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Wastes Elimination as the First Step for Lean Manufacturing

"An Empirical Study for Gaza Strip Manufacturing Firms"

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نتيجة الحكم على أطروحة ماجستير

بناءً على موافقة عمادة الدراسات العليا بالجامعة الإسلامية بغزة على تشكيل لجنة الحكم على أطروحة الباحث/ **محمد سفيان محمد أبو شعبان** لنيل درجة الماجستير في **كلية *التجارة*/ قسم إدارة الأعمال**، وموضوعها:

Wastes Elimination as the First Step for Lean Manufacturing "An Empirical Study for Gaza Strip Manufacturing Firms"

وبعد المناقشة العلنية التي تمت اليوم الأربعاء 12 جماد أول 1433 هـ، الموافق 2012/04/04م الساعة الثانية عشرة والنصف ظهرًا بمبنى القدس، اجتمعت لجنة الحكم على الأطروحة والمكونة من:

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وبعد المداولة أوصت اللجنة بمنح الباحث درجة الماجستير في **كلية *التجارة*/ قسم** إدارة الأعمال.

واللجنة إذ تمنحه هذه الدرجة فإنها توصيه بتقوى الله ولزوم طاعته وأن يسخر علمه في خدمة دينه ووطنه.

والله ولي التوفيق ،،،

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(رَبِّ أَوْزِعْنِي أَنْ أَشْكُرَ نِعْمَتَكَ الَّتِي أَنْعَمْتَ عَلَيَّ وَعَلَى وَالِدَيَّ وَأَنْ أَعْمَلَ صَالِحًا تَرْضَاهُ وَأَدْخِلْنِي بِرَحْمَتِكَ فِي عِبَادِكَ الصَّالِحِينَ)

صدق الله العظيم

(سورة النمل، آية 19)

Dedication

To my beloved mother whose love, care, and support inspired me to reach thus far.

To my father who has always loved and supported me, not only during this research, but also throughout all of my life

To my wife and our children (Maryam and Haya)

To my beloved brothers and sisters

I dedicate this study to those who encouraged me to accomplish this mission

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To complete this study, a lot of time and effort had been spent to arrive at this final product which culminated in the compilation of this thesis. During my studies, I was gratefully provided with assistance and advice from my academic staff, which made this study possible to complete. Therefore, I would like to take this opportunity to express my deep gratitude to all those who have helped to bring this research to light. Among those, I would like to single out, with great appreciation and thanks, my supervisor, **Dr. Khalil El-Namrouty,** whose contribution has greatly enhanced the quality of the material contained in this thesis.

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List of Abbreviations

Abbreviation	Meaning
WRM	Wastes Relations Matrix
FIFO	First In, First Out
LIFO	Last In, First Out
5S's	Sort, Straighten, Shine, Standardize, and Sustain
VSM	Value Stream Mapping
TPM	Total Preventive Maintenance
JIT	Just-in-Time
QC	Quality Control
Per C.	Per Capita
DAI	Development Alternatives, Inc.
GDP	Gross Domestic Product
GNI	Gross National Income
GDI	Gross Domestic Income
GFCF	Gross Fixed Capital Formation
O	Over-production
I	Inventory
D	Defects
M	Motion
T	Transportation
W	Waiting
P	Over-processing
IDS	Institute of Development Studies
MAS	Palestine Economic Policy Research Institute
Palestine Trade Center	PalTrade
PFI	Palestinian Federation of Industries
PCBS	The Palestinian Central Bureau of Statistics
ZCSC	Zaytoona Center for Studies and Consultations
CIP	Continuous Improvement Professionals
ME	The Manufacturing Edge
PFI	Palestinian Federation of Industries
H1	Hypothesis Number (1)
H2	Hypothesis Number (2)

Wastes Elimination as the First Step for Lean Manufacturing
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ABSTRACT

This Research aims to investigate the current situation of wastes elimination in the manufacturing firms in the Gaza Strip and its important role for reducing the production cost. This research considers the best ways of eliminating wastes, investigates and analyzes the production wastes in the Gaza Strip factories, and promotes for lean thinking through studying the seven wastes that are targeted by the lean manufacturing philosophy, which are: Overproduction, Inventory, Over-processing, Motion, Waiting, Defects, and Transportation. It also addresses the concept of identification and elimination of wasteful activities.

For this purpose, Wastes Relations Matrix (WRM) was implemented to analyze the effect of each waste on the other six wastes; this implementation is based on literature review and by brainstorming through a group session of three professional managers of the manufacturing business in the Gaza strip. Then, the researcher distributed a questionnaire for the managers of the manufacturing firms having more than nine fixed employees to analyze their recognition for the production wastes in their business, where the total number of these firms in the Gaza Strip was 114 (Respondents were 99 out of 114 within a recovery rate of 86.8%).

The main findings are that lean manufacturing (wastes elimination) affects positively on reducing the production cost for the manufacturing business in the Gaza strip, and the ranking nearly converged of the most wastes affecting the production cost for both of used primary sources as follows:

Serial	Primary Source	1st Waste	2nd Waste	3rd Waste	4th Waste	5th Waste	6th Waste	7th Waste
1	Wastes Relations Matrix	Defects	Motion	Each of: Waiting+ Transportation+ Over-production			Processing	Inventory
Serial	Primary Source	1st Waste	2nd Waste	3rd Waste	4th Waste	5th Waste	6th Waste	7th Waste
2	Questionnaire	Defects	Motion	Waiting	Transportation	Over-production	Processing	Inventory

The main recommendations of this research are the necessity of the manufacturing managers to implement the techniques of eliminating wastes which lead to huge improvement in their production and they should train all of their employees in all of the managerial levels about these techniques.

التخلص من فواقد الإنتاج كخطوة أولى نحو التصنيع الرشيق
"دراسة ميدانية لشركات الصناعات التحويلية في قطاع غزة"

الملخص

تهدف هذه الدراسة إلى التحقق من الواقع الحالي للتخلص من فواقد الإنتاج بالمنشآت الصناعية في قطاع غزة ودورها المهم في تقليل تكلفة الإنتاج. فيقوم هذا البحث بتوضيح أفضل الطرق المتبعة للتخلص من هذه الفواقد ويحللها ويروج للتفكير بهذه الطريقة وذلك من خلال دراسة فواقد الإنتاج السبعة المشار إليها بفلسفة التصنيع الرشيق، وهي: الإنتاج الزائد عن الحاجة، المخزون الزائد، عمليات التصنيع الزائدة، الحركة الزائدة للآلات والعاملين، انتظار الآلات والعاملين، المنتجات المعيبة، والمواصلات. وكذلك تقوم هذه الدراسة بتوضيح فكرة التعرف على النشاطات غير اللازمة للإنتاج والتخلص منها.

ولتحقيق أهداف الدراسة، تم استخدام نموذج مصفوفة العلاقات لقياس أثر كل فاقد من فواقد الإنتاج السبعة على باقي الفواقد اعتمادا على الإطار النظري باستخدام طريقة العصف الذهني ضمن مقابلة جماعية مع ثلاثة أشخاص من مدراء الصناعة في قطاع غزة، ثم قام الباحث بعدها بتوزيع استبانة على مدراء الشركات الصناعية التي لديها أكثر من 9 موظفين ثابتين لمعرفة مدى إدراكهم لأهمية التخلص من فواقد الإنتاج حيث كان عدد هذه الشركات هو 114 شركة أجاب منهم 99 شركة بنسبة استرداد بلغت 86.8%.

أهم النتائج هي أن التصنيع الرشيق (التخلص من فواقد الإنتاج) يؤثر إيجابا على تقليل تكلفة الإنتاج للمنشآت الصناعية بقطاع غزة، ولقد تقارب ترتيب أهم الفواقد المؤثرة على تكلفة الإنتاج لكلا المصدرين الأساسيين المستخدمين على النحو التالي:

م	المصدر الأساسي	الفاقد الأول	الفاقد الثاني	الفاقد الثالث	الفاقد الرابع	الفاقد الخامس	الفاقد السادس	الفاقد السابع
1	نموذج الارتباط	المنتجات المعيبة	الحركة الزائدة للآلات والعاملين	بنفس الدرجة كل من: انتظار الآلات والعاملين+ المواصلات+ الإنتاج الزائد عن الحاجة			عمليات التصنيع الزائدة	المخزون الزائد
م	المصدر الأساسي	الفاقد الأول	الفاقد الثاني	الفاقد الثالث	الفاقد الرابع	الفاقد الخامس	الفاقد السادس	الفاقد السابع
2	الاستبانة	المنتجات المعيبة	الحركة الزائدة للآلات والعاملين	انتظار الآلات والعاملين	المواصلات	الإنتاج الزائد عن الحاجة	عمليات التصنيع الزائدة	المخزون الزائد

وقد خرجت الدراسة بمجموعة من التوصيات أهمها ضرورة تطبيق إدارات الشركات الصناعية في قطاع غزة لطرق التخلص من فواقد الإنتاج لما فيها من تحسين وتطوير كبير لإنتاجهم وعليهم تدريب جميع موظفيهم بجميع المستويات الإدارية على هذه الطرق.

Chapter One

Research Framework

1.1 Introduction

1.2 Problem Statement

1.3 Research Hypotheses

1.4 Research Variables

1.5 Research Objectives

1.6 Research Limitations

1.7 Research Importance

1.1 Introduction:

A new vocabulary has developed in the past decade that stems from the Toyota Production System. Lean manufacturing is a concept whereby all production employees work together to eliminate waste. Industrial engineering, industrial technologists, and other groups within management have been attempting this by themselves since the beginning of the industrial revolution(1), but now that have a well-educated, motivated production work force, modern manufacturing management has discovered the advantage of seeking the work force's help in eliminating waste. (Meyers and Stewart, 2002).

Waste is defined as any thing that does not add value to the end product from the consumer perspective. (Meyers and Stewart, 2002).

Major businesses in the US have been trying adopting new business initiative in order to stay alive in the new market place. Lean Manufacturing is one of these initiatives that focus on cost reduction by eliminating non-value added activities. (Abdullah, 2003).

Manufacturers throughout industries from automotive to aircraft to paint to computers to furniture and so on are moving to a different system of production called Lean Manufacturing. It is not talking about adding some new techniques onto how now build products, but actually changing the way of thinking about manufacturing. The first step in implementing lean manufacturing successfully is to identify the various types of wastes, and then to eliminate or reduce them. (Abdullah, 2003).

The seven wastes that are targeted by the Lean Manufacturing Philosophy are: Overproduction, Inventory, Over-processing, Motion, Waiting, Defects, and Transportation. (Poppendieck, 2002).

Waste can be categorized into seven categories: Overproduction, Inventory, Over-processing, Motion, Waiting, Defects, and Transportation. (Rawabdeh, 2005).

(1) The Industrial Revolution: a period from 1750 to 1850 where changes in agriculture, manufacturing, transportation, and technology had a profound effect on the social, economic, and cultural conditions of the times. It began in the UK, and then spread throughout Western Europe, North America, Japan, and eventually the rest of the world. (Lucas, 2004).

If we consider that developing the Palestinian economy is the objective, the successful manufacturing procedures of the Palestinian products would be the first step. Any Palestinian company that is seeking the ability of an effective competition in the global marketplace should be in superiority of producing their products with the least possible costs to achieve excellence in price and quality.

The number of the manufacturing firms in Palestine (Gaza Strip and West Bank) is 14645. (PCBS, 2010).

There are 33933 working establishments in Gaza Strip including 3529 manufacturing firms. In reality, the manufacturing activities in Gaza Strip represent 10.4% of the total economy in the Gaza Strip. (PCBS, 2008).

The following table shows the number of the manufacturing firms operating in the Gaza Strip and their distribution by the employment group size:

Table (1.1): No. of the Manufacturing Firms Operating in the Gaza Strip and their Distribution by the Employment Group Size

Economic Activity	Total	The Employment Group Size					
		1-4	5-9	10-19	20-49	50-99	100+
Manufacturing	3529	2883	442	158	36	5	5

"Source: PCBS, (2008). *Population, Housing and Establishment Census (2007), The Economic Establishments,* The Final Results, Ramallah-Palestine".

The military aggression in the Gaza Strip (Dec.,2008 to Jan.,2009) resulted in the extensive destruction of homes, infrastructure and cut to the ways of living. Also, it has negatively affected the Palestinian private sector, where many industrial, agricultural lands and infrastructure had become unable to work as they should do. Nearly, one third of the damaged institutions are manufacturing establishments (324 institutions). (PalTrade and PFI, 2010).

Hence, this research seeks to provide a comprehensive picture of the reality of the wastes elimination management in its multiple dimensions in the manufacturing firms, stating the effect of applying this system to reduce the production cost in these firms, thus paving the way for officials to make steps and to develop policies to ensure the competition of the Palestinian industry.

1.2 Problem Statement:

The researcher thinks that managers in the Gaza Strip are focusing on the manufacturing processes or the value-added activities in order to improve their business profitability. On the other hand, they neglect the importance and effects of the non-value added activities which usually are not appeared explicitly, e.g., storage, transportation, and motion.

Cost of producing a certain product is the sum of costs of all activities that this product passes. Non-value added activities (wastes) could represent the most of product costs and they have the opportunity to be reduced without affecting the customer's satisfaction. This idea encourages managers to pay more attention to the importance of eliminating non-value added activities. (Abdullah, 2003).

Therefore, the research main question is: **What is the effect of lean manufacturing on the production cost for the manufacturing firms in the Gaza Strip??**

1.3 Research Hypotheses:

H1: There is a significant statistical effect for lean manufacturing on the production cost for the manufacturing firms in the Gaza Strip.

This hypothesis includes the following sub-hypotheses:

- H1a: There is a significant statistical effect for overproduction on the production cost for the manufacturing firms in the Gaza Strip.
- H1b: There is a significant statistical effect for inventory on the production cost for the manufacturing firms in the Gaza Strip.
- H1c: There is a significant statistical effect for over-processing on the production cost for the manufacturing firms in the Gaza Strip.
- H1d: There is a significant statistical effect for motion on the production cost for the manufacturing firms in the Gaza Strip.
- H1e: There is a significant statistical effect for waiting on the production cost for the manufacturing firms in the Gaza Strip.
- H1f: There is a significant statistical effect for defects on the production cost for the manufacturing firms in the Gaza Strip.

- H1g: There is a significant statistical effect for transportation on the production cost for the manufacturing firms in the Gaza Strip.

H2: There is no significant statistical difference among respondents regarding lean manufacturing attributed to personal variables (Age, Specialization, Scientific Qualification, and Position).

Figure (1.1) shows the relations conceptual model for H1:

Figure (1.1): The Relations Conceptual Model for H1

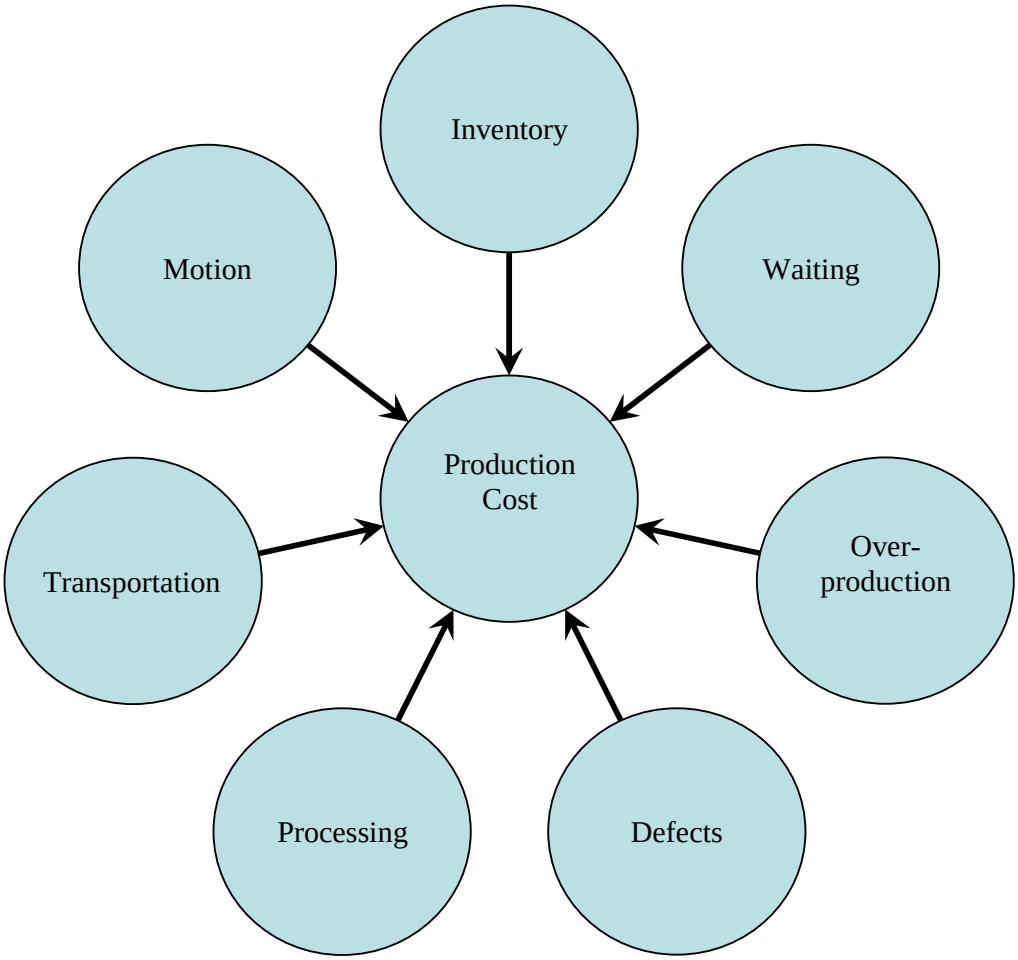
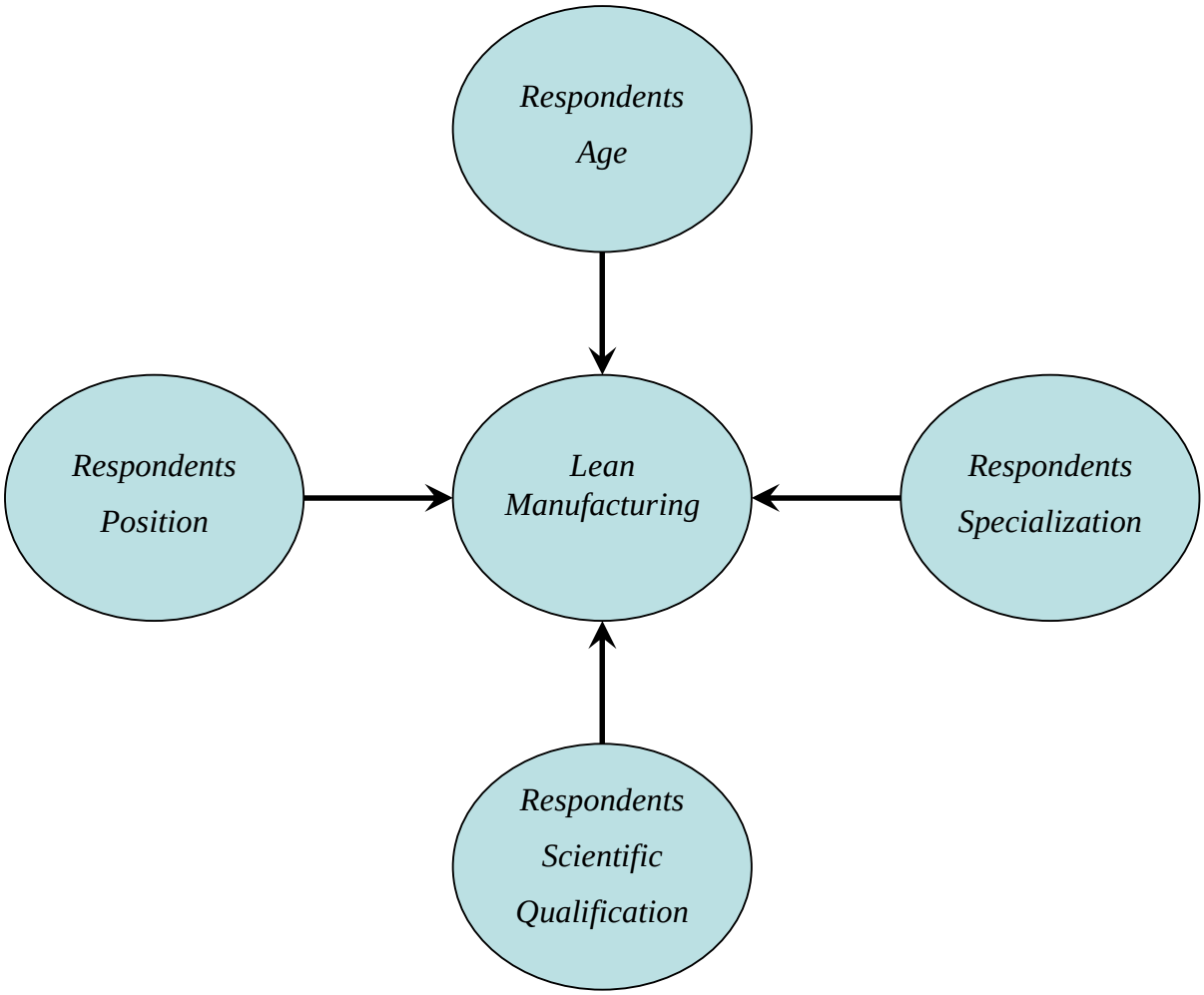


Figure (1.2) shows the relations conceptual model for H2:

Figure (1.2): The Relations Conceptual Model for H2



1.4 Research Variables:

For H1:

I. Dependent Variable: *The Production Cost*

II. Independent Variables:

1- Inventory

2- Waiting

3- Overproduction

4- Defects

5- Processing

6- Transportation

7- Motion

For H2:

I. Dependent Variable: *Lean Manufacturing*

II. Independent Variables:

1. *Respondents Age*
2. *Respondents Specialization*
3. *Respondents Scientific Qualification*
4. *Respondents Position*

1.5 Research Objectives:

The main goal of this research is to investigate the current situation of wastes elimination in the manufacturing firms in the Gaza Strip and its important role for reducing the production cost. Other research objectives are:

1. Exploring the wastes elimination procedures used by the manufacturing firms in the Gaza Strip
2. Highlighting the best ways of eliminating wastes.
3. Analyzing the production wastes in the Gaza Strip factories.
4. Dissemination and promotion of Lean thinking to the managers of Gaza Strip manufacturing firms.

1.6 Research Limitations:

In order to achieve the objectives of the study and answer the questions posed, the researcher had to overcome a series of difficulties and obstacles related to the subject of the study, whether it is related to the authenticity of the subject of the study (which gave the research importance), the dearth of information, or not receiving enough cooperation from the manufacturing firms in Gaza Strip. In addition, Palestinian manufacturing managers believe that any information related to their business is confidential and should not be shared with others especially that information related to their capital.

The main limitation hinders this research is that the last census of the manufacturing firms in the Gaza Strip had been prepared in 2007. So, there is no current specific number for these firms to depend on; especially that a lot of

manufacturing firms' buildings and capacity had been destroyed in the latest war on Gaza in December, 2009.

1.7 Research Importance:

The researcher thinks that it is very important for the manufacturing managers in the Gaza Strip to acquire the benefits of using the best ways of eliminating wastes that leads to huge improvement in the production. Also, it is so important for all of the following:

1.7.1 For the Palestinian Economy:

Any Palestinian firm that is seeking the ability of an effective competition in the global marketplace has to be in superiority of producing their products with the least possible costs to achieve excellence in price and quality.

The economic importance of this study is related to the contribution of the manufacturing firms in the local Palestinian economy.

1.7.2 For the Manufacturing Sector in the Gaza Strip:

The researcher thinks that this research will add knowledge to the decision makers in the Gaza Strip manufacturing firms through clarifying the explicit mechanism of applying wastes elimination management.

Also, this study may contribute to develop the work of the service institutions in Palestine.

1.7.3 For the Academic Society:

The researcher thinks that it is one of the few studies seeking for the relationship between wastes elimination and the production cost in the Arabic and the Palestinian areas; especially in the Gaza Strip. In addition, the research will add an empirical study in the field of wastes elimination that will enhance the Palestinian and the Arabic library.

1.7.4 For the Researcher:

The researcher thinks that this research will give him a new knowledge about the production management in order to be an affective person, and it will be a great step toward more higher education that will assist his Arabic and Palestinian society.

Chapter Two

Literature Review

2.1 History of Lean

2.2 Lean Manufacturing Definition

2.3 Main Kinds of Wastes

2.4 Lean Manufacturing Tools and Techniques

2.5 The Benefits of Lean Manufacturing

2.6 General Commentary on Wastes in the Gaza Strip Manufacturing Firms

2.7 General Commentary on Lean Manufacturing Tools and Techniques in the Gaza Strip Manufacturing Firms

2.1 The History of Lean:

After World War II, Japanese manufacturers were faced with the dilemma of vast shortages of material, financial, and human resources. The problems that Japanese manufacturers were faced with differed from those western counterparts. These conditions resulted in the birth of lean manufacturing concept. Toyota motor company, led by its president (Toyota), recognized that American automakers of the era were out produced their Japanese counterparts; in the mid 1940's American companies were outperforming their Japanese counterparts by a factor of ten. In order to make a move toward improvement early, Japanese leaders, such as, Shigeo Shingo and Taiichi Ohno, devised a new, disciplined, process-oriented system, which is known today as "Toyota Production System" or "Lean Manufacturing". (Abdullah, 2003).

Taiichi Ohno, who was given the task of developing a system that would enhance productivity at Toyota, is generally considered to be the primary force behind his system. Ohno draw among some ideas from the west and particularly from Henry Ford's book "Today and Tomorrow." Ford's moving assembly line of continuously flowing material formed the basis for the Toyota production system. After some experimentation, the Toyota production system was developed and refined between 1945 and 1970, and is still growing today all over the world. The basic underlying idea of this system is to minimize the consumption of resources that add no value to a product. (Liker, 2004).

Into the 1980s, many product markets in the United States and Europe started to come under pressure from foreign manufacturers. Products were being brought to market with higher quality and lower price. The days of planned obsolescence were over. Consumers came to expect higher quality and lower prices as a requisite for purchase. Western manufacturers began to lose market share. Some manufacturers faded away while others began to look diligently for better ways to compete. Many abandoned the old batch manufacturing models in favor of the more responsive method of Lean manufacturing in pursuit of the goals of faster response, fewer inventories, higher quality, and reduced costs. (Hobbs, 2004).

In order to compete in today's fiercely competitive market, US manufacturers have come to realize that the traditional mass production concept has to be adapted to the

new ideas of lean manufacturing. A study that was done at the Massachusetts Institute of Technology of the movement from mass production to world lean manufacturing underscored the great success of Toyota at NUMMI (New United Motor Manufacturing Inc.) and brought out the huge gap that existed between the Japanese and western automotive industry. The ideas came to be adopted in the US because the Japanese companies developed, produced and distributed products with half or less human effort, capital investment, floor space, tools, materials, time, and overall expense. (Khatri, et.al, 2011).

