.014
Within Groups	3.842	46	.084		
Total	4.628	48			

We can see in Table 4.26that as the number of working hours' increases, the GM indicator increases.

Table 4.26: Multiple Comparisons for working time (shifts) in PPP.

(I) Working hours	(J) Working hours	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
One Shift	Two Shifts	.00222	.11398	1.000	-.2810-	.2854
	Three shifts	-.25446-	.11104	.080	-.5304-	.0214
Two Shifts	One Shift	-.00222-	.11398	1.000	-.2854-	.2810
	Three shifts	-.25668-*	.09283	.024	-.4873-	-.0260-
Three shifts	One Shift	.25446	.11104	.080	-.0214-	.5304
	Two Shifts	.25668*	.09283	.024	.0260	.4873

- The confidence interval for the difference between the means of (Three shifts – Two shifts) is (0.0260-0.4873). This range does not include zero, which indicates that the difference is statistically significant.

- The confidence intervals for the remaining pairs of means all include zero, which indicates that the differences are not statistically significant.

Chapter Five

Model Simulation

5.1 Model Simulation

The assessment tool was used to assess the current GM situation for Plant #37 in the study; the evaluation was tabulated using the self-assessment tool and, as shown in Appendix4, the GM result is presented in the figure5.32, which shows good energy and resources practices. On the other hand, economic practices need more work to be greener, then come the social practices and environmental practices.

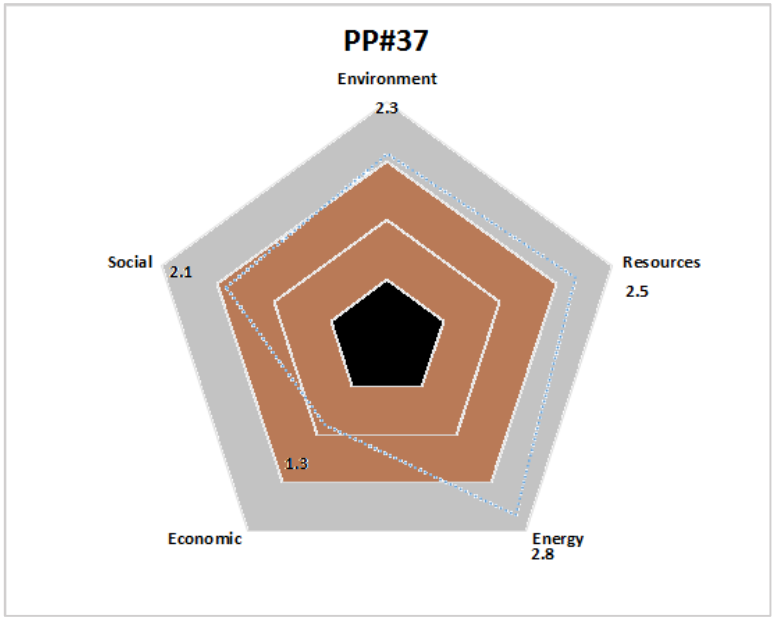

Figure 5.32: GM Indicators for Plastic Plant 37.

The assessment tool prioritizes the practices for improvement, it explains the plant's role and summarizes the actions to be taken during a certain

period of time in order to gradually move from one level to another in the GM model.

The decision for improvement should be studied based on financial and human resources capacities, taking into consideration the logical sequence of actions and the interactions between different practices. For example, using the treated wastewater in irrigation will improve the resources indicator and the environmental indicator.

Table 5.26 shows the diagnosis results for Plant #37 using the self-assessment tool, indicating the practices that are at good levels, the others that need to be re-assessed, and the plans for improvement to be put in place.

Table 5.26: Self-assessment tool 1 for a plastic plant #37

#	Sector	Practices	Status				Evaluation	Improvement Priority
			High	Mid	Low	Doesn't exist	(1-3)	
1	**Environmental**	Recycling wastes internally or externally	X				3.0	Low Priority
2		The collaboration between the firm and customers in waste recycling	X				3.0	Low Priority
3		Waste categorization before disposal			X		1.0	High Priority
4		Avoid Using material classified as sever harmful raw material		X			2.0	Medium Priority
5		The final products are recyclable	X				3.0	Low Priority
6		Use filters to reduce the emissions of the manufacturing process.		X			2.0	Medium Priority
7		Monitor water quality internally				X	0	Top Priority
8		Monitoring wastewater by external bodies				X	0	Top Priority
9		Using recyclable material for packaging				X	0	Top Priority
10		Using Environmentally friendly materials such As BPA, recyclable materials…)				X	0	Top Priority
Environmental Practices Indicator							**1.40**	
11	**Resources**	Replacing some material with eco- friendly material	X				3.0	Low Priority
12		Using recycled material as an input in the manufacturing process				X	0	Top Priority

#	Sector	Practices	Status				Evaluation	Improvement Priority
			High	Mid	Low	Doesn't exist	(1-3)	
13		Follow a system for monitoring & controlling resources in warehouses to protect chemicals from damage or leakage		X			2.0	Medium Priority
14		Rainwater is collected in reservoirs for the use in the manufacturing process and / or sanitary facilities				X	0	Top Priority
15		Using treated wastewater in irrigation				X	0	Top Priority
16		The treated water is re-used in the plant either in the manufacturing process or in the sanitary plant or other facilities				X	0	Top Priority
Resources Practices Indicator							**0.80**	
12	**Energy**	Optimal utilization of energy in terms of machine running times and idle time	X				3.0	Low Priority
13		Use clean energy sources (solar / wind)	X				3.0	Low Priority
14		Using developed energy conservation techniques (like LED)	X				3.0	Low Priority
15		Application of SOPs to contribute to the rationalization of energy consumption by employees		X			2.0	Medium Priority
Energy Conservation Practices Indicator							**2.8**	

#	Sector	Practices	Status				Evaluation	Improvement Priority
			High	Mid	Low	Doesn't exist	(1-3)	
17	**Economic**	The factory did not have to pay fines resulting from violations of environmental standards		X			2.0	Medium Priority
18		The plant achieves financial returns as a result of investment in environmental aspects such as the use of alternative energy, waste recycling, wastewater reuse and the use of modern technology				X	0	Top Priority
19		Enhance the role of the plant in environmental conservation and its use of GM practices in promoting its brand				X	0	Top Priority
20		A plan is drawn up to study potential risks and identify mitigation measures			X		1.0	High Priority
21		Investment in other practices related to green manufacturing, including periodic maintenance and training in the application of GM practices			X		1.0	High Priority
Economic Practices Indicator							0.80	
24	**Social**	Allocates a budget for social responsibility activities (environmental education, environmental conservation, etc.)				X	0	Top Priority
25		The existence of special instructions to preserve the environment on the labels of finished products				X	0	Top Priority

#	Sector	Practices	Status				Evaluation	Improvement Priority
			High	Mid	Low	Doesn't exist	(1-3)	
26		The existence of special instructions on the risk of the constituent materials of the product or the residues of the product on the environment / origin / source / etc		X			2.0	Medium Priority
27		The plant sets its own environmental procedures and practices for the preservation of the environment within a documented and generalized instructions at the plant in the sense of responsibility for preserving the environment		X			2.0	Medium Priority
28		Awareness campaigns and guidance on the effects of disposal of products and harm the environment			X		1.0	High Priority
29		The factory works to provide new job opportunities and rely on the local workforce in different operations	X				3.0	Low Priority
30		Provide means for personal protection and fire protection	X				3.0	Low Priority
31		The factory has safety measures against gases or chemicals			X		1.0	High Priority
32		Pay attention to the surrounding area of the plant in relation to agriculture and the environment				X	0	Top Priority

#	Sector	Practices	Status				Evaluation	Improvement Priority
			High	Mid	Low	Doesn't exist	(1-3)	
33		Preference is given to dealing with qualified suppliers based on their compliance with environmental standards or following a specific environmental policy (such as ISO certification)	X				3.0	Low Priority
34		Avoiding certain types of products because of their negative effects on the environment from manufacturing waste or materials in the manufacturing process				X	0	Top Priority
Social Practices Indicator							**1.40**	
GM Index							**1.40**	

In order to develop the GMS in Plant #37, it is noted that the survey results for this plant was clear that the top management haven't enough information and details about the benefit of the GM impact on the production cost and marketing which will effect on the market share; on the other hand, they agreed that they have a strong financial capacity to adapt the concept and qualified personnel. The starting point would be from the investment in the personnel and the change would be at the first level as shown in the table 5.27. Note that the answer by Black Cross (X) means that the answer before improvement level, and the answer by Red Cross (X) means that the answer after improvement level.

