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Faculty of Graduate Studies

Assessment of Technology Management Practices in Large Manufacturing Firms in Palestine

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This thesis was defended successfully on 30/12/2012, and approved by:

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Dedication

To my father, may his soul rest in peace; I will never forget how happy he was when I got accepted for this program.

To my mother, who endured all kinds of pains to make our dreams come true.

I love you mom and dad! I will never grow old enough to be able to live without you.

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الاقرار

انا الموقع ادناه مقدم الرسالة التي تحمل العنوان:

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Assessment of Technology Management Practices in Large Manufacturing Firms in Palestine

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اقر بأن ما اشتملت عليه هذه الرسالة إنما هي نتاج جهدي الخاص، باستثناء ما تمت الإشارة إليه حيثما ورد، وإن هذه الرسالة ككل، أو أي جزء منها لم يقدم من قبل لنيل أية درجة علمية أو بحث علمي أو بحثي لدى أية مؤسسة تعليمية أو بحثية أخرى .

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Declaration

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

Student's Name:	اسم الطالب :
Signature :	التوقيع :
Date :	التاريخ :

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List of Acronyms

Acronym	Definition
ANOVA	Analysis of Variance
EITIM	European Institute of Technology and Innovation Management
GDP	Gross Domestic Produce
IfM	Institute for Manufacturing
ISIC	International Standard Industrial Classification
MoNE	Ministry of National Economy
PCBS	Palestinian Central Bureau of Statistics
QA	Quality Assurance
QC	Quality Control
R&D	Research and Development
SPSS	Statistical Package for the Social Sciences
SWOT	Strengths, Weaknesses, Opportunities and Threats
TIA	Technology Impact Assessment
TRM	Technology Road Mapping

Assessment of Technology Management Practices in Large Manufacturing Firms in Palestine

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Abstract

Each day new applications and uses are being discovered for new technology, this rapid technological change has its implications on every aspect of human life. Industry and service sectors are among the so many sectors that are highly impacted by technology and technological changes.

Modern technology enabled companies to improve their performance and returns by improving productivity, accuracy, quality, and decreasing setup and production times. It has also improved the company's image and customer satisfaction.

Business owners and decision makers seeking to improve their competitiveness should pay more attention to the technology management concept; they need to adopt right approaches to the management of their technological assets and know-how. Traditional management approaches are no longer capable to meet the increased customer demands in the globalized markets. Therefore, the field of technology management has emerged as an attempt to help businesses overcome the challenges associated with the use of technology in their business strategies and operations.

The manufacturing sector is one of the most important industrial sectors in the Palestinian economy (PFI, 2012). It highly contributes to the GDP and employment generation, it should be considered in any economic development process.

In this study the researcher has targeted large manufacturing firms in Palestine; since they are playing an important role in the Palestinian economy and because they are considered relatively advanced in their technological base compared to medium and small sized enterprises.

The researcher assessed technology management practices at large manufacturing firms in Palestine by studying and analyzing different inputs that govern the process in an attempt to identify gaps and devise best practices of technology management that help firms to improve their performance and competitiveness.

The researcher utilized different research tools including quantitative and qualitative. A survey was developed and analyzed quantitatively. The other approach was qualitative where structured interviews were conducted with the largest company in each manufacturing sector in the sample. Data was analyzed using descriptive and inferential analysis and conclusions were drawn.

A framework was developed as a key output of this research to facilitate adopting technology management concept in large manufacturing firms in Palestine. The framework suggests different sets of processes to be

conducted at the strategic and operational levels. These processes help companies evaluate their current practices and identify gaps between these practices and best practices.

Chapter One

INTRODUCTION

Introduction

Technology-driven innovation is becoming extremely important to all firms competing in today's global highly competitive markets. With the increased customer expectations and accelerated rates of technological change business owners nowadays are becoming more aware of the strategic importance of technology in delivering value to their companies and the industrial networks in which they operate **(Porter, 2011)**. However, adopting new technologies should not be performed as a nice to have; the applied new technologies should be framed by the organization's vision and strategic goals, it should support the company's sustainable development and enhance the bottom line performance.

Sound technology management leads to improved productivity, reduced working hours and improved client services **(Porter, 2011)**. However, effective processes and systems need to be put in place to ensure that investments in R&D, facilities and software are all aligned with the industry and market needs.

The Palestinian industrial sector plays an important role in the economic development process. Nevertheless, this sector suffers a number of obstacles and impediments against its growth mainly represented by the political instability and movement obstacles, since the Palestinian economy is subject to the Israeli control measures. Moreover, the Palestinian

industry suffers from many institutionalized problems in terms of strategic, financial, operational and technology management.

All these settings drove the researcher to consider means that govern sustained growth and enhanced business performance in the Palestinian firms; where technology management concept was chosen as one of the most important concepts in industry nowadays.

Technology management concept has been largely applied in many industrial contexts as a need-driven approach, to explore and communicate the dynamic linkages between technological resources, organizational objectives and the changing environment **(Floyd, 1998)**.

This study explores the technology management concept in a manufacturing setting by providing an assessment for its application in large manufacturing firms in Palestine and highlights the main gaps to be avoided by applying best practice techniques proposed by the technology management framework.

This chapter aims to introduce an overview of the research title, research approach, and background. Moreover, this chapter clearly shows the problem statement, research questions, research objectives, and the structure of this thesis.

1.2 Research Significance

Most decision makers in Palestinian industrial firms would agree that technology promises improve their productivity. However, without a specific understanding of how technology can help these organizations achieve their goals, it will be difficult to make the right strategic decisions. Therefore, in order to maximize profits, organizations must align their business objectives and priorities with the proper technology improvement initiatives. This study explores the technology management concept; its impact, tools and processes that govern it. Moreover, a technology management framework is introduced to devise best practices for Palestinian firms to further their missions through the proper use of technology.

Manufacturing industries are considered among the most important industrial sectors contributing to the Palestinian economic growth, therefore it is important to provide all support to it by introducing best practices known worldwide such as the technology management concept. Manufacturing firms can be classified according to different criteria such as capital, number of employees and many other criteria. Considering the number of employees employed by the firm, manufacturing firms in Palestine can be classified into large, medium, small and micro enterprises. According to the Ministry of National Economy (**MoNE, 2012**) large firms are those firms employing more than 50 employees, medium firms are those employing 19-50 employees, small firms those employing 10- 19

firms whereas micro firms are those firms employing less than 10 employees.

This study targets large manufacturing firms in Palestine since these firms investment in technology and machinery are considered relatively high compared to other medium or small firms. Moreover, the technology management concept addressed in this thesis is considered relatively new to the Palestinian industries where firms with limited technological base and advancement in machinery may not be aware of the concept and its applications.

1.3 Research Aim

Manufacturing firms aiming to improve their performance and compete in a globalized context should adopt a comprehensive approach to technology management where technology purchasing and development decisions will be made in light of company's strategic objectives. The main goal of this research is to assess technology management practices adopted by large manufacturing firms in Palestine in an attempt to highlight gaps and devise technology management framework based on known best practices and the technological needs of these firms.

1.4 Research Objectives

For this research to achieve the above mentioned goal, the following objectives need to be realized:

- Review and identify technology management best practices adopted worldwide.

- Highlight the impact of technology management on business performance.

- Describe and evaluate technology management process at large manufacturing firms in Palestine.

- Assess the extent of technology planning practice among large manufacturing firms in Palestine.

- Identify gaps existing in technology management practice in large manufacturing firms in Palestine.

- Propose a comprehensive framework with best practices and techniques that will improve the level of technology management practice.

- Help researchers understand technology management status in the manufacturing sector in Palestine.

Furthermore, this research aims to draw attention to the technology management subject and contribute to the technology management research environment.

1.5 Research Questions

Through this research project, the researcher aims to answer the following research questions which have been designed based on the gaps observed

between the current technology management practices adopted worldwide and those currently taking place in the Palestinian manufacturing firms. Following are the research questions to be addressed:

1. What are the best well-known technology management practices?
2. What are the technology management practices currently adopted by large manufacturing firms in Palestine?
3. What are the gaps in technology management practices between Palestinian large manufacturing firms' practices and best practices?
4. What are the technology management practices and techniques that best fit large manufacturing firms operating in Palestine?

1.6 Research Hypotheses

Technology management practices adopted by Palestinian large manufacturing firms are assessed and evaluated in this study through different analytical and descriptive means. However, to further investigate the relationship between current technology management practices in Palestinian firms and the research variables the following hypotheses are developed and examined:

H1$_0$: No statistically significant differences at $\alpha = 0.05$ in the degree of technology planning practice at large manufacturing firms in Palestine can be attributed to the company's geographic location.

H2$_0$: No statistically significant differences at $\alpha = 0.05$ in the degree of technology planning practice at large manufacturing firms in Palestine can be attributed to the company's industry.

H3$_0$: No statistically significant differences at $\alpha = 0.05$ in the degree of technology identification practice at large manufacturing firms in Palestine can be attributed to the company's geographic location.

H4$_0$: No statistically significant differences at $\alpha = 0.05$ in the degree of technology identification practice at large manufacturing firms in Palestine can be attributed to the company's industry.

H5$_0$: No statistically significant differences at $\alpha = 0.05$ in the degree of technology selection practice at large manufacturing firms in Palestine can be attributed to the company's geographic location.

H6$_0$: No statistically significant differences at $\alpha = 0.05$ in the degree of technology selection practice at large manufacturing firms in Palestine can be attributed to the company's industry.

H7$_0$: No statistically significant differences at $\alpha = 0.05$ in the degree of technology acquisition practice at large manufacturing firms in Palestine can be attributed to the company's geographic location.

H8$_0$: No statistically significant differences at $\alpha = 0.05$ in the degree of technology acquisition practice at large manufacturing firms in Palestine can be attributed to the company's industry.

1.7 Research Methodology

The importance of this research comes from its ability to address technology management as one of the topics usually neglected by decision makers in the Palestinian business environment; at the same time it is being tackled by businesses worldwide as one of the hottest management topics. The research utilizes different research tools to highlight the weaknesses that exist in the technology management practice in Palestinian manufacturing firms and proposes a framework to guide development initiatives by adopting best practices and techniques.

The methodology used in this analytical study, combines quantitative and qualitative research tools, to identify and interpret the current situation in the best way possible through:

- Desk research which is basically used to review the literature available on technology management concept, impact, processes, tools and technology planning. It is based on library books, journal databases and web based research.

- Identification of existing literature and research about current technology management practices adopted in Palestine and exploring any statistics, estimates or assessments conducted. This is conducted through field visits to related institutions including research centers, chambers of commerce, Palestinian Central

Bureau of Statistics, Ministry of National Economy as well as many other universities and research centers.

- Collection of data which is used for the assessment of the current technology management practices through online survey and structured interviews with key mangers in the large manufacturing firms.

- Analysis of collected data using different statistical analysis tools.

- Description and evaluation of current technology management practices.

- Identification of gaps in order to improve system efficacy.

- Introduction of a technology management framework with best practices and techniques to be adopted by manufacturing firms in Palestine.

1.8 Research Outputs

- An assessment of technology management practices currently adopted in large manufacturing firms in Palestine.

- A technology management framework that provides guidance for manufacturing firms in their development initiatives.

1.9 Research Limitations

Each research project, no matter how well constructed is bound with certain limitations; these limitations can be utilized while addressing the same subject in future research projects. Below are the key limitations that bound this research:

- ✓ **Lack of prior research studies on Palestinian technology management:** while reviewing prior research studies conducted in the technology management in Palestine, the researcher did not find any relevant data that can be used as a basis for the research.
- ✓ **Access:** access to firms located in certain geographic areas was difficult including those companies located in Gaza Strip and Jerusalem District, therefore no interviews were conducted with companies located in these areas.
- ✓ **Sample size:** the researcher aimed at conducting more interviews in order to represent all manufacturing sectors in the research. However; most companies refused to be interviewed.

1.10 Research Outline

The thesis is organized into six chapters as shown in Table (1).

Table 1: Thesis Structure

Chapter #	Chapter Title
Chapter One	Introduction
Chapter Two	Literature Review
Chapter Three	Research Methodology
Chapter Four	Data Analysis and Discussions
Chapter Five	Technology Management Framework
Chapter Six	Conclusions and Recommendations

Chapter 1 is an introduction which outlines the whole thesis; while Chapter 2 describes all previous studies related to technology management and related subjects as well as a briefing on the manufacturing sector in Palestine. Chapter 3 presents and defends the selected research methodology. Data analysis and related discussions is provided in Chapters 4. Chapter 5 presents the technology management devised framework. Finally, Chapter 6 provides thesis conclusions and recommendations.

Chapter Two

Literature Review

Literature Review

The industrial sector plays an important role in all world economies and it highly contributes to the Gross Domestic Products (GDP) of the country **(PFI, 2012)**. Hence, supporting the industrial sector and development of existing industries must be considered in any national development policy. In this sense, any Palestinian industrial development initiative must consider the formation of the basic structural elements of the Palestinian economy, taking into consideration the structural abnormalities in the different economic sectors and the obstacles imposed by the Israeli occupation which hinders any sustained economic and industrial growth.

Technology is one of the key elements that contributes to effective industrial development; the important role that technology plays as a competitive weapon in today's global markets is now widely recognized by many organizations, governments and academic institutions. Porter (1998) has noticed the important role that technology plays in all world economies, he stated "technology has the potential to change the structure of industry and create new industries".

While technology is widely recognized as a key driver for innovation and business growth; it is still inherently difficult to manage because of its continuously changing nature. This makes it highly important for businesses to adopt comprehensive approaches for the management of their technologies.

Manufacturing industry is one of the most important industrial sectors. Therefore understanding its reality and prospective future and utilizing all possible alternatives capable of improving efficiency and productivity of these sectors is very crucial to guide decision makers in their economic development policies.

Considering the importance of the manufacturing industry and its contribution to the Palestinian economic growth and the need to highly improve this sector, focus in this research is directed to the management of technology in large manufacturing firms in Palestine in an attempt to promote and support the Palestinian economy by highlighting best practices and identifying any performance gaps.

This research is set out to assess technology management practices at large manufacturing firms in Palestine, this chapter identifies technology management concept, explores the technology management process and its impact on company's performance. The tools used by companies to apply technology management and the technology planning concept are explored as well. Finally, a briefing on the manufacturing sector in Palestine is provided.

2.1. Technology Management Overview

The field of technology management has emerged as an attempt to help businesses overcome the challenges combined with the use of technology in their business strategies and operations. Application of the technology

management concept has multiple facets and deals with many fields and disciplines; however, there is no one simple shortcut for its application which makes it necessary for companies to properly integrate technical inputs from theory and practice to improve adoption of the concept within the firm.

To bring more insight over technology management we need to explore the concept and its main constituents; according to Phaal et al (2004) the technology management concept is composed from two important business terms: technology and management; technology is characterized by the following :

- It is a specific type of knowledge; it could be useful to treat technology as a specific type of knowledge since many of the knowledge management concepts can be applied.

- It is applied and focuses on the know-how of the company.

According to Salhman (2010) the definition of technology is considered problematic since users of the term have different interpretations for it based on their intentions and knowledge of the possible extensions of the concept; technology in a business context can be considered as a resource **(Gregory, 1995)** and it is believed it is going to be more practical for the Palestinian companies to treat their technologies as a physical product that can be acquired, developed, exploited and sold.

Literature shows that it was until the Industrial Revolution that the concept of modern management has been used. In a business context and according to **(Dhillon, 2002)** the word management means "the process of work involving guiding a group of individuals to achieve defined organizational goals".

Technology management as a concept has many published definitions. For the purpose of this thesis, the researcher adopted the definition proposed by the European Institute for Technology & Innovation Management (EITIM): *"Technology management addresses the effective identification, selection, acquisition, development, exploitation and protection of technologies (product, process and infrastructural) needed to maintain a market position and business performance in accordance with the company's objectives"* (Phaal, 2004).

The above definition of technology management concept highlights two important issues:

- Effective technology management involves certain management processes including the identification, selection, acquisition/development, exploitation and protection of technologies.

- The importance of establishing and maintaining linkages between the company resources and its objectives. While it is considered challenging to create and maintain these linkages, many researchers tried to develop certain frameworks to overcome these challenges

and improve understanding of technology management related issues.

Phaal (2000) described a set of frameworks which was developed to tackle some difficulties related to these linkages by putting together theoretical and practical perspectives. They discussed the elements that should be incorporated in these frameworks and their theoretical foundations with an example of how these frameworks can be applied practically in the firm.

Today technology management field is being addressed in research from different perspectives. Currently the issue of manufacturing technology management which is the focus of this thesis has been investigated by many researchers.

Seino et al. (2011) tackled manufacturing technology management as a new approach to technology management. According to the authors manufacturing technology management aims at supervising and managing the utilization of materials and machines for producing and servicing value products, it assists in understanding people, tools, materials and machines in a manufacturing setting. They have also noticed that in spite of the fact that manufacturing technology has been playing a vital role in process innovations; manufacturing technology was not sufficiently addressed by management schools and approaches. Moreover, they have noticed that the realization of value innovations capable of bringing new value for customers and process innovations that will improve current business

operations is considered one of the most serious challenges facing manufacturing industries today. However; most manufacturing companies tend to concentrate on process innovations more than value innovations since most of the company's earnings and profits are generated from current business. The same thing applies for the Palestinian manufacturing industry; most of the development initiatives focus on process innovations and improvement of current processes and production lines since no real innovation - design from scratch- takes place.

Efficient integration between manufacturing technologies and product design has been tackled by many research studies. Seino (2007) highlighted the importance of this integration which presents a serious challenge for mangers and decision makers at many industrial firms, he promoted the use of a new practical framework for developing competitive advantage for manufacturing industries through the efficient integration between manufacturing technology sections and product design. Whether the production characteristics such as lot size and productivity rates are considered when selecting the manufacturing technology will be examined in this research.

It is now very clear that competing in today's global market of the rapid changing technologies presents a serious challenge for companies in managing their technological capabilities through the best strategic technology management models. A strategic technology management framework for small high tech. companies was developed by Sahlman and

Haapasalo, the elements of this framework were classified according to the structure of the company, its objectives and the impact of internal and external environments (**Sahlman et al, 2009**). The above presented studies revealed that the strategic technology management concept in small and medium enterprises is perceived to be complex and deployment of it is still immature; however, application of this concept will enhance the multifunctional strategic orientation as a management paradigm in these enterprises.

Winzker et al. (2009) suggested a model to organize and manage the process of technology change which proved effectiveness even in the most ambiguous environments. The model manipulates dynamics of high tech. global business environments to sustain the company's competitive advantage, by developing different management sub-models the authors try to effectively and reasonably confront many issues facing the technology management in a new strategic perspective.

This research explores the strategic visioning of the Palestinian manufacturing firms with regards to their manufacturing technologies; several questions are being addressed. Do these firms incorporate technology into their strategic plans and financial plans? Do these firms perform technology planning? What are the departments involved in the technology planning process?

2.2 Impact of Technology and Technology Management

The process of acquiring technological know-how involves more activities than those embodied in machinery or other physical artifacts. They involve the organizing, coordinating and managing activities which are much difficult to acquire and develop. Therefore managing technologies is of vital importance for companies and nations striving to make technological advances in today's global economies **(APO, 2007).**

2.2.1 Technology Impact Assessment

Technology Impact Assessment (TIA) is crucial part of any technology introduction initiative since it determines how this technology may affect the bottom line. It can be used in anticipating the unintended and indirect impacts of technology change, by defining certain predictive measures to avoid or mitigate the potential hazards that may result from unexpected occurrences. TIA is used to guide decision makers on the internal and external impacts of technology, which allows for the generation of traceable conclusions, compound the key elements to assure that the decision making process culminates in the right technology investment with the best resources and results **(Norling et al. 2000)**.

The TIA involves assessment of the technology performance through the analysis of key performance indicators by utilizing different tools which allow for well-informed and a well-based evaluation of technology.

Technology impact assessment is essential for developing forecasting scenarios and a guiding factor that help firms decide about the distribution of their financial resources among several projects. Porter (2011) indicated that TIA is conducted on four stages:

1. Impact Identification, 2.Impact Screening, 3. Impact Analysis and 4. Impact Evaluation

Companies can utilize it to assess impact of technology on their:

Sales and profit margins, market share, productivity, customer satisfaction, quality improvement, set up and production times and material losses.

2.2.2 Influence of Business Difference on Technology Management

Companies try to utilize technology resources to yield profits. However, aligning technology resources with company's objectives presents a serious challenge for businesses because companies generate profits in different ways according to the particular business characteristics (Phaal, 2000).

Keltsch et al. (2009) explored the influence of the differences in business characteristics on technology management. The authors developed a framework that distinguishes between the different business models based on the analysis of the business characteristics.

It is believed that differentiation is highly important for companies especially those who operate in small markets; businesses differ in terms of their sizes, market concentration and geographic positioning and hence

their business, marketing and technology strategies must also differ to comply with the different business requirements. In this research the researcher examines whether companies align technology and technology strategies with their strategic and business plans.

2.2.3 Influence of Technology Management on Organizational Culture and Vice Versa

Introducing new technology within a certain organization will reshape its existing organizational culture; thus top management should interfere to manage such changes without undermining the existing culture. In many cases introduction of new technologies can't be done at all since the proposed changes go so much against the company's existing culture.

Some research findings showed that workplace atmosphere is becoming the number one issue for skilled employees; therefore improper introduction of new technologies can have a negative impact on employees and can possibly contribute to staff burnout. However, Sockel et al. (2004) showed that adopting technological innovation management has improved employee satisfaction, job security, and perceptions on management and decreased employee burnout. This research examines whether the organizational culture is being considered within the so many factors that influence technology management process.

Though there are different views of this issue, some researchers considered the influence of the organizational culture on technology management; the

human dimension in the technology management literature was examined from a behavioral perspective. The "organizational culture" concept as a behavioral determinant in the technology management process was examined from both a traditional and a contemporary complex adaptive system perspective **(Lau, 2010).**

Weeks (2011) research findings showed that creating a so called "desired culture" to support the technology management process is difficult since the company's culture is emergent in nature. However, management can support positive behavior and disrupt negative behavior that can impact the technology management process. This is one of the most crucial issues that the Palestinian companies should pay attention to while attempting to introduce new technologies.