2.2Lean Manufacturing Definition:

Lean manufacturing is defined as "A philosophy, based on the Toyota Production System, and other Japanese management practices that strives to shorten the time line between the customer order and the shipment of the final product, by consistent elimination of waste". All types of companies, manufacturing, process, distribution, software development or financial services can benefit from adopting lean philosophy. As long as a company can identify a value stream, from when the customers order product to when they receive it, lean principles can be applied and waste removed. (Singh, 1999).

Also, lean manufacturing is: "Adding value by eliminating waste, being responsive to change, focusing on quality, and enhancing the effectiveness of work force".
(Liker, 2004).

Another definition for lean manufacturing: "it is a systematic approach to identify and eliminate waste (non-value added activities) through continuous improvement by following the product at the pull of the customer in pursuit of perfection". (Czarnecki and Loyd, 1998).

Also, lean manufacturing is: "A manufacturing philosophy that shortens the time between customer order and the product build/shipment by eliminating sources of waste". (liker and Lamb, 2000).

2.2.1 Traditional vs. Lean Manufacturing:

For years manufacturers have created products in anticipation of having a market for them. Operations have traditionally been driven by sales forecasts and firms tended to stockpile inventories in case they were needed. A key difference in Lean Manufacturing is that it is based on the concept that production can and should be driven by real customer demand. Instead of producing what is hoped to be sold; Lean Manufacturing can produce what your customer wants with shorter lead times. Instead of pushing product to market, it is pulled there through a system that is set up to quickly respond to customer demand. (Ibrahim, 2011).

Lean organizations are capable of producing high-quality products economically in lower volumes and bringing them to market faster than mass producers. A lean organization can make twice as much product with twice the quality and half the time and space, at half the cost, with a fraction of the normal work-in-process inventory. Lean management is about operating the most efficient and effective organization possible, with least cost and zero waste. (Minggu, 2009).

Table (2.1) illustrates the differences between the traditional mass production and lean production in terms of organizational characteristics:

Table (2.1): Organizational Characteristics of Traditional Mass Production and Lean Manufacturing

Organizational Characteristics	Traditional Mass Production	Lean Production
Business Strategy	Product-out strategy focused on exploiting economies of scale of stable product designs and non-unique technologies	Customer focused strategy focused on identifying and exploiting shifting competitive advantage
Customer Satisfaction	Makes what engineers want in large quantities at statistically acceptable quality levels; dispose of unused inventory at scale prices	Makes what customers want with zero defect, when they want it and only in the quantities they order
Leadership	Leadership by executive command	Leadership by vision and broad participation
Organization	Hierarchical structures that encourage following orders and discourage the flow of vital information that highlights defects, operator, error, equipment, abnormalities, and organizational deficiencies	Flat structures that encourage initiative and encourage the flow of vital information and highlights defects, operator, error, equipment, abnormalities, and organizational deficiencies
External Relations	Based on price	Based on long-term relationships
Information Management	Information-weak management based on abstract report	Information-rich management based on visual control systems maintained by all employees
Cultural	Culture of loyalty and obedience, subculture of alienation, and labor strife	Harmonies culture of involvement based on long-term development of human resources
Production	Large-scale machines, functional layout, minimal skills, long-production runs, massive inventories	Human-scale machines, cell-type layout, multi-skilling, one-piece flow, zero inventories
Operation Capability	Dumb tools that assume an extreme division of labor, the following of orders, and no problem solving skills	Smart tools that assume standardized work, strength in problem identification, hypothesis generation, and experimentation
Maintenance	Maintenance by maintenance specialists	Equipment management by production, maintenance and engineering
Engineering	"Isolated genius" model, with little input from customers and little respect from production realities	Team-based model, with high input from customers and concurrent development of product and production process design

"Source: CIP, (2006). *"Lean Manufacturing / Lean Production"*. http://www.dynamicbiz.us/366/article-leanmanufacturing.html".

Table (2.2) illustrates the differences between the traditional mass production and lean production in terms of manufacturing methods:

Table (2.2): Methods of Manufacturing of Traditional Mass Production and Lean Manufacturing

Manufacturing Methods	Traditional Mass Production	Lean Production
Production schedules are based on	Forecast-product is pushed through the facility	Customer order-product is pulled through the facility
Products manufactured to	Replenish finished goods inventory	Fill customer orders (immediate shipments)
Production cycle times are	Weeks/month	Hours/days
Manufacturing lot size quantities are	Large, with large batches moving between operations; product is sent a hard of each operation	Small, and based on one-piece flow between operations
Plant and equipment layout is	By department function	By product flow, using cells or lines for product families
Quality is assured	Through lot sampling	100% at the production source
Workers are typically assigned	One person per machine	With one person handling several machines
Workers empowerment is	Low-little input into how operation is performed	High-has responsibility for identifying and implementing improvements
Inventory level are	High-large warehouse of finished goods, and central storeroom for in-process staging	Low-small amounts between operations ship often
Inventory turns are	Low-6-9 turns per year or less	High 20+ turns per year
Flexibility in changing manufacturing schedules is	Low-difficult to handle and adjust to	High-easy to adjust to and implement
Manufacturing costs are	Rising and difficult to control	Stable/decreasing and under control

"Source: CIP, (2006). *"Lean Manufacturing / Lean Production"*. http://www.dynamicbiz.us/366/article-leanmanufacturing.html".

2.2.2 Value Creation and Waste:

In lean manufacturing, the value of a product is defined solely based on what the customer actually requires and is willing to pay for. Production operations can be grouped into three types of activities: (Nielsen, 2008).

- Value-added activities: are activities which transform the materials into the exact product that the customer requires.
- Non value-added activities: are activities which are not required for transforming the materials into the product that the customer wants.

Anything which is non-value-added may be defined as a waste. Anything that adds unnecessary time, effort or cost is considered non value-added. Another way of looking at waste is that any material or activity for which the customer is not willing to pay. Testing or inspecting materials is also considered waste since it can be eliminated insofar as the production process can be improved to eliminate defects from occurring.

- Necessary non value-added: are activities that do not add value from the perspective of the customer but are necessary to produce the product unless the existing supply or production process is radically changed. This kind of waste may be eliminated in the long-run but is unlikely to be eliminated in the near-term. For example, high levels of inventory may be required as buffer stock, although this could be gradually reduced as production becomes more stable.

Value added activities transform the product into something the customer wants. In manufacturing, this is generally a physical transformation of the product to make it to conform to customer expectations. Figure (2.1) shows a simplified version of the steps required to make a steel subassembly. By add-value we mean that they transform the product physically toward something the customer wants. (liker and Lamb, 2000).

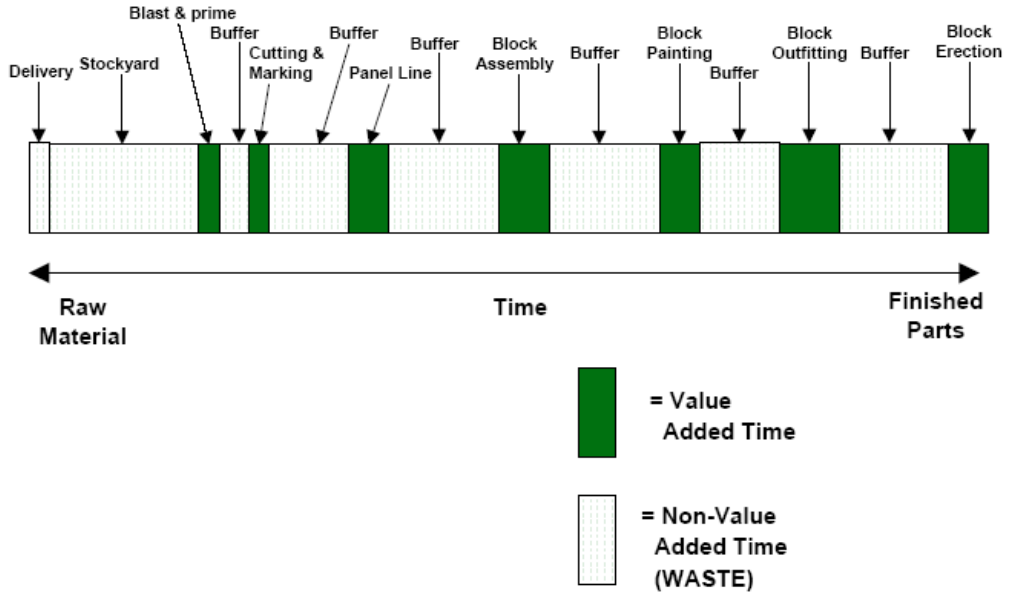


Figure (2.1): Elements of product lead-time
"Source: (liker and Lamb, 2000)"

The results of the lean approach are illustrated in Figure (2.2) below. Lean manufacturing will take some waste out of the value added activities shrinking it down as in the mass production approach, but more importantly, it reduces the pure non-value added activities, which has the large impact on lead-time. (liker and Lamb, 2000).

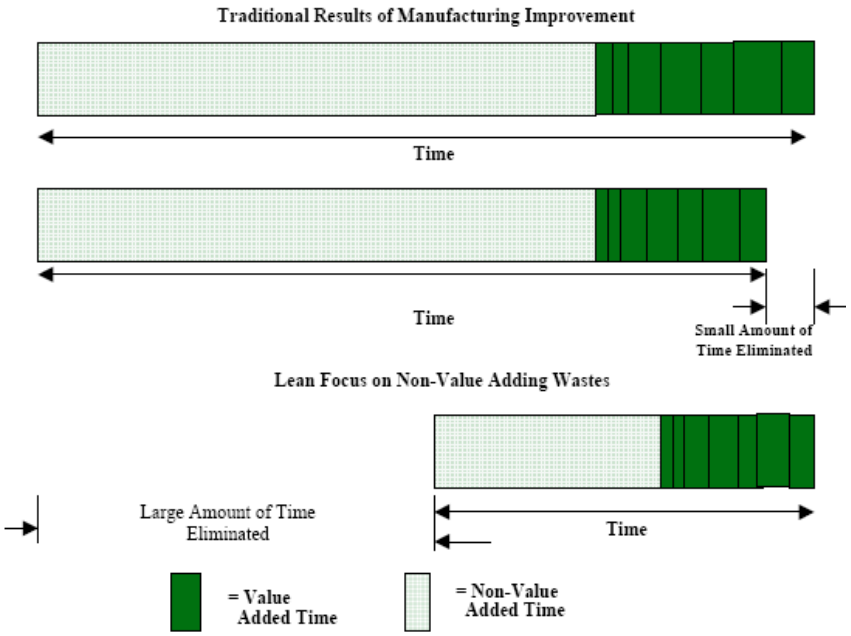


Figure (2.2): Traditional vs. Lean approaches
"Source: (liker and Lamb, 2000)"

"Lean" focuses on abolishing or reducing wastes (or "muda", the Japanese word for waste) and on maximizing or fully utilizing activities that add value from the customer's perspective. So the elimination of waste is the basic principle of lean manufacturing. (Womack and Jones, 2003).

2.3 Main Kinds of Wastes:

Seven main types of wastes were identified as a part of the Toyota Production System. However, this list has been modified and expanded by various practitioners of lean manufacturing and generally includes the following:

1. Overproduction: overproduction is unnecessarily producing more than demanded, or producing it too early before it is needed. This increases the risk of obsolescence, increases the risk of producing the wrong thing and increases the possibility of having

to sell those items at a discount or discard them as scrap. However, there are some cases when extra supplies of semi-finished or finished products are intentionally maintained, even by lean manufacturers. (Capital, 2004).

Overproduction is regarded as the most serious waste as it discourages a smooth flow of goods or services and is likely to inhibit quality and productivity. Such overproduction also tends to lead to excessive lead and storage times. As a result, defects may not be detected early, products may deteriorate and artificial pressures on work rate may not be generated. In addition, it leads to excessive work-in-process stocks which result in the physical dislocation of operations with consequent poorer communication. This state of affairs is often encouraged by bonus systems that encourage the push of unwanted goods. The pull (kanban) system was employed by Toyota as a way of overcoming this problem. (Hines and Rich, 2007).

Overproduction leads to inventory stockpiles, extra equipment, unbalanced material flow, extra parts storage, extra manpower, batch processing, complex inventory management, excessive investment, additional floor space storage, hidden problems, and large lot sizes. (Leon, 1999).

2. Defects: In addition to physical defects which directly add to the costs of goods sold, this may include errors in paperwork, provision of incorrect information about the product, late delivery, production to incorrect specifications, use of too much raw materials or generation of unnecessary scrap. (Capital, 2004).

Defects waste is a direct cost. When defect occurs, rework may be required; otherwise the product will be scrapped. Generation of defects will not only waste material and labor resources, but it will also create material shortages, hinder meeting schedules, create idle time at subsequent workstations and extend the manufacturing lead time. (Rawabdeh, 2005).

Defects waste leads to extra tools and equipments, extra manpower, stockpiling inventory, complex material flow, questionable quality, missed deliveries and low profits. (Leon, 1999).

3. Inventory: Inventory waste means having unnecessarily high levels of raw materials, works-in-process and finished products. Extra inventory leads to higher inventory financing costs, higher storage costs and higher defect rates. (Capital, 2004). Inventory tends to increase lead time, prevents rapid identification of problems and increase space requirements, thereby discouraging communication. In order to conduct effective purchasing, it is especially necessary to eliminate inventory due to incorrect lead times and due-dates. Removal of buffer stock is a major problem that should be addressed on the shop floor. (Rawabdeh, 2005).

Inventory waste leads to extra space on receiving docks, materials among processes, stagnated material flow, LIFO instead of FIFO, extensive rework, long lead time, and additional material handling resources. (Leon, 1999).

4. Transportation: Transportation includes any movement of materials that does not add any value to the product, such as moving materials between workstations. The idea is that transportation of materials between productions stages should aim for the ideal that the output of one process is immediately used as the input for the next process. Transportation between processing stages results in prolonging production cycle times, the inefficient use of labor and space and can also be a source of minor production stoppages. (Capital, 2004).

Taken to an extreme, any movement in the firms could be viewed as waste. So, transportation minimization rather than total removal is usually sought. In addition, double handling and excessive movements are likely to cause damage and deterioration with the distance of communication between processes proportional to the time it takes to feed back reports of poor quality and to take corrective action. (Hines and Rich, 2007).

Transportation waste leads to multiple storage locations, extra material racks, complex inventory management, extra facility space, incorrect inventory counts, and damaged materials. (Leon, 1999).

5. Waiting: Waiting is idle time for workers or machines due to bottlenecks or inefficient production flow on the factory floor. Waiting also includes small delays

between processing of units. Waiting results in a significant cost insofar as it increases labor costs and depreciation costs per unit of output. (Capital, 2004).

When time is being used ineffectively, then the waste of waiting occurs. This waste occurs whenever goods are not moving or being worked on. This waste affects both goods and workers, each spending time waiting. The ideal state should be no waiting time with a consequent faster flow of goods. Waiting time for workers may be used for training or maintenance activities and should not result in overproduction.
(Hines and Rich, 2007).

Waiting leads to unbalanced operations, lack of operator concern for equipment breakdown, and unplanned equipment downtime. (Leon, 1999).

6. Motion: Motion includes any unnecessary physical motions or walking by workers which divert them from actual processing work. For example, this might include walking around the factory floor to look for a tool, or even unnecessary or difficult physical movements, due to poorly designed ergonomics, which slow down the workers. (Capital, 2004).

Motion waste involves poor ergonomics of production, where operators have to stretch, bend and pick up when such actions could be avoided. Such waste is likely lead to poor productivity and quality problems. (Rawabdeh, 2005).

Motion waste leads to excessive reaching or bending, tools missing, and poor managerial control. (Leon, 1999).

7. Over-processing: Over-processing is unintentionally doing more processing work than the customer requires in terms of product quality or features- such as polishing or applying finishing in some areas of product that will not be seen by the customer. (Capital, 2004).

Over-processing occurs in situations where overly complex solutions are found to simple procedures, such as using a large inflexible machine instead of several small flexible ones. The over-complexity discourages ownership and encourages employees to overproduce to recover the large investment in the complex machines. Such

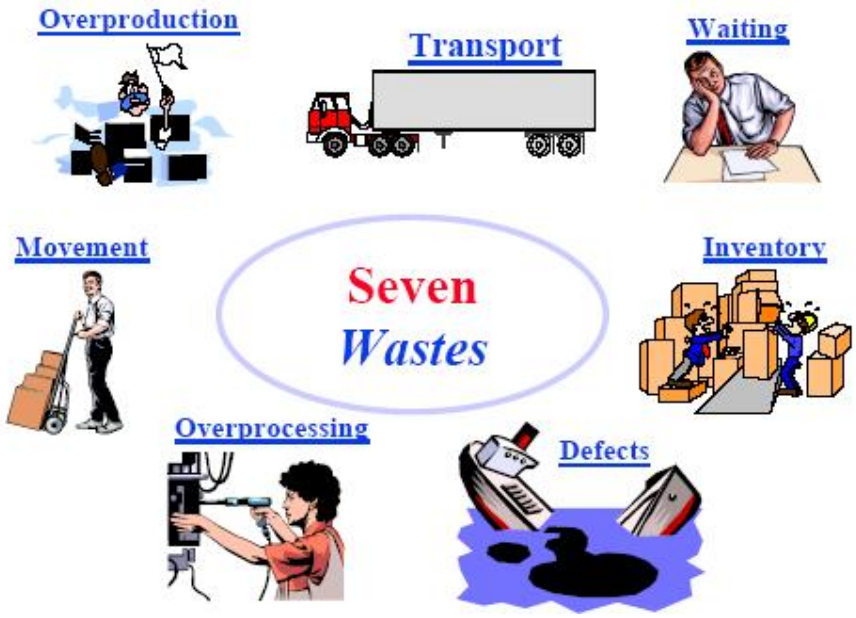
approach encourages poor layout leading to excessive transportation and poor communication. (Hines and Rich, 2007).

Over-processing leads to bottlenecks, lack of clear customer specifications, redundant approvals, extra copies, and excessive information. (Leon, 1999).

The seven wastes are shown in Figure (2.3):

Figure (2.3): Seven Wastes

"Source: (Capital, 2004)"



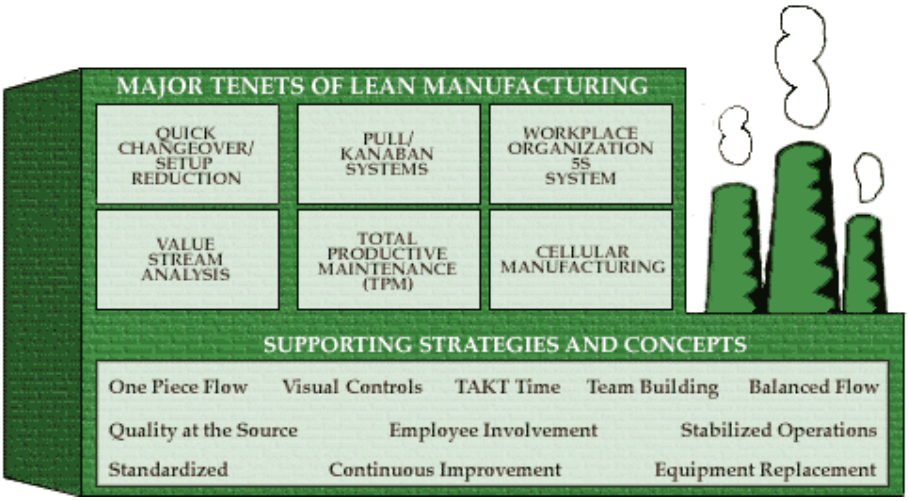
Waste sources are all related to each other and getting rid of one source of waste can lead to either elimination of, or reduction in others. Perhaps the most significant source of waste is inventory. Work-in-process and finished parts inventory do not add value to a product and they should be eliminated or reduced. When inventory is reduced, hidden problems can appear and action can be taken immediately. (Rawabdeh, 2005).

There is no question that the elimination of waste is an essential ingredient for survival in today's manufacturing world. Companies must strive to create high-quality, and low cost products that can get to the customers in the shortest time possible. There are sets of tools that were developed at Toyota and that can be utilized to eliminate or at least reduce the sources of waste. (Abdullah, 2003).

2.4 Lean Manufacturing Tools and Techniques:

Once the companies pinpoint the major sources of waste, tools such as provided in the Fig. (2.4) will guide the companies through corrective action so as to eliminate wastes. (ME, 2011).

Figure (2.4): Lean Manufacturing Tools & Techniques



"Source: ME, 2011"

In the following sections, a brief description of the foundations of lean manufacturing tools:

1. Cellular Manufacturing:

Manufacturing cells group machines, employees, materials, tooling, and material handling and storage equipment to produce families. The most important benefit of cellular manufacturing are achieved when manufacturing cells are designed, controlled and operated using just-in-time (JIT), Total Quality Management (TQM), and Total Employee Involvement (TEI) concepts and techniques. Successful implementation of manufacturing cells requires addressing selection, design, operation, and control issue. Selection refers to the identification of machine and part types for a particular cell. (Tompkins, et.al, 1996)**.**

Cell design refers to layout, production, and material handling requirements. Operation of a cell involves determining lot sizes scheduling, number of operators, and type of operator's control (push vs. pull). Finally control of a cell refers to the methods used to measure the performance of the cell. (Tompkins, et.al, 1996)**.**

Cellular layouts are characterized by the following characteristics: (Capital, 2004).

1. Continuous flow: There is a smooth flow of materials and components through the cell with virtually no transporting or waiting time between production stages.
2. One-piece flow: Cellular manufacturing utilizes a one piece flow so that one product moves through the manufacturing process one piece at a time.
3. Multi-purpose workers: There are only one or several workers in each cell and unlike batch processing where workers are responsible for a single process, in cell manufacturing the cell workers are responsible for handling each of the different processes that occur in the cell. Therefore, each worker is trained to handle each process which occurs within the cell.
4. U-shape: Cells are usually U-shaped, with the product moving from one end of the U to the other end of the U as it is processed by worker(s). The purpose of this is to minimize the walking distance and movement of material within a cell.

Cellular layout helps to achieve many of the objectives of lean manufacturing due to its ability to help eliminate many non value-added activities from the production process such as waiting times, bottlenecks, transport and works-in-process. (Alavala, 2008).

When customer demands a high variety of products as well as faster delivery rates, it is important to have flexibility in the process to accommodate their needs. This flexibility can be achieved through grouping similar products into families that can be processed on the same equipment in the same sequence. These will also shorten the time required for changeover between products, which will encourage production in smaller lots. (Alavala, 2008).

The benefits associated with cellular manufacturing including Inventory reduction, low total unit production cost, high quality output, better space utilization, lower work-in-processes, lead time reduction, higher throughput, enhanced visibility and flexibility, enhanced team work and communication, better identification of causes of defects and

machine problems, reduce transport and material handling, and smooth (balanced) work flow across a wide variety of products. (ME, 2011).

2. Standardization of Work:

A very important principle of waste elimination is the standardization of worker actions. A standardized work basically ensures that each job is organized and is carried out in the most effective manner. (Alavala, 2008).

Standard work means that production processes and guidelines are very clearly defined and communicated, in a high level of detail, so as to eliminate variation and incorrect assumptions in the way that work is performed. The goal is that production should be performed the same way every time, except insofar as the production process is intentionally modified. When production procedures are not highly standardized, workers may have different ideas of what the correct operating procedures are and easily make incorrect assumptions. A high level of process standardization also makes it easier for the company to expand capacity without disruption. (Alavala, 2008).

In lean manufacturing, standard work has several main elements: (Alavala, 2008).

1. Standard work sequence: This is the order in which a worker must perform tasks, including motions and processes. This is clearly specified to ensure that all workers performed the tasks in the most similar ways possible so as to minimize variation and therefore defects. Ideally, this is so detailed as to clearly describe every single hand movement by a worker. For example, in wood cutting, the standard work sequence would describe every specific cut and operating step from machines setup to materials handling, cutter adjustment, manual movements, and processing time. In an assembly process, it would describe the exact sequential step-by-step motions which the item is assembled.
2. Standard timing: Takt time (German for rhythm or beat) is the frequency with which a single piece is produced (see Fig. 2.5). Takt time is used to clearly specify and monitor the rate at which a process should be occurring at various production stages. For lean manufacturers, the Takt time of each

production processes is actively managed and monitored, so that a continuous flow can occur. Takt time is calculated based on the following formula:

$$Takt\ Time = \frac{Available\ work\ time\ \ per\ day}{Customer\ demand\ \ per\ day}$$

Figure (2.5): Takt Time

"Source: (Alavala, 2008)"

3. Standard in-process inventory: this is minimum units of materials, consisting primary of units under going processing, which are required to keep a cell or process moving at the desired rate. This should be clearly determined since it is necessary to maintain this minimum amount of in-process inventory in order not cause unnecessary downtime. This is used to calculate the volume and frequency of orders, or Kanban, to upstream suppliers.

Successful standardization of work processes helps assure high quality product, proud workers, satisfied customers, workplace safety, and strong factory cost performance. Reducing variation in the shop floor environment leads to remarkable productivity improvements. (Alavala, 2008).

3. Workplace Organization-The Five S's:

One of the most effective tools of continuous improvement is 5S, which is the basis for an effective lean company. 5S is a first, modular step toward serious waste reduction. 5S consists of the Japanese words Seiri (Sort), Seiton (Straighten), Seiso (Shine and

Sweep), Shitsuke (Standardize), and Seiketsu (Sustain). The 5 S's together create a process for improvement is illustrated in Fig. (2.6). (Scott, 2011).

Figure (2.6): The 5 S's

"Source: (Scott, 2011)"

The 5S's are some rules for work place organization which aim to organize each worker's work area for maximum efficiency. 5 S's are: (Scott, 2011).

1. Sort (Seiri): sort what is needed and what isn't needed, so that the things that are frequently needed are available nearby and as easy to find as possible. Things which are less often used or not needed should be relocated or discarded.
2. Straighten (Seiton): Arrange essential things in order for easy access. The objective is to minimize the amount of motion required in order for workers to do their jobs. For example, a tool box can be used by an operator or a maintenance staff who must use various tools. In the tool box, every tool is placed at a fixed spot that the user can quickly pick it up without spending time looking for it. This way of arrangement can also help the user be immediately aware of any missing tools.
3. Shine (Seiso): keep machines and work areas clean so as to eliminate problems associated with un-cleanliness. In some industries, airborne dust is among the causes of poor product service or color contamination. To be

more aware of dust, some companies paint their working places in light colors and use a high level of lighting.

4. Stabilize (Shitusuke): Make the first 3 S's a routine practice by implementing clear procedures for sorting, straightening, and shining.
5. Sustain (Seiketsu): Promote, communicate, and train in the 5 S's to ensure that the company's corporate culture. This might include assigning a team to be responsible for supervising complaints with the 5 S's.

