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A CONSTRUCTION RESOURCES MANAGEMENT SYSTEM FOR GAZA STRIP BUILDING CONTRACTORS

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Dedication

To my loving parents who supported me all the way; to my wife whose constant dedication and love enlightened me; to my daughters whose innocent energy and still is a source of inspiration; to all of my friends and colleagues who stood beside me with great commitment; I dedicate my research, hoping that I made all of them proud.

Mahmoud M.Abu Al-Kass

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Abstract

A Construction Resources Management System for Gaza Strip Building Contractors

Effective construction resources management process is a key to success of a construction project. Nowadays, successful management of construction resources has to be based on and updated information and processed utilizing a well designed construction resources management system.

The aim of the thesis is to explore the local practice in construction resources management and develop a construction resources management system to facilitate the management of construction resources mainly in the building construction. Construction resources management related literature was generally reviewed; meanwhile some construction resources management software packages have been reviewed also. The researcher explores PHP programming language capabilities and utilizes these capabilities in developing a Construction Resources Management Software which he names "construction Resources management software"(CRMS).

A survey questionnaire supported by interviews was used to explore the local practice in construction resources management. Seventy questionnaires were distributed to contractors of first; second, and third class, forty - eight questionnaires were received and analyzed.

The study shows that most of contracting companies are considered the main obstacles in using computer in construction resources management are shortage of user-friendly computer program and no understanding for importance of computer program.

The study clarified that improper cutting of material was one of the most important factors affecting on material waste. The survey also indicated that the stability of the work and work discipline was one of the most important factors affecting on increasing productivity. The study illustrated that the worker are not satisfied was one of the most important factors that may lead to affecting on reducing productivity.

CRMS is a PC-based software which has been designed to run under PHP programming language. PHP programming language is used in developing CRMS. Full description of CRMS has been given with detailed implementation procedures. CRMS has been evaluated to test its suitability to local practice. Evaluation of CRMS has addressed both conceptual and practical issues. One of the main recommendations of this research is to encourage local contracting companies to have a construction resources management software package and use it in determining the required quantities of construction materials in order to get resources in time and required quantities, save time and minimize error.

الملخص

نظام إدارة موارد التشييد لمقاولي البناء في قطاع غزة

الإدارة الفاعلة لموارد التشييد لأي مشروع يعتبر احد العوامل المهمة في نجاح هذا المشروع, في الوقت الحالي إدارة موارد التشييد الناجحة هي التي تعتمد على معلومات دقيقة ومحدثة تتم معالجتها بواسطة برنامج محوسب محكم لإدارة مواد التشييد.

الهدف من الدراسة هو التعرف على الواقع العملي المحلي لإدارة موارد التشييد في مشاريع البناء, وتطوير برنامج حاسوب متخصص في هذا المجال لكي يحسن من الممارسة المحلية في تشييد المباني, خلال البحث جرت مراجعة عامة للأدبيات المتعلقة بإدارة موارد التشييد. كما وتمت أيضا مراجعة لبعض برامج الحاسوب المتخصصة في إدارة موارد التشييد. لإجراء هذا البحث تم استخدام أسلوب الاستبانه المدعم بالمقابلة الشخصية حيث تم توزيع سبعون استبانه علي مقاولي الدرجة الأولي والثانية والثالثة وقد تم جمع ثمانية و أربعون استبانه منها.

أوضحت نتائج هذا البحث بان معظم المقاولين مهتمين في استخدام بعض التقنيات لإدارة موارد التشييد لديهم كضمان وجود أرشيف لجميع المشاريع المنفذة حول تكلفة الموارد وتوفير الوقت والجهد وتقليل الأخطاء. أيضا أوضحت النتائج أن معظم العوائق التي تحول دون استخدام برامج إدارة الموارد المتخصصة هي نقص في البرامج سهلة الاستخدام والمتخصصة في إدارة الموارد, وعدم توفر برامج حاسوب سهلة الاستخدام.

أوضحت الدراسة أن القص غير المناسب للمواد ونقل المواد بطريقة غير صحيحة كان من أهم العوامل التي تؤثر على زيادة نسبة الفاقد في مواد التشييد. كما وأظهرت الدراسة أن استقرار العمل وانضباط العمال كان من أهم الأسباب التي تؤدي إلي زيادة إنتاجية العمال.أيضا أوضحت الدراسة أن عدم رضا العمال وسوء الفهم بين العمال يساهم بشكل كبير جدا في التقليل من إنتاجية العمال.

برنامج إدارة مواد التشييد CRMS : مصمم للاستخدام بواسطة الحاسوب الشخصي, كما تم استخدام لغة برمجة (PHP) في تطويره.