2.2.4 Impact of Technology Management on Corporate Growth and Competitiveness Given the Uncertainty of Markets.

Innovations can highly affect the company's competitiveness; some of these innovations can dramatically change well-established markets overnight. Being unable to foresee technological change can lead to a real crisis. Thus technology management activities which are capable of improving the growth opportunities of the company are needed.

Shenglan (2010) investigated the relationship between corporate innovation and growth opportunities in Chinese listed firms; research results suggested a positive relationship between innovation management and growth

opportunities, where it was found that companies with higher R&D spending have higher growth opportunities. Other research studies tried to examine the impact of technological innovation capabilities on the firm competitiveness and innovation performance. Karagouni (2007) conducted a study on electronics industry in Hong Kong - Pearl River Delta region and found that R&D activities helped improve new product introduction and that strategic planning and resource allocation capabilities improved the innovation sales significantly.

Karagouni (2007) conducted another research study on 45 Greek and Cypriot small and micro firms to examine the impact of technological innovation capabilities on innovation rate, sales growth, and product competitiveness. It was found that strong strategic capabilities enhanced the innovation performance and that marketing and resource allocation capabilities improved sales growth and product competitiveness. Moreover, the study emphasized the importance of testing new operating strategies that may contribute to rapid technological change in mature industries. This makes sense; hence companies with higher R&D spending can easily identify growth opportunities and decide on their technology develop/buy strategies. Therefore this research examines the percentage that companies allocate to R&D spending from annual profits.

2.3 Technology Planning

Most businesses face challenges to adapt for threats posed by new technology and industrial history is littered with businesses that failed because they were unable to adapt to new technology. Koc (2001) stated that companies nowadays need to be more proactive in anticipating change and developing their technology strategies than they have been in the past. Therefore technology planning becomes a must for companies to sustain their business success and achieve superior financial results.

2.3.1 Importance of Technology Planning

Companies performing technology planning can reap the benefits of this practice regardless of their industry, size or experience. A good technology plan is the touchstone, no matter how the company engages into technology.

Bucher (2003) emphasized the importance of strategic technology planning as an enabler for the company to respond to the fundamental change happening in many fronts including:

- Cultural and social values change,
- Industry transitions and scientific advances and
- Technology change.

Floyd (1998) and others discussed the importance of long range technology planning in the company's strategic visioning process and the development

of long range business strategy, below are some of the benefits that can be reaped from technology planning as described by Phaal et al. (2009):

- The planning process helps ensure the effective use of technology resources.

- Technology planning provides rationale for different business units to request additional resources from top management.

- Enhanced commitment by key personnel through their involvement in the planning process.

- Improved coordination among different units and teams.

- Improved business performance and increased effectiveness.

- Informed decision making through improved data management.

2.3.2 Technology Planning Process

Given the increased competition and technology change, technology planning is considered one of the most important business activities across industry sectors and company types. According to Phaal (2000) careful technology planning must precede any business activity to ensure successful implementation; interdisciplinary team of key top management and technical personnel must be formed to develop the technology plan.

Structured and improved frameworks and tools need to be developed to comprehensively and robustly manage the technology planning process and

provide top management with the information needed to make informed decisions about technology implementation given the little commonality in industrial approaches in technology planning and strategy development.

According to Bucher (2003) strategic technology planning implies making three fundamental decisions: the first decision (which technologies?); deals with determining the key technologies required for production and continuous development of the enterprise. The second decision (make or buy?); deals with determining whether to acquire a certain technology or to develop it in house. While the third decision (keep or sell?); deals with whether companies current technologies can be made available to other companies or not. Applying this trilogy leads to the effective use of information and the coherence of the three decisions which improves the strategic technology planning since the three decisions rely on identical information for technology assessment, technology performance and technology forecasting; see Figure (1) which presents this trilogy.

In this research, the researcher tried to figure out how this trilogy is applied in the Palestinian manufacturing firms; what are the factors that govern technology planning? and how does the company plan for their (develop/ buy) or (keep/ sell) decisions?

Not-yet-deployed Technologies	Deployed Technologies	Yet-to-be-deployed Technologies

Which technologies?

Decision on technology need

Make or Buy?

Decision on procurement/development of technologies

Technology Potential

Keep or Sell?

Decision on exclusive deployment/ sale of technologies
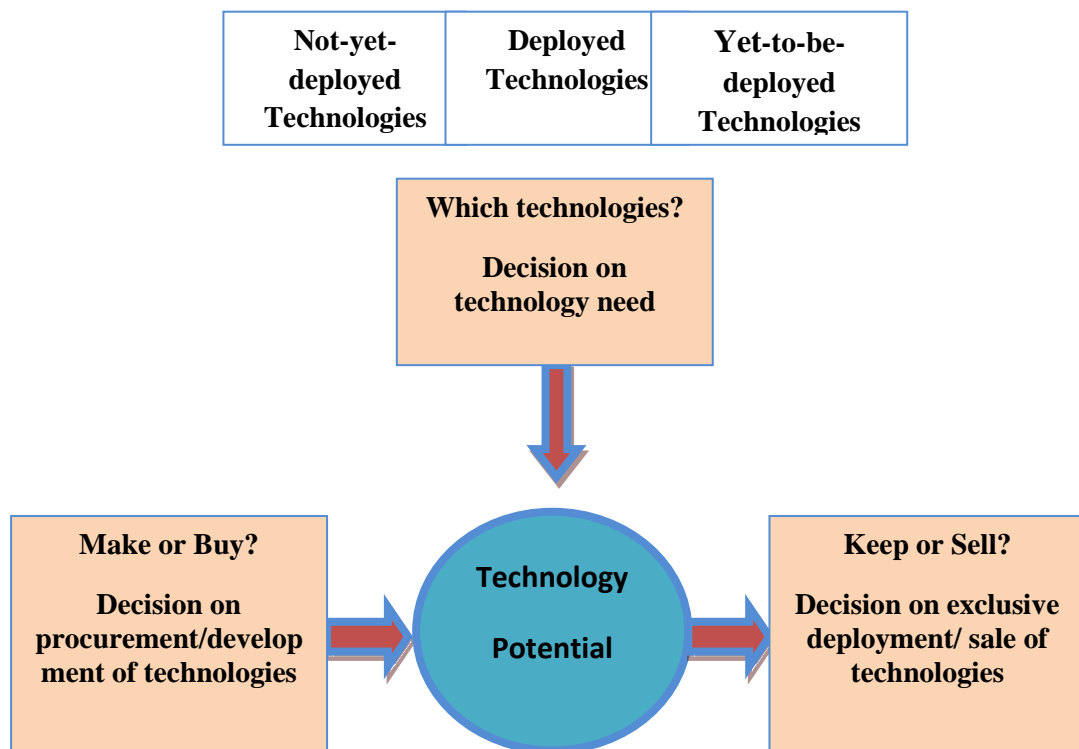
Figure 1: Trilogy of Strategic Technology Decisions **(Bucher, 2003)**

2.3.3 Integrating Technology Planning with Strategic and Business Planning

Technology planning should not be conducted as a standalone type of planning. A thorough plan capable of creating the essential linkages between organizational priorities and resource deployment should integrate strategic, technology and business planning in order to ensure that money is wisely spent. Linkages between technology and business strategies can be ensured through various mechanisms including cross functional teams, staff transfers, training and many other communication channels Floyd (1998). However, support from senior management is especially important to ensure that the strategy coincides with the overall company's mission and goals.

This research tools examine the existence of linkages between technology and business strategies and ensures that communication is happening between different business units.

Decisions related to the allocation of limited budget resources are probably among the most difficult decisions executives have to make. Therefore, the trick here is to make the decisions that will bring the best returns for the business. Just like budgets and business plans, strategic and technology plans need to be reassessed frequently in order to avoid unnecessary expenditures and to ensure that the organization projections and assumptions on customer and market needs are on track **(Chiesa et al, 1998)**. Reviewing strategic and technology plans is primarily essential to ensure that plans are not shelved due to budget limitations; the thing that is also examined in this research.

In today's global markets intense competition and technological advances make technology an essential component of strategic management; Successful application of technology is based on its fit to actual business needs as well as realistic expectations of what can be accomplished using technology, it is highly important to understand what the technology can and cannot do **(Kappel, 1998)**. Although most commercial innovations are market-pull not technology-push, there should be an appropriate balance between market-pull (requirements) and technology-push (capabilities). All businesses should use technology to open up new business areas, if the new

business areas are consistent with the overall business objectives and strategy **(Phaal, 2009).**

2.4 Technology Management Process

Similar to Gregory's definition of technology management, the EITIM proposed that technology management as a five-process model should address the effective identification, selection, acquisition and/or development, exploitation and protection of technologies. Considering this view of technology management many researchers viewed technology management as a process approach where the success of the application of this approach depends on the successful implementation of its elements; the five management processes. Gregory reviewed different approaches for the management of technology and developed a non-linear process framework which covered the range of technology management activities; he proposed some improvements and enhanced comprehensiveness and integration of technology management activities **(Gregory, 1995)**. The framework developed by Gregory was applied as a pilot study on manufacturers of measuring equipment and domestic appliance industries in Europe, Japan and the United States.

In light of process thinking another study explored the technology management concept through the lens of dynamic capabilities theory. Given the continuous technological changes, the study emphasized the importance of capturing opportunities and creating value of these

technological changes through dynamic and effective management of technology. Centindamar et al.(2009) developed a framework which was supported by a case study illustrating the value of technology management, the framework explored technology management activities in a wide business context.

This view of technology management activities in relation to other business processes was explored in a different study by Phaal (2004); where a framework to support the understanding of technological innovation was developed. Two sets of business processes necessary for effective technology management were examined, the first set comprises of core business processes of strategy, innovation and operations; the second set considers another five supporting technology management processes. Integration between these sets is supported through knowledge flows that should occur between commercial and technological functions, see Figure (2) below which represents the framework.
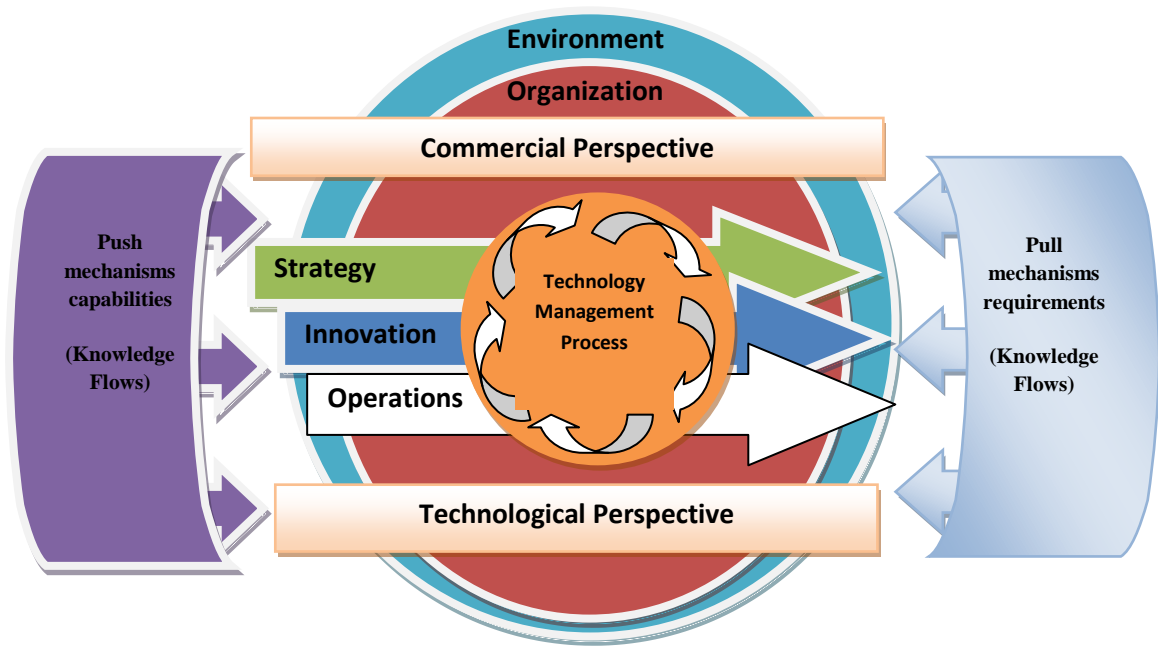
Figure 2: Technology Management Framework As Devised by Phaal **(Phaal, 2004)**

For the purpose of this research Gregory's concept of technology management process including the five technology management sub-process is adopted since it is the most applicable concept that can be applied in the Palestinian manufacturing industries.

2.4.1 Technology Management Sub-Processes:

Gregory (1995) has proposed the management of technology based on five generic processes and these are:

1. **Identification of technologies** which are currently not part of the company's technological base but may be of importance to the company in the future **(Kirby, 2001).** Example processes include but not limited to: technology intelligence, scanning, monitoring benchmarking, data collection and customer feedback. This research

tackles: How does the company decide on their current technology intelligence activities? How monitoring is to be performed? What are the means to be used for technology monitoring? How data will be collected, evaluated and communicated within the firm?

2. **Selection of technologies** that the company must support for its future products. Example processes include, forecasting, portfolio analysis, scenario analysis, financial analysis and expert judgment.

Technology selection is highly important especially when making decisions that require long term investments, decisions made must be aligned with the current business strategy and business objectives. LaDove (2006) highlighted the importance of conducting careful financial analysis at this stage to examine the company's financing capabilities and existing infrastructure.

Previous research findings revealed many factors that can influence the successful selection of technology; these factors can be classified into different groups as shown in Table (2), this research examines the factors considered by companies when making technology investment decisions.

3. **Acquisition and assimilation of technologies** that have been selected. Example processes include purchase of new equipment, hiring of new staff, R&D, technology transfer, and corporate mergers and acquisitions.

At this stage the company needs to decide whether to build its own technologies internally or to acquire it from external sources through

corporate mergers and acquisitions. Company's current capabilities and infrastructure are key determinants for the company's decision **(Baines, 2004).**

Table 2: Factors Influencing Technology Selection

Technical Factors	Institutional Factors
Present and future demand patterns	Existing institutional set-up.
Technical skills; availability of trained personnel within the company	Legal and regulatory frameworks.
Extension capacity	Skills requirements.
Availability of spare parts and raw materials;	Training and follow-up requirements.
Compatibility with customers' expectations	Know-how transfer
Compatibility with existing manufacturing systems	
Financial Factors	**Environmental Factors**
Capital costs.	Risk of a negative environmental impact.
Budget allocations.	
Current cash flows.	
Costs of spare parts and their accessibility.	

4. **Exploitation of acquired technologies.** Example processes include licensing, new product development and process improvements. If the company does not have the capabilities to develop new technologies in house, a very effective way to benefit from external R&D is to exploit it within the company through licensing or corporate R&D projects.

5. **Protection of the technological knowledge and expertise.** Example processes include patenting, contracts, trademarks, copyrights, together with security measures such as, staff retention. Companies need to slow

the pace of technology diffusion into markets by applying different mechanisms to protect it's know how.

All these processes will be explored separately in the research tools, to examine the current practices adopted by Palestinian large manufacturing firms.

2.4.2 Technology Management Process Assessment

Phaal (1998) provided structure and application of a technology management assessment procedure based on the five technology management processes. The procedure which spans both strategic and operational issues was implemented in a top-down approach. Phaal et al (2001) provided the first application of the assessment procedure on a high volume manufacturing business using action research approach. Impacts of applying the procedure were assessed in terms of benefits to the participating company.

General and specific elements in the management of technology assets and success factors of their management were identified and evaluated in a study conducted on five Finnish enterprises **(Pekka, 2003)**. The study which was carried out on two phases compared technology assets and their management within the five companies and developed indicators to monitor value and development of technology assets at enterprises. The authors propose that businesses can use the results of this research as an

indicator for the analysis and management of their technology strategies and processes.

Researchers identified many objectives for the technology management process assessment procedure; we will stick to those proposed by Phaal et al. (1998):

- "Provide a framework for linking technology with business needs.
- Identify critical technology management issues in the firm.
- Map and evaluate important technology management processes in the area of interest.
- Identify areas of strength and weakness, and hence areas of best practice for transfer, and areas for improvement.
- Lead to recommendations for action plans which have cross-functional support and can be clearly justified."

The assessment procedure of technology management process carried out on a high level strategic view assesses the impact of segmented technology areas on specific business areas. This procedure is usually conducted based on Gregory's five processes on three workshop based stages, these workshops are directed by a facilitator who should understand technology management concepts in theory and practice and must be familiar with the process and product technologies at the business being assessed. The workshop format proved to improve awareness and the communication of technology management related issues **(Phaal, 2001).**

2.5 Technology Management Tools

A large number of tools and frameworks have been developed to support managers and decision makers understand the practical and conceptual issues associated with the management of technology **(Cetindamar, 2010).** These tools can take different shapes and forms including frameworks, tables, matrices, grids, lists and software. While these tools are primarily developed to help solve issues related to the management of technology; mangers face many challenges when making use of such tools, these challenges include finding the appropriate tool, application of these tools in a practical context, means of integrating these tools with business processes and systems, and finally assessing the quality of the available tools **(Phaal et al, 2006)**.

Use of technology management tools differs according to the company's industry, structure and market. Table (3) shows some of the technology management tools, these tools are classified according to their use in the five technology management processes. Among the very important technology management tools, comes technology roadmapping which is crucially important to the Palestinian firms in order to set their competitive priorities and develop plans that help them further their missions.

Technology intelligence is also among the very important tools that should be utilized since the Palestinian market is very limited and vulnerable to changes brought by new technologies. Moreover, having the

right balance between internal and external sources of technology is very crucial for the Palestinian firms striving to improve their technological base and competitiveness.

Table 3: Main Technology Management Tools (Phaal et al, 2006).

Framework Stage	Tool	Description
Identification and Monitoring	Technology Networking	Exploratory tool for increasing external environment awareness through participant networking.
	Technology Watch	Identification of organization critical established, competing and disruptive technologies.
	Make-the-Future	Inward-facing technology opportunity identification aligned with product development programs.
	Technology Maturity Assessment	The assessment of the position of a technology's maturity along its S-curve/life cycle.
	Technology Benchmarking	Internal benchmarking of technology alternatives with the organization+ benchmarking against competitors.
Selection and Approval	Make-the-Future Selection	Inward facing technology opportunity down-selection aligned to new product drivers.
	Technology Roadmapping	Convergence of inward and outward-technology opportunities aligned to market and product drivers to enable selection of R&D programs.
	R&T Funding Approval	Technology investment decision making for technology opportunities presented by Technology Roadmapping.
Capacity Development:	Technology Make-Buy	Make/buy decision making for development of down selected technology programs capabilities.
Development Research, Acquisition and Exploitation Stages	Capability Acquisition	Definition, launch and management of technology programs aimed at developing technology maturity through R&D.
	Technology Readiness Scale	A gated process against which current technology maturity can be gauged and managed.
Technology Protection	Technology Risk Management	Management of risks arising from R&D technology programs.
	Knowledge Base Protection	Capture of valuable knowledge such that it can be re-used.
	Intellectual Property Protection	Protection against unauthorized transfer of IP outside organization.

In the following sections we will be discussing the technology intelligence, the make/buy decision and technology roadmapping as a set of tools to be adopted by Palestinian firms.

2.5.1 Technology Intelligence

In today's networked markets there is a lot of information and according to a Forrester research "the volume of the world's data doubles approximately every three years"; companies do recognize the importance of this information and they are willing to spend money and time on information retrieval which allows for better R&D planning and investment decision making. However and since there is a lot of information companies need to access the right pieces of information in order to reduce time and money spent on information retrieval and analysis, and here rises the role of technology intelligence.

Buzzanga (2008) defined technology intelligence according to the definition proposed by the Institute for Manufacturing (IfM) as "the activity that enables companies to identify the technological opportunities and threats that could affect the future growth and survival of their business. It aims at capturing and disseminating the technological information needed for strategic planning and decision-making. As technology life cycles shorten and business becomes more globalized, having effective Technology Intelligence capabilities is becoming increasingly important."

Companies apply different means to extract such intelligence ranging from internet surfing to publications and journals follow up or through attending trade shows and conferences and finally through hiring of outsourced consultants.

Through this tool the company can survey and detect emerging technologies and analyze information about the surrounding environment, where information and knowledge can then be disseminated and transmitted within the entire organizational environment in a continuous manner. However; information gathering and analysis is not enough, the company should utilize all types of documentation and communication of the analyzed information to reflect on their strategies (**Norling et al, 2000**).

2.5.2 Make - Buy Tools

While considering the organization of their R&D, firms have to decide either to develop the new technology themselves: the Make decision or they can rely on external sources for their technology: the Buy decision which involves licensing agreements, external manufacturing and R&D contracts, consultancy services and/or acquiring firms. A third possibility would be that the company utilizes both make and buy strategies (**Cassiman, 1998**).

However, the choice of which track to pursue and the integration along internal and external sourcing dimensions have always presented a challenge for firms competing in global markets, given the uncertainties

and risks that accompany new technologies **(Deb, 1996)**. One of the important aspects in technology management which management need to consider is the optimal integration of external knowledge within the company's technology and existing know-how.

Literature on make/buy decision stressed the importance of performing transaction cost and assets specificity analysis **(Cassiman et al. 1998)** to make best alignments between both. Conducting a cost/benefit ratio analysis help management decide whether the strategic benefits of the technology justify the cost and management time needed to develop it, otherwise it should be acquired from external source.