Once fully implemented, the 5S system can increase moral, create positive impressions on customers, and increase efficiency and organization. Not only will employees feel better about where they work, the effect on continuous improvement can lead to less waste, better quality and faster lead times. Any of which will make your organization more profitable and competitive in the marketplace. (Scott, 2011).

Depending on your individual situation, 5S systems can be implemented in different ways. Many follow a procedure similar to the following: (Scott, 2011).

- Organize the program committee
- Develop a plan for each "S"
- Publicly announce the program
- Provide training and education to employees
- Select a day when everybody cleans up and organizes their working area
- Evaluate the results of 5S
- Take corrective actions.

4. Value Stream Mapping:

A value stream is defined as all the value-added and non-value added actions required to bring a specific product, service, or combination of products and services, to a customer, including those in the overall supply chain as well as those in internal operations. VSM is an enterprise improvement technique to visualize an entire production processes, representing information and material flow, to improve the production process by identifying waste and its sources. A VSM, both current and future state, is created using a pre-defined set of icons (shown in Fig. 2.7). VSM

creates a common language about a production process, enabling more purposeful decisions to improve the value stream. (Tompkins, et.al, 1996).

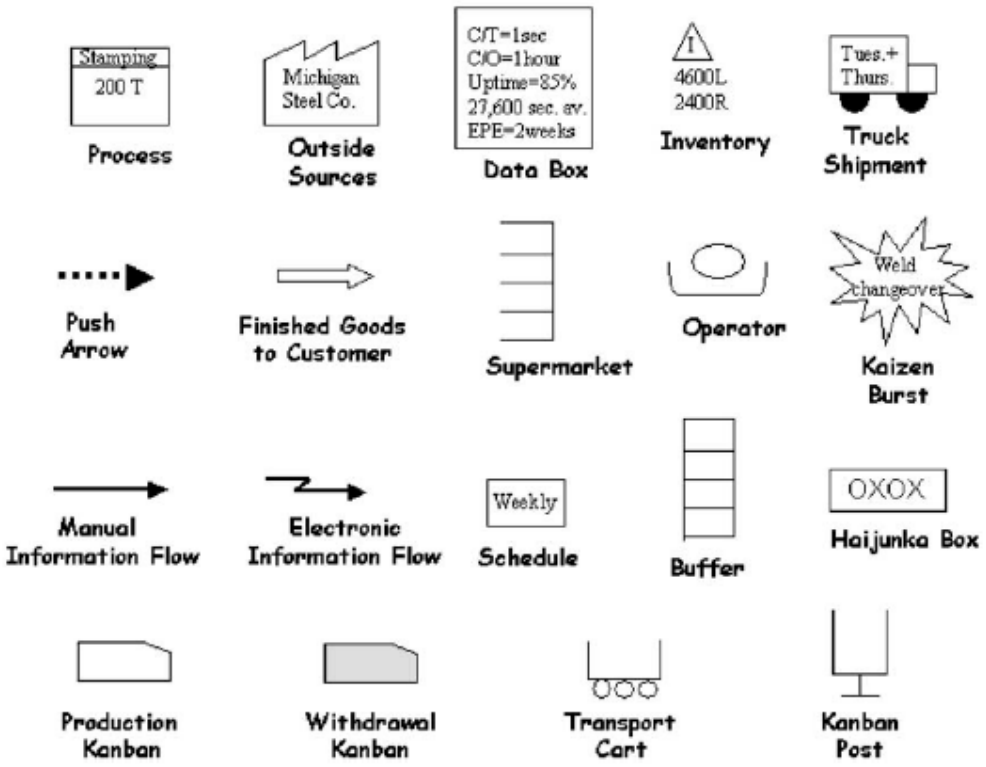


Figure (2.7): VSM Icons

"Source: (Tompkins, et.al, 1996)"

A value stream map provides a blueprint for implementing lean manufacturing concepts by illustrating how the flow of information and materials should operate. VSM is divided into two components: big picture mapping and detailed mapping. Before starting detailed mapping of any core process, it is useful to develop an overview of the key features of that entire process. The overview will help to visualize the flows, identify where waste occurs, integrate the lean manufacturing principles, decide who should be on implementation teams, and show relationships between information and physical flows. (Tompkins, et.al, 1996).

Visualizing the flow creates the ability to see where, when, and how both the information and product flows through the organization. (Tompkins, et.al, 1996).

5. Total Preventive Maintenance:

Total Preventive Maintenance (TPM) assigns basic preventive maintenance work including inspection, cleaning, tightening, and calibration to the production workers to operate the equipment. (Lixia and Bo, 2011).

TPM clearly assigns responsibility to workers to proactively identify, monitor, and correct the causes of problems leading to unnecessary machine downtime. By allocating this responsibility to the machine operators, maintenance problems are less likely to occur and therefore machine downtime can be reduced. This also requires the operators to frequently update to the maintenance team about the machine condition, so that potential technical problems could be discovered on a timely basis and prevented. (Lixia and Bo, 2011).

In TPM, the maintenance team is responsible for the higher value added maintenance activities such as improving the equipment, performing overhauls and improving, fixing problems and providing training. (Lixia and Bo, 2011).

Machine breakdown is one of the most important issues that concerns the people on the shop floor, the reliability of the equipment in the shop floor is very important since if one machine breaks down the entire production line could go down. An important tool that's necessary to account for sudden machine breakdowns is TPM.

In almost, any lean environment setting a TPM program is very important. There are three main components of TPM: (Lixia and Bo, 2011).

- Preventive Maintenance: has to do with regular planned maintenance on all equipment rather than random check ups. Workers have to carry out regular equipment maintenance to detect any anomalies as they occur. By doing so sudden machines breakdown can be prevented, which needs to improvement in the throughput of each machine.
- Corrective Maintenance: deals with decisions such as whether to fix or buy new equipment. If a machine is always down and its components are always

breaking down then it is better to replace those parts with newer ones. As a result the machine will last longer and its uptime will be higher.

- Maintenance Prevention: has to do with buying the right machine. If a machine is hard to maintain (e.g. hard to lubricate or bolts are hard to tighten) then workers will be reluctant to maintain the machine on a regular basis, which will result in a huge amount of lost money invested in that machine.

6. Just In Time:

Lean manufacturing is concerned about eliminating waste whenever it is. One of the most important steps in the implementation of lean manufacturing is JIT, since it is a management idea that attempts to eliminate sources of manufacturing waste by producing the right part in the right place at the right time. This addresses waste such as work in process material, defects, and poor scheduling of parts delivered. (Abdullah, 2003).

Monden (1998) and Levy (1997) both agree that JIT production is the back bone of lean manufacturing. JIT production is not having more raw materials, work in process or products than what are required for a smooth operation. (Abdullah, 2003).

JIT utilizes what is known as a "pull system". Customer demand, which is the generator of the order, sends the first signal to production. As a result, the product gets pulled out of the assembly process. The final assembly line goes to the preceding process and pulls or withdraws the necessary parts in the necessary quantity at the necessary time (Monden, 1998). The process goes on as each process pulls the needed parts from the preceding process further up stream. The whole process is coordinating through the use of a Kanban system. (Abdullah, 2003).

The term Kanban is defined as" a pull-based material replenishment system that uses visual signals, such as color-coded cards, to signal to upstream workstations when inputs are required at a downstream workstation. In effect, Kanban is a communication tool for a pull-based production. A Kanban could be an empty bin, a card, and an electronic display for any suitable visual promote. (Abdullah, 2003).

Kanban is an information system that is used to control the number of parts to be produced in every process (Monden, 1998). Typically there are two main kinds of Kanban: (Abdullah, 2003).

- Production Kanban: this specifies the quantity to be produced by the preceding process (Monden, 1998).
- Withdrawal Kanban: this specifies the quantity that the succeeding process should pull from preceding process.

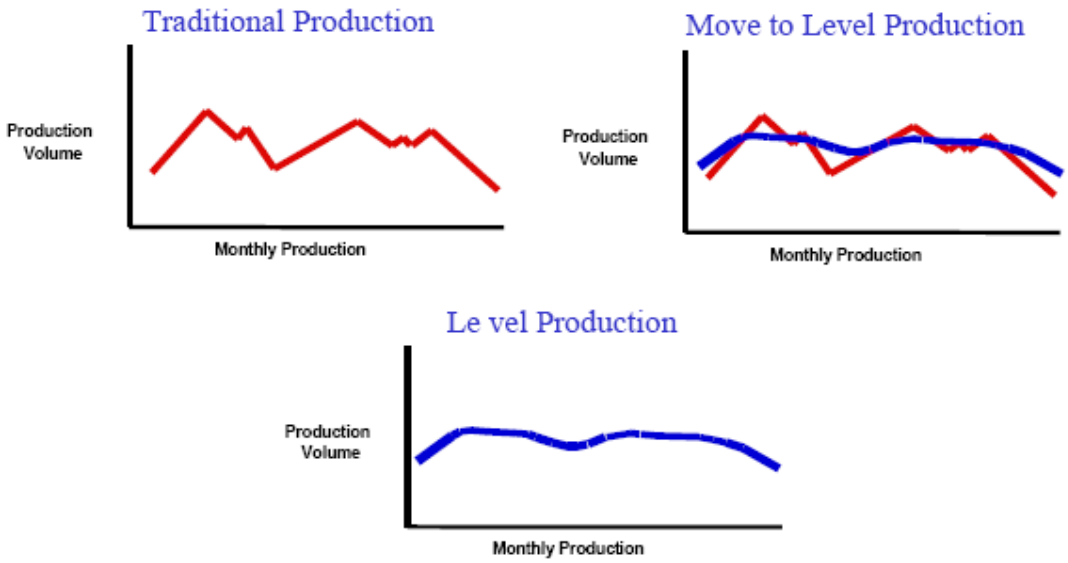
By utilizing a Kanban system under JIT, smaller lot sizes and huge inventory reductions can be achieved. Under JIT production, raw material, subassemblies and finished product inventory are kept to a minimum and the lean manufacturing principles are followed to eliminate inventory as a source of waste. Another type of waste that is eliminated under JIT production is overproduction. Since every process is producing a pace no higher than that of the subsequent process's requirements, the need to produce more than what is needed is diminished. (Abdullah, 2003).

7. Production Smoothing (Leveling):

Production leveling, also called production smoothing, aims to distribute production volumes and product mix evenly overtime, so as to minimize breaks and valleys in the workload. Any changes to volumes should be smoothed, so that they occur gradually and therefore in the most non-disruptive way possible. This will also allow the company to operate at higher average capacity utilization while also minimizing change over. (liker and Lamb, 2000).

Figure (2.8) illustrates the leveling of production overtime, so that resources are used in a more constant basis. (liker and Lamb, 2000).

Figure (2.8): Leveling Production
"Source: liker and Lamb, 2000"



Leveled mixed-model production is used to reduce risk of unsold goods, improve quality, minimize needed space, smooth demand on upstream processes, and control/monitor the production environment efficiently. (liker and Lamb, 2000).

8. Visual Management:

Visual management systems enable factory workers to be well informed about production procedures status and other important information for them to do their jobs as effectively as possible. Large visual displays are generally much more effective means of communication to workers on the factory floor than written reports and guidelines and therefore should be used as much as possible. When it comes to improve compliance with a process, visual presentation helps the team better understand a complicated including the correct sequence of events, the correct way to perform each action, internal and external relationships between actions, and other factors. Those visual tools may include the following: (ME, 2011).

1. Visual displays: charts, metrics, procedures and process documentation which are reference information for production workers. For example, trend chart for yield performance, 100% variations of defect rate, month – to – date shipping volume status, etc.

2. Visual control: indicators intended to control or signal actions to group members. This may include production status information, quality tracking information, etc. for example, color-codes panel for temperature or speed sitting control limits that help an operator quickly identify process is out of the control range. Kanban cards are another example of visual controls.
3. Visual process indicators: this communicates the correct production processes or flow of materials. For example, this would include the use of painted floor areas for non-defective stock and scrap or indicators for the correct flow of materials on the factory floor.

9. Quality at the Source (or "Do it Right the First Time"):

Quality at the source, also called "do it right at the first time", means that quality should be built into the production process in such a way that defects are unlikely to occur in the first place, or insofar as they do occur, they will be immediately detected. Lean manufacturing systems often refer to the Japanese word "Jidoka" which means that the problem should be identified and eliminated as the source. Some of the key implications of this: (Paneru, 2011).

1. In-line inspection: the main responsibility for quality inspection is done in-line by workers, not by separate quality inspectors who inspect sample lots. Although some independent QC inspectors are often sill used in lean companies, their rule is minimized (ideally there are no QC inspectors because they also are considered a waste in lean manufacturing).
2. Source inspections: in source inspections, the quality inspectors don't inspect for defects themselves, but inspect for the causes for defects. For example, they may inspect if standard offices are being done correctly by workers, or in a case where defects have occurred, they may be responsible for identifying what source of those defects. From this respective, the primary job of a quality control team is to troubleshoot the root cause of defects, implement preventive measures and provide training to workers to ensure the defects don't reoccur.

3. Clear accountability among workers: in lean manufacturing, unless there is an intentional inventory of semi-finished products, there's a direct handoff between each upstream stage and downstream stage, meaning that the workers to each upstream stage are fully responsible for the quality of the material they deliver to the downstream stage and will be held personally accountable for any defects. On the other hand, if there's a large buffer of inventory between two production stages, the workers as the upstream process are less likely to feel personally accountable for any defects.
4. Poka Yoke: simple methods for in-line quality testing (not just visual inspection), sometimes refer to as "Poka Yoke", are implemented so that the defective materials don't get passed through the production process. In Poka Yoke, 100% of the units are tested as part of the production process. These measures are performed in-line by the production workers (not the quality control team).
5. Intentional shutdowns: when defects are generated, production is shutdown until the source of the defect can be solved. This helps ensure a culture of zero tolerance for defects and also prevents defective items from working their way downstream and causing bigger problems downstream. For example, at Toyota any worker can shutdown the production line. This also ensures accountability by upstream workers.

10. Other Waste Reduction Techniques:

There are some other waste reduction tools including setup reduction, batch size reduction, and line balancing:

- Setup reduction: Lean manufacturing is to reduce unnecessary downtime due to machine setup or product changeovers since machine downtime is a significant source of unnecessary waste. This requires a culture of continuous improvement in which the company is continuously trying to find ways to reduce changeover setup times. (Rotaru, 2008).

- Batch size reduction: Lean manufacturing aims for materials to flow on the factory floor in the smallest batch sizes possible, with the ideal being one piece flow, so that work-in-progress between processing stages can be minimized. The smaller the batch size, the more likely that each upstream workstation will produce exactly what its customer needs, exactly when its customer needs it. (Alavala, 2008)
- Line Balancing: Line balancing is considered a great weapon against waste, especially the wasted time of workers. The idea is to make every workstation reduce the right volume of work that is sent to upstream workstations without stoppage. This will be guarantee that each workstation is working in a synchronized manner, neither faster nor slower than other workstations. (Paneru, 2011).

2.5 The Benefits of Lean Manufacturing:

Whether companies are looking to cut costs, gain a competitive advantage, or remain viable in the face of competition that has gone lean, there are many reasons to adopt lean manufacturing techniques. Lean benefits include reduced work-in-process, increased inventory turns, increased capacity, cycle-time reduction, and improved customer satisfaction. Some of Lean's benefits are summarized below: (ME, 2011).

1. Operational Improvements:

- A 90% reduction in lead time (cycle time)
- A 50% increase in productivity
- An 80% reduction in work-in-process inventory
- An 80% improvement in quality
- A 75% reduction in space utilization

2. Administrative Improvements:

- Reduction in order processing errors
- Streamlining of customer service functions so that customers are no longer placed on hold
- Reduction of paperwork in office areas

- Reduced staffing demands, allowing the same number of office staff to handle larger numbers of orders
- Documentation and streamlining of processing steps, enabling non-critical functions to be outsourced and allowing the company to focus its efforts on customers' needs
- Reduction in turnover and the resulting costs of attrition
- Implementation of job standards and pre-employment profiling, ensuring the hiring of only above-average performers (imagine the benefit to the organization if everyone performs as well as the top 20%)

3. Strategic Improvements:

Reduced lead time, reduced costs, and improved quality provide opportunities for new marketing campaigns, allowing your company to gain market share from competitors that is slower, have higher costs, or have poorer quality.

4. Other benefits:

- Reduced scrap and waste
- Cross-trained employees
- Reduced obsolescence
- Lower space/facility requirements
- High quality & reliability
- Lower overall costs
- Self-directed work teams
- Fast market response
- Longer machine life
- Improved customer communication
- Lower inventories
- Improved vendor support and quality
- Higher labor efficiency and quality
- Improved flexibility in reacting to changes
- Allows more strategic management focus
- Increased shipping and billing frequencies

2.6 General Commentary on Wastes in the Gaza Strip Manufacturing Firms:

For the Gaza Strip manufacturing firms, the researcher thinks of the following:

1. All kinds of wastes are found heavily.
2. Most of the managers consider these wastes as something normal and necessary to production while they are not.
3. Most of the managers do not believe in the necessity of eliminating such wastes.
4. Because of the Israeli siege on the Gaza Strip, exporting obstacles, and the small size of the Gaza strip market, the manufacturing managers in the Gaza Strip are pushed toward overproduction waste heavily.
5. The lack of employees training, using inexperienced employees in the purpose of decreasing salaries, incorrect maintenance procedures, and the high machines age lead heavily to defects waste in the Gaza strip.
6. The uncertain political situations and the random crossing point's procedures are the main causes of inventory waste where the managers feel that inventory levels existence could be very important.
7. Change-resistance of the managers' minds, electricity interruption, and the maintenance requirements are leading to the poverty of the used transportation methods in the Gaza Strip and increasing this kind of wastes.
8. Most of the managers used to deal the employees through the centralization system, and they consider time as a neglected unnecessary factor. These are the main causes of waiting waste.
9. The researcher thinks that the poverty of the managerial instructions and neglecting the important training lead to motion waste.
10. The researcher thinks that neglecting the important training of employees and missing the time importance for production in the Gaza Strip push toward Over-processing waste.

2.7 General Commentary on Lean Manufacturing Tools and Techniques in the Gaza Strip Manufacturing Firms:

For the Gaza Strip manufacturing firms, the researcher thinks of the following:

1. All of the current implemented tools and techniques to eliminate wastes are so poor.
2. Most of the managers do not know about these tools and techniques.
3. Change-resistance of the managers' minds is the most problem facing applying these profitable techniques.
4. The high degree of centralization managerial procedures and the used inflexible and complex machines are the barriers of implementing cellular manufacturing technique.
5. Neglecting the time importance and the poor planning of most of the managers lead to difficult understanding for work standardization technique.
6. The general random managerial plans and tasks in the firms lead to neglecting 5S technique.
7. Random production and absence of progress reports lead to difficulty in applying VSM technique.
8. The Israeli siege imposed on the Gaza Strip affects negatively on training employees and getting the spare parts to be able to apply TPM technique.
9. The random crossing points and exporting obstacles within the Gaza Strip small markets are the main barriers for applying JIT technique.
10. Poor current leveling of production is a result for the absence and poverty of plans and schedules.
11. Poverty of the current visual management is a result for the random production and change-resistance.
12. QC inspections are usually followed and managers do not believe in the importance of the technique of (quality at the source).

Chapter Three

The Manufacturing Economic Sector in Palestine

3.1 The Palestinian Economy Background

3.2 The Palestinian Manufacturing Sector

3.3 General Commentary on the Role of Lean Manufacturing in Supporting the Manufacturing Sector in Palestine

3.1 The Palestinian Economy Background:

The Palestinian economy had not been developed since the British Mandate in 1917 until the generation of the Palestinian Authority. In specific, the economic situation of the Gaza Strip which suffers from degradation and a rise in unemployment due to Israeli imposed siege. (ZCSC, 2006).

Approximately, (88.2%) of business owners are depending on the managerial experience that is inherited and limited to the daily routines. Therefore, there is weakness in the administrative areas. (ZCSC, 2006).

The military aggression in the Gaza Strip (Dec.,2008 to Jan.,2009) resulted in the extensive destruction of homes, infrastructure and cut to the ways of living. Also, it has negatively affected the Palestinian private sector, where many industrial, agricultural lands and infrastructure had become unable to work as they should do. Loss of the private sector (not including agriculture) was nearly 1165 institutions have been destroyed (in whole and in part) during the recent military operation in the Gaza Strip. The initial estimated financial value of the damage was nearly $140 million. The Palestinian National Authority promised to help these institutions in the restoration of their activities with the support of the European Union program. The private sector has not received this support yet, pending completion of formalities. Nearly, one third of the damaged institutions are manufacturing establishments (324 institutions). (PalTrade and PFI, 2010).

Geographically distributed sample study on the five governorates of the Gaza Strip, where it was found that 60% of the manufacturing institutions affected by those surveyed in Gaza City, and the highest proportion of the damaged facilities was for construction industry by 33%. The results showed that 44% of the establishments were destroyed completely and 54% were partially destroyed. Also, the results showed that 54% of the affected establishments reconstructed depending on the available capabilities, where the construction industry sector was the largest industries in terms of the resumption of its activities by 30%. (PalTrade and PFI, 2010).

Regarding the factors that formed a barrier to the lack of reconstruction, it was found that the most factor is the closure of the crossings, which led to lack of building materials required for this (42% of the establishments), while the results showed that

41% of the establishments attributed the cause of disability to Reconstruction for the lack of financial liquidity.17% of the establishments noted to a loss of market share because of the coming goods through the borders tunnels. (PalTrade and PFI, 2010). The study showed that the monthly sales value for these damaged institutions was $19 million before aggression. After that, the value had become $6 million. So, %66 of the sales value had been lost. The results also showed that 54% of the establishments covered by the study need less than $ 100,000 to rebuild what had been destroyed, while 13% of these facilities are in need of more than $ 500,000 for reconstruction and the resumption of their production activities. (PalTrade and PFI, 2010).

The results of the study also showed that 21% of machinery and equipment necessary for the resumption of their productive activities exist in the local market (whether these machines are new, used, or manufactured locally), while the results indicated that 44% of these machines are available in the Israeli market, and 35% are available abroad. (PalTrade and PFI, 2010).

Table (3.1) shows the key Economic Indicators in the West Bank and the Gaza Strip for the years (from 2000 to 2010):

Table (3.1): Economic Indicators in the West Bank and the Gaza Strip for the Years (from 2000 to 2010)

Indicator	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Population by mid year (thousands)											
OPT	3053.3	3138.5	3225.2	3314.5	3407.4	3508.1	3612.0	3719.2	3825.5	3935.2	4048.4
WB	1943.7	1992.6	2042.3	2093.4	2146.4	2203.7	2262.7	2323.5	2385.2	2448.4	2513.3
Gaza	1109.7	1145.9	1182.9	1221.1	1261.0	1304.4	1349.3	1395.7	1440.3	1486.8	1535.1
National Accounts (Million Dollars)											
GDP	4118.5	3765.2	3264.1	3749.6	4198.4	4559.5	4322.3	4554.1	4878.3	5241.3	5728.0
GDP per capita	1450.2	1287.9	1084.8	1210.9	1317.0	1387.2	1275.4	1303.2	1356.3	1415.7	1502.4
Household Expenditure	3982.0	3901.4	3627.8	4103.1	4400.3	4467.5	4197.5	4591.2	4851.9	5285.4	-
Public Expenditure	1100.7	1022.7	947.9	903.1	1048.9	833.3	870.4	892.7	995.9	1105.5	-
Gross Capital Formation	1561.1	1120.0	954.1	1204.0	1022.3	1265.7	1347.2	1122.9	1060.5	1137.3	-
Balance of Goods Trade	(2181.9)	(1999.4)	(1473.1)	(1751.9)	(2335.8)	(2680)	(2795)	(3178.2)	(3234.4)	(3502)	-

Indicator	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Commodity Imports	2721.5	2394.2	1800.5	2119.9	2736.5	3114.7	3245.4	3824.7	3902.8	4146.9	-
Commodity Exports	539.5	394.8	327.4	368.0	400.7	434.7	450.4	646.5	668.4	644.9	-
Balance of Services Trade	(75.2)	(494.7)	(476.5)	(314.3)	(360.9)	(221.2)	(300.4)	(373.1)	(340.3)	(281.5)	-
Services Imports	548.2	674.8	673.3	573.3	601.3	503.7	560.3	742.6	836.4	860.8	-
Services Exports	472.9	180.1	196.9	259.0	240.4	282.4	259.9	369.5	496.1	579.3	-
Prices and Inflation											
Average $/nis	4.086	4.208	4.742	4.550	4.478	4.482	4.454	4.110	3.567	3.93	3.73
Inflation Rate (%)	2.8	1.2	5.7	4.4	3.0	4.1	3.8	1.9	9.9	2.75	3.75
Labor Market											
Unemployment (%)	14.1	25.2	31.3	25.6	26.8	23.5	23.7	21.7	26.6	24.5	23.7
Social Conditions											
Poverty Rate (%)	-	27.9	-	-	25.9	24.3	24	31.2	-	26.2	25.7
Deep Poverty Rate (%)	-	19.5	-	-	14.2	15.3	13.7	18.8	-	13.7	14.1
Public Finance (Million Dollars)											
Net Domestic Revenues	939	273	290	747	1050	1370	722	1616	1780	1548.4	1900.4
Current Expenditures & Net Landing	1199	1095	994	1240	1528	1994	1426	2567	3273	2919.6	2983.2
Development Expenses	469	340	252	395	0	287	281	310	-	46.8	275.1
Surplus (deficit) before support	(260)	(822)	(704)	(493)	(478)	(624)	(704)	(951)	(1493)	(1341.9)	(1082.8)
Total Grants	510	849	697	620	353	636	1019	1322	1763	1402	1277

Indicator	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Total Surplus (Deficit) Budget	(219)	(313)	(259)	(268)	(125)	(275)	34	61	270.2	(144)	(80.9)
Public Debt	795	1191	1090	1236	1422	1602	1494	1439	1406	1732	1883

"Source: MAS, et.al, (2011). *The Economic and Social Monitor*, Issue No.26, Ramallah-Palestine".

*Base year for the 2000-2003 is 1997, for 2004-2010 is 2004.
**The inflation rate is based on the comparison of average indices of consumer prices for the comparison year with its average in the previous year. Base year for the period 2000-2006 was 1996 (1996=100), for the period 2007-2010 is 2004 (2004=100).
***Deep poverty: any standard family (5 members: two adults and 3 children) with a budget less than NIS1783 in 2010.
****Relative poverty: any standard family with a budget less than NIS2237 in 2010.
***** Figures in brackets are negative.