Table 5.27 Self-assessment tool 2 after improvement

#	Sector	Practices	Status				Evaluate	Improvement Priority
			High	Mid	Low	Doesn't exist	(1-3)	
1	**Environmental**	Recycling wastes internally or externally	X				3.0	Low Priority
2		The collaboration between the firm and customers in waste recycling	X				3.0	Low Priority
3		Waste categorization before disposal	X		X		3.0	Low Priority
4		Avoid Using material classified as sever harmful raw material		X			2.0	Medium Priority
5		The final products are recyclable	X				3.0	Low Priority
6		Use filters to reduce the emissions of the manufacturing process.		X			2.0	Medium Priority
7		Monitor water quality internally				X	0	Top Priority
8		Monitoring wastewater by external bodies				X	0	Top Priority
9		Using recyclable material for packaging				X	0	Top Priority
10		Using Environmentally friendly materials such As BPA, recyclable materials…)				X	0	Top Priority
Environmental Practices Indicator							**1.60**	
11	**Resources**	Replacing some material with eco- friendly material	X				3.0	Low Priority
12		Using recycled material as an input in the manufacturing process				X	0	Top Priority

#	Sector	Practices	Status				Evaluate	Improvement Priority
			High	Mid	Low	Doesn't exist	(1-3)	
13		Follow a system for monitoring & controlling resources in warehouses to protect chemicals from damage or leakage	X	X			3.0	Low Priority
14		Rainwater is collected in reservoirs for the use in the manufacturing process and / or sanitary facilities				X	0	Top Priority
15		Using treated wastewater in irrigation				X	0	Top Priority
16		The treated water is re-used in the plant either in the manufacturing process or in the sanitary plant or other facilities				X	0	Top Priority
Resources Practices Indicator							**1.00**	
12	**Energy**	Optimal utilization of energy in terms of machine running times and idle time	X				3.0	Low Priority
13		Use clean energy sources (solar / wind)	X				3.0	Low Priority
14		Using developed energy conservation techniques (like LED)	X				3.0	Low Priority
15		Application of SOPs to contribute to the rationalization of energy consumption by employees	X	X			3.0	Medium Priority
Energy Conservation Practices Indicator							**3.0**	

#	Sector	Practices	Status				Evaluate	Improvement Priority
			High	Mid	Low	Doesn't exist	(1-3)	
17	**Economic**	The factory did not have to pay fines resulting from violations of environmental standards	X				3.0	Low Priority
18		The plant achieves financial returns as a result of investment in environmental aspects such as the use of alternative energy, waste recycling, wastewater reuse and the use of modern technology				X	3.0	Low Priority
19		Enhance the role of the plant in environmental conservation and its use of GM practices in promoting its brand				X	2.0	Medium Priority
20		A plan is drawn up to study potential risks and identify mitigation measures			X		2.0	Medium Priority
21		Investment in other practices related to green manufacturing, including periodic maintenance and training in the application of GM practices	X		X		3.0	Low Priority
Economic Practices Indicator							2.6	
24	**Social**	Allocates a budget for social responsibility activities (environmental education, environmental conservation, etc.)				X	0	Top Priority

#	Sector	Practices	Status				Evaluate	Improvement Priority
			High	Mid	Low	Doesn't exist	(1-3)	
25		The existence of special instructions to preserve the environment on the labels of finished products	X			X	3.0	Top Priority
26		The existence of special instructions on the risk of the constituent materials of the product or the residues of the product on the environment / origin / source / etc	X	X			3.0	Medium Priority
27		The plant sets its own environmental procedures and practices for the preservation of the environment within a documented and generalized instructions at the plant in the sense of responsibility for preserving the environment	X	X			3.0	Medium Priority
28		Awareness campaigns and guidance on the effects of disposal of products and harm the environment	X		X		3.0	Low Priority
29		The factory works to provide new job opportunities and rely on the local workforce in different operations	X				3.0	Low Priority
30		Provide means for personal protection and fire protection	X				3.0	Low Priority

#	Sector	Practices	Status				Evaluate	Improvement Priority
			High	Mid	Low	Doesn't exist	(1-3)	
31		The factory has safety measures against gases or chemicals	X		X		3.0	Low Priority
32		Pay attention to the surrounding area of the plant in relation to agriculture and the environment	X			X	3.0	Top Priority
33		Preference is given to dealing with qualified suppliers based on their compliance with environmental standards or following a specific environmental policy (such as ISO certification)	X				3.0	Low Priority
34		Avoiding certain types of products because of their negative effects on the environment from manufacturing waste or materials in the manufacturing process				X	0	Top Priority
Social Practices Indicator							**2.7**	
GM Index							**2.18**	

Note that all practices in yellow color are practices of the first step of the improvement process (Awareness and capacity building level), which have been developed from level to level. By comparing the results in the first assessment and the second based on the assumption of building the capacity of the staff to implement the GM practices the expected result would be as shown in the figure5.33.

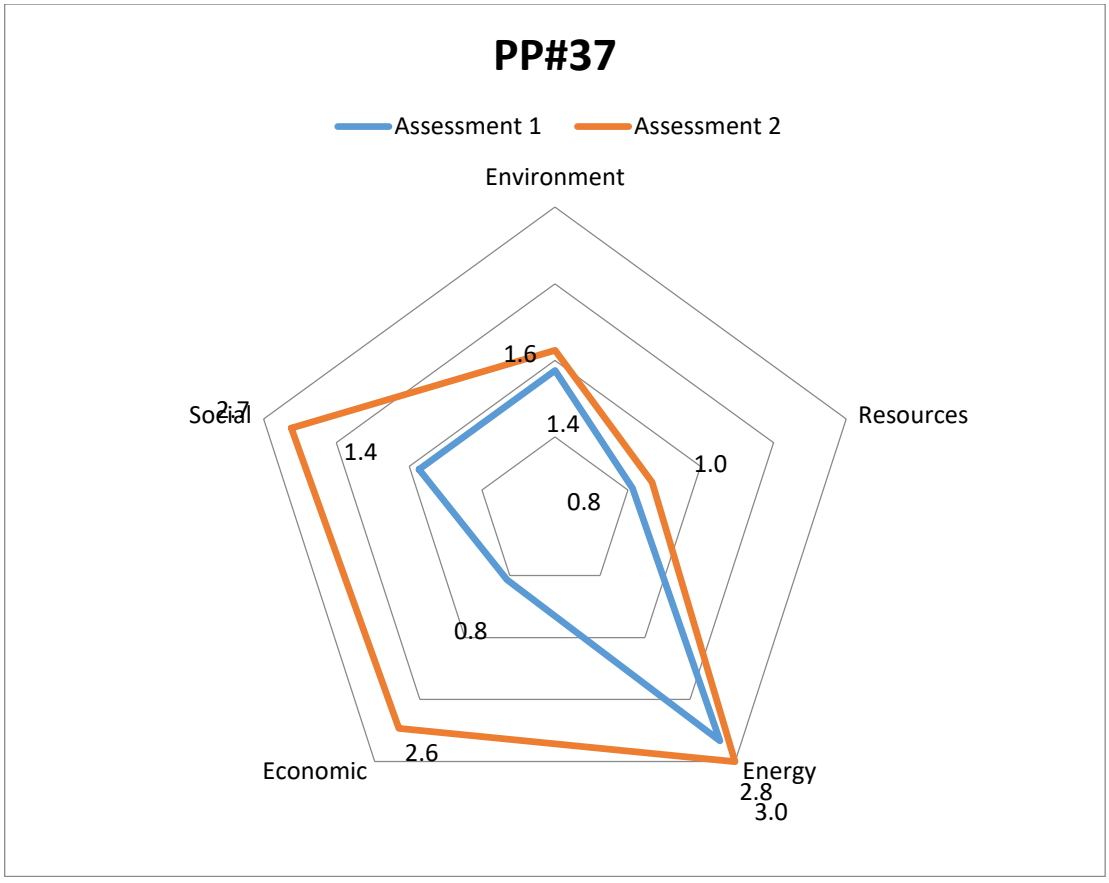

Figure 5.33: Attributes indicators before and after improvement process

According to that, the beginning should be from raising the awareness and knowledge about GM to build the capacity of the staff in order to lead the process of improvement; which is considered as one of the main indicators

of the Economic practices " Investment in other practices related to green manufacturing, including periodic maintenance and training in the application of GM practices". According to that one can see that the process of development should balance the progress of developing the existing practices from low to high, and adding new practices towards GM.