كان من التوصيات الرئيسية لهذا البحث, تشجيع المقاولين المحليين لاقتناء برنامج محوسب متخصص في إدارة موارد التشييد واستخدامه في تحديد الكميات اللازمة من الموارد للحصول عليها في الوقت المناسب والكميات المناسبة وتوفير الوقت وتقليل الأخطاء.

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INTRODUCTION

1.1 Construction industry background

The construction industry is the total through which physical development is achieved, and that is truly the locomotive of the national economy. The more resources, engineering, labor, materials, equipment, capital, and market exchange are provided from within the national economy, the higher the factor of the extent of self reliance. The increasing complexity of infrastructure projects and the environment within which they are constructed place greater demand on construction managers to deliver projects on time, within the planned budget and with high quality (Enshassi et al 2003).

Since 1993, the year when Oslo Peace Accords have been signed in Norway, Palestinian occupied territories have undergone a rapid pace of reconstruction of infrastructure which had been demolished through thirty years of occupation. In spite of lack of resources and technologies, hundreds of infrastructure, residential, and governmental projects were implemented (MAP Overview 2002).

The successful execution of construction projects and keeping them within estimated cost and prescribed schedules depend on a methodology that requires sound engineering judgment. To the dislike of owners, contractors and consultants, however, many projects experience extensive delays and thereby exceed initial time and cost estimates. This problem is more evident in the traditional or adversarial type of contracts in which the contract is awarded to the lowest bidder- the awarding strategy of the majority of public projects in developing countries including Gaza Strip.

Although the construction industry in the Middle East has suffered ever since the Gulf war, recent events in the region coupled with the restructuring of economies, joining regional and global free trade organizations, and attracting foreign investments are expected to yield an unprecedented growth in the construction activities (Odeh and Battaineh 2002).

Therefore, improving construction efficiency by means of cost-effectiveness and timeliness would certainly contribute to cost savings for the country as a whole. Efforts

directed to cost and time effectiveness were associated with managing time and cost, which in this study were approached via investigating time and cost overruns of construction projects in Gaza Strip. Unlike the developed countries, Palestine does not have a mature construction industry consisting of well-established contracting and consulting companies. Much of the building and construction is done by the informal sector. This consists of individuals building family shelters, water wells and the like. The formal sector consists of public and private domestic contractors (Enshassi et al 2003).

Time and cost overruns in Gaza Strip

One of the main objectives and policies of any public or private sectors dealing with the execution of projects is to upgrade projects performance, through reduction of costs, completion of projects within their assigned budget and time constraints, and improve quality. Construction industry in Gaza Strip is suffering from many problems which affect time, cost and quality, these factors related to political situation and techniques used in Gaza Strip, these problems are summarized as following:

- Large number of workers in comparison to the number of projects (the large number of unemployed labour in Gaza Strip);
- Borders closure and shortage of materials in markets;
- Dependency on Israel and other countries in getting construction materials;
- Continued increase in material prices;
- Dependency on donor countries to get the fund of implemented projects in Gaza Strip;
- Unstable economic situation and its correlation with Israeli one;
- Unstable political situation.

These factors above and others contributed to large proportion in making many problems in construction industry which usually related to time and cost overruns.

Delay of project and cost overruns in Gaza Strip is one of most important problems at construction management field, also research and studies in this field in Palestine are few compared to worthy expected results. Despite the importance and the significance of the construction sector in Palestine. It is noted that the parties of project contractor

don’t give the time and cost overruns the importance at the evaluation at the end of project.

This shortage of time and cost overruns control may be as a result of;

- Lack of knowledge and awareness about project performance;
- The distribution of delay and cost overruns responsibilities on contractors.
- They believe that the political conditions is the main reason of this problem.

The problem of projects delay and cost overruns can nearly be noticed in every project at Gaza Strip indicating that this problem didn't receive enough attention by both researches and responsible authorities.

1.2 Rationale

Construction projects can be accomplished utilizing management processes. These processes include planning, organizing, executing, monitoring, and controlling (Ahuja et al 1994). During any construction project the three inter-related factors of time, money, and quality need to be controlled and managed. Successful completion of projects requires all resources to be effectively managed. Resources management is considered as a means to achieve better productivity, which should be translated into cost reduction.

Computer software systems are widely used in construction management in the developed countries. Yet, using computer applications is still in its early phase of development in the developing countries. Therefore, it is logical that computerization has emphasis in the process of improvement of project management practices in the developing countries. The majority of local contractors in Gaza Strip have poor experience in managing construction materials. Resources management software systems are not quite available and there is a shortage in qualified persons to use these software packages. The results obtained from studying the local practices in managing construction resources is used to develop a computerized resources management system in order to improve the capabilities of local contractors in resources management functions.

To the researcher knowledge, a little research effort has been done to investigate the construction resources management practices of Gaza Strip contracting companies. It is important to explore and evaluate these practices, and then offer recommendations

and develop practical techniques to improve existing practice.