2.5.3 Technology Roadmapping

Many approaches have been developed to support technology management and planning one of these approaches is technology roadmapping. This approach has been developed by Motorola in the late 1970s to support integrated product-technology planning **(Phaal et al, 2003)**, since then the concept has been widely used in industry to support technology planning and technology investment decision making by identifying critical enabling technologies and technology gaps within the firm in an attempt to leverage R&D investments. Gindy et al. (2005) consider technology roadmapping as a need-driven approach used to explore and communicate the dynamic linkages between technological resources, organizational objectives and the changing environment.
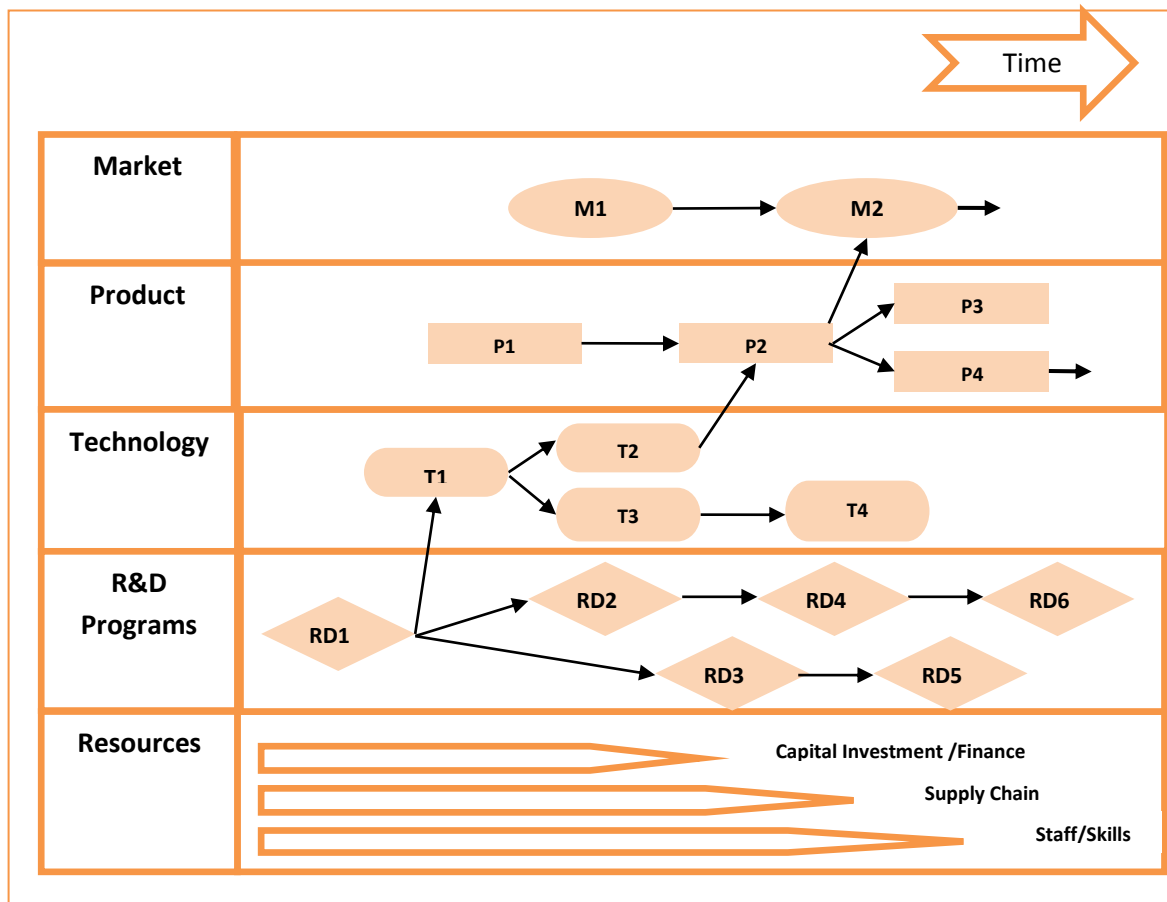
Figure 3: Schematic Technology Roadmap **(Phaal, 2005).**

Technology roadmaps can take various forms; the generic form roadmaps are generally represented in graphical time-based charts comprising of multi layers that typically includes the commercial and technological perspectives, Figure (3) represents a generic technology roadmap showing how technology can be aligned to product and service developments, business strategy, and market opportunities.

2.6 The Palestinian Manufacturing Sector

The manufacturing sector is a vital part of the Palestinian economy; it is an important source of jobs and a segment from which the country wealth can be derived; below is a brief description of this sector.

Manufacturing is the branch of manufacture and trade based on the fabrication, processing, or preparation of products from raw materials and commodities. This includes all foods, chemicals, textiles, machines, and equipment. This includes all refined metals and minerals derived from extracted ores. This includes all lumber, wood, and pulp products **(UN, 2012).**

2.6.1 Basic features of the Palestinian Industrial Sector

- Palestinian industries generated US $772 million in gross domestic product (GDP) in 2009, accounting for more than 15 percent of the total **(FPCCIA, 2012).**

- The industrial sector participated in employing 12% of the total employees in the year 2009 **(UNCTAD, 2012).**

- The Gross fixed capital formation of the industrial sector in the year 2010 was 69.8 million US $ **(PCSB, 2012).**

- The Palestinian industries are considered micro to small firms where more than 90% of the establishments are currently employing less than 10 workers and most of these firms are family businesses **(PFI, 2012).**

- The numbers of industrial establishments reached 15,617 by the year 2010, out of these 14,823 firms are operating in manufacturing industries **(PCSB, 2012).**

- The numbers of employees employed by industrial establishments reached 65,538 by the year 2010, out of these 60,401employees are currently working in manufacturing industries **(PSCB, 2012).**

2.6.2 Manufacturing Industry Sectors

The Palestinian manufacturing industry has been classified according to the International Standard Industrial Classification (ISIC) into nine main sectors UN (2012):

1. Food, Beverages and Tobacco Industry

2. Leather, Apparel and Textile Industry

3. Wood, Lumber and Furniture Industry

4. Paper, Printing, Publishing, and Allied Industry

5. Chemicals, Petroleum Refining, Rubber and Miscellaneous Plastic Industry.

6. Stone, Clay, Glass, and Concrete Industry

7. Primary Metal Industry

8. Fabricated Metals including Electronic, Electrical, and Industrial Machinery Industry.

9. Miscellaneous Manufacturing Industries.

However, in this research the target is set to investigate technology management practices at large manufacturing firms and this implied few modifications in this classification since some of the above mentioned manufacturing sectors were not found in our sample. As an example; there were no primary metal industries or fabricated metals industry among the listed large manufacturing firms and therefore our sample included the following manufacturing sectors.

1. Food and Beverages, 2. Pharmaceuticals, 3. Plastics, 4.Construction 5.Paper, 6.Textile, 7.Leather, 8.other miscellaneous industries such as; Animal Feed and Jewelry Industries.

2.7 Summary

The role that technology management plays in any industrial development should be clearly understood, and this is what the researcher tried to do in this review. She tried to reveal the bath to proper technology management deployment in large manufacturing firms in Palestine by exploring the concept and its impact, the key processes related to it and main tools used to utilize it. She wants to utilize the information obtained from this review to design the research tools to best fit the research goals and objectives.

Chapter Three

Research Methodology

The Research Methodology

This chapter presents the research methodology adopted by the researcher including, the design of the research questions and hypotheses to the significance of the research project to Palestinian market, then it explores the research tools and their design. Methods adopted for data gathering and analysis and the logic behind their use are explored as well, finally the research validity and reliability are discussed

3.1 Research Approach

This research was conducted as an attempt to assess technology management practices in large manufacturing firms in Palestine and to examine what aspects of technology management are relevant to the Palestinian industry. The researcher is trying to assess technology management practices through an analytical study of large manfcaturing industries in Palestine. The researcher utilized descriptive and inferential analysis to describe, compare and evaluate the situation in an attempt to reach meaningful generalizations that can increase the knowledge stock of technology management through the devlopment of a technology management framework that can be used in Palestinian manufacturing firms.

Taking this approach requires both quantitative and qualitative data gathering, this gives the research a 'broader perspective' where different attributes of the subject being considered can be revealed than a single data

source would give alone. This mixed methods research was defined by Creswell as an approach that collects both quantitative and qualitative data which is geared towards answering "pragmatic knowledge claims" **(Creswell, 2003)**.

Creswell discussed several approaches to mixed methods research, for example, he discussed the concept of sequential explanatory strategy as employing qualitative data to refine quantitative data. This approach was adopted in this research where an online questionnaire was designed and mailed to the firms participating in the survey then structured interviews were conducted with key companies in each manufacuring sector.

To collect data researchers make use of a number of different data collection strategies; these include primary data which is data collected for the specific research problem at hand such as, case studies, surveys and questionnaires, and secondary data which is data collected by other researchers or for other research purposes including journal articles, books, newsletters, and documentaries **(Hox et al, 2005)**. In this research the researcher itilized both primary and secondary data sources as explanied below:

- **Primary Sources**: the researcher addressed the analytical aspects of the subject through some primary sources of research including an online questionnaire that was mailed to the participating firms and

the structured interviews that were conducted with five firms who are considered among the largest in their sectors.

- **Secondary Sources**: the researcher addressed the theoritical aspects of technology management through research in secondary data sources which consists of all sources of published data including; english and arabic books and refrences, journals, articles, reports, and previous research studies that have tackled the subject.

3.2 Research Variables

The research in hands is planned to assess technology management practices in large manufacuring firms in palestine in light of three main independent variables:

1. The geographic loction of the firm; the researcher wants to examine whether the geographic location at which the company is located contributes to any differences in the practice of technology managment among firms. Five geographic locations were considered including Northern West Bank, Mid-West Bank, Southern West Bank, Jerusalem District and Gaza Strip. In spite of the fact that Palestine has a relatively small geographic area compared to other countries and it could be difficult to find differences between companies' practices, it was expected that certain difference may exist between firms in the different geographic location e.g Gaza Strip and West Bank since Gaza Strip

suffers from the Isreali closure which imposes several limitations on access and movement of products and equipments.

2. The firm's industry; the researcher wants to examine the existance of any differences in technology management practice that can be attributed to the company's industry. The researcher reviewed different international industrial classifications. However, the classification that was developed for this research fits best the manufacturing sectors actively contributing to the Palestinian economy and these include the following sectors:

   - Food and beverages industry,

   - Apparel and textile industry,

   - Paper, printing, publishing, and allied industry,

   - Rubber and miscellaneous plastic industries,

   - Concrete, stone, clay and other construction industries,

   - Pharmaceutical industries,

   - Leather industry,

   - Miscellaneous manufacturing industries.

3. The firm's capital; the researcher wanted to examine the existance of any differences in technology management practice between participating firms that can be attributed to the company's capital. Howevr, many companies refused to declare their own capital therefore this variable could not be examined.

3.3 Research Population and Sampling Mechanisms

All research projects address a problem that is of great relevance to a certain research population, in this research large manfucturing firms in Palestine were targeted since it was stated earlier that investment of these firms in technology are high and wrong investment decisions cost these firms big money. Moreover, the technological base of these firms is more developed when compared to small and meduim sized organisations.

According to MoNE(2012) firms who are currently employing 50-99 employees are considered large. There are fifty four (54) large manufacturing firms operating in Palestine, according to the general census of population, housing and establishments for the year 2007 conducted by the Palestinian Central Bureau of Statistics (PCBS). These firms are distributed between the West Bank and Gaza Strip ; where fourty seven (47) firms are located in the West Bank and another seven (7) firms are located in Gaza Strip (PCBS, 2012).

The sample size was determined and calculated based on Herbert Arkin Equation and it was found to be 47 and all these firms were targeted in the research. For the qualitative research the sample size was decided by selecting the largest firm (the one with the largest number of employees) in each manufacturing sector to be interviewed which counted to eight; however, some of these companies refused to be interviewed and others were contacted. Finally a decision was to be made and the researcher

interviewed firms who expressed their willingness and avilaibility for the interview and that counted to five firms.

3.4 Research Tools

As highlighted earlier in section (3.1) this research is based on mixed methods research with a sequential explanatory strategy where the research has employed the qualitative data to refine quantitative data; as a quantitative tool an online questionnaire was developed using Google forms, the listed large manufacturing firms in the sample were contacted and given information about the objective of the research. Then these companies were asked if they are willing to fill in the online questionnaire where four companies out of the 47 listed firms refused to fill in the online questionnaire.

The online questionnaire (Appendix B) was then mailed to the responsive firms via the researcher's email; then these companies were contacted to assure their receipt of the email message and to provide clarifications on how to fill in the online questionnaire. A period of one month was given to the participating firms to fill in the questionnaire, and some companies were contacted several times during this month to fill in the questionnaire, after receiveing the filled questionnaires the researcher commenced the qualitative part of this research.

For the qualitative part a structured interview was designed in an attempt to identify major technology management themes and draw conclusions based

on the analysis of these specific themes. It is known that there is generally little room for variation in responses using this tool since it provides consistent data that can be compared across respondents **(Crabtree, 2006)**.

The structured interview questions were formulated to answer the main research questions and the largest firms in each manufacturing sector were contacted to check their availability for an interview. The researcher targeted senior managers in the interviews since top management perspective on technology management is to be examined; therefore, some of these firms refused to be interviewed claiming the unavailability of their senior management for the interview.

Then the second largest firm in each sector was contacted. Finally five firms from those who filled in the online questionnaire accepted to be interviewed.

When interviewees confirmed their availability for interviews, the researcher scheduled dates to conduct these interviews, and interviews were then conducted.

As explained earlier the researcher targeted senior managers in different firms; Table (4) below shows the different positions that interviewee held.

Table 4: List of Interviewees

#.	Company Industry	Position
1.	Pharmaceutical Industry	Executive Manager
2.	Textile and Apparel Industry	Senior Designer
3.	Food Industry	Production Manager
4.	Plastics Industry	Plant Manager
5.	Construction Industry	Plant Manager

The researcher briefed the interviewees about the research objectives and aims of the interviews; he also confirmed confidentiality of all company's information and asked for the possibility of tape recording when a permission was given the interview was recorded, (Appendix A).

3.5 Data Management

Since data is a valuble resource of any research project, data management is a vital process that can hinder or enhance the quality of this research. This process invloves collecting, reviewing, verifying, coding and analysing data to forms suited to the analysis being conducted. Main data management processes conducted in this research are discussed in (3.5.1 and 3.5.2) sub-sections.

3.5.1 Data Collection

Quantitative data from the online questionnaire was received after contacting the companies in the sample and assuring their willingness to fill in the questionnaire. Companies received the questionnaire on their email where they were asked to read it carefully and then fill in the questionnaire.

In the qualitative research, answers for the interview questions formed the basis for the qualitative data. Interviews were recorded in order to get all the details and at the same time to be able to carry on an attentive conversation with the interviewee **(Folkestad, 2008)**.

3.5.2 Data Analysis

The submitted questionnaires were automaticlly stored in a database in the google form itself, the data was then exported to SPSS database and analysed.

Describtive analysis of data was conducted with representations of the means and percentages, while inferntial anlysis was conducted by testing the different research questions using One Way ANOVA tests **(Sawyers, 2007)**. Where the researcher examined the existance of statistically significant differences between the companies that can be attributed to their location or industry. However; when significant differences were found another Post-hoc test was conducted to understand the differences between

the survyed companies due to the specific independent variable **(Hilton et al, 2006)**.

For the structured interviews; notes were taken during the interview and main themes were highlighted after the interview was conducted. When all interviews were conducted, patterns were matched and main observations and concerns were made.The researcher made pattern analysis to conclude the main themes in the conducted interviews; then conclusions were written.

3.6 Response Rate

In the quantitative research the population was 54 and the sample size was calculated based on Herbert Arkin Equation and it was found to be 47. Out of the fourty seven (47) companies in the sample four (4) companies refused to fill in the questionnare. The questionnaire was then forwarded to fourty three (43) companies, out of these only fourty (40) companies returned the questionnaire. Of those fourty (40) who returned the questionnaire only thirty five (35) questionnares were accepted since the other five (5) questionnares had many missing fields in the returned questionnaires. Hense, the total response rate for this quesionnaire was 74% which is an acceptable response rate.

3.7 Research Validity and Reliability

Reliability and validity are two universal challenges of any research , therefore researchers in any research project should assure their research is reliable and valid by all possible means.

3.7.1 Research Validity

The vailidity of a research can be examined by assuring that the research has measured what it was supposed to measure, validity of this research was assured through the following means:

- The researcher involved 4 arbitrators who are experts in business and technology management as well as a statistician to refine the research tools, where modifications were made in order to assure the research tool can achieve the research objectives.
- The researcher has utilized multiple research methods to collect the data, including quantitative method represented by the online questionnaire and qualitative method represented by the structured interview.
- The researcher utilized multiple sources to collect data including primary and secondary data sources that are known for their cridebility and reliability.

3.7.2 Research Reliability

Reliability of a research refers to whether or not the research results can be reproduced over time, reliability is generally used for testing and evaluating quantitative research **(Golafshani, 2003)**. Reliability concept relates to the good quality of research. However, in a quantitative study it is with the "purpose of explaining" while quality concept in qualitative study has the purpose of "generating understanding". Stenbacka (2001) argued that this difference in purpose is one of the reasons that makes the qualititive research reliability concept irrelevent in most cases, therefore the reliability of this research was checked on a quantitaive level only.

In this research, the researcher checked reliability of the quantitative tool (the online questionnaire) by checking consistency through Cronbach Alpha test which was calculated for all statements in the questionnaire and the result was 96.1% which indicates high consistancy therefore the research is considered reliable.

Chapter Four

Data Gathering, Analysis and Discussions

Data Gathering, Analysis and Discussion

Qualitative and quantitative research provide different perspectives and complement each other. Moreover, utilizing both techniques improves the research validity and reliability. Therefore, and as mentioned previously in the methodology chapter, this research used both the quantitative research through the online survey and the qualitative research through the structured interviews.

The analysis chapter comprises of two parts, the first part presents and discusses findings from the returned questionnaires and the second part discusses findings from the structured interviews. The following sections addresses these parts.

4.1 Part I: Questionnaire Analysis

As a quntitative research tool, the researcher designed an online questionnaire which consists of two parts; the first part contains information about the company including the industrial sector, geographic location and company's capital and these represents the independent variables of this research as will be discussed later in this chapter. A description for the sample based on the different research variables is provided in the following sections.

4.1.1 Distributions of the Participating Firms

- **Firms' Geographic Distribution**

As shown in Figure (4), the surveyed firms are geographically distributed in the West Bank and Gaza Strip, where the highest percentage (31%) is located in the southern part of the West Bank.
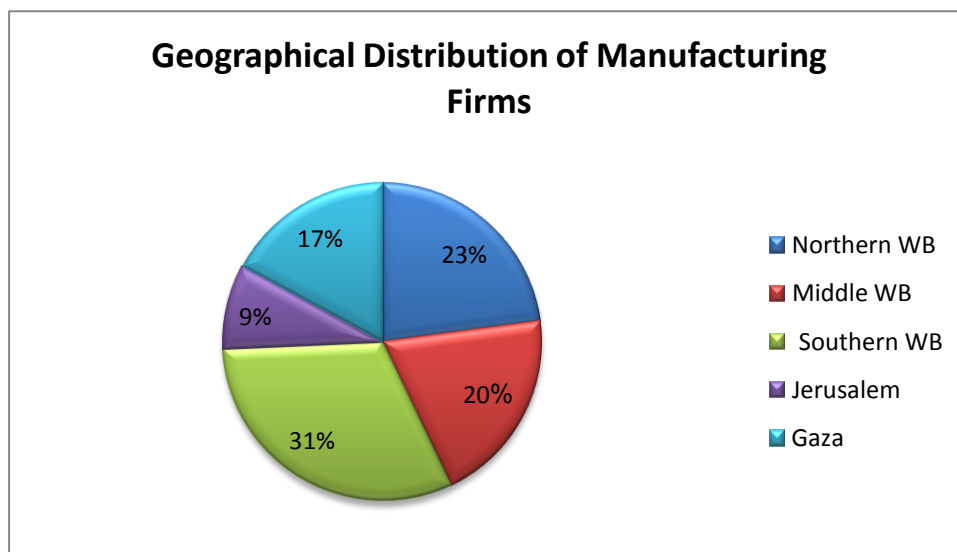
Figure 4: Geographic Distribution of Large Manufacturing Firms in Palestine

- **Firms' Industry Distribution**

As shown in Figure (5), the manufacturing sectors in this sample can be classified into the following sectors food, textile, pharmaceutical, construction, plastics, paper, leather and other miscellaneous sectors.
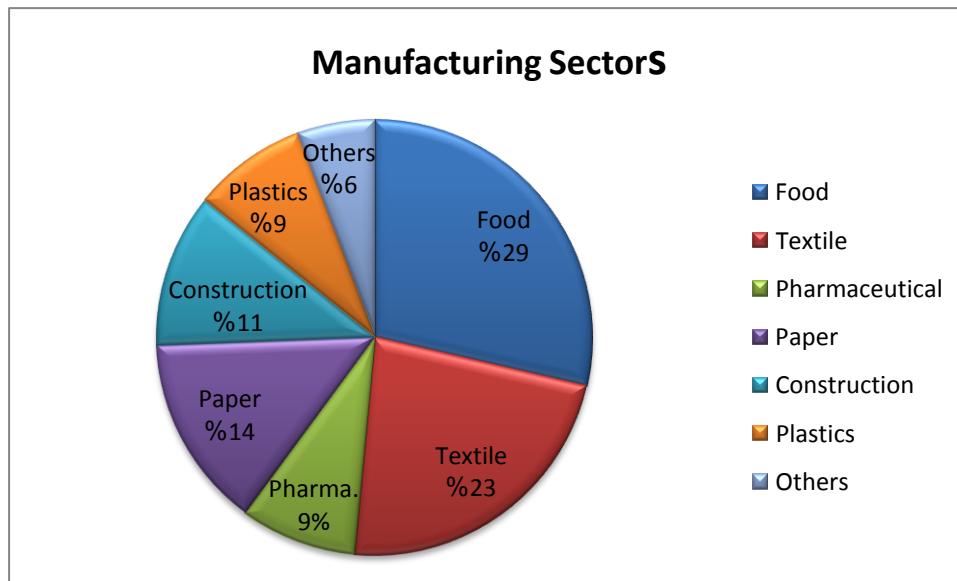
Figure 5: Distribution of Firms on the Different Manufacturing Sectors

The largest sector represented in the sample is the food sector (29%) including dairy products industry, beverages and confectionaries. The textile sector was the second largest manufacturing sector represented in the sample; it comprises of small weaving and tanning workshops which produce both textile and ready to wear clothes.