Chapter Six

Conclusion and Recommendations

6.1 Overview

This chapter presents the conclusion and summarizes research results. It also illustrates a set of recommendations based on the research results. In addition, this chapter discusses the limitations of the study, and the contribution of this study.

6.2 Conclusions

The aim of this research is to assessing the current practices and levels of GM in PPP. Also, a customized Model for GM practices in PPP is proposed based on the Deif's Model. The main procedures of the model are as follows:

1. Defining the main attributes in manufacturing that have an impact on the environment, directly or indirectly (which are environmental, resources, energy, economic and social).
2. Proposing a set of practices under each main attribute that affect the environment, and revised by experts in the field.
3. Considering the most relevant practices under each attribute to be analyzed collectively to calculate the indicators.
4. Defining GM zones and the relevant ratings (Black, Brown and Grey).

5. Calculating the greenness level for each plant according to the proposed model.
6. Proposing a self-assessment tool for the plastic plants to enhance the application of the GM concept and to adopt its practices.
7. Proposing a set of actions points towards GM under each Practice, gathered through meeting with representatives from the plants, especially those that have adopted the GM concept.
8. Proposing a logical sequence for the improvement sequence in order to develop the GMS in any plant.

The research covers Plastic Plants in West Bank in Palestine. The data were collected from a random sample of n=49 from Plastic Plants in West Bank through a survey that is specifically designed for this purpose.

The research's questionnaire is collected, and then its variables were entered in a suitable manner to SPSS. Then different statistical analysis tools such as frequency, means, reliability, means, simple and ANOVA test were conducted in order to investigate factors influencing GM implementation in PPP.

The results indicate as follows:

- The customized Model of Deif's has an excellent ability to explain GM implementation.
- The evaluation results for the most plants were within the intermediate level.
- Self-Assessment tool was designed to determine the current status of the plant.

- A set of actions points were proposed towards GM under each Practice, gathered through meeting with representatives from the plants.
- A logical sequence for the improvement stage in order to develop the GMS in any plant.
- A general assessment of the planning and development practices in PPP to see their vision for the future and development relative to GM.
- Statistical difference based on the demographic factors showed that there was statistical significance regarding working time (shifts).

6.3 Recommendations and Future Works

The current study analyzed the attributes and practices of GM that effect on PPP in Palestine, as this concept is negligible in most of these plants. The researcher came out with some recommendations for enhancing trust in the GMS in PPP. These recommendations are:

- For the government and authorities in terms of general governmental follow up and controls for the industrial sector through rigid environmental laws and legislations, it was clear that there were no specific laws and legislation for the plastics industry to control the waste and solid waste disposal.

The government and the official authorities should consider several actions and functions necessary for the success the GMS in the PPP, which include:

1- Dissemination of awareness about GM concept and operations
2- Drafting and issuing relevant regulations and legislations regarding the GMS that impact on the environment
3- Incentives (e.g. tax reduction) to encourage the industrial plants to adopt green manufacturing principles.

- A very qualified staff must be provided to promote the implementation and development of GM. This can be done by hiring specialists or supplying them from abroad, where there are many engineers specialized in this field.
- Top management must devote more financial resources for applying the GM practices.
- Top management must stimulate their employees to applyGM practices in their work through talking about the advantages and benefits for its implementation.
- Increase employee awareness, definition all issues related to GM practices.

6.3.1 Future Works

GM is a huge area, it can be applied on many industries with new attributes and practices. It is recommended to apply the GMS to the stone industry, aluminum, as well as applicable in the field of food.

It is also recommended to innovate a special model for GM based on the basic attributes that have been adopted in this research with new industrial practices that will be adopted in the new industry.

6.4 Limitations

Any study has limitations, likewise the current study had some limitations including:

- Place limitations: This study is determined in the West Bank governorates of Palestine
- Trust issues: Some plants owners were afraid to give any information that would harm them especially in front of the General Tax Authority
- In our research, it is impossible to include all potential factors, but the aim was to cover the most important and relevant determining factors.
- Lack of recent official statistics related to some elements of the study such as lack of information on sustainability practices and GM in the Palestinian Ministry of Environment, and the correct number of the PPP is not available from the union of the Palestinian plastic in each of the Palestinian provinces.

6.5 Contribution of the Study

While reading the available literature related to GMS and its attributes and practices, it was noted that the number of studies in the Arab world was

limited, and none of these studied the Palestinian context. Therefore, the current research is the first to analyze and determine the GM attributes and practices.

In this study, customized a GMS in the PPP, and the concept of GM was studied in two approaches, first, attributes influencing on GM were determined (environment, resources, economy, energy, and social), and second, practices affecting each of the attributes were also determined. In the available literature, few studies focused on determining the attributes and practices of GM.

The findings of this study are important for both practitioners' and researchers. For practitioners it can help them identify the most attributes and practices of GM in Palestine. On the other hand, for researchers it forms a first step on the way of building a comprehensive model of GM in Palestine. They can benefit from the current study' findings and build on it to include other factors that are not included.

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Appendices

Appendix 1: Arbitrators Who Reviewed the Questionnaire

Table 1: Arbitrators Who Reviewed the Questionnaire

Name	Position	University Name
Dr. Abdel Rahim Abusafa	Teaching Staff at Chemical Engineering, Energy Engineering, and Environment Department	An-Najah National University
Dr. Shehdeh Jodeh	Teaching Staff at Chemical	An-Najah National University
Dr. Amer El-Hamouz	Teaching Staff at Chemical Engineering, Energy Engineering, and Environment Department	An-Najah National University
Dr. Mohammed Othman	Head of the Industrial Engineering Department Assistant Professor, Industrial Engineering Department	An-Najah National University
Dr. Ayham Jaaron	Teaching Staff at Industrial Engineering and Director of ABET Centre at the Engineering Faculty	An-Najah National University
Dr. Hamdallah Bearat	Professor of Materials Science & Engineering Department of Chemical, Energy & Environment, and Materials Engineering	An-Najah National University
ENG. Emad Rjoub	General Manager of Royal Company	Hebron

Appendix 2: Questionnaire – Arabic Version

الأخ الفاضل/ الأخت الفاضلة

تحية طيبة وبعد،

الموضوع: تعبئة استبيان خاص بتقييم واقع التصنيع الأخضر في مصانع البلاستيك في الضفة الغربية

بداية نتقدم لحضرتكم بأطيب التحيات ونتمنى لكم تحقيق أهدافكم, بناء على الموضوع أعلاه فإن الباحث يسعى لدراسة وتقييم واقع ممارسات التصنيع الأخضر في مصانع البلاستيك في الضفة الغربية كمتطلب إتمام رسالة الماجستير في برنامج الإدارة الهندسية في جامعة النجاح الوطنية.

ولإيماننا بأهمية التواصل مع حضرتكم للحصول على معلومات دقيقة تمثل واقع التصنيع الأخضر في فلسطين، فإننا نثمن عالياً تفهمكم وتعاونكم في تعبئة الاستبيان، نحيطكم علماً أن مدة تعبئة الاستبيان يحتاج لتعبئته 30 دقيقة تقريباً.مع التعهد من قبلنا بالحفاظ على سرية هذه البيانات وأنها لأغراض البحث العلمي فقط.

شاكرين لكم حسن تعاونكم معنا

وتفضلوا بقبول وافر التقدير والاحترام،،

الباحث: وجدي عوكل

جامعة النجاح الوطنية –ماجستير إدارة هندسية

جوال رقم –0599555256

معلومات عامة عن الشركة						
1.	**رقم الاستبيان**					
2.	**المسمى الوظيفي**					
الرجاء وضع دائرة حول الخيار الذي ترونه مناسبا						
3.	**المحافظة**	1. جنين	2. طولكرم	3. نابلس	4. قلقيلية	5. طوباس	6. سلفيت
		7. رام الله والبيرة		8. القدس	9. أريحا	10. الخليل	11. بيت لحم
4.	**المواد الخام الرئيسية المستخدمة في عملية الإنتاج (بإمكانكم اختيار أكثر من إجابة على هذا السؤال)**	1. النايلون	2. بولي ايثيلين	3. بولي ايثيلين عالي الكثافة	4. بولي ايثيلين منخفض الكثافة		
		5. بولي فانيل كلورايد	6. بولي ستارين	غير ذلك (حددها).7			
5.	**عدد الموظفين في الشركة**	1. 1-9		2. 10-49	3. أكثر من 50		
6.	**عدد المهندسين في الشركة**	1. 1-2		2. 3-5	3. أكثر من 5		
7.	**سنة تأسيس الشركة**						
8.	**تصنيف الشركة في وزارة الاقتصاد الوطني**	1.شركة عادية عامة	2.شركة عادية محدودة	3.شركة مساهمة عامة	4.شركة مساهمة خصوصية		
		5. شركة عائلية	6.أخرى حدد.....				
9.	**هل الشركة مسجلة في اتحاد الصناعات البلاستيكية أم في اتحاد آخر**	1. نعم	2. في اتحاد آخر وهو _____		3. غير مسجلة في أي اتحاد		
10.	**أوقات العمل في الشركة**	1. صباحي	2. صباحي ومسائي (ورديتين)		3. صباحي ومسائي وليلي (ثلاث		