1.3 Research Aim

The aim of this research is to develop the existing common practices in construction resource management for the building construction projects in Gaza Strip. Also the research aims at developing a computerized resource management system that, hopefully may improves the local practices.

1.4 Research Objectives

The aim of this research can be broken down into the following objectives:

- Develop and evaluate the local practices of construction resource management in contracting companies in Gaza Strip.
- Find out the benefits of using computerized packages in the construction resources management.
- Develop a computerized system for construction resource management to improve the common existing practice.

1.5 Methodology Outline

The research was conducted through the following stages:

First stage: Literature Review

Construction resource management related literature would be reviewed to identify the main topics to be handled in this research. This stage includes also review of available construction resource management software packages. The researcher also explored the Microsoft Excel capabilities.

Second Stage: Field Survey

A survey of the local construction resource management practice of contracting companies in Gaza Strip was done. A structured questionnaire was used .The person in charge of resource management in the company was interviewed. Statistical analysis for questionnaires was done by using Statistical Package for the Social Science (SPSS).

Third Stage: Model formulation and Development

Construction resource management system was developed based on the results obtained from field survey and literature. The model was computerized utilization capability of PHP programming language.

1.6 Thesis Contents

Apart from this chapter, there are other five chapters and nine annexes. Chapter 2 presents the literature review of resources management in construction projects. Chapter 3 presents the Methodology. Chapter 4 presents research results. It includes the questionnaire design, the method of analysis, and analysis of the surveyed results and discussion of these results. Construction resources management software is discussed in details in Chapter 5. The discussions include the concepts, the description, the implementation, and evaluation of the resources management system. Chapter 6 presents conclusions, recommendations for the main parties involved in the construction industry, and recommendations for further studies.

There are forth Annexes, which supplement these chapters.

Annex 1: The questionnaire (In Arabic).

Annex 2: The questionnaire (English Version).

Annex 3: The system evaluation questionnaire (In Arabic).

Annex 4: The system evaluation questionnaire (English Version).

CHAPTER 2
CONSTRUCTION RESOURCES MANAGEMENT

2.1 CONSTRUCTION MATERIALS MANAGEMENT

2.1.1 Introduction

Construction materials constitute a major cost component in any construction project. The total cost of installed materials (or value of materials) may be 50% or more of the total cost (Stukhart 1995, Bernold and Treseler 1991).

Construction materials typically account for 40– 45% of the cost of all construction work. In such a highly competitive environment nowadays, it is necessary for every construction company to maintain an efficient and effective material procurement to cut administration cost, and to keep abreast of the market condition to procure materials at the right price, quality and time (Stephen et al., 2004).

Poor planning and control of materials, lack of materials when needed, poor identification of materials, re-handling and inadequate storage cause losses in labor productivity and overall delays that can indirectly increase total project costs. Effective management of materials can reduce these costs and contribute significantly to the success of the project (Jose, 2004).

When the supplies managed by procurement represents 50%, 60%,and up to 70% of the total cost for the project, it is imperious to have a strict and permanent control of the acquisitions, having in mind the financial approach being represented by such situation (Luis et al., 1999).

Both material purchasers and sellers can be benefited from information sharing as purchasers can get more comprehensive material information while sellers can know more on the current market situation (Stephen et al., 2004).

2.1.2 Background

Building materials account for a high percentage of a project's total cost and therefore are an important and attractive resource to control (Navon and Berkovich 2005).

The Webster's dictionary defines materials as "the elements, constituents, or substances of which something is composed or can be made." Ballot (1971) defines materials as the physical materials that are purchased and used to produce the final product and does not suggest that materials are the final product. In other words, materials are the parts used to produce the final product.

Bailey and Farmer (1982) define materials as the goods purchased from sources out of the organization that are used to produce finished products. Stukhart (1995) defines materials as the items that are used to produce a product and which include raw materials, parts, supplies and equipment items.

Stukhart (1995) defines material management as the activities involved to plan, control, purchase, expedite, transport, store, and issue in order to achieve an efficient flow of materials and that the required materials are bought in the required quantities, at the required time, with the required quality and at an acceptable price.

Plemmons and Bell (1995) define material management as the plan and control of all activities to ensure the correct quality and quantity of materials and equipment to be installed as specified in timely manner, obtained at reasonable cost and are available when needed.

Dobler and Burt (1996) state that material management is designed to improve the activities related to the flow of materials. They add that material management should coordinate purchasing, inventory control, receiving, warehousing, materials handling, planning, and transportation.

2.1.3 Importance and problems of materials for a project

The importance of material procurement mainly stems from the fact that the cost of materials constitutes a significant part of costs (Mohan and Dinesh, 2002).

(CII 1987; Formoso et al. 2002 and Poon et al. 2004) the importance of materials management and control has long been established (Sited Navon and Berkovich, 2004).