- It is clear that population growth rate is high (3.25% for the Gaza Strip in the year 2010). So, the consumption rate increases as a result.
- As shown, GDP growth till 2010 is a good indicator
- Balance of Goods Trade is negative, and it is going worse
- Balance of Service Trade is negative, but it is going better within a good indicator
- Inflation rate is going randomly, but it was better in 2009 than 2010
- Unemployment and poverty high rates are going approximately stable

Table (3.2) shows the percentage contribution to GDP by economic activity in the Palestinian Territories Strip for the years (from 1999 to 2009), 2004 is the base year:

Table (3.2): Percentage Contribution to GDP by Economic Activity in the Palestinian Territories for the Years (From 1999 to 2009)

Economic Activity	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Agriculture and Fishing	9.3	8.6	7.8	6.3	6.6	7.1	5.2	5.6	5.5	5.9	5.6
Manufacturing, Mining, Electricity and Water	15.0	13.9	17.1	17.2	17.5	17.1	17.0	15.0	15.3	15.6	14.3
Construction	11.6	7.2	4.2	2.9	3.8	5.7	6.8	7.2	6.6	6.4	7.4
Wholesale and Retail Trade	11.7	12.0	10.3	12.6	10.4	9.8	9.4	9.6	9.7	10.2	10.3
Transport, Storage, and Communications	7.2	7.8	7.7	7.8	6.5	6.1	5.8	6.6	7.4	7.1	7.3
Financial Intermediation	3.5	4.1	3.3	3.9	3.8	3.6	4.4	4.3	6.0	5.7	5.1
services	21.2	23.6	23.1	25.1	24.3	22.8	23.0	19.6	20.4	20.7	21.2
Public Administration and Defense	9.0	9.9	15.0	14.2	15.0	14.3	14.1	15.7	14.5	14.0	14.3
Households with Employed Persons	0.2	0.2	0.2	0.2	0.2	0.1	0.0	0.1	0.1	0.1	0.1
Public owned Employed persons	3.2	4.3	2.5	3.2	4.1	3.7	3.4	4.5	4.1	2.6	2.1

"Source: PCBS, (2010). *The Annual Statistics of Palestine*, 11th Edition".

- It is clear that services and manufacturing sectors occupy the first ranking respectively by %21.2 and %14.3 of the Palestinian GDP
- Agriculture and Fishing contribution is approximately stable after the year 2005, but it was better before that
- Contribution of manufacturing, mining, electricity and water is going worse after the year 2005
- A general look for the construction sector shows that it is going better by the years

- Wholesale and retail trade contribution was going better before 2003. It had been gone down after that, but a good indication is shown after 2008
- Contribution of transport, storage, and communications sector is going like the previous point
- The general look for the contribution of financial intermediation shows that it is going better by the years
- A huge step down occurred to the contribution of services in 2006, but still it is going better slowly after that
- There is an approximately stable contribution for the public administration and defense sector after the year 2000

For the Gaza Strip:

Table (3.3) shows the key economic indicators in the Gaza Strip for the years (from 1999 to 2009) are shown in:

Table (3.3): Economic Indicators in the Gaza Strip for the Years (from 1999 to 2009)

Indicator	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
GDP by Expenditure at Constant Prices: 2004 is the Base Year (Value in million $)											
Final Consumption	1,706.1	1,711.2	1,543.1	1,561.9	1,797.0	1,874.0	1,880.6	1,752.2	1,670.6	1,579.8	1,612.7
Gross Capital Formation	515.9	398.5	266.5	262.1	393.7	362.9	463.4	566.4	169.5	102.7	49.2
Net Exports of Goods and Services	836.2	891.0	614.8	756.6	842.1	845.9	661.2	974.0	603.2	520.9	492.1
GDP	1,385.8	1,218.7	1,194.8	1,067.4	1,348.6	1,391.0	1,682.8	1,344.6	1,236.9	1,161.6	1,169.8
Major National Accounts Variables: 2004 is the Base Year (Value in million $)											
GDP	1,385.8	1,218.7	1,194.8	1,067.4	1,348.6	1,391.0	1,682.8	1,344.6	1,236.9	1,161.6	1,169.8
GNI	1,629.9	1,419.9	1,279.2	1,156.3	1,436.9	1,450.1	1,750.6	1,414.5	1,317.1	1,250.4	1,249.5
GDI	1,781.9	1,667.7	1,652.0	1,604.1	1,745.9	1,735.2	2,183.9	1,885.3	2,081.2	2,411.2	2,038.9
Per Capita Indicators: 2004 is the Base Year (Value in $)											
GDP Per C.	1,293.9	1,098.2	1,042.7	902.4	1,104.4	1,103.1	1,290.1	996.5	886.2	806.5	786.8
GNI Per C.	1,521.8	1,279.6	1,116.3	977.5	1,176.7	1,149.9	1,342.1	1,048.4	943.7	868.1	840.4
GNDI Per C.	1,663.7	1,502.9	1,441.7	1,356.1	1,429.7	1,376.0	1,674.3	1,397.3	1,491.1	1,674.1	1,371.3

"Source: PCBS, (2010). *The Annual Statistics of Palestine*, 11th Edition".

It is clear from table (3.3) that GDP was going done till 2002. A huge step up occurred in 2003 and another step up occurred in 2005. In the year 2006, a huge step down occurred and generally had gone worse slowly after that.

Table (3.4) shows the percentage contribution to GDP by economic activity in the Gaza Strip for the years (from 1999 to 2009), 2004 is the base year:

Table (3.4): Percentage Contribution to GDP by Economic Activity in the Gaza Strip for the Years (From 1999 to 2009)

Economic Activity	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Agriculture and Fishing	7.2	8.6	9.3	7.5	7.3	8.3	5.6	6.7	7.1	7.7	8.0
Manufacturing, Mining, Electricity and Water	12.8	6.0	13.8	16.5	14.8	13.2	12.4	9.7	7.0	10.6	7.9
Construction	10.9	8.1	5.2	3.0	3.6	6.4	7.7	7.0	5.9	3.5	3.3
Wholesale and Retail Trade	11.6	11.1	9.3	12.3	10.3	9.3	10.2	9.3	8.1	7.3	8.2
Transport, Storage, and Communications	5.5	3.2	2.9	2.8	1.9	1.6	3.2	1.9	1.3	0.7	1.0
Financial Intermediation	2.7	3.3	2.5	2.9	2.5	2.4	3.6	4.1	6.6	3.7	3.5
services	27.3	32.0	30.8	31.9	28.6	27.8	25.5	26.2	32.4	33.9	35.4
Public Administration and Defense	12.9	14.6	21.7	16.8	17.7	18.0	18.8	22.2	22.0	22.8	25.0
Households with Employed Persons	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.2
Public owned Employed persons	4.2	5.9	3.2	4.6	5.4	3.8	3.7	5.9	4.4	3.4	1.9

"Source: PCBS, (2010). *The Annual Statistics of Palestine*, 11th Edition".

- It is clear that services and public administration sectors occupy the first ranking respectively.

- Manufacturing occupies the 2nd rank for Palestine, but it is in the 5th for the Gaza Strip. This point shows the poverty of this sector in the Gaza Strip, where it is better in the West Bank.

3.2 The Palestinian Manufacturing Sector:

The development of the Palestinian manufacturing sector significantly led to a significant increase in its contribution to the GDP in Palestine that arrived the proportion of (8%) during the Israeli occupation in the period from 1967 to 1991, and (16%) before the Intifada of September,2000. (Nofal, 2001).

However, the manufacturing sector still suffers from dependence on the Israeli industry which affects its development. In addition, the Palestinian industrial sector has fallen substantially as a result for the Israeli actions since Al-Aqsa Intifada till now because of the closure and siege on the Palestinian areas in the West Bank and the Gaza Strip. (PCBS, 2008).

The production had been decreased in all of the Palestinian industries in the West Bank and Gaza Strip. The industrial sector problems were not only due to the Israeli actions, but also the inability of the Palestinian Authority to develop an industrial strategy was a main cause. In addition, there were many obstacles that have prevented the self-development of this sector and its development, such as lack of raw materials, quality problems, lack of experience, the absence of regulation, the scarcity of natural materials, the problems of labor, and authority corruption. (PCBS, 2008).

The shortage of raw materials led to the deterioration of the private sector and the closure of economic establishments. The proportion of establishments operating in the manufacturing sector stopped on a temporary basis was 70%, while the number of establishments operating in part was approximately 50% . (IDS, 2010).

The damage to economic activities led to a rise in unemployment to 39.7% during the first quarter of the year 2010, and the siege has led to the high cost of living index, the average prices during the first quarter of 2010 is about 131.34 points, i.e, the index rose by 51.4% compared to 2009. (IDS, 2010).

The 2010 Israeli decision to open border crossings with the Gaza Strip affected directly on the movement of work in the tunnels, which is considered one of the

informal commercial activities. To assess the impact, a questionnaire was designed by the Institute of Development Studies and distributed to a random sample of 106 View of the owners of the direct relationship to work, the owner of Tunnel, partner, agent, dealer, and others. The results showed that the rate of 71.7% of respondents supported opening the commercial crossings with Israel and they believe that this procedure will negatively impact on the movement of imports through the tunnels and that will reflect positively on the citizen. With regard to the issue of unemployment, only the views of members were divided in kind for which it will open the commercial crossings to reduce unemployment or not, therefore, 45.3% of them believed that opening the crossings leading to lower unemployment rates, and in contrast, 44.3% do not believe this. (IDS, 2010).

Table (3.5) shows the main economic indicators for manufacturing activities, 2009:

Table (3.5): The Main Economic Indicators (Value in 1000$) for Manufacturing Activities in the Palestinian Territories for the Year (2009)

Economic Activity	No. of Enterprises	No. of Persons Engaged	Compensations of Employees	Output	Intermediate Consumption	Added Value	GFCF
Manufacturing	14645	62692	210032.8	1857965.8	1018437.0	839529.2	34851.6

"Source: PCBS, (2010). *The Annual Statistics of Palestine*, 11th Edition".

Table (3.6) shows the percentage contribution to GDP by manufacturing in the Palestinian Territories for the years (from 1999 to 2009), 2004 is the base year:

Table (3.6): Percentage Contribution to GDP by Manufacturing in the Palestinian Territories for the Years (From 1999 to 2009)

Economic Activity	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Manufacturing	12.9	12.2	13.1	12.4	12.9	13.2	13.0	11.7	11.6	11.1	10.4

"Source: PCBS, (2010). *The Annual Statistics of Palestine*, 11th Edition".

Table (3.7) shows the value added by manufacturing in the Palestinian Territories for the years (from 1999 to 2009), 2004 is the base year:

Table (3.7): The Added Value (in $USD million) by Manufacturing in the Palestinian Territories for the Years (From 1999 to 2009)

Economic Activity	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Manufacturing	584.8	505.2	499.0	411.1	491.6	554.0	591.8	505.4	527.8	539.3	539.8

"Source: PCBS, (2010). *The Annual Statistics of Palestine*, 11th Edition".

- Manufacturing occupies the 2nd rank for Palestine, but it is in the 5th for the Gaza Strip. This point shows the poverty of this sector in the Gaza Strip, where it is better in the West Bank.

Table (3.8) shows the number of manufacturing establishments working in Palestine according to the main economic activity and the employment group size categories:

Table (3.8): No. of Manufacturing Establishments Working in Palestine According to the Main Economic Activity and the Employment Group Size Categories

The Economic Activity	No. of Manufacturing Establishments	The Employment Group Size					
		0-4	5-9	10-19	20-49	50-99	100+
Manufacture of food and beverages	2548	1860	500	144	28	10	6
Manufacture of tobacco products	25	20	4	0	0	0	1
Manufacture of textiles	399	337	31	21	8	0	2
Manufacture of wearing apparel	1867	1186	371	195	102	7	6
Tanning of leather; manufacture of bags	434	270	100	46	15	3	0
Manufacture of wood and its products	564	498	52	11	3	0	0
Manufacture of paper and its products	67	29	18	10	6	4	0
Publishing, printing and reproduction	307	240	37	24	2	2	2
Manufacture of coke, Refind Betroleum Products And nuclear fuel	5	2	1	2	0	0	0
Manufacture of chemicals & its products	235	163	36	17	12	2	5
Manufacture of rubber and plastic	191	91	68	21	10	0	1

The Economic Activity	No. of Manufacturing Establishments	The Employment Group Size					
		0-4	5-9	10-19	20-49	50-99	100+
Manufacture of non-metallic products	1,809	1,053	468	222	59	6	1
Manufacture of basic metals	70	50	13	4	2	1	0
Manufacture of metal products	3,665	3,491	150	15	7	1	1
Manufacture of machinery and equipment	221	194	19	5	1	1	1
Manufacture of electrical machinery	88	72	10	6	0	0	0
Manufacture of radio,Tv equip.	26	22	0	3	1	0	0
Manufacture of medical, optical equip.	101	94	6	1	0	0	0
Manufacture of motor vehicles, trailers	10	5	4	1	0	0	0
Manufacture of other transport equipment	10	10	0	0	0	0	0
Manufacture of furniture	2,683	2,387	211	59	25	1	0
Recycling	15	9	5	1	0	0	0
Total	15340	12083	2104	808	281	38	26

"Source: PCBS, (2008). *Population, Housing and Establishment Census (2007),* The Economic Establishments, The Final Results, Ramallah-Palestine".

It is clear from the previous table that (23.9%) of these establishments work in the manufacturing of metal products (total of 3665 establishment) distributed in the West Bank and Gaza Strip where it occupies the first rank. Manufacturing of furniture comes in the second rank where it occupies about (17.5%), where the number of its establishment is (2683). Also, it is clear that (%78.8) out of these establishments employ 4 workers and less, 13.7% employ 5-9 workers, and 7.5% employ 10 workers and more.

For the Gaza Strip:

Table (3.9) shows the percentage contribution to GDP by manufacturing in the Gaza Strip for the years (from 1999 to 2009), 2004 is the base year:

Table (3.9): Percentage Contribution to GDP by Manufacturing in the Gaza Strip for the Years (From 1999 to 2009)

Economic Activity	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Manufacturing	12.8	6.0	13.8	16.5	14.8	13.2	12.4	9.7	7.0	10.6	7.9

"Source: PCBS, (2010). *The Annual Statistics of Palestine*, 11th Edition".

Table (3.10) shows the added value by manufacturing in the Gaza Strip for the years (from 1999 to 2009), 2004 is the base year:

Table (3.10): The Added Value (in $USD million) by Manufacturing in the Gaza Strip for the Years (From 1999 to 2009)

Economic Activity	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Manufacturing	174.9	46.4	107.6	109.3	132.1	113.9	126.3	85.2	33.3	28.1	28.2

"Source: PCBS, (2010). *The Annual Statistics of Palestine*, 11th Edition".

- Manufacturing occupies the 2nd rank for Palestine, but it is in the 5th for the Gaza Strip. This point shows the poverty of this sector in the Gaza Strip, where it is better in the West Bank
- The added value by manufacturing in the Gaza Strip passed a huge step down in 2006, and another huge step down in 2007. Approximately, it is stable after that. This is not a good indicator for this sector in the Gaza Strip
- Poverty of this sector could be because of the siege imposed on the Gaza Strip, economic Paris agreement which enables the Israeli occupation of controlling the process of goods entry and exit, strong and unequal competition over the Palestinian products, absence of internal clear and effective economic policy, most of the existing economic establishments suffer from defects in their managerial structure, the current small domestic market and the difficulty of marketing outside, and scarcity of capital.

There are 33933 working establishments in the Gaza Strip including 3529 manufacturing firms. In reality, the manufacturing activities in Gaza Strip represent 10.4% of the total economy in the strip. (PCBS, 2008).

Table (3.11) shows the number of manufacturing establishments working in the Gaza Strip according to the main economic activity and the employment group size categories:

Table (3.11): No. of Manufacturing Establishments Working in the Gaza Strip According to the Main Economic Activity and the Employment Group Size Categories

The Economic Activity	No. of Manufacturing Establishments	The Employment Group Size					
		0-4	5-9	10-19	20-49	50-99	100+
Manufacture of food and beverages	610	443	114	39	9	3	2
Manufacture of tobacco products	0	0	0	0	0	0	0
Manufacture of textiles	83	73	9	1	0	0	0
Manufacture of wearing apparel	473	363	68	34	4	1	3
Tanning of leather; manufacture of bags	31	24	3	2	2	0	0
Manufacture of wood and its products	204	189	15	0	0	0	0
Manufacture of paper and its products	11	2	2	6	1	0	0
Publishing, printing and reproduction	85	64	8	11	1	1	0
Manufacture of coke, Refind Betroleum Products And nuclear fuel	1	0	0	1	0	0	0
Manufacture of chemicals & its products	62	44	11	4	3	0	0
Manufacture of rubber and plastic	70	26	33	7	4	0	0
Manufacture of non-metallic products	326	230	68	24	4	0	0
Manufacture of basic metals	5	3	2	0	0	0	0

The Economic Activity	No. of Manufacturing Establishments	The Employment Group Size					
		0-4	5-9	10-19	20-49	50-99	100+
Manufacture of metal products	856	814	37	3	2	0	0
Manufacture of machinery and equipment	102	85	14	3	0	0	0
Manufacture of electrical machinery	28	21	5	2	0	0	0
Manufacture of radio,Tv equip.	13	13	0	0	0	0	0
Manufacture of medical, optical equip.	18	15	2	1	0	0	0
Manufacture of motor vehicles, trailers	10	5	4	1	0	0	0
Manufacture of other transport equipment	9	9	0	0	0	0	0
Manufacture of furniture	529	458	47	18	6	0	0
Recycling	3	2	0	1	0	0	0
Total	3,529	2,883	442	158	36	5	5

"Source: PCBS, (2008). *Population, Housing and Establishment Census (2007)*, The Economic Establishments, The Final Results, Ramallah-Palestine".

It is clear from the previous table that (24.3%) of these establishments work in the manufacturing of metal products (total of 856 establishment) distributed in the Gaza Strip and it occupies the first rank. Manufacturing of food and beverages comes in the second rank where it occupies about (17.3%), where the number of its establishment is (610).

Also, it is clear that (%81.7) out of these establishments employ 4 workers and less, 12% employ 5-9 workers, and 5.8% employ 10 workers and more.

3.3 General Commentary on the Role of Lean Manufacturing in Supporting the Manufacturing Sector in Palestine:

The manufacturing sector is one of the most important sectors for any economy, and it is considered as a mirror for the progress and development of nations.

Implementing the successful manufacturing tools and techniques for the Palestinian products would be the first step to develop the Palestinian manufacturing sector that contribute in improving the Palestinian GDP and the whole economy.

Any Palestinian company that is seeking the ability of an effective competition in the global marketplace should be in superiority of producing their products with the least possible costs to achieve excellence in price and quality.

So, implementing Lean Manufacturing in the Gaza Strip would result in:

- Improving the manufacturing sector ability that results in increasing the Palestinian GDP
- Improving the ability of global competition that lead to improving the net balance of trade
- Decreasing prices that lead to improving inflation rates
- Decreasing the unemployment rates as a result of improving the manufacturing firms profitability and performance
- Developing the different Palestinian products that result in decreasing poverty rates
- Decreasing the Palestinian dependence on the foreign grants which lead to greater power for making the internal and external decisions

Chapter Four

Previous Studies

4.1 Introduction

4.2 Palestinian Studies

4.3 Arabic Studies

4.4 Foreign Studies

4.5 General Commentary on Reviewed Studies

4.1 Introduction:

A number of published researches/papers in certified journals are viewed for the purpose of this research, focusing on lean manufacturing in other areas of the world. Due the fact that Palestinian and Arabic papers on the topic are rare, the researcher had not found a lot of related researches in these areas.

The research depends highly on the foreign researches that match research objectives, as the main source of quotation and comparison.

4.2 Palestinian Studies:

1. El-Kourd (2009)

"A Study of Lean Construction Practices in Gaza Strip" aims to apply the principles of lean to the construction in the Gaza Strip. The data of the research was taken from the daily reports showing the duration and steps of the process. Then, measuring the value and non-value added activities that used standardization tools and showed the waste cause by using the five why tools. Non-value added activities were measured by simulation.

Researcher has reached to a conclusion that using lean construction reduced the number of steps in the whole project by 57%, the non-value added decreased from 81% to 14% in the project duration, and the total cycle time of the project was reduced by 75%.

4.3 Arabic Studies:

1. Saleh (2011)

"The Role of Thinking Capital in the Possibility of Establishing Lean Manufacturing Foundations" aims to determine role of thinking capital in the Possibility of establishing Lean Manufacturing Foundations at the manufacturing firms. A special questionnaire was distributed to five manufacturing firms at Nenoy, Iraq.

Researcher has reached to a conclusion that the firms' possibilities of establishing the lean foundations are different according to the availability of thinking capital and there is a positive relationship between the thinking capital and lean foundations for all of

the studied firms. The main research recommendation is that it is needed to disseminate lean manufacturing philosophy for all of employees at all of the managerial levels for the studied companies.

2. Badran (2010)

"The Lean Manufacturing Philosophy for the Manufacturing and Service Organizations" aims to acquire the lean manufacturing philosophy and its benefits for the manufacturing and service organizations while focusing on the manufacturing and service facilities in Syria.

The researcher has reached to the conclusion that managing the production processes is very important for all kinds of organizations (General and private organizations, manufacturing and service organizations). Also, the researcher recommended increasing the empirical Arabic studies in this field.

3. Manhal and AlShawi (2009)

"Modifying Toyota Production System Model to Higher Education Environment and Measuring its Impact on University Learning Performance" aims to make benefit of the concept of Lean production to improve the quality of university learning performance. In this research, a special questionnaire was distributed randomly to students and teachers at AlBasra University in Iraq.

The researcher has reached to the conclusion that it is possible to modify TPS model and using it for improving higher education quality.

4. AlDabbagh and Hassan (2008)

"The Requirements of Implementing Lean Manufacturing for the Iraqi Industries" aims to introduce theoretical concepts to the management of the studied company including the concept importance of lean manufacturing and its requirements and determine the availability of these requirements at the studied company. For this purpose, the research focused on a specific company producing drugs and medical appliances in Iraq where the data was collected by distributing a special questionnaire

for all of the managers in all of the managerial levels at the company. (Respondents were 40 out of 45).

The researcher has reached to the conclusion that the company has an acceptable knowledge concerning lean manufacturing, and the basic requirements to apply lean manufacturing are available in this company. The main research recommendation is that it is important to use the scientific techniques of inventory control in the company.

5. Al-Khateeb (2006)

"The Modular Layout for the Factory in the Lean Manufacturing Environment" aims to get the best layout for the general establishment of electrical industries in Iraq. Therefore, a special computer program (CAFLD) was designed for getting the best layout for any factory.

In this research, the researcher has implemented the best layout and the desired results were reached.

4.4 Foreign Studies:

1. Forrester, et.al. (2010)

"Lean Production, Market Share, and Value Creation in the Agricultural Machinery Sector in Brazil" investigates the relationship between the adoption of lean manufacturing, market share, and value creation of companies in the agricultural machinery and implements sector in Brzail. For this purpose, a survey was conducted across 37 firms in the agricultural machinery and implements industry in Brazil. The data were used within a model for assessing the degree of leanness to test three hypotheses.

The researcher has reached to the conclusion that Brazilian firms and managers in this sector that have supported a transition towards the adoption of lean manufacturing practices have shown a significant improvement in their business performance including the production cost.

2. Hallgren and Olhager (2009)

"Lean and Agile Manufacturing: External and Internal Drivers and Performance Outcomes" investigates internal and external factors that drive the choice of lean and agile operation capabilities and their impact on operational performance. In this research, lean and agile manufacturing were each conceptualized as a second-order factor and measured through distinct practices. The competitive intensity of industry and the competitive strategy were modeled as potential external and internal drivers. The impact on quality, delivery, cost, and flexibility performance was analyzed using equations modeling. The model was tested with data from the high performance manufacturing project comprising a total of 211 plants from 3 industries and 7 countries.

The researcher has reached to the conclusion that lean manufacturing has a significant impact on cost performance, whereas agile manufacturing has not, and agile manufacturing has a stronger relationship with volume than does lean manufacturing.

3. Rathi (2009)

"A Framework for the Implementation of Lean Techniques in Process Industries" aims to demonstrate how to adapt lean principles and techniques to the continuous process sector by investigating the applicability of different tools, which are being successfully practiced by discrete manufacturing firms. Also, the research aims to develop decision support aids that will guide future researchers in selecting which tools may be most applicable for a given process industry.

Starting with using the classification dimensions (from the literature review) to develop a classification scheme for the process industry sector. Furthermore, a methodology for calculating theoretical applicability scores of lean tools for each type of process industry is illustrated. From these scores, the lean tools are identified which are hypothesized to have the most impact on particular production system types. Then, a survey (in two rounds) was distributed for different process industry organizations with experience in implementing lean to test the research hypotheses. Finally, cluster analysis was applied to empirically classify the observations into production system types.

The researcher has reached to the conclusions that unneeded processing, transportation of materials and WIP inventory wastes are significant in job type PI and raw material inventory was the most prevalent waste for the process industry sector. The main recommendation is that it is needed to further investigate and test the research hypotheses to help PI organizations identifying wastes and select the appropriate lean tools to be implemented.

4. Enaghani, et.al. (2009)

"The Relationship between Lean and TPM" aims to reach a prescription about the best attitude toward lean and TPM implementation by reviewing Lean and TPM concepts as well as studying experiences of famous companies, their achievements, problems and difficulties to implement TPM. Site visits and interviews had been organized with experts in two Iranian and Swedish companies which have implemented lean and TPM. These companies answered a special questionnaire during the visits and interviews.

The researcher has reached to the conclusion that lean is a culture for quality improvement starting with revolutionizing the minds of employees while TPM is a method.

5. Christodoulou (2008)

"Factors of Success for the effective implementation of lean manufacturing projects within the banking sector in South Africa" aims to identify the factors of success within the following areas: Managements' involvement, skills and expertise of resources, contribution to the company's strategy, and culture readiness. This research focuses on a specific bank in South Africa where the data was collected by conducting one-on-one semi-structured interviews with 20 individuals who took part in the implementation of lean within the bank selected for the analysis.

The researcher has reached to the conclusion that the top five success factors for the successful implementation of lean projects commitment from senior management, buy-in from staff that are being effected by the project, resources with the relevant

skills and competencies to execute the change, a culture focused on lean, and for all involved parties to understand what the project aims to deliver.

6. Piercy and Rich (2008)

"High Quality and Low Cost: The Lean Service Centre" examines the application of lean production improvement techniques and evaluates the contribution of lean techniques to services marketing improvement. Three case companies from the UK financial services sector are tracked through the process of lean improvement. Analysis of management change of a common process within each company forms the basis of the investigation.

The researcher has reached to the conclusion that services call centers can serve the traditionally competing priorities both of operational cost reduction and increased customer service quality. Also, the research has recommended to increase the studies of implementing lean manufacturing through the services sector.

7. Czabke (2007)

"Lean Thinking in the Secondary Wood Products Industry: Challenges and Benefits" identifies the common and individual pitfalls and difficulties during lean implementation, the key resources and assistance that were necessary for successful lean implementation, and the key benefits realized by case companies via lean implementation with an added focus on marketing processes.

Two lean leader companies from US and another two lean leader companies from Germany were studied to identify the successes, failures, and challenges to implementation.

This research used a case based-qualitative approach. This means that most of the data collected was in the form of words "thick description". For all four case studies, personal interviews -with the same questions- of high level management were the main source of information.