		(وردية واحدة)			وورديات)
1 1.	**الشهادات / المواصفات التي حصلت عليها الشركة**	ISO9000	ISO14000	PS	أخرى حددها.....
تقييم ممارسات التصنيع الأخضر					
يرجى من حضرتكم التكرم بالإجابة عن الأسئلة التالية حسب ما ترونه مناسبا بما تقومون به من ممارسات متعلقة بالتصنيع الأخضر في مؤسستكم (X) وذلك بالإجابة بوضع إشارة في المكان المناسب					

#	البند	عالي 3	متوسط 2	قليل 1	لا يوجد 0
الممارسات الخاصة بالبيئة					
1.	إلى أي مدى يتم إعادة تدوير مخلفات العملية التصنيعية من البلاستيك سواء داخل المصنع أو بالشراكة مع جهات خارجية				
2.	إلى أي مدى ترون مستوى التعاون بينكم وبين زبائنكم في إعادة جمع وتدوير المخلفات				
3.	إلى أي مدى يتم في مصنعكم عمل تصنيف للنفايات عند التخلص منها				
4.	إلى أي مدى يتم استخدام مواد تصنف بأنها ضارة بالبيئة في العملية التصنيعية				
5.	إلى أي مدى منتجات مصنعكم البلاستيكية قابلة للتدوير				
6.	إلى أي مدى يتم مراعاة تقليل نسبة الفاقد (المخلفات) في العملية التصنيعية خلال عملية التصميم والإنتاج				
7.	إلى أي مدى يتم معالجة المياه العادمة قبل تصريفها من مصنعكم				

#	البند	عالي 3	متوسط 2	قليل 1	لا يوجد 0
8.	إلى أي مدى يقوم المصنع باستخدام فلاتر للحد من الغازات المنبعثة من العملية التصنيعية				
9.	إلى أي مدى يقوم المصنع بإجراء فحوص دورية لفحص جودة الهواء في بيئة العمل				
10.	إلى أي مدى يتم إجراء زيارات من الجهات الخارجية لإجراء فحوص دورية لجودة الهواء				
11.	إلى أي مدى يتم توزيع تعليمات خاصة للسائقين في الحفاظ على البيئة من حيث استخدام السولار أو فلاتر /الصيانة للمركبات.				
12.	إلى أي مدى يقوم المصنع بإجراء فحوص دورية لفحص جودة المياه في المصنع				
13.	إلى أي مدى تقوم جهات خارجية بإجراء فحوص دورية لفحص جودة المياه في المصنع				
14.	إلى أي مدى يقوم المصنع بإجراء فحوص دورية على المياه العادمة لديه				
15.	ما مدى تكرار زيارة جهة خارجية لإجراء فحوص دورية على المياه العادمة				
16.	إلى أي مدى يتم استخدام مواد تغليف للمنتجات قابلة للتدوير وإعادة الاستخدام				
17.	إلى أي مدى يتم استخدام مواد صديقة للبيئة في العملية الإنتاجية (مثل مادة BPA من البلاستيك، الورق المعاد تدويره في التغليف مثلا، المطاط المعاد تدويره ... الخ)				

الممارسات الخاصة باستخدام الموارد					
18.	إلى أي مدى يتم عمل دراسات لديكم لاستبدال بعض المواد بمواد صديقة للبيئة				
19.	ما مدى استخدام مواد ناتجة من عمليات التدوير كمدخلات إلى العملية الإنتاجية				
20.	إلى أي مدى يتبع المصنع نظام متابعة ورقابة في المستودعات للمحافظة على المواد الكيميائية من التلف أو التسريب				
21.	إلى أي مدى يتم جمع مياه الأمطار في خزانات للاستفادة منها في العملية التصنيعية و/ أو للمرافق الصحية				
22.	إلى أي مدى يتم إعادة استخدام المياه المعالجة في الري				
23.	إلى أي مدى يتم إعادة استخدام المياه المعالجة مرة أخرى في المصنع سواء في العملية التصنيعية أو في مرافق المصنع الصحية أو غيرها				
الممارسات الخاصة بالطاقة					
24.	إلى أي مدى يتم الاستغلال الأمثل للطاقة فيما يخص أوقات تشغيل الماكينات وإيقافها عند الانتهاء من الحاجة لها				
25.	إلى أي مدى يتم استخدام مصادر الطاقة النظيفة (الشمسية/الرياح) كمصادر للطاقة في المصنع لديكم				
26.	إلى أي مدى يتم استخدام تقنيات حديثة للمحافظة على الطاقة (ترشيد الاستهلاك)(like LED)				
27.	إلى أي مدى يتم عمل صيانة دورية للإضاءة وعملية استبدال دورية للمصابيح				

28.	إلى أي مدى يتم مراعاة مبادئ الاستغلال الأمثل لمصادر الطاقة من خلال التصميم الخاص بمبنى المصنع (فتحات إنارة/ تهوية/ العزل...)				
29.	إلى أي مدى يتم تطبيق تعليمات عمل مكتوبة للمساهمة في ترشيد استهلاك للطاقة من قبل الموظفين				
	البعد الاقتصادي للممارسات				
30.	إلى أي مدى يقوم المصنع بدفع غرامات ناتجة عن تجاوزات للمعايير البيئية				
31.	إلى أي مدى يحقق المصنع عوائد مالية نتيجة للاستثمار في النواحي البيئية مثل استخدام طاقة بديلة أو إعادة تدوير المخلفات أو إعادة استخدام المياه العادمة واستخدام التكنولوجيا الحديثة				
#	**البند**	**عالي 3**	**متوسط 2**	**قليل 1**	**لا يوجد 0**
32.	إلى أي مدى يتم تعزيز دور المصنع في الحفاظ على البيئة واستخدامه لممارسات تصنيع اخضر في الترويج لعلامته التجارية				
33.	إلى أي مدى يتم وضع خطة لدراسة المخاطر المحتملة وتحديد إجراءات الحد منها				
34.	إلى أي مدى يتم الاستثمار في ممارسات أخرى ذات علاقة بالتصنيع الأخضر منها الصيانة الدورية والتدريب على تطبيق ممارسات تصنيع أخضر				
	البعد الاجتماعي للممارسات				
35.	إلى أي مدى تعمد الإدارة إلى تخصيص بنداً (موازنة)				

	لنشاطات المسؤولية الاجتماعية (التعليم البيئي، المحافظة على البيئة... الخ)				
36.	ما مدى وجود تعليمات خاصة للحفاظ على البيئة على ملصقات المنتجات النهائية				
37.	ما مدى وجود تعليمات خاصة بخطر المواد المكونة للمنتج او مخلفات المنتج على البيئة / منشأها/ مصدرها/ .... الخ				
38.	إلى أي مدى يحدد المصنع الإجراءات والممارسات البيئية الخاصة به للحفاظ على البيئة ضمن تعليمات موثقة ومعممة في المصنع من منطلق شعوره بالمسؤولية في الحفاظ على البيئة				
39.	إلى أي مدى تقومون بحملات توعية وإرشاد حول آثار التخلص من المنتجات وضررها على البيئة				
40.	إلى أي مدى تقومون بالتبرع / بالتطوع لرعاية مشاريع تساهم في الحفاظ على البيئة				
41.	إلى أي مدى تقومون بإجراء فحوصات طبية دورية للعمال في المصنع				
42.	إلى أي مدى يتم فحص مستوى الضجيج بشكل دوري ومتابعة الحد من أثره على العاملين				
43.	إلى أي مدى يعمل المصنع على توفير فرص عمل جديدة والاعتماد على القوى العاملة المحلية في العمليات المختلفة				
44.	إلى أي مدى تعتبر منتجات المصنع الأساسية تلبي حاجة ملحة للمجتمع (حاجة أساسية وليست كماليات)				