Chai and Yitzchakov (1995) emphasize the importance of monitoring the flow of materials and the data associated with them, such as their quantities and inventory levels (Sited Navon and Berkovich, 2004).

The importance of proper management of materials is highlighted by the fact that they account for substantial portions of project cost and time. Expert estimates and historical data analysis indicate that materials account for 50–60% of project cost and control 80% of its schedule (Naief, 2002).

Non-availability of items when needed on site is identified as the major and most common and frequent cause of delays in projects and an integrated computer-based materials management system is concluded to produce 10–12% saving in labor cost. The situation is succinctly put in the form of a question reported to have been repeatedly asked by leaders in the industry (Naief, 2002).

A prerequisite for cost-effective construction is the availability of materials at the time and location that these materials are required on site. Not any less important are the equipment and manpower required to place these materials in the exact location and sequence that have been prescribed either in the contract documents or dictated by acceptable standard practices in the industry (Mohan and Dinesh, 2002).

Unavailability of materials when needed can affect productivity, cause delays and possible suspension of activities until the required material is available. Unavailability of materials is not the only aspect that can cause problems. Excessive quantities of materials could also create serious problems to managers. Storage of materials can increase the costs of production and the total cost of any project. When there are limited areas available for storage, the managers have to find other alternatives to store the materials until they are needed. Some of these alternatives might require re-handling of materials, which will increase the costs associated with them. Provisions should be taken to handle and store the materials adequately when they are received. Special

attention should be given to the flow of materials once they are procured from suppliers (Jose, 2004).

It is obvious that materials should be obtained at the lowest cost possible to provide savings to the company (Damodara, 1999). In the late 1970's, construction companies experienced an increase in costs and a decrease in productivity. Owners of these companies thought that these increases in cost were due to inflation and economic problems. Further research concluded that these companies were not using their resources efficiently and that the decrease in productivity was also attributable to poor management (Stukhart, 1995). Material management has been an issue of concern in the construction industry. 40% of the time lost on site can be attributed to bad management, lack of materials when needed, poor identification of materials and storage (Baldwin et al 1994).

Jose (2004) stated that the need for an effective materials planning system becomes mandatory. Some companies have increased the efficiency of their activities in order to remain competitive and secure future work. Many other firms have reduced overheads and undertaken productivity improvement strategies. Considerable improvement and cost savings would seem possible through enhanced materials management. Timely availability of materials and systems are vital to successful construction. Materials management functions are often performed on a fragmented basis with minimal communication and no clearly established responsibilities assigned to the owner, engineer or contractor.

2.1.4 Problems of materials management for a project

Chai and Yitzchakov (1995) advised that the problem with materials management is the lack of up-to-date relevant information, hence the importance of monitoring the flow of materials and the data associated with them (sited Navon and Berkovich, 2005).

Navon and Berkovich (2005) assert that a computer integrated materials management system can help in data collection, their organization, their analysis and their presentation to support real-time decision making. A recent workshop sponsored by the National Institute of Standards and Technology (NIST) came to a conclusion that

"material tracking is still a very big problem on the current construction job site" (Saidi et al., 2003).

Navon and Berkovich (2004) reported that the main problem is the lack of up-to-date relevant information.

(Choo et al. 1998, Bell and Stukhart. 1987, Li et al. 2003, Poon et al. 2004) assert that the biggest problem field workers face is coping with discrepancies between anticipated, actually needed, and available resources (materials included); Reduction in man-hours needed for materials management – craft foremen can spend up to 20% of their time hunting for materials, and another 10% tracking purchase orders (PO) and expediting and Reduction in the cost of materials due to reduction in waste caused by manual and inefficient materials management and control (Navon and Berkovich, 2005).

Navon and Berkovich (2004) said that the waste represents a relatively large percentage of production costs and this waste is due to the poor materials control on construction sites.

Navon and Berkovich (2005) identified the major problems of materials arriving to the site at the wrong time, or the wrong quantity; materials that do not match the purchase-order; forgetting to order materials; information regarding the status of the orders is not available; lack of complete and up-to-date information regarding arrival of materials to the site and, or, regarding on site stocks; surplus of, or missing, materials; and waste of man-hours searching for materials and tracking them.

It is preffered that the traditional material procurement process has the following limitations. This process has specific business hours and can only work with suppliers within a defined geographical region. In addition, the traditional process can only collect limited amount of information about the suppliers and their products through the collection of paper-based catalogs. Paper-based catalogs are cumbersome to use, and require large storage areas. They also become dated very quickly, and make searching and comparison of prices and quality a nebulous task. These disadvantages make it increasingly difficult for contractors to stay abreast of market conditions and thus select the most suitable materials and suppliers for a given project (Stephen et al., 2004).