- **Capital Based Firms' Distribution**

When the questionnaire was designed the researcher wanted to examine the firm's capital as one of the independent variables that may contribute to significant differences in technology management practices among participating firms. However, most of the firms participating in this survey left this space empty indicating that they do not do financial disclousers at the stock market. The resaon why this varible was dropped from this research.

The second part of the questionnaire has thirty four (34) questions addressing six main themes that are considered key determinants of the technology management practice in the manufacturing firms as discussed previously in the literature review and these themes are:

1. Technology planning section.

2. Technology identification section.

3. Technology selection section.

4. Technology acquisition section.

5. Technhology exploitation section.

6. Technology protection section.

This research findings are discussed based on these themes.

4.1.2 Technology Planning:

The first objective of the questionnaire is to assess the extent of technology planning practice among the surveyed firms; as mentioned previosly the questionnare was divided into 6 main themes and technology planning was the first theme to be explored. Each theme contained different types of questions, some are designed based on a multible choice questions others as check box questions and others are likert scale items. The format of a typical five level Likert item is:

1. Strongly Disagree

2. Disagree

3. Don't know

4. Agree

5. Strongly agree

Questions in the likert format were grouped and analysed in each theme. However, a detailed analysis is provided for the first theme only which is technology planning.

1. Likert items were ranked from 1(strongly disagree) to 5 (strongly agree) when analyzed,

2. As shown in table (4) below, response average for each paragrpah was calculated by adding answers to each paragraph from each firm and dividing by the number of valid answers (35)

3. Theme total average was then calculated by adding response averages and dividing by the number of paragraphs(7) and the answer was 3.38.

4. The application extent of each paragraph was then identified by classifing the response averages into five degrees based on what was agreed with the arbitrators, ranging from very low to very high extents of application.

These degrees which are based on five intervals were calculated as follows:

• The interval length was calculated by dividing the response range (5 which corresponds to strongly agree minus 1 which corresponds to strongly disagree) by the number of intervals which is 5 $(5 - 1) \div 5 = 0.8$

- The intervals were then determined as follows:

1-1.80	very low
>1.80 – 2.60	low
>2.60 – 3.40	moderate
>3.40 – 4.20	high
>4.20 – 5	very high

In light of the above analysis it can be noticed that the total average response for the technology planning is 3.38 which is considered moderate, therefore we can say that there is a moderate degree of technology planning application in large manufacturing firms in Palestine. This can be justified due to the fact that there is no structured approach to technology planning is being adopted by the manufacturing firms. Technology plans in most of the times are not based on deep analysis and understanding of the internal and external environments that govern the technology planning process.

As mentioned above, research findings showed that technology planning is practiced to a moderate extent in Palestinian large manufacturing firms, below are the key findings related to this pracice.

Table 5: Technology Planning Practice

Practice of Technology Planning			
Paragraph	N	Mean	Application level
The Company performs strategic planning.	35	3.63	high
The Company seeks to achieve specific strategic goals during the next five years.	35	3.57	high
The Company seeks to achieve specific financial targets during the next five years.	35	4.34	very high
Some of the company's strategic goals are associated with the company' core technologies.	35	3.29	moderate
The Company has a clear documented policy to manage its technologies.	35	3.11	moderate
The company performs technology planning.	35	3.03	moderate
While preparing the annual budgets the Company reviews the technology plans.	35	2.77	moderate
Total (Valid)	**35**	**3.38**	**Moderate**

- Of the survyed firms 63% confirmed that they perform strategic planning and they have strategic goals to be achieved within the next five years, whearas 80% of these firms indicated they do have financial goals to be achieved within the next five years.

- Only 40% of the surveyed firms indicated that technology is incorporated in their strategic plans. Moreover, 57% of the firms indicated that technology is not considered while preparing their annual budgets.

- Of the surveyed firms 54% indicated that they do not perform technology planning, and the departments that are usually involved in this process are: (Production, Engineering, Finance, Marketing, Procurement and R&D departments). Figure (6) below shows the

different departments that participate in the technology planning process and their participation incidence.
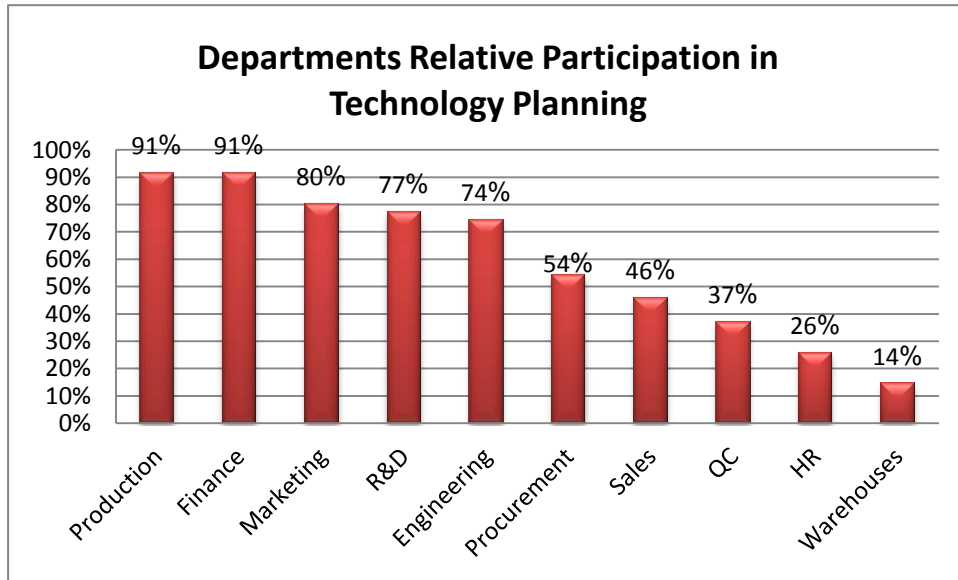
Figure 6: Departments Relative Participation in Technology Planning

As shown in Figure (6) above, a good finding was noticed with regards to the technology planning practice which is the involvement of all key departments in the process such as; production, finance, marketing and engineering departments.

The main research findings in technology planning practice are presented and the research hypotheses are examined to explore any possible significant differences in the technology planning practice that can be attributed to the independent variables in this research; the company's geographic location and the company's industry, below are the main hypothesis related to the technology planning practice.

H1$_0$: No statistically significant differences at α = 0.05 in the degree of technology planning practice at large manufacturing firms in Palestine can be attributed to the company's geographic location.

From Table (6) below we can see that significant probability is 0.083, thus we cannot reject the null hypothesis. No statistically significant differences in the degree of technology planning practice among large manufacturing firms in Palestine can be attributed to the company's geographic location.

Table 6: ANOVA Test for Technology Planning H1$_0$

ANOVA Test for Technology Planning Differences attributed to Geographic Location						
		Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Technology	**Between Groups**	4.725	4	1.181	2.293	.083
Planning	**Within Groups**	15.453	30	.515		
	Total	20.177	34			

H2$_0$: No statistically significant differences at α = 0.05 in the degree of technology planning practice at large manufacturing firms in Palestine can be attributed to the company's industry.

As shown in Table (7) we can notice that the significant probability is 0.00 which is less than 0.05; thus we reject the null hypothesis. There are significant differences in technology planning practice between large manufacturing firms in Palestine that can be attributed to the company's industry.

Table 7: ANOVA Test for Technology Planning H2$_0$

ANOVA Test for Technology Planning H2$_0$		Sum of Squares	df	Mean Square	F	Sig.
Technology Planning	**Between Groups**	12.001	6	2.000	6.850	.000
	Within Groups	8.176	28	.292		
	Total	20.177	34			

A post hoc test was conducted on SPSS in order to understand the differences that exist between the surveyed firms in the different industrial sectors in terms of their technology planning practice; these differences are shown in Table (8).

Table 8: Post Hoc Test to Measure Technology Planning Practice Differences

Area 1: Technology Planning							
Industry	**Food**	**Textile**	**Pharmaceutical**	**Paper**	**Construction**	**Plastics**	**Others**
Food	-	0.464	-1.429*	0.343	-1.107*	-0.333	0.500
Textile		-	-1.893*	-0.807*	-1.571*	-0.798*	-0.964
Pharmaceutical			-	1.086*	0.321	1.095*	0.929
Paper				-	-0.764*	-0.010	-0.157
Construction					-	0.774	0.607
Plastics						-	0.167
Others							-

Table (8) above presents pair-comparisons between industrial sectors in terms of their technology planning practice, the fields marked with (*)

represent the significant differences between the compared sectors. Below is an illustration of these differences:

- There are significant differences between food sector in one hand and pharmaceuticals and construction sectors on the other hand; these differences are in favor of pharmaceutical and construction sectors.

- There are significant differences between textile sector in one hand and pharmaceutical, paper, construction, and plastics sectors on the other hand; these differences are in favor of the pharmaceutical, paper, construction, and plastics sectors.

- There are significant differences between pharmaceutical sector in one hand and paper and plastics sectors on the other hand; these differences are in favor of the pharmaceutical sector.

- There are significant differences between paper sector and construction sector; these differences are in favor of construction sector.

Considering the above analysis, the industrial sectors can be ranked according to their practice of technology planning as shown in Table (9) below:

Table 9: Rank of Manufacturing Sectors According to Their Technology Planning Practice

Rank	Manufacturing Sector
First	Pharmaceutical
Second	Construction
Third	Food
Fourth	Plastics
Fifth	Paper
Sixth	Textile

This goes in line with the proposed hypotheses and with criteria set forth while selecting the research sample which is the large manufacturing firms, since it was expected that companies making big investment in their technologies and machineries such as pharmaceutical industries will be keen to adopt best practices to improve the effectiveness of their investment decisions.

4.1.3 Technology Management Processes

The extent to which companies perform technology management can be measured based on the practice of technology management key processes (technology identification, selection, acquisition, exploitation and protection); key indicators were developed to assess the practice of each process of these five processes, in the following section the deployment of these processes is addressed.

4.1.3.1Technology Identification

Technology identification is the first sub-process of the technology management process; it involves systematic scanning of all technologies that are or maybe of importance to the business. The extent to which technology identification is applied in large manufacturing firms in Palestine was addressed in the questionnaire by nine paragraphs which are presented as shown in Table (10). From this table we can see that the total response average counts to 3.24 which is considered a moderate degree, therefore we can say that technology identification is applied to a moderate extent in large manufacturing firms in Palestine. However; a key question should be addressed now, is there any differences in technology identification practice between the surveyed firms, and if these differences do exist to what variables they can be attributed. These questions are examined by testing the following hypotheses.

H3$_0$: No statistically significant differences at α = 0.05 in the degree of technology identification practice at large manufacturing firms in Palestine can be attributed to the company's geographic location.

Table 10: Technology Identification Practice

Technology Identification Practice			
Paragraph	N	Mean	Application level
The Company does monitor the technologies owned by competitors.	35	4.20	High
The Company classifies technologies according to their importance to the business.	35	3.86	High
The company tracks the rate of evolution of their technology.	35	3.14	Moderate
If the company does classify technologies according to their importance to the business; then it uses different policy to manage this technology than other technologies.	35	3.14	Moderate
The Company assesses and analyzes impact of new technology on its business.	35	3.06	Moderate
The current organizational arrangements systemically facilitate technology intelligence activities.	35	3.00	Moderate
The Company reviews important technology information periodically and certain actions are taken according to the obtained information.	35	2.94	Moderate
The company assesses their technology needs.	35	2.91	Moderate
Computerized systems are used to store technology intelligence information.	35	2.89	Moderate
Total (Valid)	**35**	**3.24**	**Moderate**

From Table (11), we can notice that the significant probability is 0.150, thus we cannot reject the null hypothesis. No statistically significant differences in the degree of technology identification practice among large manufacturing firms in Palestine can be attributed to the company's geographic location.

Table 11: ANOVA Test for Technology Identification $H3_0$

<table>
<tr><td colspan="7">ANOVA Test for Technology Identification $H3_0$</td></tr>
<tr><td></td><td></td><td>Sum of Squares</td><td>df</td><td>Mean Square</td><td>F</td><td>Sig.</td></tr>
<tr><td>Technology</td><td>Between Groups</td><td>6.218</td><td>4</td><td>1.555</td><td>1.826</td><td>.150</td></tr>
<tr><td>Identification</td><td>Within Groups</td><td>25.538</td><td>30</td><td>.851</td><td></td><td></td></tr>
<tr><td></td><td>Total</td><td>31.757</td><td>34</td><td></td><td></td><td></td></tr>
</table>

$H4_0$: No statistically significant differences at $\alpha = 0.05$ in the degree of technology identification practice at large manufacturing firms in Palestine can be attributed to the company's industry.

To examine this hypothesis ANOVA test was conducted on SPSS and the significant probability was 0.00 as shown in table (12) which is less than 0.05. Thus we reject the null hypothesis; which means that there are significant differences in technology identification practice between large manufacturing firms in Palestine that can be attributed to the company's industry.

Table 12: ANOVA Test for Technology Identification H4$_0$

<table>
<tr><td colspan="7" align="center">ANOVA Test for Technology Identification H4$_0$</td></tr>
<tr><td></td><td></td><td>Sum of

Squares</td><td>df</td><td>Mean Square</td><td>F</td><td>Sig.</td></tr>
<tr><td rowspan="3">Technology

Identification</td><td>Between Groups</td><td>22.929</td><td>6</td><td>3.821</td><td>12.121</td><td>**.000**</td></tr>
<tr><td>Within Groups</td><td>8.828</td><td>28</td><td>.315</td><td></td><td></td></tr>
<tr><td>Total</td><td>31.757</td><td>34</td><td></td><td></td><td></td></tr>
</table>

To understand these differences a post hoc test was conducted to test variances between sectors in technology identification practice, these differences are shown in Table (13) below.

Table 13: Post Hoc Test to Measure Technology Identification Practice Differences

Area 2: Technology Identification							
Industry	Food	Textile	Pharmaceutical	Paper	Construction	Plastics	Others
Food	-	0.492	-2.041*	-0.633*	-1.661*	-0.707	0.411
Textile		-	-2.532*	-1.125*	-2.153*	-1.199*	-0.903
Pharmaceutical			-	1.407*	0.380	1.333*	1.630*
Paper				-	-1.028*	-0.074	0.222
Construction					-	0.954*	1.250*
Plastics						-	0.296
Others							-

Form the Above table we can notice that:

- There are significant differences between food sector in one hand and pharmaceuticals, paper and construction sectors on the other hand; these differences are in favor of the pharmaceuticals, paper, and construction sectors.

- There are significant differences between textile sector in one hand and pharmaceutical, paper, construction, and plastics sectors on the other hand; these differences are in favor of the pharmaceutical, paper, construction, and plastics sectors.

- There are significant differences between pharmaceutical sector in one hand and paper and plastics sectors on the other hand; these differences are in favor of the pharmaceutical sector.

- There are significant differences between paper sector and construction sector; these differences are in favor of construction sector.

- There are significant differences between construction sector and plastics sector; these differences are in favor of the construction sector.

Different industrial sectors can now be ranked according to their technology identification practice as shown in Table (14) below.

Table 14: Rank of Manufacturing Sectors According to Their Technology Identification Practice

Rank	Manufacturing Sector
First	Pharmaceutical
Second	Construction
Third	Plastics
Fourth	Paper
Fifth	Food
Sixth	Textile

In spite of the fact that this consideration gives an idea about technology identification practice in the Palestinian manufacturing firms, a better understanding should be considered by providing detailed insights on certain technology identification aspects. The following sections considers the measures that govern technology identification practice in Palestine

The identification process is supported by inputs from the firm's external environment including information about competitors and customers and other inputs including scanning the science base. Technology identification process was assessed in the surveyed companies based on criteria related to these inputs: how the company's technological needs are monitored; how does the company monitor technological developments and the technologies owned by competitors; how does the company gather, analyze, evaluate and disseminate information related to technology intelligence activities. All these issues were addressed in the questionnaire

under the technology identification theme and they are discussed in the following sections.

1. Formulation of Technology Monitoring Process

Monitoring of technological changes and technologies owned by competitors is key for companies to plan for their competitive strategy. The main finding of the company's intelligence activities are presented here. These research findings' revealed that only 29% of the companies perform reviews for their technology needs while 71% do not perform any review. Out of the 29% of the companies which perform reviews, only 60% review their technology needs on yearly basis. Figure (7) below shows the different frequencies on which the reviews are performed.
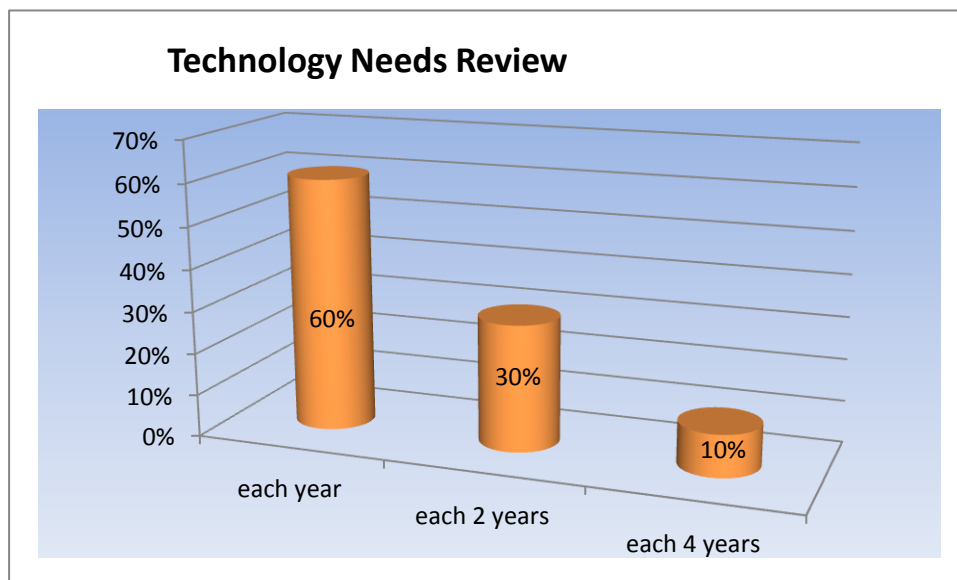
Figure 7: Technology Needs Review

Of the surveyed firms, 74% indicated that they monitor the technologies owned by competitors. However, only 43% of these firms do track technological advances in their relevant fields which increases the company's vulnerability to technological changes.

Of the surveyed firms, 75% indicated that they classify technologies according to their importance to the business. However, only 35% of these firms apply different strategies to manage technologies classified important to the business which indicates poor management of the monitoring activities.

2. Selection of Technology Intelligence Sources

Sources of technology intelligence information are vitally important and the company must utilize all possible information sources to stay abreast of the technology advances and the technology position of their competitors. Figure (8) represents the different technology information sources and their relative usage in the surveyed companies. In spite of the fact that companies utilize different sources for their technology intelligence, customers' feedback as a key source for technology intelligence is not highly utilized.
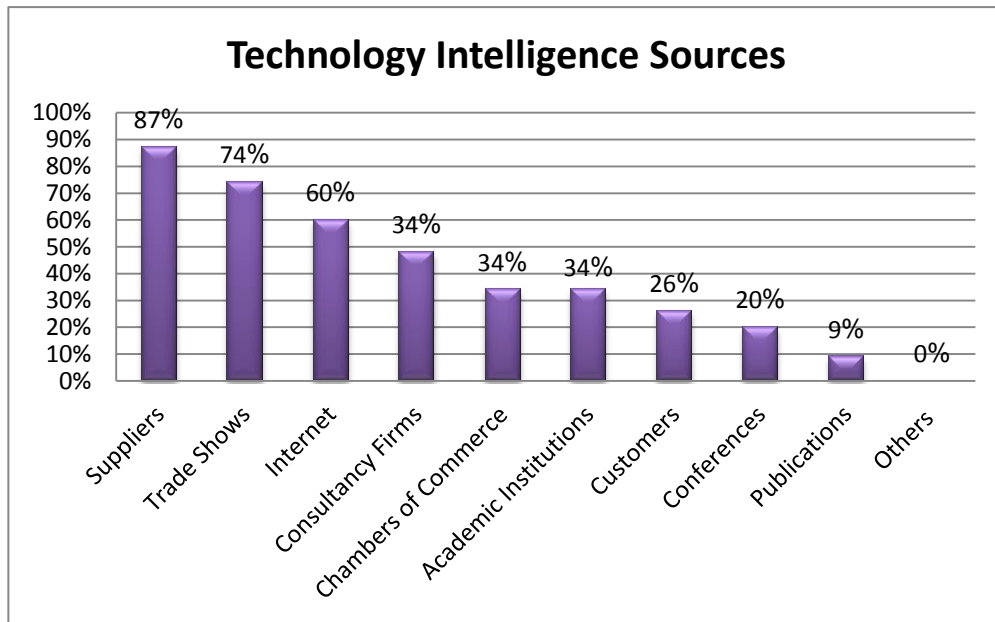
Figure 8: Technology Intelligence Sources

3. Evaluation, Storage and Communication of Technology Intelligence Information

Of the surveyed companies only 37% declared that they do analyze and evaluate the impact of modern technologies on their performance. However, only 23% of these companies use computerized systems to store technology intelligence information. Which indicates a weakness since information obtained from intelligence activities cannot be fully utilized without prior analysis and evaluation.

4. Organization of Technology Intelligence Activities

The organization of technology intelligence activities is highly important in the technology identification process since this process is highly affected by the existing organizational structure. The research findings indicated

that the existing organizational settings do not facilitate the technology intelligence activities in more than half of the surveyed companies, where 66% of these firms declared that the company does not have a separate unit dedicated to technology intelligence activities. Moreover, 77% of those who confirmed the existence of a technology intelligence unit indicated that no certain budget is allocated for the unit and only 14% of these companies do review its performance.