45.	إلى أي مدى يتخذ المصنع الإجراءات الملائمة والتصميم المناسب لمكان العمل من اجل توفير بيئة عمل صحية وملائمة لسلامة الموظفين خلال ممارستهم العمل				
46.	إلى أي مدى تقومون بتوفير وسائل الحماية الشخصية ومكافحة ضد الحرائق				
47.	إلى أي مدى تتوفر في المصنع وسائل الحماية والأمان ضد تسرب الغازات أو المواد الكيميائية				
48.	إلى أي مدى يتم الاهتمام بالمساحة المحيطة بالمصنع فيما يتعلق بالزراعة والبيئة				
49.	إلى أي مدى يتم تفضيل التعامل مع موردين مؤهلين بناء على مدى التزامهم بمعايير بيئية أو إتباعهم سياسة بيئية معينة (كحصولهم على شهادات أيزو)				
50.	إلى أي مدى باعتقادك رضا زبائنكم عن منتجاتكم من حيث التزامها بمعايير وشروط التصنيع الأخضر مقارنة بمنافسين آخرين (من حيث إمكانية تدويرها، صديقة للبيئة...الخ)				
51.	إلى أي مدى يتم تجنب إنتاج بعض أنواع المنتجات بسبب آثارها السلبية على البيئة من مخلفات التصنيع أو المواد الداخلة في العملية التصنيعية				

هذا الجزء من الاستبانة يتعلق بعملية التخطيط والتطوير في مؤسستكم بما يتعلق بممارسات التصنيع الأخضر. يرجى من حضرتكم في المكان (X)التكرم بالإجابة عن الأسئلة التالية حسب ما ترونه مناسبا لما تقومون به في مؤسستكم وذلك بالإجابة بوضع إشارة المناسب

	البند	عالي 3	متوسط 2	قليل 1	لا يوجد 0
52.	مستوى جودة منتجات المصنع في الثلاث سنوات الأخيرة مقارنة بجودة منتجات المنافسين				
53.	إلى أي مدى يتم المشاركة من خلال المصنع في ورشات ومؤتمرات تتعلق بالتخطيط وتطوير الإنتاج والعمليات الإنتاجية				
54.	إلى أي مدى يطبق المصنع نظام التشريعات (تشريعات ملزمة) حكومية خاصة بحماية البيئة				
55.	إلى أي مدى يعتمد المصنع على عمليات البحث والتطوير في تصميم وطرح منتجات جديدة للأسواق				
56.	مستوى المعرفة والوعي بمبادي التصنيع الأخضر لدى القائمين على العمل في المصنع				
57.	إلى أي مدى يتم اعتماد ممارسات التصنيع الأخضر في المصنع بناء على الوعي بآثاره الايجابية				
58.	إلى أي مدى لدى الإدارة العليا الرغبة بالاستثمار وتبني مبدأ التصنيع الأخضر (النظيف)				
59.	إلى أي مدى بإمكان المصنع من حيث الكفاءات البشرية المتوفرة لديه تطبيق مبادئ التصنيع الأخضر (النظيف)				
60.	إلى أي مدى بإمكان المصنع (ماليا) تطبيق ممارسات				

	التصنيع الأخضر				
61.	إلى أي مدى تبني وتطبيق ممارسات التصنيع الأخضر (النظيف) سيساهم في زيادة الحصة السوقية				
62.	إلى أي مدى تبني وتطبيق ممارسات التصنيع الأخضر (النظيف) سيساهم في تقليل تكلفة الإنتاج				
63.	لأي درجة تعتقد أن يتم إعطاء إعفاءات من الضرائب مع ممارسة التصنيع الأخضر كحوافز تشجيعية من الحكومة				

الرجاء من حضرتكم تزويدنا بقيمة مرجعية للبنود التالية في المصنع لديكم كما هو موضح لكل بند من البنود أدناه

#	البند	القيمة
1.	نسبة المنتجات القابلة للتدوير في المصنع إلى المنتجات الكلية	
2.	نسبة الفاقد من العملية الإنتاجية الذي لا يمكن استغلاله	
3.	نسبة الغاز ..... (أهم الغازات الملوثة المنبعثة) الناتج من العملية الإنتاجية	
4.	نسبة مواد التغليف والتعبئة القابلة للتدوير	
5.	نسبة المواد الداخلة في العملية الإنتاجية والناتجة من عملية تدوير سابقة	
6.	نسبة المياه المستخدمة في المصنع الناتجة من عمليات جمع مياه الأمطار أو معالجة المياه الناتجة من العملية الإنتاجية / المياه العادمة	
7.	نسبة الطاقة النظيفة المستخدمة (الشمسية مثلا) من الطاقة الكلية المستخدمة في المصنع من المصادر الأخرى الملوثة للبيئة	
8.	إلى المصابيح الكلية(like LED)نسبة مصابيح الإنارة من الأنواع الموفر للطاقة	
9.	معدل العائد على الاستثمار نتيجة للاستثمار في النواحي البيئية مثل استخدام طاقة بديلة أو إعادة تدوير المخلفات أو إعادة استخدام المياه العادمة واستخدام التكنولوجيا الحديثة	
10	عدد حملات التوعية السنوية التي تقومون بها سنويا فيما يخص الحفاظ على البيئة وآثار التخلص	

	من المنتجات على البيئة	
11	عدد المشاريع التي يتم رعايتها سنويا فيما يخص الحفاظ على البيئة	
12	عدد مرات فحص العاملين طبيا في السنة	
13	عدد الحوادث بسبب الحرائق في المصنع المقيدة سنويا	
14	عدد الحوادث بسبب تسرب الغاز أو مواد سامة في المصنع المقيدة سنويا	
15	نسبة المساحة الخضراء المحيطة بالمصنع (والتابعة لأرض المصنع) إلى المساحة الكلية	
16	عدد الدورات/المؤتمرات التي تمت المشاركة بها سنويا فيما يخص موضوع التصنيع النظيف/ الأخضر أو فيما يتعلق الحفاظ على موارد البيئة	
17	الموازنة السنوية المخصصة لنشاطات المسؤولية الاجتماعية بالشيكل	
18	عدد الرعايات السنوية أو التبرعات لمشاريع تساهم في الحفاظ على البيئة	
19	عدد الموردين المؤهلين الملتزمين بالمعايير البيئية الذين لديهم سياسة بيئية أو حاصلين على شهادة أيزو إلى عدد الموردين الكلي في المصنع	
20	عدد الفحوصات السنوية لفحص جودة المياه في المصنع	
21	نسبة المياه المعالجة التي يتم استخدامها لأغراض الري بشكل عام	
22	نسبة المياه المعالجة التي يتم استخدامها لأغراض التصنيع أو في مرافق المصنع الصحية من المياه المستخدمة بشكل عام في المصنع	
23	عدد فرص العمل السنوية الجديدة التي يوفرها المصنع للمجتمع	

ما هي أبرز المعيقات والتحديات التي ممكن أن تواجهكم في تطبيق ممارسات التصنيع الأخضر؟

.....

.....

.....

.....

أي معلومات أو اقتراحات تودون إضافتها

.....

.....

.....

شاكرين لكم حسن تعاونكم

Appendix3: Questionnaire – English Version

Dear Sir/Madam

After Greetings,

Topic: Filling out a questionnaire to assess the status of GM in plastic plants in the West Bank

We would like to extend our best regards to you and wish you the best of your goals, based on the above subject, the researcher seeks to study and evaluate the reality of the green manufacturing practices in the plastic plants in the West Bank as a requirement to complete the master's thesis in engineering management program at An-Najah National University.

We believe in the importance of communicating with your presence to obtain accurate information that represents the reality of green manufacturing in Palestine, so we highly appreciate your understanding and cooperation in filling out the questionnaire. Please note that the filling time of the questionnaire needs to be completed within approximately 20 minutes. With our commitment to keep these data confidential and for scientific research only.