The main research conclusion is that all plants became more efficient and hence more cost effective and profitable after implementing lean manufacturing. Also, the

researcher has recommended including some companies that failed with implementing lean thinking to get a richer set of data.

8. McGrath (2007)

"Impact Analysis of Large Scale Lean Manufacturing Initiatives Upon Manufacturing Process Innovation In Irish Companies" aims to determine the extent to which the main principles of lean manufacturing have been and/or still being carried out in both companies and to establish some of the main issues involved in the execution of those principles over time in each of the processes.

This research focuses on two medical device companies based in the South of Ireland. Interviews were carried out there, and the respondents were chosen for their experience and expertise in lean manufacturing and production areas.

The researcher has reached to the conclusion that both companies have made some great improvements in terms of the value streams of their respective plants and also in the reduction of waste and inventory. Another result has been reached that lean manufacturing is a considered as a strategic tool to improve the competitive position of the organization. The researcher has recommended creating a longer study involving more organizations of information technology systems to facilitate lean manufacturing.

9. Rawabdeh (2005)

"A Model for the assessment of Waste in Job Shop Environments" investigates the waste in a job shop environment and proposes an assessment method aimed at helping companies to identify root causes of waste. For this purpose, the seven wastes and their relationships were explored. A waste matrix was developed to quantify the relationships among wastes. An assessment questionnaire was employed to allocate the source of waste and differentiate between levels of waste. The matrix and questionnaire were incorporated in the assessment to rank the existing waste in the job shop.

The researcher has developed a model that serves as a guideline for simplifying the search of wastes problems and identifies opportunities for waste elimination.

10. Berg and Ohlsson (2005)

"Lean Manufacturing at Volvo Truck Production" develops a strategy for the implementation of lean manufacturing in the Wacol factory's manufacturing area. This research is conducted in cooperation with Volvo Truck production Australia in Wacol, Brisbane. A comprehensive questionnaire based on lean theories and the situation in the factory was accomplished among both white collars and blue collars.

The main research conclusion is that overproduction is the most serious waste because it contributes to the other six wastes where production costs money and there is no reason to produce items that are not demanded. Also, the researcher recommended that it is important to have the support from the whole organization when starting a large project like lean.

11. Stephen (2004)

"Application of DMAIC to integrate Lean Manufacturing and Six Sigma" derives a step-by-step unambiguous roadmap that a manufacturing facility should follow toward its goal to achieve lean six sigma and develop tools to improve the communication between project teams and facilitate lean and six sigma technology transfers between multiple organizational units. For this purpose, the research focuses on the way of the integration of lean and six sigma; by an integration matrix formed by lean implementation protocols and six sigma project phases.

The main research conclusion is that the slow rate of corporate improvement is not due to lack of knowledge of six sigma or lean. Rather, the fault lies in making the transition from theory to implementation. Also, the main recommendation is that it is needed to find better and more efficient tools/algorithms into the integration matrix.

12. Koh, et.al. (2004)

"The Interaction Effects of Lean Production Manufacuring Practices, Compensation, and Information Systems on Production Costs" re-examines if lean production manufacturing practices interact with the compensation system and information system to reduce production costs. Decision trees (algorithm using

CHAID) are constructed on data from 77 US manufacturing firms in the electronic industry.

The researcher has reached to the conclusion that lower production costs can be achieved when lean production manufacturing practices, such as, TQM and JIT, are used. Also, the research recommendation is that it is needed to align organizational infrastructure and management control systems with manufacturing practices to realize the benefits of lean manufacturing.

13. Yamashita (2004)

"Implementation of Lean Manufacturing Process to XYZ Company in Minneapolis Area" aims to determine how the consultant of (SAMA) is implementing the lean manufacturing process based on the company, to identify approaches to redirect non-value added activities into value added activities to improve production efficiency, and to provide solutions to production processes that reduce cost, free up working capital, and reduce customer lead time.

This case study research focuses on behaviors that organizations must exhibit to correctly implement and sustain lean manufacturing practices in Minneapolis area, USA.

Also, it focuses on how the business consultants execute organizational change such as "lean manufacturing implementation process" in the real business world.

The method used for gathering all the information in this research was an interview session conducted with full-time senior consultant within the Stout Advanced Manufacturing Assistance (SAMA) at University of Wisconsin-Stout.

The main research conclusions are higher quality products with less recourses and capital are achieved by implementing lean manufacturing and lean manufacturing leads to reductions in scrap, rework, returns, and waste.

14. Abdullah (2003)

"Lean *Manufacturing Tools and Techniques in the Process industry with a focus* on Steel" investigates how lean manufacturing tools can be adapted from the discrete to the continuous manufacturing environment, evaluates lean manufacturing tools benefits at a specific application instance, and develops a general methodology to implement lean manufacturing tools and techniques in the process industry.

The ideas are tested on a large steel manufacturing company. Value stream mapping is used to first map the current state and then used to identify sources of waste and to identify lean tools to try to eliminate this waste. The future state map is then developed for a system with lean tools applied to it. To quantify the benefits gained from using lean tools and techniques in the VSM, a detailed simulation model is developed for the company and a designed experiment is used to analyze the outputs of the simulation model for different lean configurations.

Also, a total of 23 surveys were sent to different integrated steel plants all over the U.S., and 6 surveys out of them were returned.

The main research conclusions are the driving force behind implementing lean was cost reduction for the steel companies (as with others), tools like 5S and VS can have significant impact on the company when implemented, by further helping in elimination of wastes, such as excess inventory. The main research recommendation is that it is needed to follow the same methodology of this research to other application areas with the continuous PI.

15. Ross & Associates Environmental Consulting, Ltd. (2003)

"Lean Manufacturing and the Environment: Research on Advanced Manufacturing Systems and the Environment and Recommendations for Leveraging Better Environmental Performance" helps public environmental agencies better understand the environmental implications of lean manufacturing and help them in adjusting the environmental management and regulatory initiatives to boost the environmental and economic benefits of lean initiatives.

The research included extensive review and analysis of publications addressing lean manufacturing trends, methods, case studies, and results. Then, series of telephone

interviews with "lean experts" from both industry and nonprofit entities were conducted. After that, a series of brief case studies were completed four organizations experience with implementing lean production systems.

The researcher has reached to the conclusion that lean produces an operational and cultural environment highly conductive to waste minimization and pollution prevention, and it can be leveraged to produce more environmental improvement. The main research recommendation is that it is needed to develop a pilot/demonstration program to encourage companies who are implementing lean to achieve more waste reduction.

16. Kilpatrick (1997)

"Lean Manufacturing Principles: A Comprehensive Framework for Improving Production Efficiency" analyzes the dynamics of linear distribution systems and shows how lean manufacturing represents an opportunity to sidestep many previously insurmountable difficulties that arise as a result of producing to fill inventory levels

A framework was created to analyze manufacturing systems and assess the impact of various practices on system performance. A literature review of Lean Manufacturing resulted in the discovery of significant gaps in two areas: (1) modeling the effects of implementing Lean Manufacturing using control theory principles, and (2) a design framework for building Cellular Manufacturing Systems and making the transition from traditional manufacturing to Lean Manufacturing. To fill these gabs, a special model was created.

The main research conclusions are inventory increasing lead to ever increasing costs in the form of invested capital, damaged finished goods, scrapped product, costly inventory control system and eliminating all defects is crucial to minimize lead time. The main recommendation is that an axiomatic design approach is needed to eliminate defects through machine design.

17. Joing (1995)

"Applicability of Lean Manufacturing and Quick Response Manufacturing in a High-Mix Low-Volume Environment" determines the availability of Lean Manufacturing and Quick Response Manufacturing philosophies to deal with high-mix, low-volume products at a plant that manufactures electronic systems, in addition to other two key production characteristics: demand variability and degree of customization.

This research focuses on the high-mix, low-volume type of production in addition to other two key production characteristics: demand variability and degree of customization.

The research focused steps toward manufacturing improvement are: choosing metrics, reorganizing the factory, selecting lot sizes, implementing a production control strategy, and deciding on a material presentation method. A case study was created for circuit card assembly at four plants related to Raytheon Systems Limited in Scotland. The main research conclusion was that on-time delivery and customer satisfaction improved while lead times and inventories dropped significantly. The main research recommendation is that effort is needed to look at where the existing production system falls on the dimensions of the fixed (mix, volume, demand variability, and degree of customization) and see if any or all can be moved to the left on the continuum without upsetting customers.

4.5General Commentary on Reviewed Studies:

The attention to applying lean manufacturing into practices has become more popular. Manufacturing firms have implemented lean manufacturing practices with different tools and methods to achieve their objectives and benefits.

Based on previous researches, this research constructs its hypotheses, and some of notes can be highlighted:

1. Many evidences from past researches on the production wastes elimination effect on the firm performance. Applications of lean manufacturing into business practices by managers have been significant. The empirical and theoretical researches recommended that wastes elimination plays an important role in any organization.

2. Previous researches have confirmed the importance of lean manufacturing.

3. Previous researches addressed the importance of using lean manufacturing tools.

4. Previous researches have shown that every waste affects other wastes.

5. Previous researches have shown that there is no one-size fits all manufacturing philosophy.

6. The previous Palestinian and Arabic researches are few in this field.

7. Some of the previous researches could be a good reference for implementing lean manufacturing in the Gaza Strip.

It may be noteworthy that:

- This research may be the first attempt to apply a framework to examining the impact of production wastes elimination on the manufacturing firms in the Gaza strip.
- Two primary sources were used in the methodology to test the hypotheses (WRM and Questionnaire), while most of previous studies used only one primary source.
- This research included all of the seven wastes, not only some of these wastes, as the independent variables. So, it could be considered as the first reference for lean manufacturing philosophy implementation in the Gaza strip.

Chapter Five

The Design, Methodology, and Hypotheses Testing

5.1 Introduction

5.2 The Used Primary Sources

5.3 General Commentary on Results

5.1 Introduction:

As discussed in Chapter two, tools and techniques of lean manufacturing are used to eliminate or reduce the wastes. So, the research methodology was as follows:

The analytical descriptive approach was followed, which is suitable to describe the study subject in depth. The researcher used secondary and primary sources as follows:

1. Secondary sources: they are books, journals and documents, thesis, and scientific websites specialized in eliminating wastes.
2. The primary sources: they are Wastes Relations Matrix (WRM) and the Questionnaire.

5.2 The Used Primary Sources:

A. Wastes Relations Matrix (WRM): through conducting a brainstorming session with three professional persons, ***(brainstorming group whose details are shown in Appendix A)***, to answer special questions.

WRM was illustrated and analyzed to show the relations among the seven wastes; this illustration and analysis are based on literature review and the answers of the brainstorming group.

The idea of establishing WRM was excerpted from the previous study of (Rawabdeh, 2005).

B. The Questionnaire: a special questionnaire ***(shown in Appendix C)*** was distributed to the top management of all of the manufacturing firms having more than nine fixed employees in the Gaza Strip, and the researcher offloaded and analyzed the results and resolution through the use of the statistical procedures.

As seen in (Table1.1, Chapter.1), the last census of the manufacturing firms in the Gaza Strip prepared in 2007 shows that the total number of the related firms having more than nine fixed employees is 204. As a result of destroying many firms by the military aggression in the Gaza Strip (Dec., 2008 to Jan., 2009) and closure of other firms during the last period, the researcher surveyed all of the found related firms in the Gaza Strip and their total number was 114. (Respondents were 99 out of 114).

- Population: the top management of all of the manufacturing firms having more than nine fixed employees in the Gaza Strip, and the researcher surveyed all of

the population and their total number was 114. (Respondents were 99 out of 114).

- Questionnaire Contents: ***(Details are shown in Appendix C)***

  1. Personal Respondents Information
  2. Establishment General Information
  3. Establishment Production Cost Management Information
  4. Questions about the Importance of Production Cost Minimization in the establishment, which included the fields of the contribution of minimizing each of the independent variables (seven wastes) in reducing the dependent variable (the production cost).

5.2.1. Wastes Relations Matrix (WRM):

It was used to test the main hypothesis:

H1: There is a significant effect for lean manufacturing on the production cost.

The researcher thinks that all types of wastes are dependent, since each type of waste has its own influence on others and at the same time is influenced by others and resulting in increasing the cost of production.

For testing this idea, each type of wastes was denoted using its first letter, where (O: Over-production, I: Inventory, P: Over-processing, M: Motion, W: Waiting, D: Defects, T: Transportation).

Then, each relation was assigned by the symbol "i_j", where:

- (i): one of the seven wastes
- (j): the other six wastes

For instance, "O_I" indicates the direct effect of overproduction on inventory, and so on.

Note that some relations will not be discussed because the brainstorming group thinks that there is no direct effect of (i) on (j).

5.2.1.1 Wastes Dependence:

1. Overproduction Waste:

- "O_I": Over-production means high raw material inventory, increases the work-in-process, and requires more storage of equipment and handling tools. Also, producing more products requires high finished products storage.
- "O_D": Because of the higher production rate, the probability of raw materials defects increases. When the operator produces more, less effort will be spent on each unit which leads to less quality and more defects.
- "O_M": Over-production causes excess workers motions during process. When the operator produces more, improper ergonomics motions increase.
- "O_T": Over-production means more transportation from the raw materials store to the production floor, more transportation between the various production stages. Also, overproduction means more transportation of the finished products to warehouse.
- "O_W": Over-production increases the waiting of semi-finished products between machines. The operator waiting during the production process increases as overproduction increases. Overproduction may increase machines breakdown, which means waiting for maintenance.

2. Inventory Waste:

- "I_O": Existence of a high level of raw materials in inventory pushes to produce not according to the demand.
- "I_D": Raw materials inventory for along time increases defects. Inventory between production processes on the shop floor increases the probability of semi-product damage. Storing of the finished products in warehouse for along time may cause product damage.
- "I_M": Higher levels of work-in-process increase the time for searching, selecting, grasping, reaching, moving, and handling.
- "I_T": High levels of inventory mean more transportation between the store and the production floor. High levels of work-in-process inventory increase the transportation between workstations and obstruct the movement on the shop floor.

3. Defects Waste:

- "D_O": Increasing the number of defects pushes to produce more parts to consume the loss.
- "D_I": As defective parts increase, the WIP level increases.
- "D_M": Defective parts require a repairing process for them. Therefore, more required motions of the workers.
- "D_T": Repairing of the defective parts increases transportation efforts.
- "D_W": Producing defective parts requires to explore the cause of error and to take corrective actions. Therefore, other parts will wait to be processed.

4. Motion Waste:

- "M_I": Insufficient workers motions cause accumulating of work-in-process.
- "M_D": Insufficient workers motions during production increase defects parts number. Unskilled and untrained workers of the proper motions increase defects.
- "M_P": When jobs are non-standardized, there will be an opportunity of over-processing. Process waste will also be increased due to the lack of understanding the available technology capacity.
- "M_W": When there are no standard motions of the worker during production process, the required time for the next part to be processed increases.

5. Transportation Waste:

- "T_O": Items are produced more than needed just to fill materials handling equipment in order to reduce the transporting cost per unit and to minimize the number of transports.
- "T_I": If there is no sufficient methods and number of equipments for transportation, work-in-process inventory increases.
- "T_D": Insufficient transportation methods and unsafe transportation equipments increase the probability of defects producing. Also, improper handling of the products may cause parts damage.
- "T_M": insufficient and non-standardized Transportation methods increase the workers motions by double handling and searching.

- "T_W": When the transportation is not on time or ineffective, the waiting time for parts to be transported increases.

6. Process Waste:

- "P_O": An important aspect of process waste is that in order to reduce the cost of the operation per machine time, machines are pushed to operate full time shift which finally results in overproduction.
- "P_I": Combining operations in one cell will decrease WIP amounts because of eliminating buffers.
- "P_D": Insufficient and improper processes lead to produce defects.
- "P_M": Non-standardized process requires more worker motions
- "P_W": Unsuitable technology used, by means of high setup times and adjustments or repetitive downtimes, leads to higher waiting times.

7. Waiting Waste:

- "W_O" When a machine is waiting because its supplier is serving another customer, then the machine be forced to produce more just to keep running.
- "W_I" Waiting of parts between workstations increases work-in-process. Also, waiting of the finished items in warehouse increases inventory.
- "W_D": Waiting of parts in work-in-process inventory may cause defects due to the surrounding conditions.
- "W_M": Waiting of parts in work-in-process inventory may cause unnecessary motion of workers and machines.

5.2.1.2 Strength of Waste Relations:

So far, the relations between the types of wastes are investigated. The numerous types of relations and the nature of each type suggest that all these relations are not of equal weights. The need to assign weights to relations is justified by the need of knowing which type of waste contributes more to the wasteful activities in the shop floor. Criterion was set to measure strength of waste relations.

5.2.1.2.1. Measurement Criterion Development:

The Criterion consists of six developed questions; each answer has a certain weight from one to five as follows:

Note: "i" stand for any type of waste affects on "j", which is the other type of waste.

Question	Weight
1- Does i produce j?	
a. Always	5
b. Sometimes	3
c. Rarely	1
2- What is the type of the relation between i and j?	
a. As i increases, j increases	5
b. As i increases, j reaches a constant level	3
c. Random relation according to conditions	1
3- The effect of j due to i:	
a. Appears directly and clearly.	5
b. Often appears, but needs time to do	3
c. Rarely appears with along time	1
4- Eliminating the effect of i on j is achieved by:	
a. Engineering and complex methods	5
b. Simple and direct	3
c. Only by an instruction	1
5- The effect of j due to i, mainly influences on:	
a. Quality of products only	1
b. Productivity of Resources only	1
c. Lead time only	1
d. Quality and productivity	3
e. Productivity and lead time	3
f. Quality and lead time	3
g. Quality, productivity and lead time	5

6- In which degree does the effect of i on j increases Manufacturing Lead time?

a. High degree 5

b. Medium degree 3

c. Low degree 1

5.2.1.2.2. Measurement Criterion Analysis and Results:

The criterion was applied on all the relations and the analyses were carried out using the following steps:

Step (1): Answering each question with respect to each discussed relation.

The answer questions (1-6), with respect to over production and inventory (O_I), where "b" for question (1), "b" for question (2) and so on.

Question	1		2		3		4		5		6		Score	Relation
Relations	Ans.	Wt.	Ans.	Wt	Ans.	Wt.	Ans.	Wt.	Ans.	Wt.	Ans.	Wt.		
O_I	b		b		b		a		e		c			
O_D	c		c		c		a		c		c			

Step (2): each answer was assigned its own weight mentioned in the measurement criterion. Each number besides each character represents the weight of the answer. All numbers were separated in single columns representing weights.

Question	1		2		3		4		5		6		Score	Relation
Relations	Ans.	Wt.	Ans.	Wt	Ans.	Wt.	Ans.	Wt.	Ans.	Wt.	Ans.	Wt.		
O_I	b	3	b	3	b	3	a	5	e	3	c	1		
O_D	c	c	1	c	1	c	a	5	c	1	c	1		

Step (3): the weighting of all answers of each relation were added together, resulting to the overall summations.

Question	1		2		3		4		5		6		Score	Relation
Relations	Ans.	Wt.	Ans.	Wt	Ans.	Wt.	Ans.	Wt.	Ans.	Wt.	Ans.	Wt.		
O_I	b	3	b	3	b	3	a	5	e	3	c	1	18	
O_D	c	c	1	c	1	c	a	5	c	1	c	1	10	

Step (4): the score indicates that strength of each relations. In order to distinguish different relations it was noticed that the higher scores represent stronger relation and vice versa.

Table (5.1) below shows the Range Divisions of Strength of Direct Relation:

Table (5.1): The Range Divisions of Strength of Direct Relations

Range	Type of Relation	*Symbol*
26 To 30	Absolutely Necessary	*A*
21 To 25	Especially Important	*E*
16 To 20	Important	*I*
11 To 15	Ordinary Closeness	*O*
6 To 10	Unimportant	*U*

Step (5): the scores were translated into symbols representing the different relations. Table (5.2) shows the Measurement Criterion Question's Answers (done by brainstorming):

Table (5.2): The Measurement Criterion Question's Answers

Question	1		2		3		4		5		6		Score	Relation
Relations	Ans.	Wt.	Ans.	Wt.	Ans.	Wt.	Ans.	Wt.	Ans.	Wt.	Ans.	Wt.		
O_I	b	3	b	3	b	3	a	5	e	3	c	1	18	I
O_D	c	c	1	c	1	c	a	5	c	1	c	1	10	U
O_M	b	3	a	5	a	5	a	5	a	1	c	1	20	I
O_T	b	3	c	1	c	1	a	5	g	5	b	3	18	I
O_W	b	3	a	5	b	3	a	5	e	3	b	3	22	E
I_O	c	1	c	1	c	1	c	1	b	1	c	1	6	U
I_D	b	3	c	1	b	3	b	3	b	1	c	1	12	O
I_M	a	5	a	5	a	5	a	5	g	5	a	5	30	A
I_T	b	3	b	3	b	3	b	3	a	1	c	1	14	O
D_I	a	5	a	5	a	5	a	5	g	5	a	5	30	A
D_O	b	3	c	1	b	3	b	3	e	3	b	3	16	I
D_M	a	5	a	5	a	5	c	1	e	3	b	3	22	E
D_T	a	5	a	5	a	5	b	3	e	3	b	3	24	E
D_W	a	5	a	5	b	3	b	3	e	3	a	5	24	E
M_I	c	1	a	5	b	3	c	1	e	3	c	1	16	I
M_D	b	3	b	3	b	3	a	5	g	5	a	5	24	E
M_W	a	5	a	5	a	5	a	5	e	3	a	5	28	A
M_P	b	3	b	3	a	5	c	1	d	3	b	3	18	I
T_O	b	3	c	1	c	1	b	3	e	3	c	1	12	O
T_I	b	3	b	3	b	3	b	3	e	3	b	3	18	I
T_D	b	3	c	1	a	5	b	3	e	3	b	3	18	I
T_M	a	5	b	3	a	5	b	3	c	1	b	3	20	I
T_W	b	3	a	5	b	3	b	3	e	3	b	3	20	I
P_O	c	1	c	1	b	3	b	3	c	1	b	3	12	O
P_I	c	1	b	3	b	3	b	3	f	3	c	1	14	O
P_D	b	3	c	1	b	3	b	3	f	3	b	3	16	I
P_M	b	3	c	1	c	1	c	1	e	3	c	1	10	U
P_W	b	3	c	1	a	5	b	3	e	3	b	3	18	I
W_O	b	3	a	5	b	3	a	5	g	5	b	3	24	E
W_I	a	5	a	5	a	5	c	1	e	3	b	3	22	E
W_D	a	5	a	5	a	5	a	5	e	3	b	3	26	A
W_M	c	1	c	1	c	1	c	1	b	1	c	1	6	U

5.2.1.3 Hypothesis Testing by Applying WRM:

1. WRM Scores:

WRM organizes what was obtained through the criterion analysis. Each row shows the effect of a certain waste on the other six wastes; similarly each column shows to what degree is a certain type of waste affected by others. The WRM is presented in Table (5.3):

Table (5.3): Waste Relation Matrix

F/T	O	I	D	M	T	P	W
O		I	U	I	I	X	E
I	U		O	A	O	X	X
D	I	A		E	E	X	E
M	X	I	E		X	I	A
T	O	I	I	I		X	I
P	O	O	I	U	X		I
W	E	E	A	U	X	X	

Note: The symbol "X" indicates that there is no direct effect of (i) on (j).

2. Matrix Value:

The waste matrix represents real relationships among wastes. It may be used in several decision-making processes aiming towards waste allocation in factories. To prove this, weights were assigned to the relations. Further more, similar relations were assigned a new score out of 10; these scores are shown in Table (5.4):

Table (5.4): Matrix Value

Type of relation	Weight
A	10
E	8
I	6
O	4
U	2
X	0

The weights of each row and column were added to obtain the score, and then the percentages were calculated by dividing each score by the total score. These

percentages represent the probability that a certain type of waste will affect others or be affected by others. Table (5.5) summarizes the previous analysis:

Table (5.5): Weights of Direct Waste Relations

F/T	O	I	D	M	T	P	W	Score	%
O		6	2	6	6	0	8	28	14.3
I	2		4	10	4	0	0	20	10.2
D	6	10		8	8	0	8	40	20.4
M	0	6	8		0	6	10	30	15.3
T	4	6	6	6		0	6	28	14.3
P	4	4	6	2	0		6	22	11.2
W	8	8	10	2	0	0		28	14.3
Score	22	40	36	34	20	6	38	196	100
%	11.2	20.4	18.4	17.3	10.2	3.1	19.4	100	

3. WRM Results:

Table (5.6) shows the ranking of the most waste affecting other wastes:

Table (5.6): The Ranking of the Most Waste Affecting Other Wastes

The Primary Source	1st Waste	2nd Waste	3rd Waste	4th Waste	5th Waste	6th Waste	7th Waste
WRM	Defects	Motion	Each of: Waiting+ Transportation+ Over-production			Processing	Inventory

Table (5.7) shows the ranking of the most waste affected by other wastes:

Table (5.7): The Ranking of the Most Waste Affected by Other Wastes

The Primary Source	1st Waste	2nd Waste	3rd Waste	4th Waste	5th Waste	6th Waste	7th Waste
WRM	Inventory	Waiting	Defects	Motion	Over-production	Transportation	Processing

- The researcher, who prepared and presented the brainstorming session as the neutral agent, thinks that the results are logical and they show a right mirror to the situation in the Gaza Strip
- Defects occupied the first rank as a logical result where this kind of wastes pushes to produce more parts to consume the loss, increases the work-in-process inventory levels, requires repairing processes and more workers motions, increases transportation efforts for repairs, and results in other parts waiting to be processed
- Inventory waste which is considered as one of the most important wastes outside Gaza strip could be different here because Gaza lives an exceptional situation under the Israeli siege and random crossing points that push all of the managers to keep unordinary levels of inventory to be aware of production sustainability under Gaza uncertain situations

Table (5.3) confirms that there is a significant effect for all of the seven mentioned wastes on the production cost for the manufacturing firms in the Gaza Strip.

Result: Hypothesis is accepted.

Note that the supporting results of the related previous studies for these points and the researcher comments are shown below the questionnaire hypotheses testing.

5.2.2. The Questionnaire:

Which is the second primary source used in this research to test the hypotheses.

A special questionnaire was distributed to the top management of all of the manufacturing firms having more than nine fixed employees in the Gaza Strip, and their total number was 114. (Respondents were 99 out of 114).