As discussed earlier technology intelligence and its organization are crucial for a successful technology identification process. However, some differences were found between the surveyed firms in their technology intelligence performance. Some of these differences are represented in Figure (9) below, we can notice that some firms in certain industries have a technology intelligence unit such as construction industry and pharmaceutical industry where all the surveyed companies indicated the existence of such unit whereas in other industries that are less developed such as textile and paper industries this unit was totally inexistent.
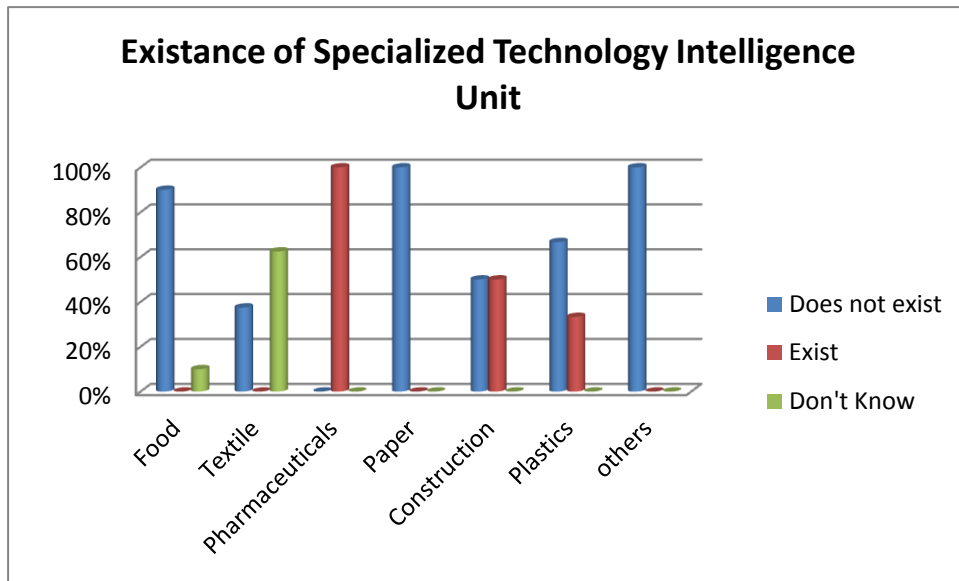
Figure 9: Existence of Technology Intelligence Unit Based on Industry

Figure (10) shows the relative percentages of those who allocate specific budget for their technology intelligence unit and those who do not among the different manufacturing sectors represented in the research sample. As shown in Figure (10) below firms operating in pharmaceutical sector do no allocate a certain budget for their technology intelligence unit although they indicated its existence. This can be justified by the fact that although personnel are working for this unit, they are assigned for other activities at the same time.
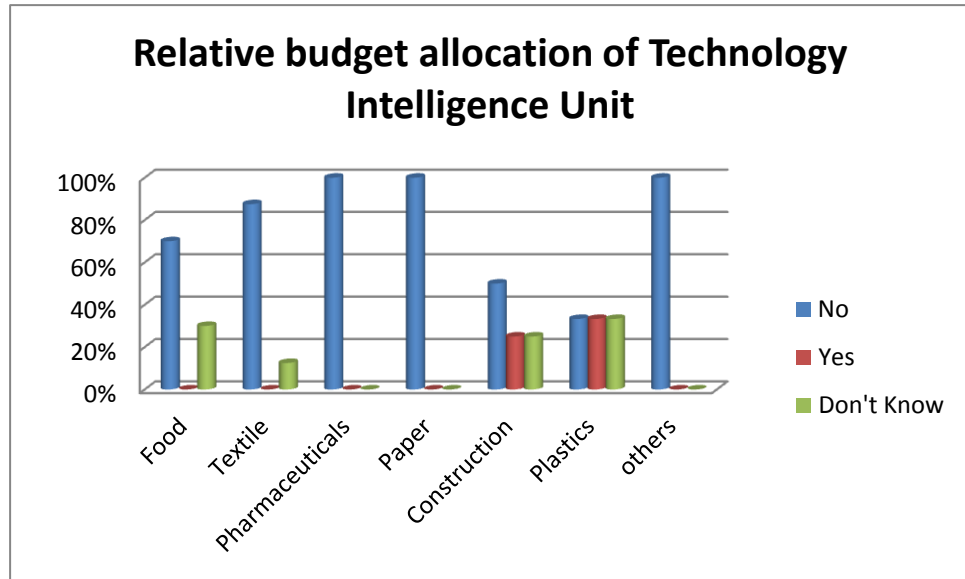
Figure 10: Relative Budget Allocation of Technology Intelligence Unit

From Figure (11) we can notice that not all manufacturing sectors conduct periodic reviews for the performance of their technology intelligence unit. Some companies in some industrial sectors such as pharmaceuticals, construction and plastic industry do perform periodic reviews for the performance of the technology intelligence unit whereas companies in other industrial sectors do not perform these reviews at all. Non tracking of the technology intelligence performance represents a weakness that may hinder the effectiveness of technology monitoring and tracking.
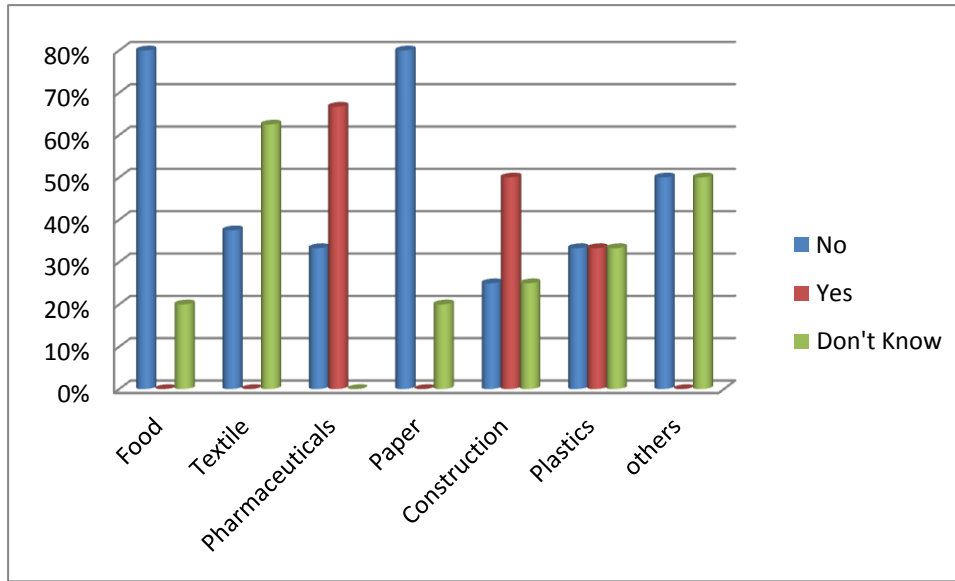
Figure 11: Performance Review of Technology Intelligence Unit

4.1.3.2 Technology Selection:

Technology Selection is the second sub-process of the technology management process; it involves defining requirements and prioritizing alternative technologies. The extent to which technology selection is applied in large manufacturing firms in Palestine was addressed in the questionnaire by the paragraphs presented in Table (15). From this table we can see that the total response average counts to 3.31 which is considered a moderate degree. Therefore we can say that technology selection is applied to a moderate extent in large manufacturing firms in Palestine. However; a key question should be addressed now is there any differences in technology selection practice between the surveyed firms and if these differences exist to what variables it can be attributed. These questions are examined by testing the following research hypotheses.

Table 15: Technology Selection Practice

Technology Selection Practice			
Paragraph	**N**	**Mean**	**Application level**
The Company considers the potential of new technology to improve quality while selecting a particular technology.	35	4.22	Very High
The Company uses economic analysis results as inputs for the technology selection.	35	2.40	low
Total (Valid)	**35**	**3.31**	**Moderate**

H5$_0$: No statistically significant differences at $\alpha = 0.05$ in the degree of technology selection practice at large manufacturing firms in Palestine can be attributed to the company's geographic location.

To test the above hypothesis an ANOVA test was conducted and the significant probability was found to be 0.282 as shown in Table (16). Thus, we cannot reject the null hypothesis; and no statistically significant differences in the degree of technology selection practice among the participating firms can be attributed to the company's geographic location.

Table 16: ANOVA Test for Technology Selection H5$_0$

		Sum of Squares	df	Mean Square	F	Sig.
		ANOVA Test for Technology Selection H5$_0$				
Technology Selection	**Between Groups**	4.078	4	1.019	1.328	.282
	Within Groups	23.022	30	.767		
	Total	27.100	34			

H6$_0$: No statistically significant differences at $\alpha = 0.05$ in the degree of technology selection practice at large manufacturing firms in Palestine can be attributed to the company's industry.

To test the above hypothesis ANOVA test was we conducted and the significant probability was found to be 0.001 as shown in Table (17). Thus, we reject the null hypothesis; there are significant differences in technology selection practice between large manufacturing firms in Palestine that can be attributed to the company's industry.

Table 17: ANOVA Test for Technology Selection H6$_0$

		Sum of Squares	df	Mean Square	F	Sig.
		ANOVA Test for Technology Selection H6$_0$				
Technology Selection	**Between Groups**	14.067	6	2.344	5.037	.001
	Within Groups	13.033	28	.465		
	Total	27.100	34			

To understand these differences a post hoc test was conducted to test variances between sectors in technology selection practice, these differences are shown in Table (18) below.

Table 18: Post Hoc Test to Measure Difference in Technology Selection

Area 3: Technology Selection							
Industry	**Food**	**Textile**	**Pharmaceutical**	**Paper**	**Construction**	**Plastics**	**Others**
Food	-	0.600	-1.567*	-0.100	-0.900*	-0.733	0.400
Textile		-	-2.167*	-0.700	-1.500*	-1.333*	-1.000
Pharmaceutical			-	1.467*	0.667	0.833	1.167
Paper				-	-0.800	-0.633	-0.300
Construction					-	0.167	0.500
Plastics						-	0.333
Others							-

- There are significant differences between food sector in one hand and pharmaceuticals and construction sectors on the other hand; these differences are in favor of the pharmaceuticals and construction sectors.

- There are significant differences between textile sector in one hand and pharmaceutical, construction and plastics sectors on the other hand; these differences are in favor of the pharmaceutical, construction and plastics sectors.

- There are significant differences between pharmaceutical sector and paper sector; these differences are in favor of the pharmaceutical sector.

Different industrial sectors can now be ranked according to their technology selection practice as shown in Table (19) below.

Table 19: Rank of Manufacturing Sectors According to Their Technology Selection Practice

Rank	Manufacturing Sector
First	Pharmaceutical
Second	Construction
Third	Plastics
Fourth	Paper
Fifth	Food
Sixth	Textile

In light of all the previous discussions on the technology selection practice and variables that affect its application, more research findings will be discussed now. Earlier in this research we have discussed many factors that affect technology selection decisions, our research findings showed the most important factors that influence technology selection in large manufacturing firms in Palestine, see Figure (12) below.
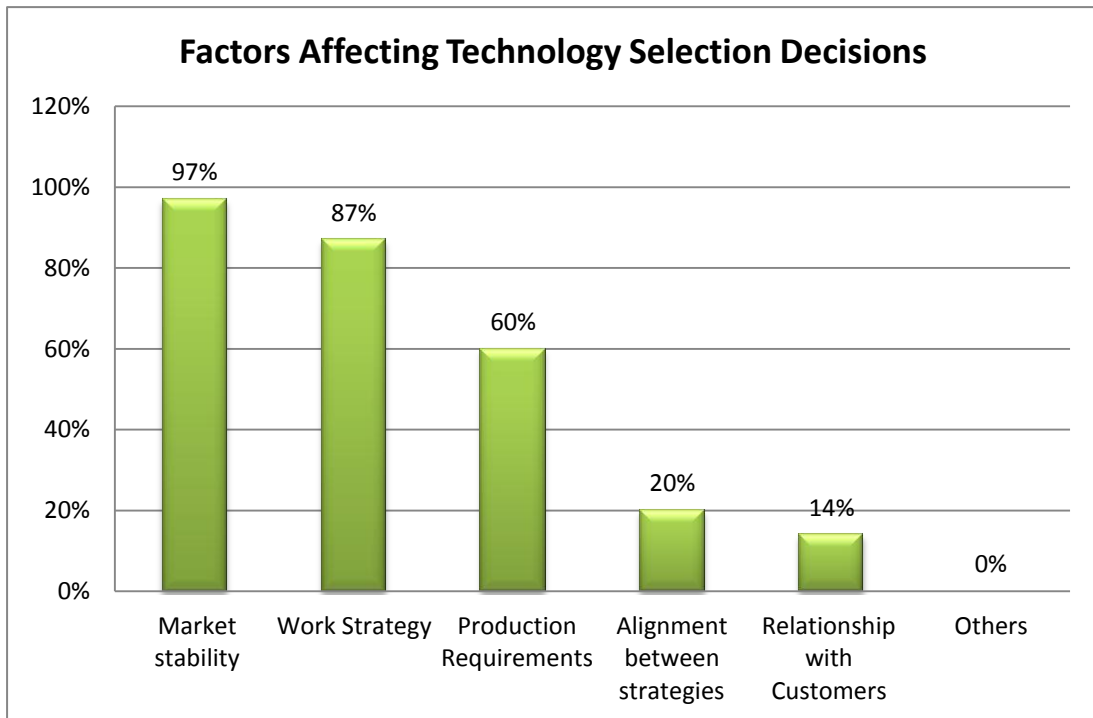
Figure 12: Factor Affecting Technology Selection Decisions

As shown in Figure (12) above market stability is the key factor that affects technology selection decisions, therefore market instability is considered a key inhibitor for successful technology selection.

Researchers have identified many factors that influence the technology investment decision. As can be seen in Figure (13) and in spite of the fact that 31% of the companies surveyed considered the financing capabilities among the most important factors that affect their technology investment decisions; it was found that only 20% of these companies rely on economic analysis results as a basis for their selection of technologies.

Companies make big investment in certain technologies because they believe in the potential that these technologies can have in improving their current product and process qualities. Therefore, it seems justifiable that

more than 75% of the surveyed companies considered the potential that new technology may have on their quality improvement while making their investment decisions.
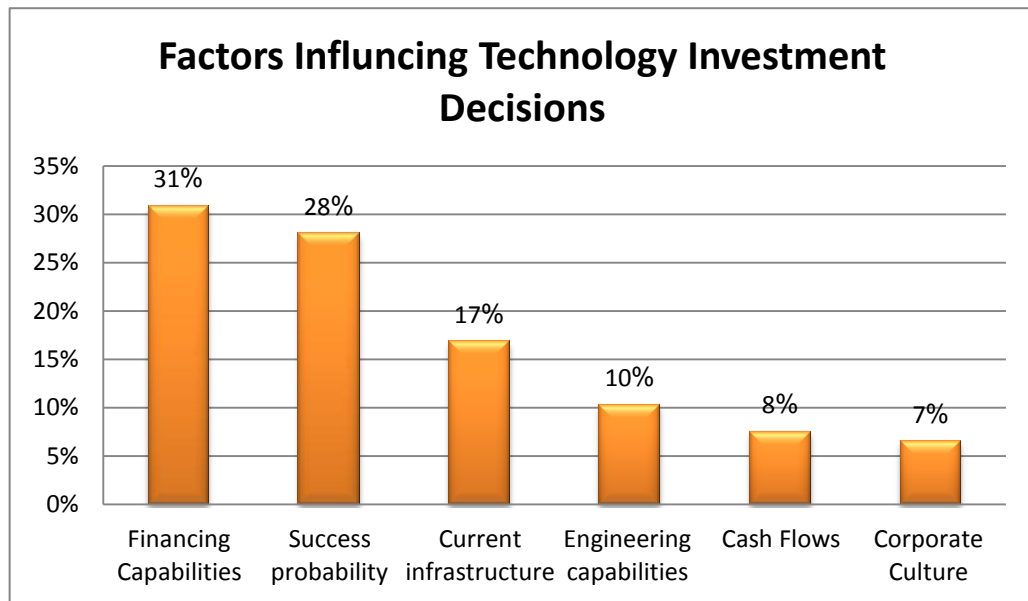
Figure 13: Factors Influencing Technology Investment Decisions

4.1.3.3 Technology Acquisition

Technology acquisition is the third sub-process of the technology management process; it involves acquiring of new technologies either from external sources or through internal development. The extent to which technology acquisition is applied in large manufacturing firms in Palestine was addressed in the questionnaire by the paragraphs presented in Table (20) below.

Table 20: Technology Acquisition Practice

Technology Acquisition Practice			
Paragraph	N	Mean	Application level
The company developed /currently developing one of its core technologies internally.	35	3.03	Moderate
Total (Valid)	**35**	**3.03**	**Moderate**

From the above table we can see that the total response average counts to 3.03 which is considered a moderate degree. Therefore, we can say that technology acquisition concepts are applied to a moderate extent in large manufacturing firms in Palestine. However; a key question should be addressed now is there any differences in technology acquisition practice between the surveyed firms and if these differences exist to what variables it can be attributed. In order to examine all these questions the researcher tested the following research hypotheses.

H7$_0$: No statistically significant differences at $\alpha = 0.05$ in the degree of technology acquisition practice at large manufacturing firms in Palestine can be attributed to the company's geographic location.

To test the above hypothesis ANOVA test was conducted in order to check if there are significant differences between large manufacturing companies in Palestine in technology acquisition practice that can be attributed to the company's geographic location. From Table (21) we can see that

significant probability is 0.339. Thus, we cannot reject the null hypothesis. No statistically significant differences in the degree of technology acquisition practice among large manufacturing firms in Palestine can be attributed to the company's geographic location.

Table 21: ANOVA Test for Technology Acquisition H7$_0$

ANOVA Test for Technology Acquisition H7$_0$						
		Sum of Squares	df	Mean Square	F	Sig.
Technology	Between Groups	9.664	4	2.416	1.182	**.339**
Acquisition	Within Groups	61.307	30	2.044		
	Total	70.971	34			

H8$_0$: No statistically significant differences at $\alpha = 0.05$ in the degree of technology acquisition practice at large manufacturing firms in Palestine can be attributed to the company's industry.

To test the above hypothesis ANOVA test was conducted in order to check if there are significant differences between large manufacturing companies in Palestine in technology acquisition practice that can be attributed to the company's industry. From Table (22) we can see that significant probability is 0.00, thus we reject the hypothesis. There are significant differences in technology acquisition practice between large manufacturing companies in Palestine that can be attributed to the company's industry.

Table 22: ANOVA Test for Technology Acquisition H8$_0$

ANOVA Test for Technology Acquisition H8$_0$						
		Sum of Squares	df	Mean Square	F	Sig.
Technology Acquisition	Between Groups	41.821	6	6.970	6.695	**.000**
	Within Groups	29.150	28	1.041		
	Total	70.971	34			

To understand these differences a post hoc test was conducted to test variances between sectors in technology acquisition practice, these differences are shown in Table (23).

Table 23: Post Hoc Test for Differences in Technology Acquisition Practice

Area 4: Technology Acquisition							
Industry	Food	Textile	Pharmaceutical	Paper	Construction	Plastics	Others
Food	-	0.050	-2.700*	-0.500	-1.950*	-2.700*	0.300
Textile		-	-2.750*	-0.550	-2.000*	-2.750*	0.250
Pharmaceutical			-	2.200*	0.750	0.000	3.000*
Paper				-	-1.450*	-2.200*	0.800
Construction					-	-0.750	2.250*
Plastics						-	3.000*
Others							-

- There are significant differences between food sector in one hand and pharmaceuticals, construction and plastics sectors on the other hand; these differences are in favor of the pharmaceuticals, construction, and plastics sectors.

- There are significant differences between textile sector in one hand and pharmaceuticals, construction and plastics sectors on the other hand; these differences are in favor of the pharmaceuticals, construction, and plastics sectors.

- There are significant differences between pharmaceutical sector in one hand and paper and others sectors on the other hand; these differences are in favor of the pharmaceutical sector.

- There are significant differences between paper sector in one hand and construction and plastics sectors on the other hand; these differences are in favor of construction and plastics sectors.

- There are significant differences between construction and others sectors; these differences are in favor of the construction sector.

- There are significant differences between plastics sector and others sectors; these differences are in favor of the plastics sector.

Different industrial sectors can now be ranked according to their technology acquisition practice as shown in Table (24) below.

Table 24: Rank of Manufacturing Sectors According to Their Technology Acquisition Practice

Rank	Manufacturing Sector
First	Pharmaceutical
Second	Plastics
Third	Construction
Fourth	Paper
Fifth	Food
Sixth	Textile

In light of all the previous discussions on technology acquisition process and variables that affect its application, one can find that it is highly important to maintain balance between internal R&D and external technology acquisitions for different reasons including the protection of the company's financial interests, improvement of company's competitiveness among rivals, and above all for cost savings.

There are different reasons standing behind each one of these perspectives; companies that tend to develop their technologies internally justified this by the following reasons: 1. Gain more expertise in the respective field 2. Relatedness of the technological area to current R&D activities in the company 3. Less costs associated with the technology development 4. Maintain confidentiality within the company.

Companies that tend to acquire technology from external sources justified this by: 1. Having no experience in the specific technology area 2. Increased trust in new technology 3. R&D is engaged with different developments. Figure (14) shows the different reasons behind each technology acquisition policy with their respective percentages.