Thank you for your cooperation with us

Yours sincerely,

Researcher: Wajdi Okal

An-Najah National University - Master of Engineering Management

Jawwal No. 0599555256

General information about the plant							
1.	**No. of questionnaire:**						
2.	**Title of Position:**						
Please circle the option that you think is appropriate for your organization							
3.	**Governorate**	**Jenin**	**Tulkarm**	**Qalqilya**	**Tubas**	**Salfeet**	**Ramallah and Beerih**
		Jerusalem		**Jericho**	**Hebron**	**Bethlehem**	**Nablus**
4.	**The raw material used in your production (you can select more than one material).**	**Nylon**	**Poly ethylene**	**High density poly ethylene**	**Low density poly ethylene**		
		Poly Stareen	**Chloride poly fanil**	**Something else**			
5.	**Number of employees**	**1-9**		**10-49**	**more than 50**		
6.	**Number of Engineers working with the plant**	**1-2**		**3-5**	**more than 5**		
7.	**The year of plant**						

	establishment				
8.	**The category of company registration**	**Ordinary company**	**Ordinary limited company**	**Private Partnership company**	**Civil general company**
		Civil private company	**Other (specify)**		
9.	**Is the company member in the union of Plastic Company, or any other union**	**Yes**	**In some other union (Specify)**		**Not a member in any union**
10.	**Work time in the plant**	**One shift**	**Two shifts**		**Three shits**
11.	**Certificate the company got**	**ISO 9000**	**ISO 14000**	**PS**	**Other**

Evaluation of Green Manufacturing practices				
Please answer the following questions as you see fit with your Green Manufacturing practices in your organization				
Environmental Practices				
Item	**High 3**	**Medium**	**Low 1**	**Not found 0**

		2		
1. To what extent the recycling of waste outs of plastic is achieved, in or out the factory?				
2- How could you describe the cooperation between you and your customers in the issue of wastes recycling?				
3- To what extent the categorization of wastes is made in your factory?				
4- To what extent you use material categorize as harm of environment during manufacturing process?				
5- To what extent your plastic wastes is recyclable?				
6- To what extent you work in reducing the percentage of wastes out during production and design process?				
7. To what extent wastewater is treated before discharge?				
8- Do you use filters for treating gases resulting from production process?				
9- How often the factory carry a				

periodical test for air in the factory environment?				
10- How often do external parties visit the factory to carry for the air quality test?				
11- Do you distribute guidance for drivers on the use of diesel and filters, and maintenance for cars?				
13- How often do external tests are carried for water quality?				
14- How often does the plant carry tests for waste water?				
15- How often do external parties visit the plant to carry waste water tests?				
16- To what extent you use recyclable packing materials?				
17- To what extent you use environment friend materials, such as BPA, recycled paper, and others?				
Resources Practices				
18- To what extent you have studies on the replace some materials with environment friend materials?				
19- How much you use recycled				

materials in your production?				
20- To what extent you have, and apply control measures in the factory, mainly with chemicals?				
21- To what extent you use the system of rain water gathering so as to reuse?				
22-To what extent you use waste water for irrigation?				
23- To what extent you use waste water in manufacturing process, or in other facilities?				
Energy Practices				
24- To what extent you systemize the use of power in all steps of work?				
25- To what extent you use pure energy sources, as solar, as source, in your factory?				
26- How much you use new electricity techniques for power saving as LED?				
27- To what extent periodic maintenance of lighting and periodic replacement of lamps				
28- To what extent you used the principals the best ways of power use in				

the factory design process?				
29- How often you use written text for the best use of energy?				
Economic Practices				
30. How often did the factory pay fines for violating the measures of environmental criteria?				
31- How much your factory make returns resulting from investing in environment , as renewable energy , or recycling materials , or reusing waste water and other technologies?				
32- How often you maintain to role of the factory in clean environment, and using practices of GM in the promotion of the brand?				
33-To what extent you have studies in the possible risks and dangers, and how to reduce them?				
34- To what extent you invest in the green manufacturing, as periodic maintenance and training on best practices?				
Social Practices				

35 -To what extent you special financial item in your budget for social responsibility (environmental education) and others?				
36- How much you use environment keeping stickers on your products?				
37 – How often you use stickers showing the dangers of products waste on environment?				
38- To what extent you have written document showing best practices for environment keeping, as a social and ethical responsibility?				
39- To what extent do you public awareness campaigns on industry wastes and damaging results on the environment?				
40- How often do you donate, volunteer for sponsoring environment keeping activities?				
41- How often you medical tests for your labor?				
42- To what extent you apply sound and noise control in the factory, and reduce				

it?				
43- To what extent you save work opportunities, and how you depend on local labor?				
44- To what extent your production satisfy the local needs (primary need and nor minor ones)?				
45- How much you consider that your work environment suitable, design wise, for saving very health, safe environment for your employees?				
46- To what extent you provide and save individual measures and fire safety measures?				
47- To what your factory is equipped for facing gas and chemicals leakages?				
48- To what extent you care for factory surrounding area, and you use for farming and planting?				
49- To what extent you prefer dealing with suppliers who are committed to environment protection standards? Or those with ISO certificates?				
50 – To what extent you think your				

customers are satisfied with your products? And your commitment to green and clean environment conditions?				
51- To what extent you are committed nor to produce some item due to harm they cause to the environment? Due to the wastes.				
This part of the questionnaire relates to the planning and development process in your organization, Please answer the following questions as you see fit with your				
52- The quality of your production in the last 3 years compared with other factories?				
53- How much you participate in workshops, conferences related to planning and development?				
54- To what extent you are committed to implementation of governmental procedures and regulation related to environment protect?				
55- To what extent you depend on researches and studies in developing new products?				
56- How much is the knowledge on GM				

among factory workers and supervisors?				
57- To what extent it applies GM standards based on awareness of its positive effects?				
58- How much your administration is committed to GM and environment protection?				
59- In accordance to employees, to what extent you could apply GM standards?				
60 – To what extent, from financial side, you could apply the green industry?				
61- Do you think that following the GM measures will increase your share in the market?				
62- How much you think, using GM standards will share in the reducing of industry costs?				
63. How much reduction in taxes should be awarded to committed industries in GM and safe environment?				

Please provide us with a reference value for the following items:	
Item.	**Value**
1- Percentage of recyclable products to the total products	
2- Percentage of loss production process that can't be used.	
3- Percentage of spoiled gas resulting from production process.	
4- Percentage of packing items that are able of recycling.	
5- Percentage material entering used in production resulting from recycling process.	
6- Percentage of water used from rain gathering, or waste water treatment?	
7- Percentage of clean energy sources (solar) compared to total energy use, and other sources that have bad effects on the environment.	
8- Number of lighting lambs with energy saving (Like LED) compared to other styles.	
9- Percentage of investment returns resulting from the investment in different side, energy, recycling, or waste water use.	
10- Number of annual public awareness campaign you carry in relation to environment protecting.	
11- Number of projects you annually sponsor that are related to environment protect.	
12- Number of annual medical checks for employees.	
13- Number of annual accidents registered due to fire.	
14- Number of annual registered accidents resulting from gas leakage	
15- Percentage of green area round the factory compared to the total are of	

the factory	
16- Number of workshops, conferences and other events you participated in in relation of green manufacturing, or on environmental resources conservation	
17- What is your annual budget related to your social responsibility.	NIS
18- Your annual sponsor ship or donations in relation to environment protection.	
19- Number of suppliers committed to environment protection standards, or having ISO certificate, compared to the total number of suppliers.	
20- Number of annual water quality tests.	
21- Percentage of treated water that used for irrigation.	
22- Percentage of treated water used in industry process, or other factory facilities, compared to total used water.	
23- Total number of employment opportunities offered by the factory annual.	

- **What are the main obstacles you are facing, or may face, while implementing Green Manufacturing?**

- **Any information you would like to add.**

Thanking you for your kind time and cooperation.

Appendix 4 Self-assessment tool

4.1: Self-Assessment Tool (Sheet #1)

Table 4.1 Self-Assessment Tool (Sheet#1)

#	Sector	Practices	Status				Evaluation	Improvement Priority
			High	Mid	Low	Doesn't exist	(1-3)	
1	**Environmental**	Recycling wastes internally or externally						
2		The collaboration between the firm and customers in waste recycling						
3		Waste categorization before disposal						
4		Avoid Using material classified as sever harmful raw material						
5		The final products are recyclable						
6		Use filters to reduce the emissions of the manufacturing process.						
7		Monitor water quality internally						
8		Monitoring wastewater by external bodies						
9		Using recyclable material for packaging						
10		Using Environmentally friendly materials such As BPA, recyclable materials…)						
Environmental Practices Indicator								
11	**Resources**	Replacing some material with eco-friendly material						
12		Using recycled material as an input in the manufacturing process						