5.2.2.1 Data Measurement:

In order to be able to select the appropriate method of analysis, the level of measurement must be understood. For each type of measurement, there is/are an appropriate method/s that can be applied and not others. In this research, ordinal scales were used. Ordinal scale is a ranking or a rating data that normally uses integers in

ascending or descending order. The numbers assigned to the important (1,2,3,4,5) do not indicate that the interval between scales are equal, nor do they indicate absolute quantities. They are merely numerical labels. Based on Likert scale (shown in Table 5.8), we have the following:

Table (5.8): Likert Scale

Item	***Strongly agree***	***Agree***	***Not Sure***	***Disagree***	***Strongly Disagree***
Scale	5	4	3	2	1

5.2.2.2 Statistical analysis Tools:

The researcher would use quantitative data analysis methods. The Data analysis will be made utilizing (SPSS 18). The researcher would utilize the following statistical tools:

1) Cronbach's Alpha and Split-Half Methods for Reliability Statistics.
2) Spearman Rank correlation for Validity.
3) Frequency and Descriptive analysis.
4) Nonparametric Tests (Sign test, and Kruskal-Wallis test).
   - Sign test is used to determine if the mean of a paragraph is significantly different from a hypothesized value 3 (Middle value of Likert scale). If the P-value (Sig.) is smaller than or equal to the level of significance, $\alpha = 0.05$, then the mean of a paragraph is significantly different from a hypothesized value 3. The sign of the Test value indicates whether the mean is significantly greater or smaller than hypothesized value 3. On the other hand, if the P-value (Sig.) is greater than the level of significance, $\alpha = 0.05$, then the mean a paragraph is insignificantly different from a hypothesized value 3.
   - Kruskal-Wallis test is used to examine if there is a statistical significant difference between several means among the respondents toward Lean Manufacturing attributed to (age, Specialization, Scientific qualification, and Position).

5.2.2.3 Validity of Questionnaire:

Validity has a number of different aspects and assessment approaches. Statistical validity is used to evaluate instrument validity, which include internal validity and

structure validity. Refers to the degree to which an instrument measures what it is supposed to be.

A. Internal Validity:

Internal validity of the questionnaire is the first statistical test that used to test the validity of the questionnaire. It is measured by a scouting sample, which consisted of 30 questionnaires through measuring the correlation coefficients between each paragraph in one field and the whole filed.

The related tables are shown in (Appendix D).

Table (D.1) clarifies the correlation coefficient for each paragraph of the Contribution of overproduction and the total of the field. The p-values (Sig.) are less than 0.05, so the correlation coefficients of this field are significant at $\alpha = 0.05$, so it can be said that the paragraphs of this field are consistent and valid to be measure what it was set for.

The same clarification for all of the other independent variables (wastes of production) is shown by the tables (D.2, D.3, D.4, D.5, D.6, and D.7 in Appendix D).

B. Structure Validity of the Questionnaire:

Structure validity is the second statistical test that used to test the validity of the questionnaire structure by testing the validity of each field and the validity of the whole questionnaire. It measures the correlation coefficient between one filed and all the fields of the questionnaire that have the same level of liker scale.

Table (5.9): Correlation Coefficient of Each Field and the Whole of Questionnaire

No.	Field	Spearman Correlation Coefficient	P-Value (Sig.)
1.	Contribution of overproduction	0.465	0.005*
2.	Contribution of excess inventory	0.745	0.000*
3.	Contribution of over-processing	0.681	0.000*
4.	Contribution of workers motion	0.888	0.000*
5.	Contribution of workers and machines waiting	0.858	0.000*
6.	Contribution of defects	0.619	0.000*
7.	Contribution of materials and products transportation	0.840	0.000*

* Correlation is significant at the 0.05 level

Table (5.9) clarifies the correlation coefficient for each filed and the whole questionnaire. The p-values (Sig.) are less than 0.05, so the correlation coefficients of

all the fields are significant at $\alpha = 0.05$, so it can be said that the fields are valid to be measured what it was set for to achieve the main aim of the study.

5.2.2.4 Reliability of the Questionnaire:

The reliability of an instrument is the degree of consistency which measures the attribute; it is supposed to be measuring. The less variation an instrument produces in repeated measurements of an attribute, the higher its reliability. Reliability can be equated with the stability, consistency, or dependability of a measuring tool. The test is repeated to the same sample of people on two occasions and then compares the scores obtained by computing a reliability coefficient (Polit & Hunger, 1985).

1. Cronbach's Coefficient Alpha:

This method is used to measure the reliability of the questionnaire between each field and the mean of the whole fields of the questionnaire. The normal range of Cronbach's coefficient alpha value between 0.0 and + 1.0, and the higher values reflects a higher degree of internal consistency. The Cronbach's coefficient alpha was calculated for each field of the questionnaire.

Table (5.10) shows the values of Cronbach's Alpha for each filed of the questionnaire and the entire questionnaire. For the fields, values of Cronbach's Alpha were in the range from 0.554 and 0.920. This range is considered high; the result ensures the reliability of each field of the questionnaire. Cronbach's Alpha equals 0.937 for the entire questionnaire which indicates an excellent reliability of the entire questionnaire.

Table (5.10) Cronbach's Alpha for each filed of the questionnaire and the entire questionnaire

No.	Field	Cronbach's Alpha
1.	Contribution of overproduction	0.554
2.	Contribution of excess inventory	0.888
3.	Contribution of over-processing	0.775
4.	Contribution of workers motion	0.920
5.	Contribution of workers and machines waiting	0.746
6.	Contribution of defects	0.730
7.	Contribution of materials and products transportation	0.891
	All paragraphs of the questionnaire	**0.937**

2. Split Half Method:

Table (5.11): Correlation Coefficient for Each Filed of the Questionnaire

No.	Field	Correlation Coefficient	Spearman-Brown Correlation Coefficient
1.	Contribution of overproduction	0.535	0.700
2.	Contribution of excess inventory	0.852	0.922
3.	Contribution of over-processing	0.740	0.853
4.	Contribution of workers motion	0.870	0.931
5.	Contribution of workers and machines waiting	0.620	0.769
6.	Contribution of defects	0.783	0.880
7.	Contribution of materials and products transportation	0.803	0.892
	All paragraphs of the questionnaire	**0.903**	**0.949**

Table (5.11) clarifies the correlation coefficient for each field of the questionnaire. The correlation coefficients of all field are significant at $\alpha = 0.05$, so it can be said that the fields are consistent and valid to be measure what it was set for.

The Thereby, it can be said that the researcher proved that the questionnaire was valid, reliable, and ready for distribution for the population sample.

5.2.2.5 Hypotheses Testing by Applying the Questionnaire:

A. Personal Information:

Note that all of the related tables are shown in (Appendix E).

1- Gender:

Table (E.1) shows that 96.9% of the population is Males and 3.1% of the population is Females. These ratios are related to people culture in Gaza where most of females prefer to work through services facilities.

2- Age:

Table (E.2) shows that 25.3% of the sample are of "26-35 years old", 29.3% of the sample are of "36-45 years old ", and 31.3% of the sample are of "46-60 years old". These ratios are logical where the person lives his/her effective days in this period of life.

3- Specialization:

Table (E.3) shows that 66.7% of the respondents studied "commerce". This ratio gives a good indication about the future of the manufacturing business in the Gaza Strip, and it is a logical point according to the nature of their work.

4- Scientific qualification:

Table (E.4) shows that 50.5% of the managers are bachelor (or more) holders. This is a good indicator showing that people in Gaza Strip became acquiring the importance of high education to be able to implement correct actions through their work.

5- Position:

Table (E.5) shows that the respondents were highly experienced.

B. Establishment Information:

Note that all of the related tables are shown in (Appendix F).

6-The establishment location:

Table (F.1) shows that most of the manufacturing business locate in Gaza City (67.3%), and (32.7%) of these firms are distributed among the other regions. The reason is that most of capital and various projects locate in Gaza City itself which is the richest among governorates.

7- The total number of your fixed employees is:

Table (F.2) shows that 93% of the manufacturing business in Gaza Strip includes less than 50 workers (Note that we neglected the firms including less than 10 workers). This result shows highly that the manufacturing business in Gaza still in the stages of growth because of lots of political and economical difficulties.

8- The establishment capital is:

Table (F.3) shows that more than 28% of the Gaza Strip manufacturing firms are individual, and more than 24% of these firms are just partnership. This point shows highly the poverty of the manufacturing business in this region, and confirms that manufacturing here still in the primary growth stage.

9- The legal form of the establishment is:

Table (F.4) shows that only (20.4%) of the manufacturing firms capital is more than $900,000. This indicator supports the last point highly and shows the poverty of our manufacturing business in the Gaza Strip.

10- Is the establishment licensed?

More than (89%) of the manufacturing firms in the Gaza Strip are licensed. This result supports that the Palestinian product follows the governmental instructions highly.

11- The establishment is managed by:

Less than (30%) of the manufacturing firms in the Gaza Strip are managed by the special management. This result also supports that the manufacturing business in the Gaza Strip still so poor.

12- Is the establishment a member of the Palestinian Federation of Industries?

More than (75%) of the manufacturing firms in the Gaza Strip are members of PFI.

13- Determine the source of the raw materials used in manufacturing (you can place more than one source):

Respondents answered that it is for Gaza strip 31.94%, 23.79% for West Bank, 41.82% for Israel, 32.65% for Egypt, and 34.45% for other countries.

By using the famous illegal tunnels, the common sources of the raw materials used in manufacturing are Israel and Egypt. That is a logical result according to the geographical location of the Gaza Strip and the strict Israeli restrictions of importing. Without these tunnels between Gaza and Egypt, the rates will be negative to Egypt and positive to Israel.

14- Closure of crossings has a negative role on your products by a …… ratio:

Table (F.5) shows that 64.7% are highly affected by crossings closure. This is a logical result because of scarcity of raw materials in Gaza Strip.

15- The weekly total hours of electricity interruption during your work is:

Table (F.6) shows that nearly (94%) of the manufacturing firms in the Gaza Strip suffer from electricity interruption problem. It is a logical result where all of people in Gaza suffer from the same problem.

16- Do you have a special electricity generator for your work?

As a result of electricity interruption, 85.9% of the manufacturing firms use electrical generators.

17- Your generator will by an alternative of electricity by the ratio:

Table (F.7) shows that more than (88%) of the manufacturing firms can not use the special generator as an alternative of electricity.

18- What happens when the electricity interruption occurs?

Table (F.8) shows that more than (78%) of the manufacturing firms run the generator as the best suitable alternative.

C. Cost Management Information:

19- More than 36% of the manufacturing firms have no cost plan. This ratio means that lots of managers in Gaza Strip do not believe in the necessary planning.

20- More than 38% of the manufacturing firms believe that their employees are not experienced about minimizing production cost. This ratio means that lots of employees and managers do not care about the production cost and they consider it as unnecessary factor.

21- More than 55% of the manufacturing firms have no department including production cost management. This ratio means that more than half of manufacturing business in Gaza strip does not care of production cost.

22- More than 47% of the manufacturing firms do not have production schedules. This ratio means that about half of the manufacturing business in the Gaza strip produce randomly.

23- More than 45% of the manufacturing firms do not follow the product cost. This ratio supports the previous two points.

24- More than (45%) of the manufacturing firms' heads mentioned that they haven't specialist(s) to follow up the production cost. This is another problem in the managers concept for the production in the Gaza Strip.

25- Less than (45%) of the manufacturing firms heads agrees that their production problems are related for neglecting the production cost management. This point supports the previous one.

D. Research Hypotheses:

Clarification for the following tables related to (H1):

- Mean: The average of respondents answers
- Proportional Mean (%): (Mean/5)*100
- P-value (Sig.): Calculated by SPSS program,
  If it is (more than 0.05), the respondent is not sure
  If it is (less than 0.05), the respondent agrees or disagrees
- Test Value: Calculated by SPSS program,
  If it is (positive), the respondent agrees
  If it is (negative), the respondent disagrees
- Rank: According to Mean (or Proportional Mean)

Hypothesis H1a:

There's a significant statistical effect of overproduction on the production cost.

Table (5.12) shows the following results:

- The mean of the filed "Overproduction" equals 4.09 (81.79%), Test-value = 8.96, and P-value=0.000 which is smaller than the level of significance $\alpha = 0.05$. The sign of the test is positive, so the mean of this field is significantly greater than the hypothesized value 3.

Result: Hypothesis is accepted.

This result agrees with Berg and Ohlsson (2005) who mentioned that waste from overproduction is the most serious waste because it contributes to the other six wastes where production costs money and there is no reason to produce items that are not demanded.

This finding is supported with Christodoulou (2008) who found that 13 out of 20 interviewees confirmed that business's strategic intent for the adoption of lean manufacturing is reducing costs.

So, it is so clear now that overproduction, which is unnecessarily producing more than demanded, increases the risk of obsolescence, increases the risk of producing the wrong thing and increases the production cost. However, the manufacturing managers in the Gaza Strip are pushed toward this kind of waste heavily because of the Israeli siege on Gaza, exporting obstacles, and the related small size of the Gaza strip market.

Table (5.12): Means and Test Values for "Overproduction"

No	Field	Mean	Proportional mean (%)	Test value	P-value (Sig.)	Rank
1.	Minimizing overproduction in your company leads to preventing accumulation of units within the store.	4.26	85.11	8.69	0.000*	1
2.	Minimizing overproduction in your company leads to reducing defects in your products.	4.01	80.21	7.34	0.000*	5
3.	Minimizing overproduction in your company allows more space within the work that can be exploited	4.17	83.40	8.21	0.000*	2
4.	Minimizing overproduction in your company reduces the staff and machines waiting in the other units.	4.08	81.68	8.18	0.000*	4
5.	Minimizing overproduction in your company leads to better exploiting of the available human and material resources.	4.15	82.98	8.62	0.000*	3
6.	By the nature of your work, minimizing overproduction in your company reduces transport of materials between work stations and machines.	3.92	78.49	7.62	0.000*	7
7.	According to your experience, minimizing overproduction in your company reduces the need for re-manufacturing of the product.	3.99	79.78	7.29	0.000*	6
	All paragraphs of the field " Overproduction"	**4.09**	**81.79**	**8.96**	**0.000***	

* The mean is significantly different from 3

<u>Hypothesis H1b:</u>
There's a significant statistical effect of inventory on the production cost.

Table (5.13) shows the following results:

- The mean of the filed "Inventory" equals 3.98 (79.57%), Test-value = 8.30, and P-value=0.000 which is smaller than the level of significance $\alpha = 0.05$. The sign of the test is positive, so the mean of this field is significantly greater than the hypothesized value 3.

Result: Hypothesis is accepted.

This result agrees with Abdullah (2003) who found that the current state map for ABS revealed a huge amount of waste represented by excessive inventory.

Also, this result is consistent with Rathi (2009) who demonstrated that the raw material inventory was the most prevalent waste for the process industry sector.

So, it is so clear now that inventory waste, which is having unnecessarily high levels of raw materials, works-in-process and finished products, leads to higher inventory financing costs and higher storage costs. However, the huge uncertainty political situations and the randomly crossing point's procedures are the main causes of such waste where the managers feel that inventory levels existence could be very important.

Table (5.13): Means and Test Values for "Inventory"

No	Field	Mean	Proportional mean (%)	Test value	P-value (Sig.)	Rank
1.	Excess inventory minimization balances the flow of materials through the stages of production so as to ensure there is no idle capacity.	4.00	80.00	7.72	0.000*	3
2.	When you minimize the excess inventory through working, your production defective units are less.	3.91	78.30	7.29	0.000*	6
3.	Policy of minimizing the excess inventory leads to lower following-up and conditioning costs of production units.	4.12	82.34	7.81	0.000*	1
4.	When you minimize the excess inventory through working, you are better exploiting areas of the workplace.	3.93	78.51	7.04	0.000*	5
5.	Excess inventory minimization reduces the number of workers needed in your production.	4.02	80.43	7.16	0.000*	2
6.	By the nature of your work, excess inventory minimization reduces the materials transport between work stations and machines	3.91	78.30	6.75	0.000*	6
7.	According to your experience in your work, excess inventory minimization reduces the re-manufacturing of the product.	3.96	79.14	7.07	0.000*	4
	All paragraphs of the field " Inventory"	**3.98**	**79.57**	**8.30**	**0.000***	

* The mean is significantly different from 3

<u>Hypothesis H1c:</u>
There's a significant statistical effect of over-processing on the production cost.

Table (5.14) shows the following results:

- The mean of the filed "Over-processing" equals 4.02 (80.33%), Test-value = 8.44, and P-value=0.000 which is smaller than the level of significance $\alpha = 0.05$. The sign of the test is positive, so the mean of this field is significantly greater than the hypothesized value 3.

Result: Hypothesis is accepted.

This result agrees with Rathi (2009) who found that unneeded processing, transportation of materials, and WIP inventory wastes are significant in job type PI Also, this result is supported with Visser (2009) who found that the success of lean office (wastes elimination) improves BPM case management by performing work more efficiently and effectively.

So, it is so clear now that over-processing waste, which is unintentionally doing more processing work, leads to higher costs. The researcher thinks that neglecting the important training of employees and missing the time importance for production in the Gaza Strip push toward this kind of waste.

Table (5.14): Means and Test Values for "Over-processing"

No	Field	Mean	Proportional mean (%)	Test value	P-value (Sig.)	Rank
1-	Over-processing minimization leads to a better use of time and efforts.	4.03	80.64	7.68	0.000*	4
2-	Over-processing minimization helps in reducing the movement barriers of people and materials during the work.	4.04	80.85	7.94	0.000*	3
3-	Over-processing minimization balances the flow of materials through the stages of production so as to ensure there is no idle capacity.	4.01	80.21	7.94	0.000*	6
4-	Over-processing minimization in your company can reduce the workers useless movements.	4.15	82.95	7.75	0.000*	2
5-	Over-processing minimization reduces the materials used in your product line.	4.18	83.64	7.84	0.000*	1
6-	By the nature of your work, over-processing minimization reduces the materials transport between work stations and machines.	4.02	80.42	7.59	0.000*	5
7-	According to your experience in your work, over-processing minimization reduces the workers stress.	3.96	79.15	7.50	0.000*	7
	All paragraphs of the field " Over-processing"	**4.02**	**80.33**	**8.44**	**0.000***	

* The mean is significantly different from 3

Hypothesis H1d:

There's a significant statistical effect of motion on the production cost.

Table (5.15) shows the following results:

- The mean of the filed "Motion" equals 4.15 (83.01%), Test-value = 9.02, and P-value=0.000 which is smaller than the level of significance $\alpha = 0.05$. The sign of the test is positive, so the mean of this field is significantly greater than the hypothesized value 3.

Result: Hypothesis is accepted.

This finding is supported with Capital (2004) who confirmed that a survey by Industry Week Magazine reported a median savings of 7% of cost of goods sold as a result of implementing lean for the USA companies.

Also, this result is supported with Czabke (2007) who studied two lean leader companies for the secondary wood industries and found that the implementation of lean thinking resulted in more efficient and cost effective manufacturing.

So, it is so clear now that motion waste, which is any unnecessary physical motions or walking by workers which divert them from actual processing work, leads to higher costs. The researcher thinks that the poverty of the managerial instructions and neglecting the important training lead to such kind of waste.

Table (5.15): Means and Test Values for "Motion"

No	Field	Mean	Proportional mean (%)	Test value	P-value (Sig.)	Rank
1-	Workers motion minimization facilitates the task of management in controlling the work.	4.13	82.53	8.09	0.000*	5
2-	Workers motion minimization in your company reduces the waiting machines and leads to greater exploitation of the potential.	4.16	83.26	8.73	0.000*	4
3-	Workers motion minimization reduces the injuries at work.	4.18	83.66	8.46	0.000*	3
4-	Workers motion minimization in your company reduces the energy wasted.	4.24	84.83	8.55	0.000*	1
5-	Workers motion minimization leads to better exploiting of the areas.	4.22	84.49	8.33	0.000*	2
6-	By the nature of your work, workers motion minimization reduces the production of defective units.	4.08	81.57	8.04	0.000*	7
7-	According to your experience in your work, workers motion minimization reduces the re-manufacturing of the product.	4.11	82.27	7.75	0.000*	6
	All paragraphs of the field " Motion"	**4.15**	**83.01**	**9.02**	**0.000***	

* The mean is significantly different from 3

Hypothesis H1e:
There's a significant statistical effect of waiting on the production cost.

Table (5.16) shows the following results:

- The mean of the filed "Waiting" equals 4.11 (82.10%), Test-value = 8.86, and P-value=0.000 which is smaller than the level of significance $\alpha = 0.05$. The sign of the test is positive, so the mean of this field is significantly greater than the hypothesized value 3.

Result: Hypothesis is accepted.

This result is supported with Visser (2009) who found that the success of lean office (wastes elimination) improves BPM case management by performing work more efficiently and effectively.

Also, this finding is supported with Forrester, et.al. (2010) who found that Brazilian firms and managers in the agricultural machinery and implements sector that have supported a transition towards the adoption of lean manufacturing practices has shown a significant improvement in their business performance including the production cost. So, it is so clear now that waiting waste, which is idle time for workers or machines due to bottlenecks or inefficient production flow on the factory floor, results in a significant cost insofar as it increases labor costs and depreciation costs per unit of output. In Gaza Strip, most of the managers used to deal the employees through the centralization system, and they consider time as a neglected unnecessary factor. These are the main causes of the "waiting" waste in the manufacturing business in this region.

Table (5.16): Means and Test Values for "Waiting"

No	Field	Mean	Proportional mean (%)	Test value	P-value (Sig.)	Rank
1-	Workers and machines waiting minimization help in greater exploitation of the potential of working.	4.16	83.23	8.24	0.000*	2
2-	Workers and machines waiting minimization during your production reduce the work injury.	4.10	81.91	8.03	0.000*	4
3-	Workers and machines waiting minimization improve the skills of communication between departments, and thus reduce errors during the production process.	4.06	81.29	8.34	0.000*	6
4-	Workers and machines waiting minimization facilitate the task of management in the control of human resources.	4.14	82.77	8.67	0.000*	3
5-	Workers and machines waiting minimization facilitate the monitoring of product quality.	4.18	83.62	8.60	0.000*	1
6-	By the nature of your work, workers and machines waiting minimization reduces the materials transport between work stations and machines.	4.08	81.51	8.06	0.000*	5
7-	According to your experience, workers and machines waiting minimization reduces the product re-manufacturing.	4.03	80.64	7.81	0.000*	7
	All paragraphs of the field "Waiting"	**4.11**	**82.10**	**8.86**	**0.000***	

* The mean is significantly different from 3

Hypothesis H1f:

There's a significant statistical effect of defects on the production cost.

Table (5.17) shows the following results:

- The mean of the filed "Defects" equals 4.18 (83.56%), Test-value = 8.97, and P-value=0.000 which is smaller than the level of significance $\alpha = 0.05$. The sign of the test is positive, so the mean of this field is significantly greater than the hypothesized value 3.

Result: Hypothesis is accepted.

This result agrees with Kilpatrick (1997) who demonstrated through his model that zero defects are indispensable in achieving the goal of reducing order lead time.

Also, this result is supported with Christodoulou (2008) who found that 13 out of 20 interviewees confirmed that business's strategic intent for the adoption of lean is reducing costs.

So, it is so clear now that defects waste, which are physical defects which directly add to the costs of goods sold including errors in paperwork, provision of incorrect information about the product, late delivery, production to incorrect specifications, use of too much raw materials or generation of unnecessary scrap, results in a significant cost. In the Gaza Strip, the researcher thinks that the poverty of employees training, using inexperienced employees in the purpose of decreasing salaries, incorrect maintenance procedures, and the high machines age lead heavily to this kind of waste.

Table (5.17): Means and Test Values for "Defects"

No	Field	Mean	Proportional mean (%)	Test value	P-value (Sig.)	Rank
1-	Defects minimization leads to better reputation with customers and increasing the marketing of the product.	4.57	91.40	9.17	0.000*	1
2-	Defects minimization reduces the bottlenecks that impede the movement of workers and materials during the work.	4.29	85.87	8.95	0.000*	2
3-	Defects minimization reduces re-manufacturing the same products.	4.09	81.74	8.10	0.000*	5
4-	Defects minimization reduces the excess movement of workers.	4.12	82.34	8.22	0.000*	3
5-	Defects minimization leads to the optimal use materials and human resources.	4.06	81.14	6.98	0.000*	6
6-	By the nature of your work, defects minimization reduces the materials transport between work stations and machines.	4.03	80.65	7.59	0.000*	7
7-	According to your experience in your work, defects minimization reduces the re-manufacturing of the product.	4.11	82.15	7.81	0.000*	4
	All paragraphs of the filed " Defects"	**4.18**	**83.56**	**8.97**	**0.000***	

* The mean is significantly different from 3

Hypothesis H1g:

There's a significant statistical effect of transportation on the production cost.

Table (5.18) shows the following results:

- The mean of the filed "Transportation" equals 4.10 (81.94%), Test-value = 8.50, and P-value=0.000 which is smaller than the level of significance $\alpha = 0.05$. The sign of the test is positive, so the mean of this field is significantly greater than the hypothesized value 3.

Result: Hypothesis is accepted.

This result agrees with Rathi (2009) who found that unneeded processing, transportation of materials, and WIP inventory wastes are significant in job type PI.

Also, this result is supported with Czabke (2007) who studied two lean leader companies for the secondary wood industries and found that the implementation of lean thinking resulted in more efficient and cost effective manufacturing.

So, it is so clear now that transportation waste, which is any movement of materials that does not add any value to the product, results in a significant cost. In the Gaza Strip, the researcher thinks that change-resistance in the managers' minds, electricity interruption, and the maintenance requirements are leading to the poverty of the used transportation methods.

Table (5.18): Means and Test Values for "Transportation"

No	Field	Mean	Proportional mean (%)	Test value	P-value (Sig.)	Rank
1-	Materials and products transportation minimization reduces the necessary energy, such as, number of workers and electricity.	4.16	83.19	8.36	0.000*	3
2-	Materials and products transportation minimization reduces the bottlenecks that impede the movement of people and materials during the work.	3.99	79.79	7.13	0.000*	7
3-	Materials and products transportation minimization in your company reduces the risk of damaged units or defects.	4.03	80.64	7.78	0.000*	6
4-	Materials and products transportation minimization reduces the waiting workers and machines.	4.11	82.15	8.33	0.000*	4
5-	Materials and products transportation minimization leads to better exploiting of the areas.	4.17	83.44	8.62	0.000*	1
6-	By the nature of your work, materials and products transportation minimization facilitates the control of materials and human resources.	4.17	83.40	8.21	0.000*	2
7-	According to your experience in your work, materials and products transportation minimization reduces the re-manufacturing of the product.	4.11	82.11	7.44	0.000*	5
	All paragraphs of the filed " Transportation"	**4.10**	**81.94**	**8.50**	**0.000***	

* The mean is significantly different from 3

Hypothesis H1: There is a significant statistical effect of lean manufacturing on the production cost.

Table (5.19) shows the following results:

- The mean of all paragraphs of the questionnaire equals 4.07 (81.32%), Test-value = 9.08, and P-value=0.000 which is smaller than the level of significance $\alpha = 0.05$. The sign of the test is positive, so the mean of all paragraphs of the questionnaire is significantly greater than the hypothesized value 3.

Result: Hypothesis is accepted.

This finding agrees with Forrester, et.al. (2010) who investigated the relationship between the adoption of lean manufacturing, market share, and value creation of companies in the agricultural machinery and implements sector in Brazil and reached to the conclusion that Brazilian firms and managers in this sector that have supported a transition towards the adoption of lean manufacturing practices have shown a significant improvement in their business performance including the production cost.