Resaons Behind Internal Technology Development Decisions

Reason	Percentage
For Confidentiality Reasons	46%
Relatedness to Current Company R&D	34%
Less Cost	11%
Gain Expertise	9%

Reasons Behind External Technology Acquisition Decisions

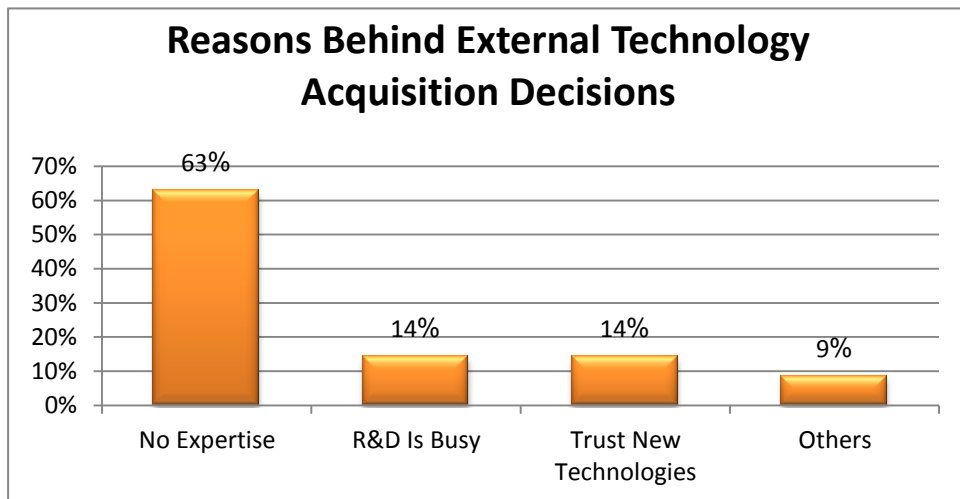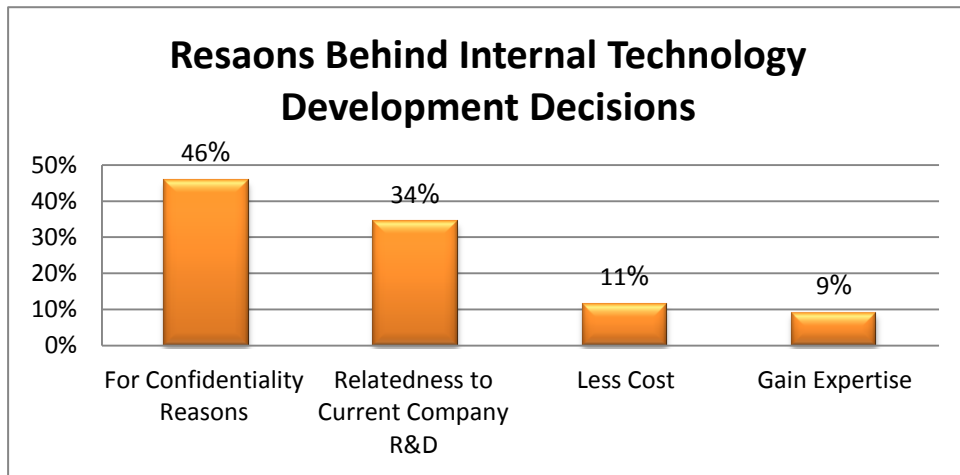| Reason	Percentage
No Expertise	63%
R&D Is Busy	14%
Trust New Technologies	14%
Others	9%

Figure 14: Reasons Behind Technology Acquisition Decisions

The findings of this research showed little dependence among the surveyed companies on R&D as a source of technology acquisition, where we find that less than 20% of the companies use R&D as an internal source for technology development. This is clearly justified by reviewing the R&D spending in the surveyed companies since most of the surveyed companies indicated an R&D spending that counts to less than (0.5 %) of the annual profits. This indicator is important especially when examining the factors that affect the R&D spending. As shown in Figure (15), annual profits are the number one factor considered during the R&D budget allocation which is a wrong practice; R&D spending should be defined based on the business objectives and plans.
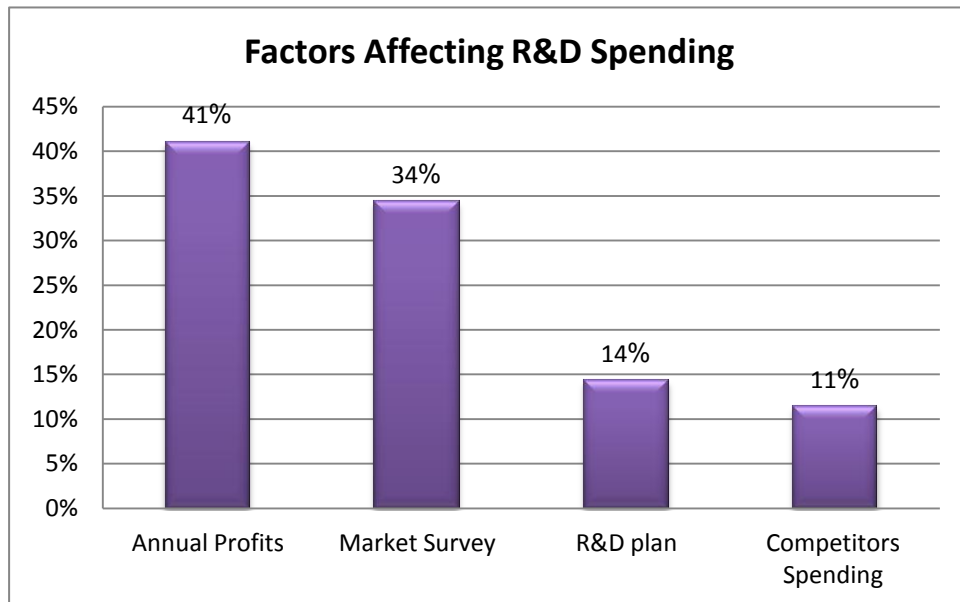
Figure 15: Factors Affecting R&D Spending

4.1.3.4 Technology Exploitation

Companies apply different policies to exploit technologies within their business including: merging technology within their processes and products, joint ventures, licenses or manufacturing/ marketing contracts. Figure (16) shows how companies do exploit technologies within their business.

Figure 16: Technology Exploitation Policies

Companies exploit new technology within their business for different reasons depending on the company's business and technology strategies. The surveyed firms indicated different reasons for their exploitation and ranked these reasons according to their importance to the business. Figure (17) shows these reasons and their relative importance to the business.

Reasons Behind Technology Exploitation Decisions

Improve Productivity: 33%
Decrease Production Time: 27%
Improve Quality: 22%
Decrease Setup Time: 10%
Improve Accurcy: 4%
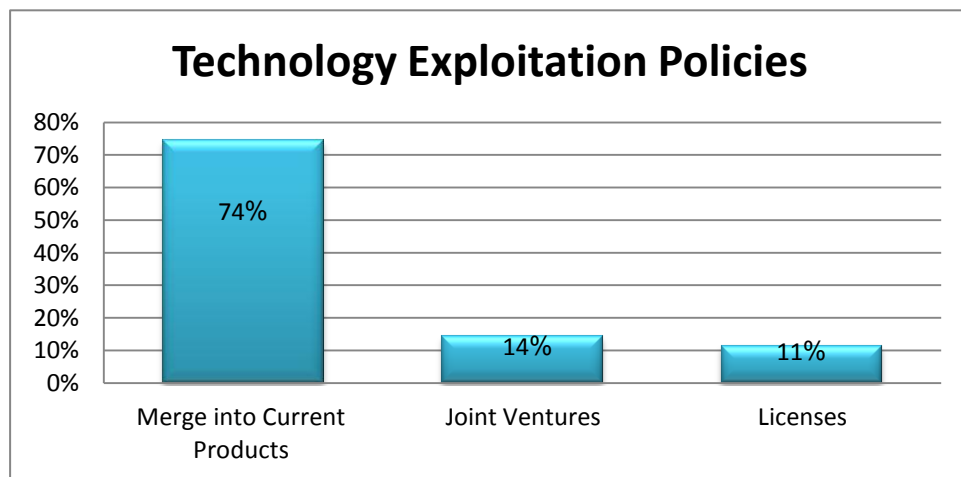Improve Flexibility: 3%
Increase Safety: 1%
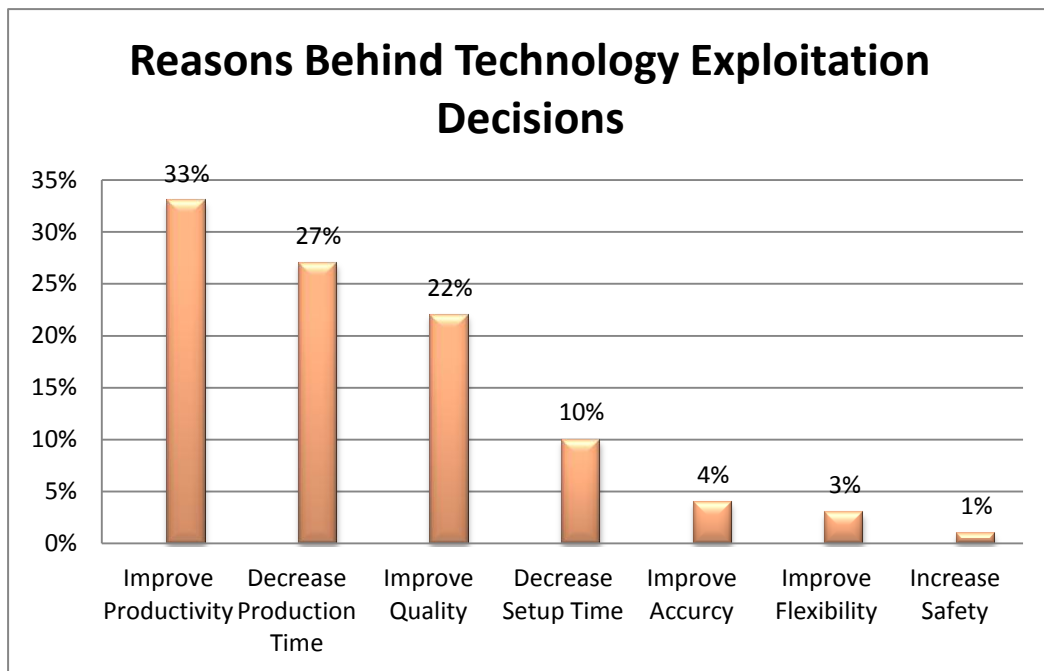
Figure 17: Reasons behind Technology Exploitation Decisions

As shown in Figure (17), the most important reason behind adopting new technology is to improve quality. Of the surveyed companies, 69% indicated that this reason is the most important behind their exploitation policy. The second important reason is the role that new technology can play in reducing production time, where 83% of the companies indicated this relative importance for this reason. Finally the third important reason behind technology exploitation was the reduction of set up time, where 60% of the surveyed companies indicated this reason behind their technology exploitation policy. As can be seen above companies do not consider safety improvement among the important reasons that drive technology exploitation policies.

4.1.3.5 Technology Protection

The surveyed companies indicated that they do protect their own technologies by applying different protection means including: design registration, confidentiality, and staff retention measures. These means and their relative usage are represented in Figure (18) below.

Usage of Technology Protection Means
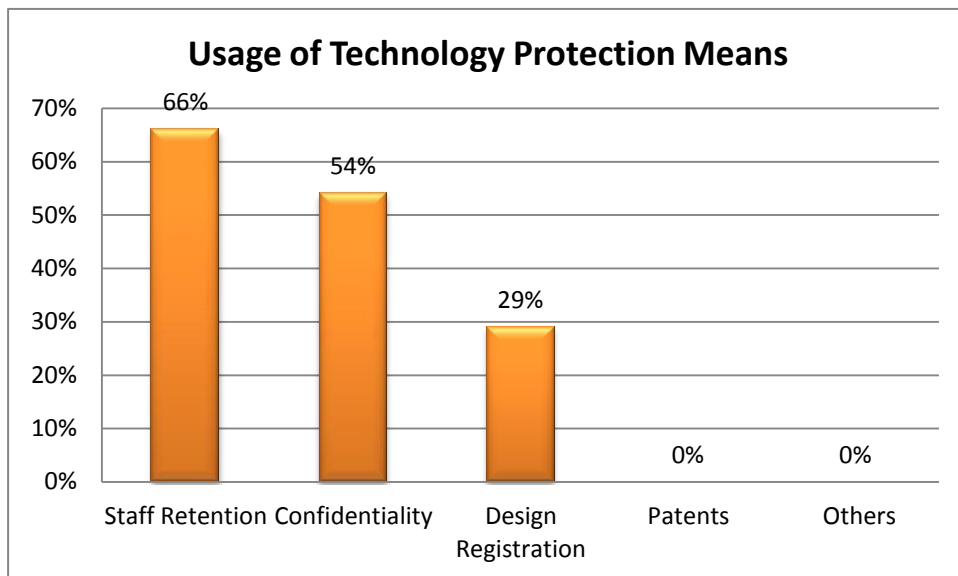
Figure 18: Usage of Different Technology Protection Means

As shown in Figure (18), companies never used legal protection methods such as patenting to protect their own technologies, which could be an indicator for not possessing distinctive technological competencies.

4.2 Part II: Interviews

As an attempt to obtain more information that reflects the real situation of technology management practices in the Palestinian manufacturing sectors and give more insights over other business and operational themes that are difficult to be explored through questionnaires; it was decided to conduct

interviews with the largest companies in each sector of the sectors represented in our sample. However, when these companies were contacted not all of them accepted to be interviewed therefore we sticked to those who accepted and those where 5 companies representing one firm from the construction sector , two firms from pharmaceutical sector, one firm from textile and apparel sector and another firm from plastics industries.

The interviews which took the structured interview format (Appendix A) were conducted in a face-to-face mode where key decision makers in these companies were interviewed. The interviewees occupied different senior positions ranging from a deputy general manger to a plant manager to a production manager and a senior designer; these interviewees had an experience in the company ranging from 14 to 35 years. Many findings of these interviews can be summarized in the following sections.

4.2.1 Technology Needs Assessment

Assessing the technology needs is a key milestone to the technology management process, unless the company assesses and identifies their technology needs it is going to be difficult to manage technology or compete on a technological basis.

Assessing internal technological needs should not be conducted in isolation from the market needs the company currently competing in. Different companies indicated different means for the anticipation of market needs depending on the industry, for example in a textile sector the interviewee

emphasized that they meet their customer requirements 90% of the time since their business is highly dependent on customs. However, other interviewees indicated different means including tracking of their competitors' products and performance.

Others indicated that they study market needs by following up latest technological and industry trends through participation in international conferences or via internet. They also get feedback through direct contact of their sales force or marketing representatives with their clients and customers as well as their suppliers.

The interviewed companies indicated that they apply different measures to assess their technology needs; these measures can be summarized as follows:

1. Track company's performance; the company assesses their technology needs by tracking their performance through key performance indicators as an attempt to identify areas for improvement either by introducing new technologies or by other means. Productivity, quality, capacity, set up and production times and material losses are key indicators that should be examined to identify what should be done to improve them.

2. Track the performance of competitors; this is highly important as a means to understand competitors' strategies and strengths and weakness of their products. Companies do track their competitors

through visits to their showrooms and exhibitions or through browsing their websites or catalogues.

3. Follow up regulations; regulations can be important means by which the company can keep abreast of all technological trends and identify areas that should be improved. Regulations imposed by regulatory bodies and responsible authorities may require companies to upgrade their production lines, their premises and so on to comply with the standards whether it is national or international.

4.2.2 Product Development Process

In the interviews we tried to examine how product development takes place at these companies, and it was noticed that the process is similar in nature between these companies, though small differences may be found which can be attributed to the different structures among these companies. Figure (19) represents the whole product development process with its main stages, so as a first step the marketing department conduct a market research to examine the market needs and requirements, this research can be conducted by tracking competitors, follow up customer feedback, tracking latest technological trends.

| Market Research | Investigation of Financial Capability | Investigation of Technical Capability | Further investigation by R&D and/or Production | Top Mangement Decision |

Figure 19: Product Development Process

When the marketing department/ team specify the market requirement and the potential of each product findings of this research is reflected to top management and finance department to examine the financial capability. So, if the management is convinced in the potential of this product or this technology they will forward these findings to the technical department to examine the technical and scientific capabilities.

As technical departments working together under different nomenclatures such as, quality team, quality circle, or technical committee, these technical departments incorporate different functional units in the company including: production, engineering, R&D, QA/QC within this investigation process to investigate the scientific and technical capabilities from each department perspective. It may be identified through this investigation that

the company does not have the required scientific capability and know-how, still this product have a high potential in this occasion the company may choose contract manufacturing to resolve this issue. However, and considering that this technical committee found that they have the primary technical capability to develop this product a more detailed investigation would still be required, since it is not only about bringing money to this investment that counts the company's know-how is a key determinant for the company's capability.

After conducting the primary and detailed technical capability investigation the technical committee will submit his recommendations to the top management, and therefore if the top management is convinced that this product has a good potential and they have the technical and financial capabilities the decision will be taken to include this product in their coming plans.

4.2.3 Technology Investment Decisions

In the interviews the factors that influence the technology investment decisions in the surveyed firms have been examined, the interviewed companies indicated many factors that can be summarized as shown in Figure (20) below. It is clear that the current financial and scientific capabilities are key determinants of the technology investment decisions; however, it is not only the capabilities that influence investment in technology, the market share of the company, the technology potential and

the expected life of this technology are other key determinants of the technology investment decisions.

Figure 20: Factors Affecting Technology Investment Decisions
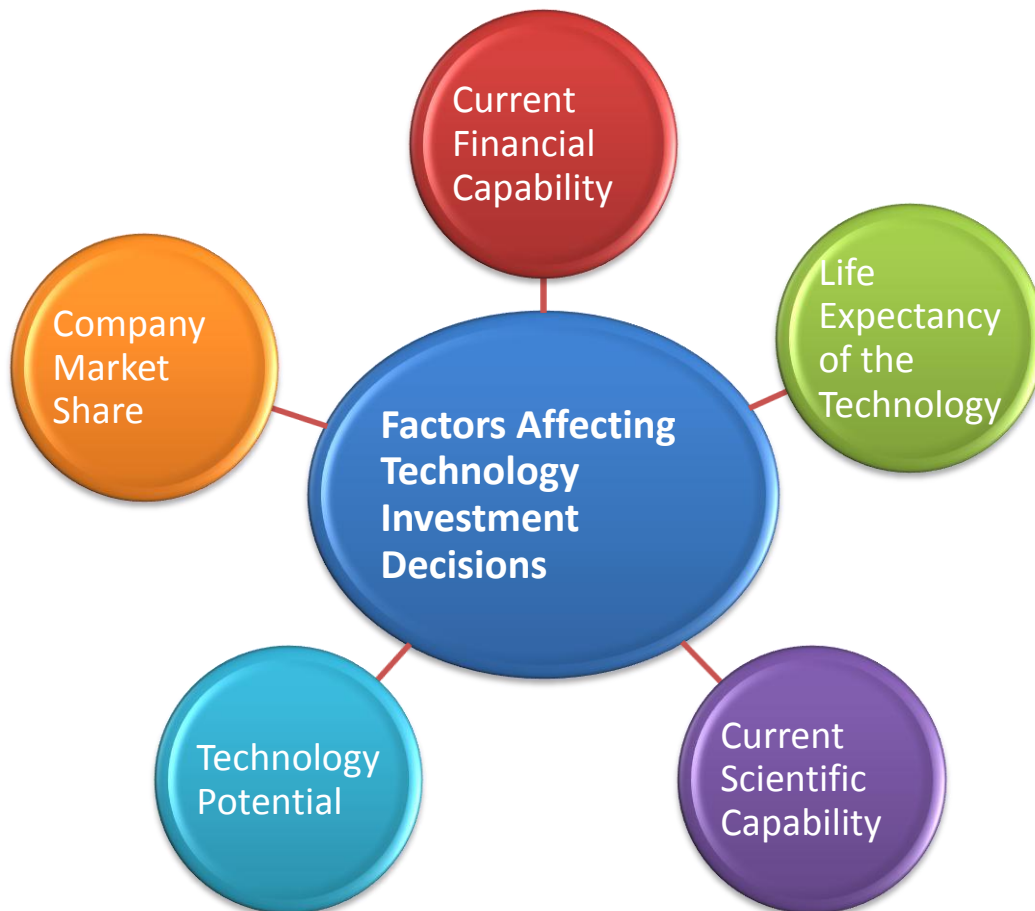
As illustrated earlier in the product development section, if the company identifies a potential for a new product or technology, investigation of the financial and technical capabilities will be conducted. Thus, if the technical and financial departments come to an agreement that it is technically and economically feasible to develop this product, recommendations will be

raised to top management in order to decide whether to invest in this product or not.

Investing in new technology is not an easy decision to make and top management will be faced with a key question: are we going to internally develop our technologies/ products or shall we acquire it from external sources? Companies perspectives varied widely in this regard, some companies indicated that they never developed their technologies internally because they either:

1. Do not have the capability to develop,

2. They trust external technologies and can't allow any margins for risks,

3. They think results will be better if they acquired external technologies,

4. They want to save time and money associated with internal technology development,

5. Finally, it could be the only option they have if certain technologies are protected by patents.

However; this is not the case for all companies, some companies indicated that these decisions are governed by the know-how they have and the cost of investment. Therefore, if this technology is related to our field of expertise and the significant body of knowledge that we developed through accumulation of experience we would often develop this product internally.

Moreover, they indicated that even if it is not in our field of expertise we would generally improve our knowledge through utilization of different software packages to perform simulation and scenario writing which will improve our understanding and reduce experimentation costs.

Some of the companies indicated that they prefer to develop their technologies internally if they have the required capability since they face difficulties in the acquired technologies and production lines, "these technologies are like black boxes" he said. We face difficulties in operating and maintaining them especially that most of our labors are unskilled and those who are skilled does not necessarily have the required skill to deal with complex systems where automation of production lines is the norm.

On the contrary of what the previous interviewee mentioned another company stated that "we prefer to acquire technology from external sources since we don't have the capabilities to develop internally".

As shown in Figure (20), the scientific and technical capabilities are key determinants of the company's investment decisions, and these are mainly governed with their current R&D and production capabilities. However, when R&D spending was examined in the questionnaire the average reported R&D spending was less than 0.05% of annual profits. The interviewed firms indicated that it is difficult to exactly specify the amounts of money spent on research and development activities; however, as a

percentage of annual profits the R&D spending of the interviewed companies ranged from 1% to 2%.

Companies operating in pharmaceutical industries indicated that R&D activities are very costly. According to an interviewee "some hundred thousand dollars could be spent on a bio-equivalence study for one product as an example". This is due to the different nature of pharmaceutical industry which requires a lot of stability tests before the introduction of a new drug. To overcome this problem many companies engage in joint ventures or contract manufacturing because they can't afford to pay for all the associated R&D expenses.

4.2.4 Technology Impact Assessment

A key issue in technology management is to understand the impact that new technologies may have on overall business performance. Interviewed firms indicated different measures of improvement resulted from adopting new technologies including:

1. Increased sales, profits, and market share.
2. Increased customer satisfaction, due to improved product qualities and properties.
3. Improved productivity, due to less machine down times and failures.
4. Less set up and production times
5. Reduced material losses

However, these firms indicated that it is difficult to relate customer satisfaction or sales increase to an exact technology since success factors works collaboratively. Therefore, it is necessarily important for the Palestinian manufacturing firms to set criteria and basis for their technology assessment impact assessment, to facilitate improvement initiatives and investment decision making.