Navon and Berkovich (2004) identified the major problems were:

- Materials arriving to the site at the wrong time, or in the wrong quantity.
- Materials whose specifications do not match the ones in the purchase-order.
- Forgetting to order materials.
- Unavailability of information regarding the status of the orders is not.
- Lack of complete and up-to-date information regarding arrival of materials to the site and, or, regarding on site stocks.
- Surplus of, or missing, materials.
- Lack of storage space for materials on site.
- Waste of man-hours searching for materials and tracking them.

2.1.5 What is material management?

Different researchers provide different definitions for material management. Therefore, different definitions can be found in different references. Basically, material management is concerned with the planning, identification, procuring, storage, receiving and distribution of materials. The purpose of material management is to assure that the right materials are in the right place, in the right quantities when needed. The responsibility of one department (i.e. material management department) for the flow of materials from the time the materials are ordered, received, and stored until they are used is the basis of material management.

Tersine and Campbell (1977) define material management as the process to provide the right materials at the right place at the right time in order to maintain a desired level of production at minimum cost. The purpose of material management is to control the flow of materials effectively.

Beekman (1978) states that a material management structure should be organized in such a way that it allows for integral planning and coordination of the flow of materials, in order to use the resources in an optimal way and to minimize costs.

Chandler (1978) states that material management systems should be implemented to plan, order, check deliveries, warehousing, controlling the use of materials, and paying for materials. He adds that these activities should be interrelated.

Ammer (1980) defines material management as the process in which a company acquires the materials that it needs to achieve their objectives. This process usually begins with the requisition of materials from the supplier until the material is used or incorporated into a product.

Bailey and Farmer (1982) define material management as a concept concerned with the management of materials until the materials have been used and converted into the final product. Activities include cooperation with designers, purchasing, receiving, storage, quality control, inventory control, and material control.

Gossom (1983) indicates that a material management system should have standard procedures for planning, expediting, transportation, receipt, and storage to ensure an efficient system for materials control .

Cavinato (1984) states that material management involves the control of the flow of goods in a firm. It is the combination of purchasing with production, distribution, marketing and finance.

Materials management is an important element in project planning and control.
Materials represent a major expense in construction, so minimizing procurement or purchase costs presents important opportunities for reducing costs. Poor materials management can also result in large and unavoidable costs during construction. First, if materials are purchased early, capital may be tied up and interest charges incurred on The excess inventory of materials. Even worse, materials may deteriorate during storage or be stolen unless special care is taken. For example, electrical equipment often must be stored in waterproof locations. Second, delays and extra expenses may be incurred if materials required for particular activities are not available (Jose, 2004).

Accordingly, insuring a timely flow of material is an important concern of project managers. Materials management is not just a concern during the monitoring stage in which construction is taking place. Decisions about material procurement may also be required during the initial planning and scheduling stages. For example, activities can

be inserted in the project schedule to represent purchasing of major items such as elevators for buildings (Dubler and Burt, 1996).

The availability of materials may greatly influence the schedule in projects with a fast track or very tight time schedule. Sufficient time for obtaining the necessary materials must be allowed. In some cases, more expensive suppliers or shippers may be employed to save time. Materials management is also a problem at the organization level if central purchasing and inventory control is used for standard items. In this case, the various projects undertaken by the organization would present requests to the central purchasing group. In turn, this group would maintain inventories of standard items to reduce the delay in providing material or to obtain lower costs due to bulk purchasing (Cavinato, 1994).

When the inventory becomes too low, a new order is recommended. For items that are non-standard or not kept in inventory, the calculation is even simpler since no inventory must be considered. With a materials requirement system, much of the detailed record keeping is automated and project managers are alerted to purchasing requirements (Stukhart, 1995).

The role that a materials manager plays in an organization is strictly economical since the materials manager should keep the total cost of materials as low as possible. The person in charge of handling materials should keep in mind the goals of the company and insure that the company is not paying extra money for materials. The goal of every company is to make a profit. This is the basis for company survival, costs should not exceed income, but keeping in mind customer's expectations. The typical tasks associated with a material management system are (Tersine and Campbell (1977), Ammer (1980), Stukhart (1995)):

- Procurement and purchasing
- Expediting
- Materials planning
- Materials handling
- Distribution
- Cost control
- Inventory management / Receiving/ Warehousing

- Transportation

Figure2.1 depicts the different phases of the material management process including the relationship and interdependency between the different activities in each phase. From this figure it can be seen that decisions taken at each phase in the system, directly affect the activities of the phases that follow (Thabet , 2001).