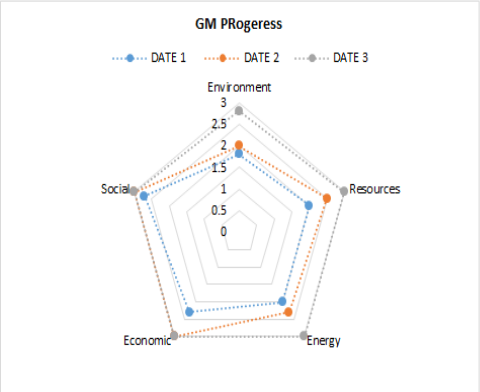
#	Sector	Practices	Status				Evaluation	Improvement Priority
			High	Mid	Low	Doesn't exist	(1-3)	
13		Follow a system for monitoring & controlling resources in warehouses to protect chemicals from damage or leakage						
14		Rainwater is collected in reservoirs for the use in the manufacturing process and / or sanitary facilities						
15		Using treated wastewater in irrigation						
16		The treated water is re-used in the plant either in the manufacturing process or in the sanitary plant or other facilities						
Resources Practices Indicator								
12	**Energy**	Optimal utilization of energy in terms of machine running times and idle time						
13		Use clean energy sources (solar / wind)						
14		Using developed energy conservation techniques (like LED)						
15		Application of SOPs to contribute to the rationalization of energy consumption by employees						
Energy Conservation Practices Indicator								
17	**Economic**	The factory did not have to pay fines resulting from violations of environmental standards						
18		The plant achieves financial returns as a result of investment in environmental aspects such as the use of alternative energy, waste recycling, wastewater reuse and the use of modern technology						

#	Sector	Practices	Status				Evaluation	Improvement Priority
			High	Mid	Low	Doesn't exist	(1-3)	
19		Enhance the role of the plant in environmental conservation and its use of GM practices in promoting its brand						
20		A plan is drawn up to study potential risks and identify mitigation measures						
21		Investment in other practices related to green manufacturing, including periodic maintenance and training in the application of GM practices						
Economic Practices Indicator								
24	**Social**	Allocates a budget for social responsibility activities (environmental education, environmental conservation, etc.)						
25		The existence of special instructions to preserve the environment on the labels of finished products						
26		The existence of special instructions on the risk of the constituent materials of the product or the residues of the product on the environment / origin / source / etc						
27		The plant sets its own environmental procedures and practices for the preservation of the environment within a documented and generalized instructions at the plant in the sense of responsibility for preserving the environment						
28		Awareness campaigns and guidance on the effects of disposal of products and harm the environment						

#	Sector	Practices	Status				Evaluation	Improvement Priority
			High	Mid	Low	Doesn't exist	(1-3)	
29		The factory works to provide new job opportunities and rely on the local workforce in different operations						
30		Provide means for personal protection and fire protection						
31		The factory has safety measures against gases or chemicals						
32		Pay attention to the surrounding area of the plant in relation to agriculture and the environment						
33		Preference is given to dealing with qualified suppliers based on their compliance with environmental standards or following a specific environmental policy (such as ISO certificate)						
34		Avoiding certain types of products because of their negative effects on the environment from manufacturing waste or materials in the manufacturing process						
Social Practices Indicator								
GM Index								

4.2: Self-Assessment Tool (Sheet #2)

Practices	DATE 1	DATE 2	DATE 3
Environment	1.8	2	2.8
Resources	2	2.5	3
Energy	2	2.3	3
Economic	2.3	3	3
Social	2.7	3	3
GM Indicator	2.16	2.56	2.96



Appendix 5: Improvement Actions Tables:

Table 5.1: Actions for Environmental Practices

# of Practices	Environmental Practices	Actions		
Q1	Recycling wastes internally or externally by third party	Develop new strategies and techniques for recycling	Provide special recycling machines	Cooperate with outside companies in the recycling process
Q2	The collaboration between the firm and customers in waste recycling	The existence of a working mechanism with customers for the collection and recycling of waste	The existence of special agreements with customers for the collection and recycling of these wastes	
Q3	Waste categorization before disposal	Classification of waste (cardboard, nylon, plastic, etc.)		
Q4	Avoid Using material classified as sever harmful raw material	The use of environmentally friendly alternative materials such as BPA and others	Find and contract with suppliers who comply with high environmental standards in raw materials,	
Q5	The final products are recyclable	Replacement of non-recyclable products with recyclable products and increase consumer awareness of these procedures		
Q8	Use filters to reduce the emissions of the manufacturing process.	Determine the emission zones in the plant	Study the need of filters required to be replaced/purchased periodically	Regular maintenance of filters
Q12	Monitor water quality internally	Work on periodic water tests with special laboratories	Use appropriate techniques to maintain water quality	
Q15	Monitoring	Contracting		

	wastewater by external bodies	**with competent authorities for the inspection and monitoring of water quality**		
Q16	**Using recyclable material for packaging**	**Use recyclable nylon in the packaging process**		
Q17	**Using Environmental friendly materials such As BPA, recyclable materials…)**	**Use of environmentally friendly alternative materials such as BPA and others**	**Conduct periodic studies in this field**	**Search for new sources of suppliers committed to providing materials with high environmental standards**

Table 5.2: Actions for Resources Practices

# of Practices	Resources Practices	Actions		
Q18	Replacing some material with eco-friendly material	The existence of a special department/unit for conducting these studies	Contracting with consultants with high scientific and practical experience in this field	Applying the results of studies
Q19	Using recycled material as an input in the manufacturing process	Purchase of recycled raw materials, recycling of some products or waste		
Q20	Follow a system for monitoring &controlling resources in warehouses to protect chemicals from damage or leakage	Use of modern computerized techniques within warehouses	Follow advanced methods in the planning of warehouses in order to store resources properly and keep materials from damage and leakage	
Q21	Rainwater is collected in reservoirs for the use in the manufacturing process and / or sanitary facilities	Working on the existence of a specific mechanism for collecting rainwater		
Q22	Using treated wastewater in irrigation	Collection of treated water in additional tanks	Irrigating surrounding plants and crops with the treated water	
Q23	The treated water is re-used in the plant either in the manufacturing process or in the sanitary plant or other facilities	Collection of treated water in additional tanks		

Table 5.3: Actions for Energy Practices

# of Practices	Energy Practices	Actions		
Q24	Optimal utilization of energy in terms of machine running times and idle time	Determine the operating process in terms of optimal use of energy sources		
Q25	Use clean energy sources (solar / wind)	Study the replacement of current energy sources with clean energy sources	Replacement of current energy sources with clean energy sources	
Q26	Using developed energy conservation techniques (like LED)	Replacing old lighting system, use modern lighting such as (LED)		
Q29	Application of SOPs to contribute to the rationalization of energy consumption by employees	Take some measures to promote energy conservation	Prepare clear and general work instructions for employees in the factory, especially for additional measures, and measures to rationalize energy consumption	

Table 5.4: Actions for Economic Practices

# of Practices	Economic Practices	Actions		
Q30	The factory did not have to pay fines resulting from violations of environmental standards	Working within the procedures and laws of the Environment Authority		
Q31	The plant achieves financial returns as a result of investment in environmental aspects such as the use of clean energy, waste recycling, wastewater reuse and the use of modern technology	Cost reduction due to clean energy usage	Cost reduction due to recycling waste and using it again in the manufacturing process	Cost reduction due to using treated wastewater again
Q32	Enhance the role of the plant in environmental conservation and its use of GM practices in promoting its brand	Use the green manufacturing practices logo	Community awareness of green manufacturing principles	
Q33	A plan is drawn up to study potential risks and identify mitigation measures	Study and develop a plan for possible risks	Follow-up implementation of risk-management plan	
Q34	Investment in other practices related to green manufacturing, including periodic maintenance and training in the application of GM practices	Establish a periodic maintenance schedule for the machines	Preparing procedures for the proper GM practices and adopting them in the factory (providing energy use, stopping machines and lighting in places that are not working)	
Q30	The factory did not have to pay fines resulting from violations of environmental standards	Working within the procedures and laws of the Environment Authority		

Table 5.4: ActionsforSocial Practices

# of Practices	Social Practices	Actions		
Q35	Allocates a budget for social responsibility activities (environmental education, environmental conservation, etc.)	Allocate a clear item in the annual budget for environmental-social responsibility		
Q36	The existence of special instructions to preserve the environment on the labels of finished products	All products contain environmental stickers	All labels contain information indicating proper disposal methods after use	All labels contain the risk of misuse of the product to the environment (exp. burning ...)
Q37	The existence of special instructions on the risk of the constituent materials of the product or the residues of the product on the environment / origin / source / etc.	The final product labels contain basic constituent materials of the product	Warning of the severity of specific materials in the product when disposed of	
Q38	The plant sets its own environmental procedures and practices for the preservation of the environment within a documented and generalized instructions at the plant in the sense of responsibility for preserving the environment	Adopt clear and generalized environmental policy	The factory holds certificates of international standards in the field of environment	The factory has certificates of local specifications in the field of environment
Q39	Awareness campaigns and guidance on the effects of disposal of products and harm the environment	Awareness campaigns - Distribution of awareness leaflets	Measuring the impact of awareness and environmental awareness on the society periodically	
Q43	The factory works to provide new job opportunities and	Reliance on local workers	Equal employment opportunities	