Moreover, this finding agrees with Hallgren and Olhager (2009) who investigated internal and external factors that drive the choice of lean and agile operation capabilities and their impact on operational performance. In this research, the impact on quality, delivery, cost, and flexibility performance was analyzed using equations modeling for a total of 211 plants from 3 industries and 7 countries. In this research, the researcher has reached to the conclusion that lean manufacturing has a significant impact on cost performance.

Also, this result agrees with Czabke (2007) who identified the common and individual pitfalls and difficulties during lean implementation for two lean leader companies from US and another two lean leader companies from Germany, where personal interviews -with the same questions- of high level management were the main source of information. The researcher found that all plants became more efficient and hence more cost effective and profitable by implementing lean manufacturing techniques.

This result is consistent with McGrath (2007) who determined the extent to which the main principles of lean manufacturing have been and/or still being carried out on two medical device companies based in the South of Ireland. Interviews were carried out

there, and the respondents were chosen for their experience and expertise in lean manufacturing and production areas, and the researcher reached to the conclusion that both companies have made some great improvements in terms of the value streams of their respective plants and also in the reduction of wastes.

Also, This result is supported with Rawabdeh (2005) who investigated the waste in a job shop environment and proposes an assessment method aimed at helping companies to identify root causes of waste, and the researcher has developed a model that serves as a guideline for simplifying the search of wastes problems and identifies opportunities for waste elimination to improve the job shop performance.

Moreover, this finding agrees with Koh, et.al. (2004) who re-examined if lean production manufacturing practices interact with the compensation system and information system to reduce production costs, and reached to the conclusion that lower production costs can be achieved when lean production manufacturing practices, such as, TQM and JIT, are used.

Also, this result is consistent with Yamashita (2004) who determined how the consultant of (SAMA) is implementing the lean manufacturing process based on the company and focused on behaviors that organizations must exhibit to correctly implement and sustain lean manufacturing practices in Minneapolis area. The researcher found that higher quality products with less recourses and capital are achieved by implementing lean manufacturing which also leads to reductions in scrap, rework, returns, and waste.

Also, this result is consistent with Abdullah (2003) who investigated how lean manufacturing tools can be adapted from the discrete to the continuous manufacturing environment on a large steel manufacturing company. This research concluded that for the steel companies (as with others), the driving force behind implementing lean was cost reduction.

So, it is so clear now that lean manufacturing, which is a systematic approach to identify and eliminate waste (non-value added activities) through continuous improvement by following the product at the pull of the customer in pursuit of perfection, results in a significant cost. In the Gaza Strip, the researcher thinks that following the mentioned tools and techniques in chapter2 would also lead to high

improvements in lead time, productivity, work-in-process inventory, quality, space utilization, processing errors, staffing demands, opportunities for new marketing campaigns, scrap, cross-trained employees, self-directed work teams, fast market response, longer machine life, customer communication, flexibility in reacting to changes, and strategic management focus.

Table (5.19): Means and Test Values for "All Paragraphs of the Questionnaire"

Field	Mean	Proportional mean (%)	Test value	P-value (Sig.)
Over-production	**4.09**	**81.79**	**8.96**	**0.000***
Inventory	**3.98**	**79.57**	**8.30**	**0.000***
Over-processing	**4.02**	**80.33**	**8.44**	**0.000***
Motion	**4.15**	**83.01**	**9.02**	**0.000***
Waiting	**4.11**	**82.10**	**8.86**	**0.000***
Defects	**4.18**	**83.56**	**8.97**	**0.000***
Transportation	**4.10**	**81.94**	**8.50**	**0.000***
All paragraphs of the questionnaire	**4.07**	**81.32**	**9.08**	**0.000***

*The mean is significantly different from 3

Hypothesis H2: There is no significant statistical difference at significant level (α=0.05) among respondents perception regarding lean manufacturing attributed to personal variables (Age, Specialization, Scientific qualification, Position).

This hypothesis can be divided into the following sub-hypotheses:

Hypothesis H2a:

There is no significant statistical difference among respondents perception regarding lean manufacturing attributed to age.

Table (5.20) shows that the p-value (Sig.) is greater than the level of significance α = 0.05 for the other fields, then there is insignificant difference among respondents perception regarding lean manufacturing attributed to age.

Result: Hypothesis is accepted.

Table (5.20): Kruskal-Wallis Test of the Fields and their p-values for Age

No	Field	Test Value	df	Sig.
1.	Contribution of overproduction	3.868	4	0.424
2.	Contribution of excess inventory	0.537	4	0.970
3.	Contribution of over-processing	6.008	4	0.199
4.	Contribution of workers motion	4.245	4	0.374
5.	Contribution of workers and machines waiting	0.473	4	0.976
6.	Contribution of defects	4.182	4	0.382
7.	Contribution of materials and products transportation	2.462	4	0.651
	All paragraphs of the questionnaire	**2.431**	**4**	**0.657**

Hypothesis H2b:

There is no significant statistical difference among respondents perception regarding lean manufacturing attributed to specialization.

Table (5.21) shows that the p-value (Sig.) is greater than the level of significance α = 0.05 for the other fields, then there is insignificant difference among respondents perception regarding lean manufacturing attributed to specialization.

Result: Hypothesis is accepted.

The researcher thinks that existence of 66.7% managers (most of Gaza Strip manufacturing managers) who studied at the same faculty of commerce, with the same specialization, would lead to this result especially that another ratio of 9.1% are engineers (highly educated).

Table (5.21): Kruskal-Wallis Test of the Fields and their p-values for Specialization

No	Field	Test Value	df	Sig.
1.	Contribution of overproduction	4.839	5	0.436
2.	Contribution of excess inventory	5.091	5	0.405
3.	Contribution of over-processing	4.610	5	0.465
4.	Contribution of workers motion	1.343	5	0.930
5.	Contribution of workers and machines waiting	4.809	5	0.440
6.	Contribution of defects	2.149	5	0.828
7.	Contribution of materials and products transportation	4.536	5	0.475
	All paragraphs of the questionnaire	3.957	5	0.556

Hypothesis H2c:

There is no significant statistical difference among respondents perception regarding lean manufacturing attributed to scientific qualification.

Table (5.22) shows that the p-value (Sig.) is greater than the level of significance α = 0.05 for the other fields, then there is insignificant difference among respondents perception regarding lean manufacturing attributed to scientific qualification.

Result: Hypothesis is accepted.

The researcher thinks that existence of 50.5% managers holding bachelor or more would lead to this result especially that another ratio of 22.2% of these managers are holding diplomas.

Table (5.22): Kruskal-Wallis Test of the Fields and their p-values for Scientific Qualification

No	Field	Test Value	df	Sig.
1.	Contribution of overproduction	3.904	4	0.419
2.	Contribution of excess inventory	8.367	4	0.079
3.	Contribution of over-processing	3.468	4	0.483
4.	Contribution of workers motion	1.158	4	0.885
5.	Contribution of workers and machines waiting	6.051	4	0.195
6.	Contribution of defects	3.655	4	0.455
7.	Contribution of materials and products transportation	3.986	4	0.408
	All paragraphs of the questionnaire	**3.862**	**4**	**0.425**

Hypothesis H2d:

There is no significant statistical difference among respondents perception regarding lean manufacturing attributed to position.

Table (5.23) shows that the p-value (Sig.) is smaller than the level of significance α = 0.05 for the fields “overproduction, inventory, motion, defects, and transportation", then there is significant difference among respondents perception regarding overproduction, inventory, motion, defects, and transportation attributed to position.

Table (5.23) shows that the p-value (Sig.) is greater than the level of significance α = 0.05 for the other fields "over-processing and waiting", then there is insignificant

difference among respondents perception regarding over-processing and waiting attributed to position.

Result: There is a significant statistical difference among respondents perception regarding overproduction, inventory, motion, defects, and transportation wastes attributed to position, and there is no significant statistical difference among respondents perception regarding over-processing and waiting wastes attributed to position.

The researcher thinks that the position in the manufacturing firm would lead to changes according to the clearness and importance of the waste to the position.

Table (5.23): Kruskal-Wallis Test of the Fields and their p-values for Position

No	Field	Test Value	df	Sig.
1.	Contribution of overproduction	11.628	4	0.020*
2.	Contribution of excess inventory	12.929	4	0.012*
3.	Contribution of over-processing	7.875	4	0.096
4.	Contribution of workers motion	10.480	4	0.033*
5.	Contribution of workers and machines waiting	7.051	4	0.133
6.	Contribution of defects	13.649	4	0.009*
7.	Contribution of materials and products transportation	20.636	4	0.000*
	All paragraphs of the questionnaire	**19.181**	**4**	**0.001***

* The mean difference is significant a 0.05 level

Table (5.24) shows the mean rank for each field of Position. We conclude the following:

- For the fields "overproduction, inventory, motion, transportation, and all paragraphs of the questionnaire ", "General Manager" respondents have the highest mean among the other Positions toward these fields.
- For the field "defects", "another Position" respondents have the highest mean among the other Positions toward this field.

Table (5.24): Mean Rank for Each Field of Position

No	Fields	Mean Rank				
		General Manager	Manager	Department Head	Division Head	Another
1.	Contribution of overproduction	57.64	50.65	32.23	41.20	30.14
2.	Contribution of excess inventory	52.75	53.53	26.88	28.80	39.50
3.	Contribution of over-processing	48.41	51.09	31.79	70.50	47.43
4.	Contribution of workers motion	51.80	51.60	25.50	58.50	41.64
5.	Contribution of workers and machines waiting	52.86	50.12	31.05	45.10	36.00
6.	Contribution of defects	52.13	51.40	20.41	38.10	53.93
7.	Contribution of materials and products transportation	58.08	52.83	22.50	28.30	32.79
	All paragraphs of the questionnaire	**56.21**	**54.99**	**19.31**	**41.00**	**42.50**

5.3 General Commentary on Results:

It may be noteworthy that this research may be the first attempt confirming the significant effect of lean manufacturing on the production cost in the Gaza strip. Generally, managers of the manufacturing firms in the Gaza Strip believe in the effect of lean manufacturing on the production cost.

Based on methodology and hypotheses testing, some of notes can be highlighted:

1. Even under the difficult economic and difficult situations, results have confirmed the importance of applying lean manufacturing in the Gaza Strip manufacturing firms. So, the managers have to take lean manufacturing in consideration and implement the tools and techniques as possible.

2. The main hypothesis was tested by using two primary sources, and the ranking nearly converged of the most wastes affecting the production cost between the two

used primary sources in the Gaza Strip where all of the wastes have to be reduced as possible in order to increase the firm profitability.

3. Results ranked the wastes affected by other wastes.

4. Results have shown that every waste affects the other wastes.

5. Unfortunately, about half of the Gaza Strip manufacturing firms produce randomly, without planning and scheduling.

6. Although the managers reasons in the Gaza Strip to keep unordinary levels of inventory under Gaza uncertain situations, they have to keep the minimum possible levels because still it is waste and affecting the firm profitability.

Chapter Six

Conclusions and Recommendations

7.1 Introduction

7.2 Conclusions

7.3 Recommendations

7.4 Future Researches

7.1 Introduction:

The main objectives of this research are to investigate the current situation of wastes elimination in the manufacturing firms in the Gaza Strip and its important role for reducing the production cost, exploring the implemented wastes elimination tools and techniques, and promote for lean thinking.

In order to enhance the manufacturing business in the Gaza Strip, it is hoped that this research will provide a reference for the best tools and techniques of eliminating wastes, and it is hoped that it will succeed to change the managers' minds into lean thinking.

As a result of this research, the role of lean manufacturing in developing the manufacturing business was emphasized, and empirical evidence was provided to support the conceptual model to link between wastes elimination and reducing production cost.

In this chapter, the conclusions and recommendations of this research will be discussed.

7.2 Conclusions:

By noting that this research studied the manufacturing firms including more than nine fixed employees, the conclusions of this research are as follows:

A. About Heads of the Manufacturing Business in the Gaza Strip:

1. Manufacturing business heads in the Gaza strip are mostly males where most of females prefer to work in service facilities.
2. A good indicator is that most of manufacturing managers are highly educated, and people in the Gaza Strip became acquiring the importance of high education.

B. About The Manufacturing Firms in the Gaza Strip:

1. Most of capital and various projects including the manufacturing business locate in Gaza City governorate.

2. After neglecting the firms including less than 10 workers, (93%) of the manufacturing firms in the Gaza Strip work with less than 50 workers. Also, more than (70%) of the manufacturing firms in the Gaza Strip are managed by the individual owner. This point confirms highly that the manufacturing business in the Gaza Strip is in the stages of growth because of lots of political and economical reasons and problems.
3. Because of scarcity of raw materials in the Gaza Strip, the manufacturing firms in the Gaza strip are highly affected by the closure of the crossing points. Another big problem facing these firms is electricity interruption.

C. About Production Cost Management in the Gaza Manufacturing Firms:

1. Unfortunately, more than 36% of the manufacturing firms have no cost plan. This big ratio means that lots of managers in the Gaza Strip do not believe in the necessary planning.
2. More than 38% of these manufacturing firms do not believe in the importance of the production cost plans. Also, more than (55%) of these firms do not believe that their production problems are related for neglecting the production cost management.
3. By neglecting the necessary production scheduling, about half of these manufacturing firms produce randomly.

D. About the Importance of Lean Manufacturing on the Production Cost for the Manufacturing Firms in the Gaza Strip:

1. Lean manufacturing (wastes elimination) affects positively on reducing the production cost.
2. The ranking nearly converged of the most wastes affecting the production cost between the two used primary sources as shown in table (6.1):

Table (6.1): The Ranking of the Most Wastes Affecting the Production Cost between the Two Used Primary Sources

Serial	Primary Source	1st Waste	2nd Waste	3rd Waste	4th Waste	5th Waste	6th Waste	7th Waste
1	Wastes Relationships Matrix	Defects	Motion	Each of: Waiting+ Transportation+ Over-production			Processing	Inventory
Serial	Primary Source	1st Waste	2nd Waste	3rd Waste	4th Waste	5th Waste	6th Waste	7th Waste
2	Questionnaire	Defects	Motion	Waiting	Transportation	Over-production	Processing	Inventory

E. About Respondents Perception Regarding Lean Manufacturing Attributed to Personal Variables in the Gaza Strip Manufacturing Firms:

1. There is no significant statistical difference among respondents perception regarding lean manufacturing attributed to age, specialization, and scientific qualification.
2. Attributed to position, there is a significant statistical difference among respondents perception regarding overproduction, inventory, motion, defects, and transportation wastes, and there is no significant statistical difference among respondents perception regarding over-processing and waiting wastes.

7.3 Recommendations:

A. For the Managers of the Manufacturing Firms in the Gaza Strip:

1. It is hoped that this research will provide the manufacturing managers within the suitable tools and techniques of eliminating wastes, such as, 5S's system, VSM, TPM, and JIT. Also, it is so necessary for them to implement these techniques which lead to huge improvement in their production.
2. Managers should train all of their employees in all of the managerial levels about applying lean manufacturing tools and techniques.
3. All of the wastes in the manufacturing firm have to be studied and analyzed separately to be able to apply lean manufacturing tools and techniques to reduce the production cost.

4. More intensive manufacturing education is needed for the heads of the manufacturing business to develop their techniques of managing their firms.
5. The manufacturing firms should develop their general plans and schedules according to the nature of their production to be able to reduce production costs.
6. The production cost management must be included into the tasks of a department in the manufacturing firm. Sometimes, it is needed to be a special department.
7. Special plans and specialist(s) for following up the product cost from the starting point to the ending point have to be developed.
8. The common individual-owner form in the Gaza manufacturing business needs to be extended into partnership, private joint stock, and public forms to enhance the related firms and develop their production and increase profitability.

B. For the Managers of the Services Sector in the Gaza Strip:

It is hoped that this research will provide these managers within the suitable tools and techniques of eliminating wastes, such as, 5S's system, VSM, and TPM which are also available for services applications.

C. For the Palestinian Government:

Despite of the political and economical obstacles, more attention from the government is needed for the manufacturing business in the Gaza Strip to develop this important sector which contributes highly in improving GDP and reducing unemployment rates.

D. For the Palestinian Society:

This research may promote for Lean thinking to all kinds of employees and managers in Palestine in order to enhance their performance.

7.4 Future Researches:

It may be noteworthy that this research may be the first attempt to apply a framework to examining the impact of production wastes elimination on the manufacturing firms in the Gaza strip. It could be extended within one of the following suggested researches titles:

1. Reducing Wastes by Implementing Value Stream Mapping for the Gaza Strip manufacturing firms.
2. 5S as an important technique for eliminating production wastes of the Gaza Strip manufacturing firms.
3. The Relationship between Lean Manufacturing and Total Preventive Maintenance for the Gaza Strip Manufacturing Firms.
4. Possibility of Applying Lean Manufacturing Techniques for the Gaza Strip Services Sector.

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Appendices

Appendix A: Brainstorming Group
Appendix B: Questionnaire Revision
Appendix C.1: Copy of the Questionnaire - English
Appendix C.2: Copy of the Questionnaire – Arabic
Appendix D: Internal Validity of the Questionnaire
Appendix E: The Personal Information of the Questionnaire
Appendix F: The Establishment Information of the Questionnaire

Appendix A

Brainstorming Group

List of Professional Persons:

Serial	Name	Position	Place of Work	Manufacturing Related Experience (Years)	Scientific Qualification
1	Mr. Hani Sharaf	General Manager	Sharaf Co. for the metallic industries	10	MBA and Mechanical Engineering Bachelor
2	Mr. Abdullah El-Barassi	Business Advisor	DAI	7	Industrial Engineering Bachelor
3	Mr. Basel Qandeel	Manager of the Modern Industries Center	GUPI	2	MBA and Industrial Engineering Bachelor

All of the members of this group had been met in a brainstorming session with the researcher at Sharaf Co. for the metallic industries in Nov., 26, 2011 at 10:00 a.m.

Appendix B

Questionnaire Revision

List of Academic and Professional Referees:

Serial	Referee	Place of Work
1	Prof. Dr. Yousef Ashor	IUG
2	Prof. Dr. Majed Al-Farra	IUG
3	Prof. Dr. Mohammed Meqdad	IUG
4	Dr. Roshdi Wadi	IUG
5	Dr. Wasim Al-Habeel	IUG
6	Dr. Samir Safi	IUG
7	Mr. Arafat Elaf	IUG
8	Dr. Nehaya Al-Telbani	Al-Azhar University
9	Dr. Saif-Aldeen Oda	The Palestinian Monetary Authority

Appendix C.1

Copy of the Questionnaire - English

Wastes Elimination as the First Step for Lean Manufacturing

"An Empirical Study for Gaza Strip Manufacturing Firms"

Dear Sir(s):……..

The researcher makes a study "Wastes Elimination as the First Step for Lean Manufacturing" for getting the master degree. The researcher implies this questionnaire to get the required data and information for acquiring the importance of wastes elimination for the manufacturing firms, and getting solutions to develop and improve these firms.

The questionnaire consists of eight pages directed to your top manager (or his/her deputies) for the unique scientific purpose.

Thank you,,,

The Researcher

Mohammed AbuShaaban

Mobile: 059-9717565

First: Your Personal Information:

Please, place the symbol (X) on the appropriate box:

1- Sex: Male ☐ Female ☐

2- Age (years old):

16−25	26−35	36−45	46−60	more than 60
☐	☐	☐	☐	☐

3- Specialization:

Engineering	Accounting	Management	Economics	Finance	Another
☐	☐	☐	☐	☐	☐ …….

4- Scientific qualification:

Master/PhD	Bachelor	Diploma	High School	Less than High School
☐	☐	☐	☐	☐ …….

5- Position:

General Manager	Manager	Department Head	Division Head	Another
☐	☐	☐	☐	☐ …….

Second: Your Establishment Information:

Please, place the symbol (X) on the appropriate box:

6-The establishment locates in:

The North	Gaza City	Middle	Khanyounis	Rafah
☐	☐	☐	☐	☐

7- The total number of your fixed employees is:

Less than 10	10−19	20−49	50−99	more than 100
☐	☐	☐	☐	☐

8- The establishment capital is:

Less than $150000	$150000−$399000	$400000−$649000	$650000−$899000	more than $900000
☐	☐	☐	☐	☐

9- The legal form of the establishment is:

Individual	Partnership	Private Joint Stock	Public	Another
☐	☐	☐	☐	☐ …….

Serial	Question	Yes	No
10	Is the establishment licensed?		

Serial	The Paragraph	An individual owner	Special Management
11	The establishment is managed by		

Serial	Question	Yes	No
12	Is the establishment a member of the Palestinian federation of industries?		

13- Determine the source of the raw materials used in manufacturing (you can place more than one source):

Gaza Strip ☐	West Bank ☐	Israel ☐	Egypt ☐	Another ☐
Ratio: ..…%	Ratio: ..…%	Ratio: ..…%	Ratio: ..…%	Ratio: ..…% Country: ……

14- The periodic closure of crossings has a negative role on your products by a …… ratio:

Very Large	Large	Medium	Small	Very Small
☐	☐	☐	☐	☐

15- The weekly total hours of electricity interruption during your work is:

Less than 10	10−19	20−29	30−39	More than 40
☐	☐	☐	☐	☐

Serial	Question	Yes	No
16	Do you have a special electricity generator for your work?		

17- If the answer of Q.16 is "Yes", your generator will by an alternative of electricity by the ratio:

Less than %20	%20−%39	%40−%59	%60−%79	%80−%100
☐	☐	☐	☐	☐

18- When the electricity interruption happens, …… .

Laying off workers	Running the electricity generator	Working without electricity
☐	☐	☐

Third: Your Production Cost Management Information:

Please, place the symbol (X) on the appropriate box:

Serial	Question	Yes	No
19	Does the establishment work according to production cost minimization plan?		
20	Are the employees experienced in production cost minimization?		
21	Do you have a department including production cost management?		

If the answer of Q.21 is "No", continue from Q.29:

Serial	Question	Yes	No
22	Is the production cost management department independent?		
23	Is this department managed by a specialist?		

24- The production cost management division is related to:

Accounting Dept.	Quality Dept.	Risk Dept.	Planning Dept.	Another
☐	☐	☐	☐	☐.....

Serial	Question	Yes	No
25	Does the production cost management department contribute in your production plans?		
26	Does your top management contribute in production cost management plans?		
27	Is your management concerned with your production cost?		
28	Do you think that production cost management division has a large impact in improving your establishment efficiency?		
29	Do you have production schedules?		

Serial	Question	Yes	No
30	Do you have plans for following up the product cost from the starting point to the ending point?		
31	Is your production cost followed up by specialist(s)		
32	Are the production problems related for neglecting the production cost management?		
33	Is your production cost followed up continuously?		

Fourth: General Questions about the Importance of Production Cost Minimization:

Please, place the symbol (X) on the appropriate box:

S.	The Paragraph	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
A. Contribution of overproduction minimization in reducing the production cost.						
.1	Minimizing overproduction in your company leads to preventing accumulation of units within the store.					
.2	Minimizing overproduction in your company leads to reducing defects in your products.					
.3	Minimizing overproduction in your company allows more space within the work that can be exploited					
.4	Minimizing overproduction in your company reduces the staff and machines waiting in the other units.					
.5	Minimizing overproduction in your company leads to better exploiting of the available human and material resources.					
.6	By the nature of your work, minimizing overproduction in your company reduces transport of materials between work stations and machines.					
.7	According to your experience, minimizing overproduction in your company reduces the need for re-manufacturing of the product.					
B. Contribution of excess inventory minimization in reducing the production cost.						
.8	Excess inventory minimization balances the flow of materials through the stages of production so as to ensure there is no idle capacity.					

S.	The Paragraph	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
.9	When you minimize the excess inventory through working, your production defective units are less.					
.10	Policy of minimizing the excess inventory leads to lower following-up and conditioning costs of production units.					
.11	When you minimize the excess inventory through working, you are better exploiting areas of the workplace.					
.12	Excess inventory minimization reduces the number of workers needed in your production.					
.13	By the nature of your work, excess inventory minimization reduces the materials transport between work stations and machines.					
.14	According to your experience in your work, excess inventory minimization reduces the re-manufacturing of the product.					
C. Contribution of over-processing minimization in reducing the production cost.						
.15	Over-processing minimization leads to a better use of time and efforts.					
.16	Over-processing minimization helps in reducing the movement barriers of people and materials during the work.					
.17	Over-processing minimization balances the flow of materials through the stages of production so as to ensure there is no idle capacity.					
.18	Over-processing minimization in your company can reduce the workers useless movements.					
.19	Over-processing minimization reduces the materials used in your product line.					
.20	By the nature of your work, over-processing minimization reduces the materials transport between work stations and machines.					
.21	According to your experience in your work, over-processing minimization reduces the workers stress.					
D. Contribution of workers motion minimization in reducing the production cost.						
.22	Workers motion minimization facilitates the task of management in controlling the work.					
.23	Workers motion minimization in your company reduces the waiting machines and thus leads to greater exploitation of the potential.					
.24	Workers motion minimization reduces the injuries at work.					
.25	Workers motion minimization in your company reduces the energy wasted.					

S.	The Paragraph	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
.26	Workers motion minimization leads to better exploiting of the areas.					
.27	By the nature of your work, workers motion minimization reduces the production of defective units.					
.28	According to your experience in your work, workers motion minimization reduces the re-manufacturing of the product.					
E. Contribution of workers and machines waiting minimization in reducing the production cost.						
.29	Workers and machines waiting minimization helps in greater exploitation of the potential of working.					
.30	Workers and machines waiting minimization during your production reduces the work injury.					
.31	Workers and machines waiting minimization improves the skills of communication between departments, and thus reduce errors during the production process.					
.32	Workers and machines waiting minimization facilitates the task of management in the control of human resources.					
.33	Workers and machines waiting minimization facilitates the monitoring of product quality.					
.34	By the nature of your work, workers and machines waiting minimization reduces the materials transport between work stations and machines.					
.35	According to your experience, workers and machines waiting minimization reduces the re-manufacturing of the product.					
F. Contribution of defects minimization in reducing the production cost.						
.36	Defects minimization leads to better reputation with customers and increasing the marketing of the product.					
.37	Defects minimization reduces the bottlenecks that impede the movement of workers and materials during the work.					
.38	Defects minimization reduces re-manufacturing the same products.					
.39	Defects minimization reduces the excess movement of workers.					
.40	Defects minimization leads to the optimal use materials and human resources.					

S.	The Paragraph	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
.41	By the nature of your work, defects minimization reduces the materials transport between work stations and machines.					
.42	According to your experience in your work, defects minimization reduces the re-manufacturing of the product.					
G. Contribution of materials and products transportation minimization in reducing the production cost.						
.43	Materials and products transportation minimization reduces the necessary energy, such as, number of workers and electricity.					
.44	Materials and products transportation minimization reduces the bottlenecks that impede the movement of people and materials during the work.					
.45	Materials and products transportation minimization in your company reduces the risk of damaged units or defects.					
.46	Materials and products transportation minimization reduces the waiting workers and machines.					
.47	Materials and products transportation minimization leads to better exploiting of the areas.					
.48	By the nature of your work, materials and products transportation minimization facilitates the control of materials and human resources.					
.49	According to your experience in your work, materials and products transportation minimization reduces the re-manufacturing of the product.					