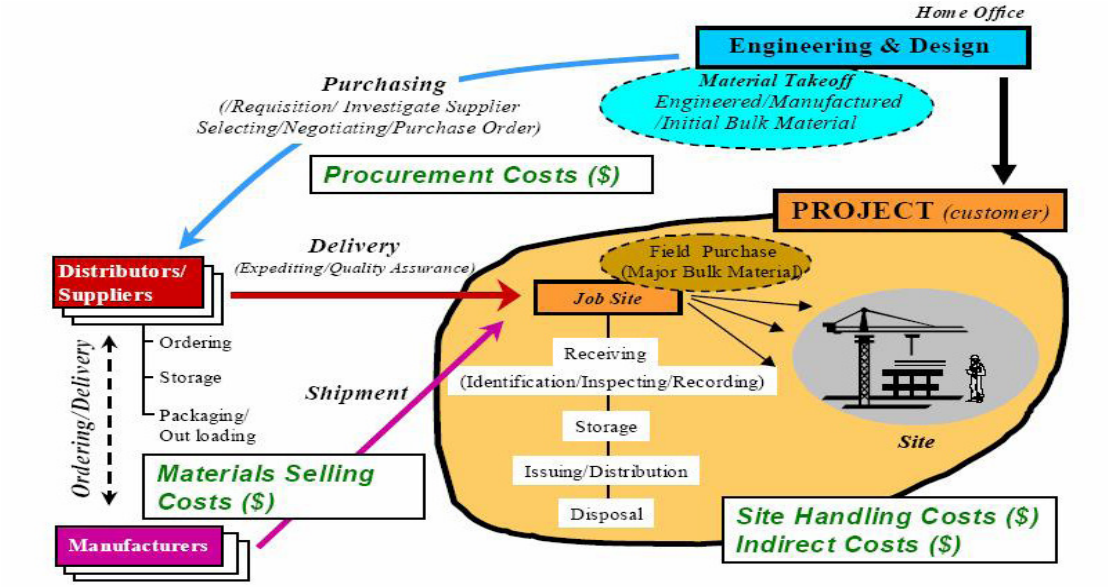

Figure2.1: Typical Materials Management in Construction (Thabet , 2001).

2.1.6 Studies of Effectiveness of materials management

Navon and Berkovich (2004) developed and evaluated an automated model for management and control of materials ordering, purchasing, and supply and use. The model was implemented in a prototype system and used in ongoing construction projects. The model provides a comprehensive approach, encompassing materials purchasing aspects, their delivery to the site and their dispatching for use in the building. The model can reduce the time needed for materials management, reduce wastage caused by manually ordering the materials and ensure that materials on site on time, in the right quantity and according to specifications.

Motete et al. (2003) said that the results of investigations into three key areas, namely, the factors underlying material wastage on building sites, their frequencies of occurrence, and relative contributions to wastage levels; materials prone to excessive wastages, their wastage rates, and the resultant contributions to project cost overrun;

and ways of minimizing material wastages on building sites. The descriptive survey method was used, which involved in-depth interviews at the exploratory stage and questionnaire surveys at the quantitative data gathering stage. Results show that construction related factors are the most frequently occurring, and the most significant contributors to overall wastage of materials on site. Bricks have the highest wastage rates, though wastage on concrete has the highest impact on cost overrun in projects where they are used. Effective supervision and control of material usage is perceived to be the most significant strategy for minimizing material wastage on site.

Femi and Josep (1999) the aim of this study is to examine the current practices in materials management and control techniques amongst medium sized building contractors engaged in speculative housing in the UK, with a view to enhancing an understanding of the factors which contribute to the occurrence of unacceptably high waste on building sites. The study is depending on case studies of four medium sized house building sites in UK. The study found, that site managers exercised very little control over material wastage; and that sub-contractors are the main contributors to excessive wastage on sites, with this being most acute amongst joiners and plasterers.

Timo and Mikko (2004) was put the new project management methods emerging for construction projects generate new kinds of challenges for the delivery process of the project materials. The basic philosophy of the emerging methods is to create short-term schedules for project tasks based on a constraint analysis of project resources. This approach places two requirements for the material deliveries: Transparency to material availability and short response times in the supply chain. They put suitable solution for managing the material logistics of construction projects. The solution consists of a shipment tracking-based approach tested in pilot implementations to provide inventory transparency, and a pro-active delivery approach for efficient material deliveries validated in expert group discussions.

Luis et al. (1999) a methodology to diagnose and evaluate the procurement process for investment projects. They depended on literature review was carried out along with study of cases, surveys and interviews to professionals involved in this area. The results obtained show that the main problem of procurement is related to schedule delays and lack of specified quality for the project. To prevent this situation it is often necessary to

dedicate important resources (money, personnel, time, etc.) to monitor and control the process. When applying the methodology to some projects, it was found that the main sources of "waste" were engineering, the system itself, the suppliers, and the policies. A great potential for improvement was detected if state of the art technologies such as, electronic mail, EDI (Electronic Data Interchange), bar codes, and other systems were applied to the procurement process. They concluded that technologies could help to eliminate the root causes for many types of wastes that were detected and experience of the company.