# of Practices	Social Practices	Actions		
	rely on the local workforce in different operations		for males and females	
Q46	Provide means for personal protection and fire protection	Use modern firefighting techniques and equipment	Work within certain public safety procedures	Provide clothing, safety and personal protection for firefighters (camshafts, thermal clothing, if necessary in some factories)
Q47	The factory has safety measures against gases or chemicals	Use of modern technologies and technologies against leaks of gases	Separate chemicals and gases from other materials in stores	Use of special marks in places where flammable or leaky materials are kept
Q48	Pay attention to the surrounding area of the plant in relation to agriculture and the environment	Disposal of waste in proper and correct manner	Cultivation areas surrounding the plant	
Q49	Preference is given to dealing with qualified suppliers based on their compliance with environmental standards or following a specific environmental policy (such as ISO certification)	Follow a supplier evaluation methodology based on their commitment to different environmental standards	Update the list of suppliers qualification periodically	
Q51	Avoiding certain types of products because of their negative effects on the environment from manufacturing waste or materials in the manufacturing process	Study the environmental impact of the materials	Replacement of harmful substances with materials less harmful to the environment	Eliminate products with high environmental damage and replace them with products that are less harmful to the environment

Appendix 6: The names of the companies surveyed

Table 6.1: The names of the companies surveyed

رقم الشركة	اسم الشركة	المدينة
1	شركة رويال للصناعات البلاستيكية	الخليل
2	شركة بيو زمزم للصناعات البلاستيكية	الخليل
3	شركة زمزم للصناعات البلاستيكية	الخليل
4	شركة أبكو بلاستيك للصناعات البلاستيكية	الخليل
5	شركة جولف للصناعات البلاستيكية	الخليل
6	شركة الهرم للصناعات البلاستيكية	الخليل
7	شركة الزير للصناعات البلاستيكية	الخليل
8	شركة الصداقة للصناعات البلاستيكية	الخليل
9	شركة بلاست للصناعات البلاستيكية	الخليل
10	شركة فرانسيس للصناعات البلاستيكية	الخليل
11	شركة تفوح للصناعات البلاستيكية	الخليل
12	شركة الاهرامات للصناعات البلاستيكية	الخليل
13	شركة البيان للصناعات البلاستيكية	الخليل
14	شركة شاور للصناعات البلاستيكية	الخليل
15	شركة الزرو للصناعات البلاستيكية	الخليل
16	شركة الرحى للصناعات البلاستيكية	الخليل
17	شركة الزين للصناعات البلاستيكية	الخليل
18	شركة الرائد للصناعات البلاستيكية	الخليل

19	شركة امكو للصناعات البلاستيكية	الخليل
20	شركة تبانة للصناعات البلاستيكية	الخليل
21	شركة الربعاية للصناعات البلاستيكية	الخليل
22	الشركة الدولية للصناعات البلاستيكية	الخليل
23	شركة الدرمان للصناعات البلاستيكية	الخليل
24	شركة باستوبال للصناعات البلاستيكية	الخليل
25	شركة الوفاء للصناعات البلاستيكية	الخليل
26	شركة البركة للصناعات البلاستيكية	الخليل
27	شركة الرحمة للصناعات البلاستيكية	الخليل
28	شركة جابر للصناعات البلاستيكية	الخليل
29	شركة النجوم اللامعة للصناعات البلاستيكية	الخليل
30	شركة جراند بلاست للصناعات البلاستيكية	بيت لحم
31	شركة بيت لحم بلاستيك للصناعات البلاستيكية	بيت لحم
32	شركة النجمة للصناعات البلاستيكية	بيت لحم
33	شركة الرباح للصناعات البلاستيكية	رام الله
34	شركة بلاست تيك للصناعات البلاستيكية	رام الله
35	شركة بلاستيكو للصناعات البلاستيكية	رام الله
36	شركة حطاطوة للصناعات البلاستيكية	رام الله
37	شركة عابدين للصناعات البلاستيكية	رام الله
38	شركة عليان للصناعات البلاستيكية	رام الله
39	شركة الراجح للصناعات البلاستيكية	نابلس
40	شركة العقاد للصناعات البلاستيكية	نابلس
41	شركة زهدي الصناعية للصناعات البلاستيكية	نابلس

42	شركة أبو عيسى للصناعات البلاستيكية	نابلس
43	شركة الكامل للصناعات البلاستيكية	جنين
44	شركة الصباريني للصناعات البلاستيكية	جنين
45	شركة الاراضي المقدسة للصناعات البلاستيكية	جنين
46	شركة الحمدان للصناعات البلاستيكية	جنين
47	شركة اليرموك للصناعات البلاستيكية	جنين
48	شركة السيلاوي للصناعات البلاستيكية	جنين
49	شركة الشهد للصناعات البلاستيكية	طولكرم

جامعة النجاح الوطنية
كلية الدراسات العليا

تخصيص نموذج للتصنيع الأخضر للصناعات البلاستيكية الفلسطينية

إعداد
وجدي عوكل

إشراف
د. أحمد الرمحي
د. يحيى صالح

قدمت هذه الأطروحة استكمالا لمتطلبات الحصول على درجة الماجستير في الأدارة الهندسية بكلية الدراسات العليا في جامعة النجاح الوطنية في نابلس، فلسطين
2018

تخصيص نموذج للتصنيع الأخضر للصناعات البلاستيكية الفلسطينية

إعداد

وجدي عوكل

إشراف

د. أحمد الرمحي

د. يحيى صالح

الملخص

ازداد في عالمنا المعاصر وحول العالم الاهتمام في الأعمال التي من شأنها التخفيض والحد من الآثار السلبية التي تحيط بالبيئة وصحة الإنسان. إن الكثير من القطاعات على اختلافها تؤثر وتساهم بشكل سلبي وقاسي، ويظهر ذلك بشكل خاص في القطاعات الصناعية المتصفة بالاستهلاك الضخم والكبير للمصادر الطبيعية، وينتج عنها كميات كبيرة من المخلفات الصلبة. ومن اجل الحد من هذه الآثار، بدأت الكثير من الصناعات تستخدم وتوظف وتتبنى وتطبق استراتيجيات تتلخص بالانتقال إلى الصناعة الخضراء وذلك لتصبح صناعات صديقة للبيئة.

تهدف هذه الدراسة إلى تقييم مدى ممارسة وتطبيق مفهوم الصناعة الخضراء في فلسطين ، وفي الضفة الغربية بشكل محدد، وذلك في قطاع الصناعات البلاستيكية، استنادا إلى نموذج عام للصناعة الخضراء في الأدبيات, تم تخصيص وتطوير نظام خاص في الصناعات البلاستيكية، واخذ هذا النموذج في الاعتبار خمسة صفات أساسية مرتبطة بمؤشرات هامة، هي: البيئة، استخدام المصادر، استهلاك الطاقة، والصفات الاقتصادية والاجتماعية. تم لهذا الغرض جمع المعلومات من خلال استبانه نفذت ذاتيا من الباحث بالاعتماد على عينة عشوائية ضمت 49 مصنعا تعمل في الضفة الغربية، وتم تحليل البيانات التي تم جمعها من خلال برنامج إحصائي (SPSS) وذلك من خلال تحليل 3 مستويات، (منخفض، متوسط، مرتفع) والتي تعمل على قياس مستوى الصناعة الخضراء المطبقة في المصانع.

أظهرت التحاليل الإحصائية أن معظم مصانع البلاستيك التي خضعت للدراسة، يمارسون الصناعة الخضراء بدرجة متوسطة، بناءا عليه فانه تم تشجيع أصحاب العمل في مجال الصناعات البلاستيكية على ضرورة استخدام وتطبيق ومراجعة الاستراتيجيات المطبقة حاليا وذلك بهدف

الوصول إلى تطوير وتحسين نسبة مستويات التصنيع الأخضر في مصانعهم، إضافة إلى أن الدراسة توصي باستخدام النموذج المطور والمعدل الذي يشمل على المؤشرات الخمسة كأداة تقييم، وذلك لتقييم مدى تطبيق معايير التصنيع الأخضر في المصانع المقامة حاليا أو التي سيتمم إقامتها في فلسطين مستقبلا.