Thank you,,,

The Researcher

Mohammed AbuShaaban

Mobile: 059-9717565

Appendix C.2

Copy of the Questionnaire - Arabic

Wastes Elimination as the First Step for Lean Manufacturing

"An Empirical Study for Gaza Strip Manufacturing Firms"

السادة:.....

المحترمين ,,,

السلام عليكم ورحمة الله وبركاته ,,

يقوم الباحث بدراسة لأغراض البحث العلمي بعنوان **"**التخلص من فواقد الإنتاج كخطوة أولى نحو التصنيع الرشيق" كمتطلب تكميلي للحصول على درجة الماجستير وهو بصدد تطبيق هذه الإستبانه للحصول على البيانات والمعلومات اللازمة والتعرف على أهمية التخلص من فواقد الإنتاج في الشركات الصناعية, وإيجاد الحلول للمعوقات التي تواجه هذه الصناعات, والعمل على وضع آليات لتطويرها وتنميتها.

إن هذه الاستبانة مكونة من سبعة صفحات وهي موجهة للعاملين بالإدارة العليا لديكم، فالرجاء تعبئة هذه الاستبانة مع العلم أن البيانات الواردة فيها هي لغرض البحث العلمي ولن يتم نشرها أو الإعلان عنها أو استخدامها إلا لغرض البحث العلمي.

شاكرين لكم حسن تعاونكم,,,

والله ولي التوفيق,,,

الباحث

محمد سفيان أبوشعبان

059-9717565

أولا: بياناتكم الشخصية:

الرجاء وضع علامة(X) على الخانة المختارة:

1- الجنس: ذكر , أنثى ☐ ☐

2- السن:

16-25 سنة	26-35 سنة	36-45 سنة	46-60 سنة	أكثر من 60 سنة
☐	☐	☐	☐	☐

3- التخصص:

هندسة	محاسبة	إدارة	اقتصاد	علوم مالية	غير ذلك
☐	☐	☐	☐	☐	☐ حدد .....

4- المؤهل العلمي:

دراسات عليا	بكالوريوس	دبلوم	ثانوية	أقل من ثانوية
☐	☐	☐	☐	☐

5- الوظيفة:

مدير عام	مدير	رئيس قسم	رئيس شعبة	غير ذلك
☐	☐	☐	☐	☐ حدد .....

ثانيا: البيانات الخاصة بمنشأتكم:

الرجاء وضع علامة(X) على الخانة المختارة:

6- تقع المنشأة في:

محافظة الشمال	محافظة غزة	محافظة الوسطى	محافظة خانيونس	محافظة رفح
☐	☐	☐	☐	☐

7- العدد الإجمالي للموظفين والعاملين الثابتين بمنشأتكم هو:

أقل من 10	10-19	20-49	50-99	أكثر من 100
☐	☐	☐	☐	☐

8- يقدر رأس مال شركتكم بمبلغ:

أقل من $150000	$150000-$399000	$400000-$649000	$650000-$899000	$900000 فأكثر
☐	☐	☐	☐	☐

9- الشكل القانوني للمنشأة :

منشأة فردية	شركة تضامنية	شركة مساهمة خاصة	شركة مساهمة عامة	غير ذلك
☐	☐	☐	☐	☐ حدد .....

م	السؤال	نعم	لا
10	هل المنشأة لديها ترخيص من الجهات الحكومية؟		

م	الفقرة	فرد من الملاك	إدارة متخصصة من الشركة
11	إدارة المنشأة تتم بواسطة		

م	السؤال	نعم	لا
12	هل المنشأة عضو بإتحاد الصناعات الفلسطينية؟		

13- حدد مصدر المواد الخام التي يتم استعمالها في التصنيع (يمكن الإشارة إلى أكثر من مصدر):

قطاع غزة	الضفة الغربية	إسرائيل	مصر	غير ذلك
☐ بنسبة .....%	☐ بنسبة.....%	☐ بنسبة .....%	☐بنسبة .....%	☐ دولة ..... بنسبة.....%

14-الإغلاقات المتكررة والمستمرة للمعابر لها دور سلبي على منتجات شركتكم بشكل:

كبير جدا	كبير	متوسط	ضئيل	ضئيل جدا
☐	☐	☐	☐	☐

15- عدد ساعات انقطاع الكهرباء أثناء العمل لديكم في الأسبوع الواحد هو:

أقل من 10 ساعات	10-19 ساعة	20-29 ساعة	30-39 ساعة	أكثر من 40 ساعة
☐	☐	☐	☐	☐

م	السؤال	نعم	لا
16	هل يوجد لدى منشأتكم مولد كهرباء خاص بعملكم؟		

17- إذا كانت إجابة السؤال السابق رقم16 ب"نعم"، فإن مولدكم حينها يحل محل الكهرباء بنسبة:

أقل من 20%	20-39%	40-59%	60-79%	80-100%
☐	☐	☐	☐	☐

18-في حال انقطاع التيار الكهربائي في منشأتكم:

يتم تسريح العمال	يتم تشغيل مولد الكهرباء	يتم ممارسة العمل بدون كهرباء
☐	☐	☐

ثالثا : معلومات خاصة بإدارة تكلفة الإنتاج:

الرجاء وضع علامة(X) على الخانة المختارة:

م	السؤال	نعم	لا
19	هل تعمل منشأتكم وفق خطة إدارية لتقليل تكاليف الإنتاج؟		
20	هل يوجد لدى العاملين بمنشأتكم الخبرة في تقليل تكاليف الإنتاج؟		
21	هل يوجد بمنشأتكم قسم يشمل إدارة تكاليف الإنتاج؟		

إذا كانت الإجابة عن السؤال السابق رقم21 ب"لا" ، أكمل من السؤال رقم (29) :

م	السؤال	نعم	لا
22	هل قسم إدارة تكاليف الإنتاج لديكم مستقل بذاته؟		
23	هل يتم إدارة هذا القسم لديكم من قبل متخصص؟		

24- الدائرة التي يتبع إليها قسم إدارة تكاليف الإنتاج لديكم هي:

دائرة المحاسبة والموازنة	دائرة الجودة	دائرة المخاطرة	دائرة التخطيط	غير ذلك
☐	☐	☐	☐	☐ حدد .....

م	السؤال	نعم	لا
25	هل يشارك قسم إدارة تكاليف الإنتاج لديكم في وضع خطط الإنتاج؟		
26	هل تشارك الإدارة العليا لديكم في وضع خطط لإدارة تكاليف الإنتاج؟		
27	هل تهتم إدارة شركتكم بقسم إدارة تكاليف الإنتاج؟		
28	هل تعتقد بأن لقسم إدارة تكاليف الإنتاج مساهمة في تحسين كفاءة منشأتكم؟		
29	هل يتم وضع جداول زمنية لعملية الإنتاج بمنشأتكم؟		
30	هل يتم وضع خطط إنتاجية لمتابعة تكلفة منتجاتكم من البداية إلى النهاية؟		
31	هل يتم لديكم متابعة تكاليف الإنتاج من قبل متخصصين بالشركة؟		
32	هل أسباب مشاكل الإنتاج لديكم ترجع لعدم الاهتمام بتقليل تكاليف الإنتاج؟		
33	هل يتم متابعة تكاليف الإنتاج بشكل مستمر بمنشأتكم؟		

رابعا : أسئلة عامة على أهمية تقليل تكاليف الانتاج:

الرجاء وضع علامة(X) على الخانة المختارة:

م	الفقرة	موافق بشدة	موافق	غير متأكد	غير موافق	غير موافق بشدة
أ – مساهمة تقليل الإنتاج الزائد عن الحاجة في تخفيض تكاليف العملية الإنتاجية.						
.1	يؤدي تقليل الإنتاج الزائد عن الحاجة في شركتكم إلى منع تكدس الوحدات المنتجة في المخازن.					
.2	يساعد تقليل الإنتاج الزائد عن الحاجة في تقليل الوحدات المعيبة من إنتاجكم.					

م	الفقرة	موافق بشدة	موافق	غير متأكد	غير موافق	غير موافق بشدة
3.	تقليل الإنتاج الزائد عن الحاجة لديكم يتيح مساحات أكبر داخل العمل يمكن استغلالها.					
4.	يؤدي تقليل الإنتاج الزائد عن الحاجة في وحدات عملكم إلى تقليل انتظار العاملين والماكنات في الوحدات الأخرى لديكم.					
5.	يؤدي تقليل الإنتاج الزائد عن الحاجة إلى استغلال الطاقات المادية والبشرية الموجودة لديكم بشكل أفضل.					
6.	حسب طبيعة عملكم، فان تقليل الإنتاج الزائد عن الحاجة يقلل من عمليات نقل المواد بين محطات وماكنات العمل.					
7.	حسب خبرتكم، فان تقليل الإنتاج الزائد عن الحاجة يقلل من عمليات إعادة التصنيع للمنتج لديكم.					
ب- مساهمة تقليل وحدات التخزين بين الماكنات وتقليل فائض المخازن في تخفيض تكاليف العملية الإنتاجية.						
8.	إن تقليل وحدات التخزين بين الماكنات وتقليل فائض المخازن لديكم يعمل على تحقيق التوازن في تدفق المواد خلال مراحل الإنتاج بشكل يضمن عدم وجود طاقات عاطلة.					
9.	عند تقليل وحدات التخزين بين الماكنات وتقليل فائض المخازن لديكم، فانه تقل وحدات إنتاجكم المعيبة.					
10.	سياسة تقليل وحدات التخزين بين الماكنات وتقليل فائض المخازن لديكم توفر في تكاليف حصرها ومتابعتها والاحتفاظ بها.					
11.	عند تقليل وحدات التخزين بين الماكنات وتقليل فائض المخازن لديكم، فإنكم تستغلون مساحات مكان العمل بشكل أفضل.					
12.	إن تقليل وحدات التخزين بين الماكنات وتقليل فائض المخازن لديكم يقلل من أعداد العاملين اللازمين في إنتاجكم.					
13.	حسب طبيعة عملكم، فان تقليلكم لوحدات التخزين بين الماكنات وتقليل فائض المخازن يقلل من عمليات نقل المواد اللازمة بين محطات وماكنات العمل.					
14.	حسب خبرتكم في عملكم، فان تقليلكم لوحدات التخزين بين الماكنات وتقليل فائض المخازن يقلل من عمليات إعادة التصنيع للمنتج.					
ج- مساهمة تقليل عمليات التصنيع الزائدة للمنتج في تخفيض تكاليف العملية الإنتاجية.						
15.	إن تقليل عمليات التصنيع الزائدة للمنتج في شركتكم يؤدي إلى استغلال أفضل للأوقات والجهود المبذولة .					
16.	إن تقليل عمليات التصنيع الزائدة للمنتج تساعد في الحد من إعاقة حركة الأفراد و المواد خلال العمل.					
17.	إن تقليل عمليات التصنيع الزائدة للمنتج لديكم يعمل على تحقيق التوازن في تدفق المواد خلال مراحل الإنتاج بشكل يضمن عدم وجود طاقات عاطلة.					

م	الفقرة	موافق بشدة	موافق	غير متأكد	غير موافق	غير موافق بشدة
18.	إن تقليل عمليات التصنيع الزائدة للمنتج في شركتكم يؤدي إلى تقليل حركة العاملين الزائدة عن الحاجة.					
19.	تساعد عملية تقليل عمليات التصنيع الزائدة للمنتج في تقليل المواد المستخدمة في إنتاجكم.					
20.	حسب طبيعة عملكم، فان تقليلكم لعمليات التصنيع الزائدة للمنتج يقلل من عمليات نقل المواد اللازمة بين محطات وماكنات العمل.					
21.	حسب خبرتكم في عملكم، فان تقليلكم لعمليات التصنيع الزائدة للمنتج يقلل من الضغوط النفسية على العاملين.					
د- مساهمة تقليل حركة وتنقل العاملين في تخفيض تكاليف العملية الإنتاجية.						
22.	تساعد عملية تقليل حركة وتنقل العاملين لديكم في تسهيل مهمة الإدارة في مراقبتهم.					
23.	إن تقليل حركة وتنفل العاملين في شركتكم يقلل من انتظار الماكنات وبالتالي يؤدي لاستغلال أكبر للطاقات.					
24.	إن تقليل حركة وتنقل العاملين لديكم يقلل من خطر الإصابات أثناء العمل.					
25.	إن تقليل حركة وتنقل العاملين في شركتكم يقلل من طاقاتهم المهدورة.					
26.	يعمل تقليل حركة وتنقل العاملين لديكم على استغلال مساحات مكان العمل بشكل أفضل.					
27.	حسب طبيعة عملكم، فان تقليلكم لحركة وتنقل العاملين لديكم يقلل من وحدات الإنتاج المعيبة.					
28.	حسب خبرتكم في عملكم، فان تقليلكم لحركة وتنقل العاملين لديكم يقلل من عمليات إعادة التصنيع للمنتج.					
ه- مساهمة تقليل وقت انتظار العاملين والماكنات لوصول وحدات العمل إليهم في تخفيض تكاليف العملية الإنتاجية.						
29.	إن تقليل وقت انتظار العاملين والماكنات لوصول وحدات العمل إليهم يساعد في أكبر استغلال للطاقات العاملة لديكم.					
30.	إن تقليل وقت انتظار العاملين والماكنات لوصول وحدات العمل إليهم خلال عمليات إنتاجكم يقلل من إصابات العمل.					
31.	تساعد عملية تقليل وقت انتظار العاملين والماكنات لوصول وحدات العمل إليهم لديكم في تحسين مهارات الاتصال بين الأقسام، وبالتالي تقليل الأخطاء خلال العملية الإنتاجية.					
32.	تساعد عملية تقليل وقت انتظار العاملين والماكنات لوصول وحدات العمل إليهم لديكم في تسهيل مهمة الإدارة في مراقبة الموارد البشرية.					
33.	تساعد عملية تقليل وقت انتظار العاملين والماكنات لوصول وحدات العمل إليهم لديكم في تسهيل مراقبة جودة المنتج.					
34.	حسب طبيعة عملكم، فان تقليلكم لوقت انتظار العاملين والماكنات لوصول وحدات العمل إليهم يقلل من عمليات نقل المواد اللازمة بين محطات وماكنات العمل.					
35.	حسب خبرتكم، فان تقليلكم لوقت انتظار العاملين والماكنات لوصول وحدات العمل إليهم يقلل من عمليات إعادة التصنيع للمنتج.					

م	الفقرة	موافق بشدة	موافق	غير متأكد	غير موافق	غير موافق بشدة
و- مساهمة تقليل المنتجات المعيبة في تخفيض تكاليف العملية الإنتاجية.						
36.	يؤدي تقليل منتجاتكم المعيبة إلى مصداقية وسمعة أفضل مع العملاء مما يزيد من تسويق المنتج.					
37.	تساعد عملية تقليل المنتجات المعيبة لديكم في تخفيض نقاط الاختناق التي تعوق حركة الأفراد و المواد خلال العمل.					
38.	تساعد عملية تقليل المنتجات المعيبة لديكم في تقليل عمليات إعادة التصنيع لنفس هذه المنتجات.					
39.	إن تقليل وحدات الإنتاج المعيبة يؤدي إلى تقليل حركة العاملين الزائدة عن الحاجة لديكم.					
40.	تساعد عملية تقليل منتجاتكم المعيبة في الاستخدام الأمثل لعناصر الإنتاج المادية والبشرية.					
41.	حسب طبيعة عملكم، فان تقليلكم لوحدات الإنتاج المعيبة يقلل من عمليات نقل المواد اللازمة بين محطات وماكنات العمل.					
42.	حسب خبرتكم في عملكم، فان تقليلكم لوحدات الإنتاج المعيبة يقلل من عمليات إعادة التصنيع للمنتج.					
ي- مساهمة تقليل عمليات نقل مواد وقطع الإنتاج في تخفيض تكاليف العملية الإنتاجية.						
43.	إن تقليل عمليات نقل مواد وقطع الإنتاج لديكم يقلل من الطاقات اللازمة كتقليل عدد العاملين والكهرباء.					
44.	تساعد عملية نقل مواد وقطع الإنتاج لديكم في تخفيض نقاط الاختناق التي تعوق حركة الأفراد و المواد خلال العمل.					
45.	إن تقليل عمليات نقل مواد وقطع الإنتاج في شركتكم يقلل من خطر إصابتها بضرر أو عيوب.					
46.	إن تقليل عمليات نقل مواد وقطع الإنتاج يقلل من انتظار العاملين والماكنات لديكم.					
47.	يعمل تقليل عمليات نقل مواد وقطع الإنتاج لديكم على استغلال مساحات مكان العمل بشكل أفضل وبالتالي تخفيض تكاليف العملية الإنتاجية.					
48.	حسب طبيعة عملكم، فان تقليلكم لعمليات نقل مواد وقطع الإنتاج يسهل عمليات المراقبة للموارد المادية والبشرية.					
49.	حسب خبرتكم في عملكم، فان تقليلكم لعمليات نقل مواد وقطع الإنتاج يقلل من عمليات إعادة التصنيع للمنتج.					

نشكر لكم حسن تعاونكم ،،

الباحث

محمد سفيان أبوشعبان

059-9717565

Appendix D

Internal Validity of the Questionnaire

Table (D.1): Correlation Coefficient of Each Paragraph of Contribution of Overproduction and the Total of this Field

No.	Paragraph	Spearman Correlation Coefficient	P-Value (Sig.)
1.	Minimizing overproduction in your company leads to preventing accumulation of units within the store.	0.346	0.033*
2.	Minimizing overproduction in your company leads to reducing defects in your products.	0.431	0.009*
3.	Minimizing overproduction in your company allows more space within the work that can be exploited	0.387	0.019*
4.	Minimizing overproduction in your company reduces the staff and machines waiting in the other units.	0.684	0.000*
5.	Minimizing overproduction in your company leads to better exploiting of the available human and material resources.	0.744	0.000*
6.	By the nature of your work, minimizing overproduction in your company reduces transport of materials between work stations and machines.	0.570	0.001*
7.	According to your experience, minimizing overproduction in your company reduces the need for re-manufacturing of the product.	0.533	0.002*

* Correlation is significant at the 0.05 level

Table (D.2): Correlation Coefficient of Each Paragraph of Contribution of Excess Inventory and the Total of this Field

No.	Paragraph	Spearman Correlation Coefficient	P-Value (Sig.)
1.	Excess inventory minimization balances the flow of materials through the stages of production so as to ensure there is no idle capacity.	0.605	0.000*
2.	When you minimize the excess inventory through working, your production defective units are less.	0.512	0.002*
3.	Policy of minimizing the excess inventory leads to lower following-up and conditioning costs of production units.	0.726	0.000*
4.	When you minimize the excess inventory through working, you are better exploiting areas of the workplace.	0.692	0.000*
5.	Excess inventory minimization reduces the number of workers needed in your production.	0.849	0.000*
6.	By the nature of your work, excess inventory minimization reduces the materials transport between work stations and machines.	0.857	0.000*
7.	According to your experience in your work, excess inventory minimization reduces the re-manufacturing of the product.	0.646	0.000*

* Correlation is significant at the 0.05 level

Table (D.3): Correlation Coefficient of Each Paragraph of Contribution of Overprocessing and the Total of this Field

No.	Paragraph	Spearman Correlation Coefficient	P-Value (Sig.)
1.	Overprocessing minimization leads to a better use of time and efforts.	0.409	0.014*
2.	Overprocessing minimization helps in reducing the movement barriers of people and materials during work.	0.681	0.000*
3.	Overprocessing minimization balances the flow of materials through the stages of production so as to ensure there is no idle capacity.	0.813	0.000*
4.	Overprocessing minimization in your company can reduce the workers useless movements.	0.596	0.000*
5.	Overprocessing minimization reduces the materials used in your product line.	0.779	0.000*
6.	By the nature of your work, over-processing minimization reduces the materials transport between work stations and machines.	0.747	0.000*
7.	According to your experience in your work, over-processing minimization reduces the workers stress.	0.546	0.001*

* Correlation is significant at the 0.05 level

Table (D.4): Correlation Coefficient of Each Paragraph of Contribution of Motion and the Total of this Field

No.	Paragraph	Spearman Correlation Coefficient	P-Value (Sig.)
1.	Workers motion minimization facilitates the task of management in controlling the work.	0.738	0.000*
2.	Workers motion minimization in your company reduces the waiting machines and leads to greater exploitation of the potential.	0.732	0.000*
3.	Workers motion minimization reduces the injuries at work.	0.875	0.000*
4.	Workers motion minimization in your company reduces the energy wasted.	0.633	0.000*
5.	Workers motion minimization leads to better exploiting of the areas.	0.724	0.000*
6.	By the nature of your work, workers motion minimization reduces the production of defective units.	0.510	0.003*
7.	According to your experience in your work, workers motion minimization reduces the re-manufacturing of the product.	0.822	0.000*

* Correlation is significant at the 0.05 level

Table (D.5): Correlation Coefficient of Each Paragraph of Contribution of Waiting and the Total of this Field

No.	Paragraph	Spearman Correlation Coefficient	P-Value (Sig.)
1.	Workers and machines waiting minimization help in greater exploitation of the potential of working.	0.437	0.009*
2.	Workers and machines waiting minimization during your production reduce the work injury.	0.697	0.000*
3.	Workers and machines waiting minimization improve the skills of communication between departments, and thus reduce errors during the production process.	0.469	0.005*
4.	Workers and machines waiting minimization facilitate the task of management in the control of human resources.	0.646	0.000*
5.	Workers and machines waiting minimization facilitate the monitoring of product quality.	0.813	0.000*
6.	By the nature of your work, workers and machines waiting minimization reduces the materials transport between work stations and machines.	0.724	0.000*
7.	According to your experience, workers and machines waiting minimization reduces the re-manufacturing of the product.	0.707	0.000*

* Correlation is significant at the 0.05 level

Table (D.6): Correlation Coefficient of Each Paragraph of Contribution of Defects and the Total of this Field

No.	Paragraph	Spearman Correlation Coefficient	P-Value (Sig.)
1.	Defects minimization leads to better reputation with customers and increasing the marketing of the product.	0.380	0.000*
2.	Defects minimization reduces the bottlenecks that impede the movement of workers and materials during the work.	0.615	0.000*
3.	Defects minimization reduces re-manufacturing the same products.	0.693	0.000*
4.	Defects minimization reduces the excess movement of workers.	0.562	0.001*
5.	Defects minimization leads to the optimal use materials and human resources.	0.790	0.000*
6.	By the nature of your work, defects minimization reduces the materials transport between work stations and machines.	0.568	0.001*
7.	According to your experience in your work, defects minimization reduces the re-manufacturing of the product.	0.593	0.000*

* Correlation is significant at the 0.05 level

Table (D.7): Correlation Coefficient of Each Paragraph of Contribution of Transportation and the Total of this Field

No.	Paragraph	Spearman Correlation Coefficient	P-Value (Sig.)
1.	Materials and products transportation minimization reduces the necessary energy, such as, number of workers and electricity.	0.847	0.000*
2.	Materials and products transportation minimization reduces the bottlenecks that impede the movement of people and materials during the work.	0.821	0.000*
3.	Materials and products transportation minimization in your company reduces the risk of damaged units or defects.	0.802	0.000*
4.	Materials and products transportation minimization reduces the waiting workers and machines.	0.797	0.000*
5.	Materials and products transportation minimization leads to better exploiting of the areas.	0.644	0.000*
6.	By the nature of your work, materials and products transportation minimization facilitates the control of materials and human resources.	0.808	0.000*
7.	According to your experience in your work, materials and products transportation minimization reduces the re-manufacturing of the product.	0.790	0.000*

* Correlation is significant at the 0.05 level

Appendix E

The Personal Information of the Questionnaire

Table (E.1): Gender

Sex	Frequency	Percent
male	96	96.9
female	3	3.1
Total	99	100.0

Table (E.2): Age

Age (years old)	Frequency	Percent
16-25	3	3.0
26-35	25	25.3
36-45	29	29.3
46-60	31	31.3
60-<	11	11.1
Total	99	100.0

Table (E.3): Specialization

Specialization	Frequency	Percent
Engineering	9	9.1
Accounting	16	16.2
Management	34	34.3
Economics	11	11.1
Finance	5	5.1
Another	24	24.2
Total	99	100.0

Table (E.4): Scientific Qualification

Scientific Qualification	Frequency	Percent
Master/PhD	8	8.1
Bachelor	42	42.4
Diploma	22	22.2
High School	13	13.1
Less than High School	14	14.1
Total	99	100.0

Table (E.5): Position

Position	Frequency	Percent
General Manager	33	33.3
Manager	40	40.4
Department Head	13	13.1
Division Head	5	5.1
Another	8	8.1
Total	99	100.0

Appendix F

The Establishment Information of the Questionnaire

Table (F.1): The Establishment Location

Location	Frequency	Percent
The North Governorate	15	15.3
Gaza City	66	67.3
Middle Governorate	8	8.2
Khanyounis Governorate	7	7.1
Rafah Governorate	2	2.0
Total	98	100.0

Table (F.2): The Total Number of your Fixed Employees

Number of fixed employees	Frequency	Percent
10 -19	53	53.5
20 – 49	39	39.4
50 – 99	4	4.0
more than 100	3	3.0
Total	99	100.0

Table (F.3): The Establishment Capital

Establishment capital	Frequency	Percent
Less than $150000	6	6.1
$150000 to $399000	29	29.6
$400000 to$649000	25	25.5
$650000 to $899000	18	18.4
more than $900000	20	20.4
Total	98	100.0

Table (F.4): The Legal Form of the Establishment

Legal form of the establishment	Frequency	Percent
Individual	28	28.3
Partnership	24	24.2
Private Joint Stock	36	36.4
Public	9	9.1
Another	2	2.0
Total	99	100.0

Table (F.5): The Negative Role of Crossings Closure

The negative role of periodic closure of crossings	Frequency	Percent
Small	8	8.1
Medium	27	27.3
Large	25	25.3
Very Large	39	39.4
Total	99	100.0

Table (F.6): The Weekly Electricity Interruption

Weekly total hours of electricity interruption	Frequency	Percent
Less than 10	6	6.1
19-10	17	17.2
29-20	44	44.4
39-30	24	24.2
More than 40	8	8.1
Total	99	100.0

Table (F.7): The Ratio of Generator Efficiency to be the Alternative

The generator is an alternative of electricity by the ratio	Frequency	Percent
Less than %20	3	3.5
20% - 39%	12	14.1
40% - 59%	28	32.9
60% - 79%	32	37.6
80% - 100%	10	11.8
Total	85	100.0

Table (F.8): What Happens when Electricity Interruption Occurs

When the electricity interruption happens	Frequency	Percent
Laying off workers	12	12.5
Running the electricity generator	75	78.1
Working without electricity	9	9.4
Total	96	100.0