Dakshina et al. (2008) this research examines the effect of this policy change on bidding and participation differences across two groups of bidders: entrants and incumbents. They find the implications of the observed changes on the duration of the entrants' presence in the procurement auctions. They find that overall, the release of the engineering cost estimate prior to bidding reduces informational asymmetries and as a result entrants and incumbents bid more alike. When we introduce fixed effects to control for differences in private costs, we find that entrants (1) submit relatively more aggressive low bids before the policy change and (2) adjust their bidding behavior after the policy change to correct for their earlier lack of information. Entrants adjust their bidding behavior roughly 20% more than the incumbents after the policy change. These results are similar when we change the specification of the dependent variable.

The objective of the research effort by Mohan and Dinesh (2002) is identify "procurement delays" for "shortages" as it was felt that the shortages could in the extreme case be interpreted to mean a shortfall leading to cessation of work on the project .The primary objectives of this research were to: (1) ascertain the occurrence of material and equipment procurement delays in construction projects in Nepal and (2) determine the causes of the delays and determine the cost. They concluded that the total cost impact was insignificant, averaging about 0.48% of the total budgeted costs of the project.

2.1.7 Benefits of material management

The main benefits of an efficient Materials Management and Control System are: Increased productivity and avoidance of delays, mainly due to the availability of the right materials prior to work commencement (Navon and Berkovich, 2005).
Navon and Berkovich (2004) the main benefits from efficient Materials Management and Control System are: Increased productivity and avoidance of delays. Estimates of increased productivity vary from 8% up to 12%. This is mainly due to the availability of the right materials prior to work commencement and the ability to plan the work activities according to the availability of materials.

Berkovich (2004) and Navon (2005) stated that these researches showed that on projects lacking materials management systems craft foremen spend up to 20% of their time hunting materials and another 10% tracking purchase orders (PO) and expediting (time that they could devote otherwise to supervising workers). Leaving the crews unsupervised has a detrimental effect on labor productivity. Reduction in the cost of materials, this is due to reduction in waste caused by manual and inefficient materials management and controls.

An effective material management system can bring many benefits for a company.
Previous studies by the Construction Industry Institute (CII) concluded that labor productivity could be improved by six percent and can produce 4-6% additional savings (Bernold and Treseler, 1991). Among these benefits are:
- Reducing the overall costs of materials
- Better handling of materials
- Reduction in duplicated orders
- Materials will be on site when needed and in the quantities required
- Improvements in labor productivity
- Improvements in project schedule
- Quality control
- Better field material control
- Better relations with suppliers
- Reduce of materials surplus
- Reduce storage of materials on site

- Labor savings
- Purchase savings
- Better cash flow management

From a study of twenty heavy construction sites, the following benefits from the introduction of materials management systems were noted (Stukhart and Bell 1987):

• In one project, a 6% reduction in craft labor costs occurred due to the improved availability of materials as needed on site. Other projects, an 8% savings due to reduced delay for materials estimated.

2.1.8 Material management steps

There are several steps within the scope of material management and each of these steps can give rise to potential problems. The more the responsibility is divided, the more potential problems that exist.

Table 2.1 shows the steps in material management and the pertinent action related to these steps. Some actions are described in terms of the documentation produced, such as receiving report and vendor data. (Ahuja et al., 1994).

Table 2.1: Material management steps (Ahuja et al 1994)

Sequence	Contribution action
1-RFQ (Requisition)	Drawings, specifications. Material bills Terms and conditions
2-Bids	Approved bidders list Pre qualification of bidders Bid evaluations
3-P.O. (Purchase Order)	Bid clarification Notice of award
4-Expediting	Vender data Manufacturer inspection Delivery Routings
5-Transport	Carrier and route Ownership en route Custom
6-Receiving	Inspection and acceptance Receiving report Storage
7-Inventory	Dispersal (i.e. material handling) Inventory level

2.2 CONSTRUCTION LABOR MANAGEMENT

2.2.1 Introduction

Site workers (labor) account for up to 40% of the direct capital cost of large construction projects, and there is a need to maximize the productivity of labor resources (Thomas et al., 2004).

Construction projects are mostly labor-based with basic hand tools and equipment, as labor costs comprise 30 to 50 % of overall projects costs (Guhathakurta and Yates, 1993 cited in Enshassi et al., 2007).

Human resource management is an inevitable dimension of project management since it is people who deliver projects people are the predominant resource in an organization and there is a positive association between human resource management practices and

achievement of outstanding success. Organizing and managing the project team are the main duties of human resource management (Zeynep et al., 2008).

Zeynep et al. (2008) stated that the owner, consultants, contractor, subcontractors and suppliers constitute the supply chain in construction higher success can be achieved by increasing the quality of communication between different parties and team operation among different parties .