Chapter Five

Technology Management Framework

The Technology Management Framework

Transferring theory into practical application has always presented a challenge for scientists and practitioners; technology management is not a special case therefore, a large number of models and theories have been developed to adopt technology management in industrial contexts. Phaal (2004) developed a framework to support the understanding of technological innovation in relation to other business processes. The framework combined two sets of business processes necessary for effective technology management were examined, the first set comprised of core business processes of strategy, innovation and operations; the second set considered another five supporting technology management processes. Integration between these sets was supported through knowledge flows that should occur between commercial and technological functions; see Figure (2) Section (2.4).

Drejer (1996) has evaluated the decision process through which companies acquire their technologies and investigated industrial practices to create a formal and rational decision process of technology management, he then presented an in depth case study for manufacturing technology acquisitions.

Based on reviews of technology management practice and findings of this research, the researcher devised a conceptual framework for technology management to be deployed in the Palestinian large manufacturing firms.

In this framework certain clusters of strategic and business operations are combined to technology management basic processes in an attempt to transfer technology management concepts into action, and bridge the gaps between the Palestinian firms' current technology management practices and best practices known worldwide.

This chapter will be describing this framework and discuss how it can be used in the Palestinian firms. As shown in Figure (21) below the framework consists of three types of processes: the first set of processes is performed on the company's strategic level; where strategic analysis is performed to define the company's strategic goals. The set consists of the competitive analysis, need assessment and technology planning. The second set describes the basic business operations including the market research, technology investment analysis and technology impact assessment; these operations are directly affecting the third set of processes which consist of five technology management basic processes and these are the identification, selection, acquisition, exploitation and protection of technology.

The first set of the framework targets strategic level processes; this set is suggested since the research findings showed a big opportunity for improvement in the area of strategic planning and positioning; the surveyed companies reported their product development process with prior effective technology and business planning was lacking. Moreover, it was noticed that companies are often in much hurry to implement solutions, when these

solutions may not always be the correct intervention. This results from a weak understanding of the business needs and the weak alignment between technology and business plans which leads to improper technology selection decisions.

Therefore, it is especially important that companies define their core technical competencies in order to understand the basis upon which they are competing; at the same time it is especially important to identify the business needs necessary to achieve a competitive edge for the company.

Taking this into consideration a set of strategic processes including the competitive analysis, need assessment and technology roadmapping was introduced as the first set of our framework.

The second set was developed as supporting processes to guide the first set through analyzing the impact of technology in improving the company's performance and performing a market research to identify available technologies as well as the market needs, finally the company needs to analyze their investment options and investigate their financial and technical capabilities. These processes were devised since it was noticed that the company lack skills in analyzing their investment priorities and their technological needs are not assessed so often; therefore it is especially important to perform these process to guide the company's investment decisions.

The third set which consists of the main technology management processes was introduced are to guarantee that the right technology management processes are in place which enables to identify, select, acquire, exploit and protect technologies that serve the company's priorities and strategic objectives.
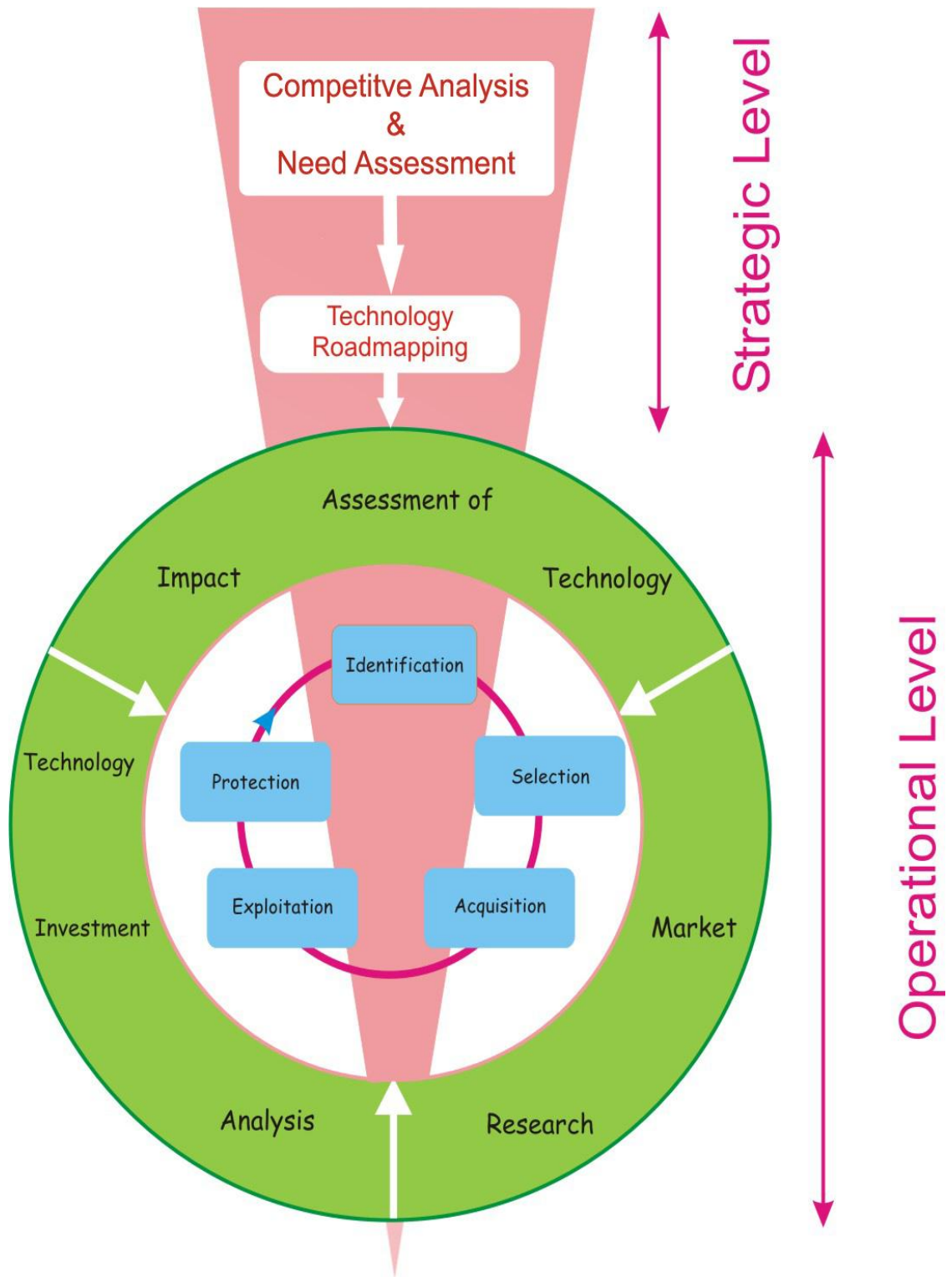
Figure 21: Technology Management Framework

5.1 The First Set: The Strategic Operations

At this level top management had to decide on very strategic issues, what are their competitive priorities and what is needed to achieve these competitive advantages?

5.1.1 The Competitive Analysis

Companies must decide on how their business will compete; this has to be clearly explained in their business plans. The competitive analysis is a statement of the business strategy and how it relates to the competition; at this stage the company needs to identify bases of competition and assess their key competitive advantages and core technical competencies; in order to structure their technology strategy based on the overall competitive strategy. It is an opportunity for the company to describe major competitors and compare their position to the firm's position in terms of the factors that most influence revenues. Figure (22) below shows the basis on which companies can compete including, product quality, available resources, company's image, market share, growth opportunities and others.

By performing SWOT analysis or any other useful competitive analysis techniques, the company can evaluate the competition by determining the strengths and weaknesses of the competitors within their market, strategies that will provide them with a distinctive advantage, the barriers that can be developed in order to prevent competition from entering their market, and any weaknesses that should be improved within their products **(Porter, 2011).**

Figure 22: Firms' Basis of Comparison

5.1.2 Need Assessment

The need assessment is a process where planners gather information to identify a problem, then the collected information is analyzed to identify the causes of the problem, finally a plan can be developed which addresses an array of solutions that can be implemented to solve the problem. It is a process of determining and addressing an expressed or implied organizational need which represents the gap between the desired goals and the current status, it is a planning tool undertaken to identify the goals of a project. The need can be a desire to improve current performance or to correct a deficiency. Conducting a needs assessment protects the assets of an organization and assures that resources are allocated to serve a specific purpose. At this stage the company should identify their basic product segments and define the needs of each product segment in an attempt to allocate resources needed for each segment.

5.1.3 Technology Roadmapping

Companies need to think about what their business really need and how they are planning to meet these needs. Technology planning answers these questions; it is the process that will help companies achieve their strategic goals and save money spent on technology; though most importantly it will help the company to anticipate change and avoid any crises caused by wrong technology investment decisions.

Companies need to perform technology planning systematically and should adopt a formal and structured approach to it; their technology plans should be prepared in a manner that anticipates technological change and they must be aligned with the company's strategic objectives and business plan; the planning horizons of these plans should be relatively long to enable the company to develop its technological base. Moreover, in order for these technology plans to achieve the purpose they are set for, involvement of all related personnel including senior marketing and technology managers in the planning process must be assured. Companies can utilize technology roadmapping as a type of technology planning which is mainly used to identify critical technologies and technology gaps, and means that should be pursued to leverage R&D investments **(Gindy, 2005).**

In some cases companies fail to strategically plan for their technologies and to avoid such failures; companies should:

1. Educate top management on technology importance and its crucial impact.

2. Concentrate on long term benefits of technology and do not pressure for short term payoffs.

3. Improve organizational structure to best suit communication about technology.

4. Improve R&D performance and reduce the isolation of R&D units from external markets and technology trends.

5.2 The Second Set: The Business Operations

At this level the company should identify they key technologies that their business depends on and assess the importance of applying each technology to the business through investigating the markets and the available options to invest in such technologies.

5.2.1Market Research

Market research is an organized effort to gather information about markets and customers. It is a very important component in developing the business plan and key to get advantage over competitors. By utilizing effective market research the company can determine the market size and demographics, store locations, business needs and competition. This can be uncovered by utilizing different research tools including on-line surveys, focus groups, interviews and many other tools.

As mentioned earlier in section (4.2.2) market research can be used to develop business and marketing plans or to measure the success of a current plan; however, for this research to be effective companies need to utilize both primary and secondary data sources. Primary data sources such as information obtained by questionnaires, surveys and interviews about current business practices; secondary data can be obtained from analyzing already published data on markets and trends.

5.2.2 Technology Investment Analysis

When the company identifies a potential for a new product or technology, investigation of the financial and technical capabilities shall be conducted. Thus, if the technical and financial departments come to an agreement that it is technically and economically feasible to develop this product; top management will be faced with so many questions and should decide on them:

1. Why is the technology being implemented?
2. What are the alternatives considered?
3. What are the criterion and processes that will be used to select this particular technology and vendor?
4. What returns can be expected from investing in such technology?
5. What are the requirements to implement the technology?
6. What are the cost implications of implementing the particular technology?
7. What are the steps required to change key business processes and ensure full advantage of the new technology?
8. What is the vendor's capacity to provide technical support?
9. What quantitative benefits do we expect to realize from applying this technology?
10. What investments need to be made to make right selection of technology?

By answering these questions the company will have a clear perspective on how to invest in technology and consequences of each decision can be clearly identified.

5.2.3 Technology Impact Assessment

Technology Impact Assessment is a helpful tool in the decision-making process which allows for the generation of traceable conclusions, compound the key elements to assure that the decision making process culminates in the right technology investment with the best resources and results. It involves assessment of the technology performance through the analysis of key performance indicators by utilizing different tools which allow for well-informed and a well-based evaluation of technology.

Technology impact assessment is essential for developing forecasting scenarios and a guiding factor that help firms decide about the distribution of their financial resources among several projects, it allows for defining of certain predictive measures to avoid or mitigate the potential hazards that may result from unexpected occurrences.

5.3 The Third Set: Technology Management Processes

Companies striving to achieve a distinctive competitive advantage will have no substitute to successful technology management in order to improve their bottom line performance and profit margins.

In the third set of our technology management framework, the company needs to implement certain processes to manage their technologies, these processes similar to those identified by the European Institute for Technology and Innovation Management include: identification, selection, acquisition, exploitation and protection of technology.

5.3.1 Technology Identification

Companies should utilize technology intelligence and market scanning to identify all technologies that are or may be of importance to the business they should monitor technology emergence in order to reduce their vulnerability to technology change. However, this process should not be performed in an ad-hoc manner; companies need to establish technology intelligence activities within the firm so technology identification can be performed in a systemic manner. There should be skilled personnel who are assigned to this task; information resulting from this intelligence should be analyzed and communicated to all related business units. This can be supported by the use of proper software packages which can be used to store, analyze and communicate technology intelligence information.

5.3.2 Technology Selection

Technology selection results in large financial and human commitments for the firm, therefore companies need to select technologies that are aligned with their business and financial objectives and capable to support and promote the business. Selection criteria should be developed and drawn

from all related sources; the company should utilize economic analysis results and many other infrastructure requirements can assist in the technology selection process. The competitive analysis and need assessment will lead to highlights on key technologies and products that the business should invest in. However, undefined technology strategy will harm the technology selection process.

5.3.3 Technology Acquisition

Companies at this stage need to decide on the appropriate means to acquire the selected technologies; inputs from the technology investment analysis will highly facilitate this process. If the scientific and technical feasibility for the development of this technology is assured, the company now should decide whether the strategic benefits of the technology justify the cost and management time needed to develop it, otherwise it should be acquired from external sources. However, companies need to place more efforts in R&D in order to improve their technological competitiveness.

5.3.4 Technology Exploitation

If certain technologies are acquired or developed, the company at this stage needs to assure that these technologies are invested in producing marketable products or they realize the value of such investment through other means such as joint ventures. Companies need to exploit all technologies available at hands to improve their productivity and product quality as well as to improve their customer satisfaction.

5.3.5 Technology Protection

Technology protection is concerned with the preservation of technologies and expertise for the benefit of the firm. Companies usually utilize traditional routes to protect their technologies including patenting and design registration; however, what matters here is that the company should utilize all possible means to protect their technology and knowhow.

5.4 Summary

Sustaining competitiveness in global markets presents a real challenge to all businesses given the technological uncertainties that bound all innovative activities and making it extremely difficult to forecast how the market will react to new product introduction. Given this fact, development of practical and explicit technology management frameworks becomes an imperative. Hence, for the Palestinian firms to improve their current performance such a framework should be adopted, since it provides a means for these firms to perform their strategic technology assessment and identify any technology related performance gaps.

Chapter Six

Conclusions and Recommendations

Conclusions and Recommendations

This chapter serves as a conclusion for this thesis, where main conclusions, recommendations and suggested future work are described.

6.1 Research Contribution

The findings of this research project constitute a basis for large manufacturing firms in Palestine to perform their technology management assessment, where the whole technology management process and sub-processes have been examined and main features and characteristics that govern the practice of these processes in the Palestinian industrial context were identified.

Companies can utilize this study to structure their technology management assessment and identify major gaps in their current performance which can be mitigated by adopting the provided framework that overcome these gaps through the integration of business and technological processes.

Moreover, researchers can utilize this research as a starting point for further research projects that approaches different aspects of the subject, since the subject was not targeted by other researchers before.

6.2 Conclusions

In this research the technology management concept was explored and current practices at large manufacturing firms were examined. A framework that suggests certain business and technology management

processes was also devised. The research main conclusions can be summarized as follows:

1. **Technology Planning**

   - A low percentage of the participating companies perform technology planning or have a technology plans, and those who perform it have relatively short planning horizons which is not the proper practice.

   - Weak alignment between technology and business strategies was found since technology is not highly incorporated in strategic and financial plans.

   - The unclear technology strategy hindered proper technology selection.

2. **Technology Identification**

   - Companies perform technology identification in an ad-hoc manner.

   - Technology intelligence personnel are almost non-existent in the surveyed firms.

   - The surveyed companies suffer from a lack of skills and organization of technology monitoring activities.

   - Non-tracking of emerging technologies and technological advances increases companies' vulnerability to technology change.

3. **Technology Selection**

   - Market instability is a key inhibitor to successful technology selection.

- Alignment between business and technology strategy is not a key factor that affects the technology selection.

- The surveyed companies do not utilize economic analysis results to guide their technology investment decisions.

- Customer satisfaction and customer relations are not highly considered while making technology investment decisions.

- Production requirements are being considered among the factors that influence technology investment decision, however, it should be given more emphasis.

- The company's corporate culture is not considered among the factors that influence the company's technology investment decision.

- Company's financing capability is the key factor that guides technology investment decision.

- Quality improvement potential of new technology is considered the major qualitative measure that influences the company's technology investment decision.

4. Technology Acquisition

- Research findings showed little dependence on R&D as a source for technology acquisition.

- Low R&D expenditures compared to external equipment and technology acquisition indicates overdependence on external technology.

- Company's R&D spending is mainly determined based on the company's annual profits; which is not the right practice this decision should be guided by the business objectives.

- Companies prefer internal technology development when they are keen about their confidentiality.

- Companies prefer external technology acquisitions when they have no experience in the specific technology area.

5. Technology Exploitation

- Companies exploit technology mainly in an attempt to improve their productivity.

6. Technology Protection

- The surveyed companies never used legal protection methods such as patenting to protect their own technologies, which indicates that distinctive technological competencies do not exist.

- Staff retention is a key measure that companies apply to protect their own technologies.

6.3 Recommendations:

For the Palestinian manufacturing firms to improve their technology management performance the following is advised:

1. Top management should be educated on technology importance and its crucial impact.

2. Companies should concentrate on the long term benefits of technology and do not pressure for short term payoffs.

3. Companies should improve organizational structure to best suit communication about technology.

4. Companies should be more aware of their core technical competencies; therefore their technology strategy must be structured based on their overall competitive strategy.

5. Companies should identify areas where technical competencies of the business should be improved.

6. Companies must adopt a more formal and structured approach to technology planning.

7. Companies should develop their own technology strategy as a means to incorporate technology in the overall business strategy.

8. In order for the technology strategy to be aligned with the overall business strategy; senior marketing and technology managers should be involved in the strategic planning process.

9. Companies should monitor technology emergence in order to reduce their vulnerability to technological change.

10. Customer feedback should be incorporated while performing technology planning.

11. Companies should select technologies that are aligned with their business and financial objectives.

12. The selected technology must serve the competitive priorities of the firm.

13. Companies should perform economic and strategic analysis to evaluate the different technology alternatives.

14. Companies should highly consider the different product characteristics while selecting their manufacturing technology.

15. Companies should consider qualitative measures while selecting their manufacturing technology including the company's image and customer satisfaction.

16. Companies need to place more efforts in R&D to improve their technological competitiveness and reduce their isolation from external markets.

17. Companies must adopt modern concepts such as customer satisfaction, value chains in order to stay competitive against international rivals; since traditional business concepts are now lubricant.

6.4 Future Work

One of the main limitations of this research was the lack of prior research studies on the subject which is considered relatively new to the manufacturing industry and business environment. This presents an important opportunity for other researchers interested in the subject to explore technology management from other perspectives.

Since the Palestinian manufacturing industry incorporates different manufacturing sectors which differ in their internal business operations and

external market characteristics; sector-wise assessments are required for a comprehensive understanding of the circumstances that govern technology management practices in each sector.

This research has utilized a quantitative research tool represented by the online survey and a qualitative tool represented by the structured interviews, this mixed approach allowed for a broader view of the subject since different attributes of technology management were revealed. However, researchers should utilize different research tools to explore the subject mainly by using case studies which allow for better assessment of technology management process on the operational and technical levels.

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Appendices

A. The Structured Interview Questions

B. The Online Questionnaire

Appendix A: The Structured Interview

المحور الاول: معلومات عامة

	اسم الشركة:
	اسم الشخص المُقابَل:
	المسمى الوظيفي:
	الخبرة في الشركة:
	الموافق		**اليوم**
ص / م.			**الساعة**

المحور الثاني: تقديم عن الرسالة.

صباح الخير/ مساء الخير

بداية اود ان أشكرك على استجابتك لتلبية دعوتنا في المقابلة. واسمحلي بداية أن أقوم بالتعريف عن نفسي: أنا الطالبة رمزية جعايصة ـ طالبة ماجستير في جامعة النجاح الوطنية ـ برنامج الادارة الهندسية.

اقوم بتحضير رسالة الماجستر في مجال ادارة التكنولوجيا، حيث أسعى من خلالها إلى التعرف على الممارسات التي تنتهجها الشركات الصناعية الفلسطينية الكبرى في إدارة التكنولوجيا بهدف تسليط الضوء على الممارسات الجيدة وترسيخها وخلق الوعي لدى الشركات حول بعض الممارسات الخاطئة التي تتم أثناء ادارة التكنولوجيا بهدف الحد منها وتقليلها ما أمكن.

الهدف من المقابلة التعرف من خلالكم ومن خلال خبرتكم داخل الشركة على السلوك العام المتبع في الشركة فيما يعرف بادارة التكنولوجيا والتي قد تكون مبهمة قليلا كمفهوم ولكن نتم ممارستها داخل الشركة بشكل او بآخر، وأحب أن انوه هنا بانه ليس هناك اجابات صحيحة واخرى خاطئة واجابات مرغوب بها واخرى غير مرغوب بها.

ضمان السرية: سيتم التعامل مع هذه المعلومات بسرية تامة ولن يتم ذكر اسم الشركة او ما قد يدل عليها من قريب او بعيد.

تسجيل المقابلة: إذا لم يكن لديك اي مانع سأقوم بتسجيل هذه المقابلة وذلك بهدف ادارة حوار يقظ معك وحتى لا انشغل بتدوين الملاحظات واغفل عن اي معلومة قد تذكرها.

المدة الزمنية للمقابلة: قد تستغرق هذه المقابلة ما مدته 30-40 دقيقة.

المحور الثالث: الاسئلة

1. **ان عملية تطوير المنتجات تختلف من شركة لاخرى ويعزى هذا الاختلاف الى طبيعة المنتجات التي تقدمها الشركة لزبائنها ويعتمد أيضا على السوق والزبائن الذين تستهدفهم. وتختلف سياسة الشركة تجاه زبائنها باختلاف قدرتها على التنبؤ برغباتهم وآلية التعامل مع هذه الرغبات. في القسم التالي ساقوم بطرح مجموعة من الاسئلة توضح سياسة الشركة في تطوير منتجاتها والطرق المتبعة في استطلاع رغبات الزبائن.**

   - بداية كيف تتم عملية ابتكار المنتجات في الشركة لديكم؟

   - هل تقوم الشركة بدراسة رغبات الزبائن واحتياجات السوق قبل طرح منتج معين؟

   - كيف تقوم الشركة بدراسة احتياجات الزبائن؟

   - هل تقوم الشركة بتطوير منتجاتها انطلاقا من رغبات الزبائن.

   - هل توجد عملية منهجية تقوم الشركة عادة باتباعها أثناء تطوير المنتجات؟؟ وهل من الممكن وصف هذه العملية؟

2. كما ذكرنا سابقا فان ابتكار المنتجات في الشركة يعتمد على دراسة السوق وفهم احتياجات الزبائن، ولكن هذه العملية يجب ان تتم ضمن منظومة متكاملة تراعى فيها التقنيات المتاحة لدى الشركة حاليا وامكانية الاستثمار في تقنيات جديدة وطريقة استغلال هذه التقنيات لتطوير منتجات مربحة تلبي رغبات الزبائن. وهذا ما سنناقشه في هذا الجزء.

- هل من الممكن أن تشرح لي ماذا يعني مفهوم إدارة التكنولوجيا للشركة؟

- هل من الممكن وصف العملية التي تتم فيها ادارة التكنولوجيا داخل الشركة؟

- كيف تقوم الشركة بتحديد احياجاتها التكنولوجية؟

3. إن الاستثمار الذي تقوم به الشركة قد يكون مكلفا جدا، ما يجعل من الخطورة بمكان وضع هذه المبالغ المستثمرة في غير مكانها الصحيح، في الجزء التالي سنناقش الالية التي تتم فيها صناعة قرار الاستثمار في تكنولوجيا معينة.

- كيف تتم صناعة القرارات المتعلقة بالاستثمار في تكنولوجيا معينة؟

- ما هي المعايير القائمة حاليا في الشركة والتي تضمن الشركة من خلالها القيام باختيار التكنولوجيا المناسبة؟ (معايير الاختيار الناجح للتكنولوجيا)

- في حال رغبت الشركة بتبني تكنولوجيا معينة فهل يتم التوجه عادة نحو تطوير هذه التكنولوجيا داخليا ام نقلها والاستحواذ عليها من مصادر خارجية؟

- ما هي الدوافع الكامنة وراء كل حالة من الحالتين السابقتين.

- كم تبلغ نسبة الانفاق على مشاريع البحث والتطوير من صافي الارباح السنوية.

4. كما تقدم سابقا فان الاستثمار في التكنولوجيا لتطوير المنتجات وتحسين اداء الشركة يعد من اجدى الاستثمارات بشرط اتباع عملية ممنهجة سليمة تخدم الاهداف الاستراتيجية للشركة. وهذا ما سنناقشه الان.

- ما هي العوامل التي قد تدفع الشركة لتبني تكنولوجيا حديثة لديها؟

- هل قمتم سابقا برصد وتحليل أثر اضافة أي تكنولوجيا جديدة على اداء الشركة؟

- ما هي المؤشرات التي قمتم باستخدامها من اجل رصد هذا الاثر؟ (كملاحظة الانتاجية، رضا الزبائن، مستوى الجودة، معدل الارباح السنوية.

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Appendix B: The Online Questionnaire

استبانة تقييم ممارسات إدارة التكنولوجيا في الشركات الفلسطينية الصناعية الكبرى

الأخ الفاضل / الأخت الفاضلة

يسعى الباحث في هذه الاستبانة إلى التعرف على الممارسات الحالية التي تقوم بها الشركات الفلسطينية الصناعية الكبرى لإدارة التكنولوجيا الخاصة بها، وذلك من خلال دراسة المدخلات المختلفة التي تؤثر في صناعة القرارات المرتبطة بعملية إدارة التكنولوجيا في مراحلها المختلفة وتحليلها، والخروج بتوصيات تساعد الشركات الفلسطينية على وضع آليات لتطوير وتحسين أدائها من خلال الاستخدام الأمثل للتكنولوجيا.

وتتجسد الإدارة الفعالة للتكنولوجيا بتحديد واختيار واقتناء وتوطين وحماية التكنولوجيا اللازمة لتطوير أداء الشركة والمحافظة على وضعها في السوق وتنميته بالشكل الذي ينسجم مع أهداف الشركة التي تم تحديدها مسبقا.

و حيث نؤمن أنكم خير مصدر للوصول الى المعلومات المطلوبة، و نعهد بكم الاهتمام والاستعداد لمؤازرة الأبحاث العلمية التي تهدف لخدمة مجتمعنا و تطويره، نتوجه إليكم و كلنا أمل أن نجد التعاون من قبلكم، وذلك من خلال الإجابة على الأسئلة الموجودة في هذه الاستبانة، و التي نتعهد لكم بالمحافظة على عدم إظهار هوية المجيب عنها، و عدم استخدامها في أي مجال غير مجال البحث العلمي. و لكم جزيل الشكر و العرفان ...

الباحث...

الجزء الأول: معلومات عامة عن الشركة

موقع الشركة
- شمال الضفة الغربية
- وسط الضفة الغربية
- جنوب الضفة الغربية
- محافظة القدس
- قطاع غزة

نوع الصناعة

إذا كانت صناعة الشركة غير مدرجة ضمن الخيارات أدناه، قم بتحديدها في مربع النص أدناه.

- ⊙ صناعة دوائية
- ⊙ صناعة غذائية
- ⊙ صناعة بلاستيكية
- ⊙ صناعة انشائية
- ⊙ صناعة ورقية
- ⊙ صناعة نسيج
- ⊙ صناعة جلدية
- ⊙ أخرى: [_____]

رأس مال الشركة

[_____]

الجزء الثاني: ممارسات إدارة التكنولوجيا

أولا: التخطيط التكنولوجي

1. تقوم الشركة بعمل تخطيط استراتيجي.
   - ⊙ أوافق بشدة
   - ⊙ أوافق
   - ⊙ لا أعلم
   - ⊙ أعارض
   - ⊙ أعارض بشدة

2. تسعى الشركة لتحقيق أهداف استراتيجية معينة خلال السنوات الخمس القادمة.
   - ⊙ أوافق بشدة
   - ⊙ أوافق
   - ⊙ لا أعلم
   - ⊙ أعارض
   - ⊙ أعارض بشدة

3. تسعى الشركة لتحقيق أهداف مالية محددة خلال السنوات الخمس القادمة.
   - ⊙ أوافق بشدة
   - ⊙ أوافق
   - ⊙ لا أعلم
   - ⊙ أعارض
   - ⊙ أعارض بشدة

4. ترتبط بعض الاهداف الاستراتيجية للشركة بالتكنولوجيا الخاصة بعملها.
   - ⊙ أوافق بشدة
   - ⊙ أوافق
   - ⊙ لا أعلم
   - ⊙ أعارض
   - ⊙ أعارض بشدة

5. تمتلك الشركة سياسة واضحة مكتوبة لإدارة التكنولوجيا الخاصة بعملها.

○ أوافق بشدة
○ أوافق
○ لا أعلم
○ أعارض
○ أعارض بشدة

6. تقوم الشركة بعمل تخطيط تكنولوجي.

○ أوافق بشدة
○ أوافق
○ لا أعلم
○ أعارض
○ أعارض بشدة

7. إذا كانت الشركة تقوم بعمل تخطيط تكنولوجي ، فما هي الدوائر التي تشترك في هذه العملية؟

☐ دائرة الأنتاج
☐ دائرة البحث والتطوير
☐ دائرة المشتريات
☐ دائرة المبيعات
☐ دائرة التسويق
☐ دائرة رقابة الجودة
☐ الدائرة الهندسية
☐ المستودعات
☐ الدائرة المالية
☐ دائرة الموارد البشرية

8. أثناء إعداد الموازنة العامة للشركة، تتم مراجعة الخطط التكنولوجية المختلفة للعمل.

○ أوافق بشدة
○ أوافق
○ لا أعلم
○ أعارض
○ أعارض بشدة

ثانيا: تحديد التكنولوجيا

تشكيل آلية رصد الاحتياجات التكنولوجية

9. تقوم الشركة بدراسة الاحتياجات التكنولوجية الخاصة بنشاطها.

○ أوافق بشدة
○ أوافق
○ لا أعلم
○ أعارض
○ أعارض بشدة

10. إذا كانت الشركة تقوم بدراسة الاحتياجات التكنولوجية، فما هي المدة الزمنية التي تقوم فيها الشركة بمراجعة هذه الاحتياجات؟

غير ذلك، قم بتحديده في مربع النص أدناه

○ كل سنة

○ كل سنتين
○ كل ثلاث سنوات
○ كل أربع سنوات
○ كل خمس سنوات
○ أخرى:

11. تقوم الشركة بتصنيف التكنولوجيا المختلفة من حيث أهميتها لعمل الشركة.

○ أوافق بشدة
○ أوافق
○ لا أعلم
○ أعارض
○ أعارض بشدة

12. إذا كانت الشركة تقوم بتصنيف التكنولوجيا من حيث أهميتها لعملها، فإن سياسة الشركة في إدارة هذه التكنولوجيا تختلف عن إدارة غيرها من التكنولوجيا.

○ أوافق بشدة
○ أوافق
○ لا أعلم
○ أعارض
○ أعارض بشدة

13. تقوم الشركة بمراقبة التكنولوجيا المختلفة التي تمتلكها الشركات المنافسة.

○ أوافق بشدة
○ أوافق
○ لا أعلم
○ أعارض
○ أعارض بشدة

14. تقوم الشركة برصد التطور التكنولوجي في مجال التكنولوجيا المتعلقة بنشاطها.

○ أوافق بشدة
○ أوافق
○ لا أعلم
○ أعارض
○ أعارض بشدة

اختيار مصادر المعلومات

15. أي من المصادر التالية لجمع المعلومات التكنولوجية يتم استخدامه:

غير ذلك، قم بتحديده في مربع النص أدناه

☐ الزبائن
☐ الموردين
☐ المعارض التجارية
☐ المنشورات العلمية
☐ الغرف التجارية
☐ الجامعات والمعاهد العلمية
☐ الشركات الاستشارية

☐ المؤتمرات واللقاءات العلمية والمهنية

☐ الانترنت

☐ أخرى:

تقييم وحفظ وتوصيل المعلومات

16. تقوم الشركة بتقييم وتحليل أثر التكنولوجيا الحديثة على نشاطها.
- ⚪ أوافق بشدة
- ⚪ أوافق
- ⚪ لا أعلم
- ⚪ أعارض
- ⚪ أعارض بشدة

17. يتم استخدام أنظمة محوسبة لحفظ المعلومات التي يتم جمعها وتحليلها عن التكنولوجيا.
- ⚪ أوافق بشدة
- ⚪ أوافق
- ⚪ لا أعلم
- ⚪ أعارض
- ⚪ أعارض بشدة

تنظيم آليات جمع المعلومات حول التكنولوجيا

18. تسهل الترتيبات التنظيمية والادارية القائمة حاليا في الشركة عملية جمع المعلومات عن التكنولوجيا بطريقة منهجية.
- ⚪ أوافق بشدة
- ⚪ أوافق
- ⚪ لا أعلم
- ⚪ أعارض
- ⚪ أعارض بشدة

19. يتم مراجعة المعلومات المهمة عن التكنولوجيا بطريقة دورية ويتم اتخاذ اجراءات محددة للمتابعة.
- ⚪ أوافق بشدة
- ⚪ أوافق
- ⚪ لا أعلم
- ⚪ أعارض
- ⚪ أعارض بشدة

20. يوجد لدى الشركة وحدة مخصصة مكلفة بجمع المعلومات التكنولوجية.
- ⚪ نعم
- ⚪ لا
- ☐ لا أعلم

21. إذا كان لدى الشركة وحدة مكلفة بجمع المعلومات التكنولوجية ، فهل يتم تخصيص ميزانية محددة لهذه الوحدة؟
- ⚪ نعم
- ⚪ لا
- ⚪ لا أعلم

22. إذا كان لدى الشركة وحدة مكلفة بجمع المعلومات التكنولوجية ، فهل يتم تقييم أداء هذه الوحدة بشكل دوري؟

○ نعم
○ لا
○ لا أعلم

ثالثا: اختيار التكنولوجيا

23. هناك عدة عوامل تؤثر في الاختيار الناجح للتكنولوجيا، من العوامل المذكورة ادناه فم بتحديد العوامل الثلاثة الأكثر تأثيرا من وجهة نظر الشركة:

في حال كان هناك عوامل أخرى ذات اهمية للشركة برجاء تحديدها في مربع النص أدناه.

☐ وجود استراتيجية واضحة للعمل
☐ انسجام استراتيجية العمل مع استراتيجية التكنولوجيا
☐ استقرار السوق ومعدل نموه
☐ علاقة الشركة بزبائنها
☐ المواصفات الانتاجية المطلوبة كحجم التشغيلة ومعدلات الانتاجية وحجم المخزون
☐ أخرى: [ ]

24. تعتمد الادارة العليا في قرارها للاستثمار في تكنولوجيا معينة على :

☐ القدرة على تمويل الاستثمار
☐ معدلات التدفق النقدي الحالي للشركة
☐ مستوى القدرات الهندسية
☐ توقعات الشركة لاحتمالية نجاح الاستثمار في هذه التكنولوجيا
☐ مستوى البنية التحتية المتوفرة
☐ الثقافة السائدة في الشركة

25. تعتمد الشركة على نتائج التحليل الاقتصادي في عملية اختيار التكنولوجيا مثل (فترة الاسترداد، Net present value).

○ أوافق بشدة
○ أوافق
○ لا أعلم
○ أعارض
○ أعارض بشدة

26. تعتمد الشركة عند اختيارها لتكنولوجيا معينة على قدرة هذه التكنولوجيا واسهامها في رفع مستوى الجودة .

○ أوافق بشدة
○ أوافق
○ لا أعلم
○ أعارض
○ أعارض بشدة

رابعا: اقتناء التكنولوجيا

27. قامت الشركة سابقا أو تقوم حاليا بتطوير أي من التكنولوجيا الخاصة بعملها داخليا .

○ أوافق بشدة
○ أوافق
○ لا أعلم
○ أعارض

◯ أعارض بشدة

28. تقدر نسبة الانفاق السنوي على نشاطات البحث والتطوير من صافي أرباح الشركة بـ

[ ]

29. عند إعداد الميزانية السنوية العامة، على ماذا تعتمد الإدارة في تحديد الميزانية المخصصة للانفاق على نشاطات البحث والتطوير

اذا كانت الشركة تعتمد امور اخرى غير المذكورة ادناه، برجاء تحديدها في مربع النص أدناه.

◯ الخطة الحالية للبحث والتطوير
◯ معدل انفاق الشركات المنافسة على عمليات البحث والتطوير
◯ معدل الأرباح السنوية للشركة
◯ قيام الشركة بدراسة حاجة السوق
◯ أخرى: [ ]

30. في حال قررت الشركة تطوير بعض التقنيات داخليا، أي من التالية يبرر سبب هذه الرغبة:

◯ رغبة الشركة بأن تكتسب خبرات في مجال تقنية معينة.
◯ مجال التقنية موضوع البحث والتطوير قريب من القدرات الفنية الموجود حاليا لدى الشركة.
◯ تكلفة مشاريع البحث والتطوير اقل بكثير من تكلفة شراء التكنولوجيا المطلوبة.
◯ رغبة الشركة في المحافظة على سرية توجهاتها التكنولوجية.

31. في حال قررت الشركة امتلاك تكنولوجيا معينة من مصادر خارجية، أي من التالية يعتبر سببا لقيام الشركة بذلك:

غير ذلك، قم بتحديده في مربع النص أدناه.

◯ الشركة لا تمتلك المهارات اللازمة لتطوير هذه التقنيات
◯ انشغال وحدة البحث والتطوير الموجودة بعمليات تطوير مرحلية
◯ زيادة ثقة الشركة في أداء التكنولوجيا الحديثة
◯ أخرى: [ ]

خامسا: توطين التكنولوجيا

32. في حال قررت الشركة توظيف تكنولوجيا معينة لديها، أي من التالية يمثل توجه الشركة:

◯ دمجها في منتجاتها من خلال عمليات التصنيع المختلفة لديها
◯ تعاقدات التصنيع او التسويق
◯ المشاريع بالشراكة
◯ عقود الامتياز

33. في حال قررت الشركة توظيف التكنولوجيا الحديثة لتحسين أدائها، أي من العوامل التالية يؤثر في هذا القرار:

توضيح: برجاء اختيار ثلاثة عوامل فقط ، وترتيبها حسب الأهمية للشركة(الرقم 3 يعني الأكثر أهمية، الرقم 1 يعني الأقل أهمية)

	3	2	1
زيادة الجودة	◯	◯	◯
تقليل وقت الانتاج	◯	◯	◯
زيادة القدرة التصنيعية	◯	◯	◯
زيادة الدقة في الانتاج	◯	◯	◯
زيادة المرونة في التصنيع	◯	◯	◯

○	○	○	تقليل وقت التجهيز
○	○	○	زيادة السلامة والأمان

سادسا: حماية التكنولوجيا

34.تقوم الشركة بحماية التقنيات المختلفة الموجودة لديها من خلال:

غير ذلك، قم بتحديده في مربع النص أدناه

☐ تسجيل براءات الاختراع

☐ تسجيل التصاميم المختلفة

☐ اعتماد ضمانات محددة للمحافظة على السرية

☐ الاحتفاظ بالموظفين ذوي الاختصاص و الخبرة في الشركة

☐ أخرى: [_____]

[إرسال]

جامعة النجاح الوطنية

كلية الدراسات العليا

تقييم ممارسات ادارة التكنولوجيا في الشركات الصناعية الفلسطينية الكبيرة

إعداد

رمزية رشاد اسماعيل

اشراف

د. حسام عرمان

قدمت هذه الأطروحة استكمالا لمتطلبات درجة الماجستير في الإدارة الهندسية بكلية الدراسات العليا في جامعة النجاح الوطنية في نابلس، فلسطين.

2012

تقييم ممارسات ادارة التكنولوجيا في الشركات الصناعية الفلسطينية الكبيرة

إعداد

رمزية رشاد اسماعيل

إشراف

د. حسام عرمان

الملخص

لقد تعددت صور استخدام وتوظيف التكنولوجيا الحديثة، والقت بظلالها على العمليات الانتاجية فى القطاعات الصناعية والخدمية المختلفة. ولقد رافق هذا التطور التكنولوجي المتسارع زيادة كبيرة في عمليات الدراسة والبحث والتطوير وذلك نتيجة للتوجه العالمي لاستخدام التكنولوجيا فى ادارة الاستثمارات والمشروعات الانتاجية والخدمية المختلفة.

واستطاعت التكنولوجيا الحديثة ان تساعد المصانع والشركات في تحقيق عوائد كبيرة متمثلة بزيادة نسب الانتاجية وتقليل اوقات الانتاج والتجهيز، كما ساهمت في تحسين معدلات الجودة ورضا الزبائن.

لقد غدت الادارة التكنولوجية من المفاهيم التي يجدر تبنيها في المنظومات الصناعية كمتطلب يضمن لها قدرة تنافسية عالية للدخول الى الاسواق العالمية. الامر الذي يدعو المسؤولون وصناع القرار في هذه المنظومات لتطوير وتحسين نمط الادارة التقليدية وايلاء اهمية كبيرة لادارة التكنولوجيا.

يعتبر قطاع الصناعات التحويلية من اهم القطاعات الصناعية في فلسطين وذلك لما يسهمه هذا القطاع من مساهمة فاعلة في الناتج المحلي الاجمالي وتشغيل الايدي العاملة، وعليه ينبغي ان يكون جزءا رئيسا في اي عملية تنمية اقتصادية. ولقد استهدف الباحث في دراسته الشركات الكبيرة العاملة في قطاع الصناعات التحويلية لما تلعبه من دور بارز في اقتصادنا الفلسطيني ولما احرزته من تطور تكنولوجي نسبي مقارنة بالشركات المتوسطة وصغيرة الحجم.

وفي هذه الدراسة يسعى الباحث إلى التعرف على الممارسات الحالية التي تقوم بها الشركات الكبيرة العاملة في قطاع الصناعات التحويلية في فلسطين لإدارة التكنولوجيا الخاصة بها، وذلك من خلال دراسة المدخلات المختلفة التي تؤثر في صناعة القرارات المرتبطة بعملية إدارة التكنولوجيا في مراحلها المختلفة وتحليلها، بهدف تحديد نقاط القوة والضعف في هذا الاداء من خلال ربط الممارسات الحالية للشركات الفلسطينية الصناعية الكبيرة بممارسات الادارة التكنولوجية الصحيحة المتعارف عليها، وذلك بهدف الخروج بتوصيات تساعد الشركات الفلسطينية على وضع آليات لتطوير وتحسين أدائها من خلال الاستخدام الأمثل للتكنولوجيا.

ولقد قام الباحث باستخدام ادوات بحثية كمية ممثلة بالاستبانة التي تم اعدادها وتوزيعها عبر الايميل للشركات الصناعية الكبيرة في فلسطين، واخرى نوعية من خلال المقابلات الممنهجة التي تم عقدها مع كبرى الشركات الممثلة في عينة الدراسة، ولقد تم توظيف الوسائل الاحصائية المختلفة لتحليل البيانات كالتحليل الوصفي للنتائج والتحليل الاستنتاجي لفرضيات الدراسة.

كما قام الباحث بتطوير نموذج يساعد الشركات على تبني مفهوم الادارة التكنولوجية وتقييم الوضع الحالي لديها من خلال ربط مخرجات عملية التحليل الاستراتيجي التنافسي وتحديد الاحتياجات ونتائج تخطيط رسم المسار التكنولوجي بالإدارة الفعلية للعمليات التكنولوجية المختلفة.