Construction industry is a project oriented industry. Effective project management is key for the successful accomplishment of sophisticated project (Zeynep et al., 2008).

Zeynep et al. (2008) stated that construction project commonly experiences uncertainty because of shortages in resources and the nature of the project.

Construction workers are not machines, always behaving the same way under the same conditions. Even under apparently identical work conditions, different productivity values might be obtained. The productivity for the same work item is not constant throughout the construction period, and varies at different stages of the production (Aynur and Serdar, 2004).

2.2.2 A. project resources plan (people, materials and equipment).

A. Human resources plan

Labor is defined as the on-site workforce employed by contractors (Olomolaiye at el 1999). Human Resource Management (HRM) is of strategic importance in all organizations. It contributes to the success of the organization and creates competitive advantage for the organization. The way HRM practices and policies take shape also affects the employee's experiences of work and the employment relationship. HRM is therefore important in any organization (Martina at el., 2007) .

HRM includes: organizational planning, staff accusation, and team development. However, training and motivation are the two main parts of team development practices (Tobass and Bakar, 2009).

Human resource management (HRM) has been broadly defined as a field of organizational activity and professional practice. It has remained a complex and obscure entity, variously interpreted by practitioners and researchers (Tobass and Bakar, 2009).

It is generally accepted that human resources (HR) represent the most variable, uncontrollable, and important element in production. Moreover, because HR serves as the connecting link in all production inputs appropriate to clients demands (Aynur and Serdar, 2007).

With rapid changes in technology, worker's needs, current market, and competitive environment, planning for human resource have become an important and challenging task for development. HR planning involves plans for future needs of employees, their required skills, acquisition of employees, and personnel development (Tobass and Bakar, 2009).

With the increasing complexity of modern construction project demand for efficient and competent managers in the industry grows. A manager must be able to organize not only technologies but also human resources. Managers are responsible for selecting, obtaining, distributing, organizing, and putting to use all of those resources that are necessary to pursue and achieve an organization's objectives (Olomolaiye et al., 1999).

Manpower or labor has four major aspects that are of interest to management properly understand the management and control of labor as a resource, the manager must be aware of the interplay among the following elements: labor cost & labor productivity, labor organization (Halpin & Woodhead, 1998).

2.2.3 Labor Cost

There is no doubt that construction is a key activity within any economy; it influences, and is influenced by, the nation's gross domestic product (GDP) (Cox *et al*, 1998, cited in Enshassi et al., 2007).

Aynur and Serdar (2004) the construction process results in relatively high costs and labor becomes a more important input in the production phase. Moreover, the labor cost is somewhere between 20% and 50% of the total project cost and reduction of these costs can be best carried out by the productivity improvement.

Labor typically represents approximately 35% of total construction costs, an important responsibility of the construction planner is to determine necessary requirements, management supervisory and manual levels) for each project Judicious planning of

labor resources can contribute towards controlling project costs, improving quality and optimizing construction output (Olomolaiye et al., 1999).

The construction sector has a strategic role in all developed and developing countries. Employing more than 7% of Europe's work force, the sector is the largest industrial employer in the continent. Similar to Europe, construction industry accounts for some 14% of the gross national product and about 8% of total employment in the US (Aynur and Serdar, 2004).

Recent statistics estimate construction investment in the European sector, representing approximately 12% of GDP. Employing more than 7% of Europe's work force, the sector is the largest industrial employer in the continent and represents enormous potential opportunities for those contractors able to successfully compete with 'foreign' competition. In a construction context, this competitive aspect has created a need for comparative international productivity rates to be established (Olomolaiye et al 1999).

Construction investment is generally 3–10% of a nation's gross domestic product (GDP), and construction investment in Korea is 15% of the GDP. Then productivity improvement in the construction industry is more influential in improving GDP than it is in any other industry, also construction companies have placed a high priority on productivity to enhance their profits and ensure competitiveness (Gwang et al., 2005).

According to Aynur and Serdar (2004) labor represents even the most significant risk to contractors. Construction industries in many developed and developing countries suffer from delays and cost overruns due to labor productivity.

Improved productivity is a vital tool in countering inflationary effects and determining wage policies. Improved productivity is thus always counted among the basic means of solving economic problems. It is increasingly recognized that capital alone is an inadequate means of producing more wealth or for starting a business in developing countries increased productivity enhances investments without any burden to governments (Aynur and Serdar., 2007).

Investment strategies occur along several dimensions such as capabilities of the company resources, pricing (financial decisions), product (construction project-related factors and finally research and development(Zeynep et al., 2008) .

Schedule management enables the project to complete on time by the use of a series of processes, including activity definition, sequencing, resource estimating, duration estimating, schedule development and schedule control. A project manager has to be familiar with the project environment and the conditions that may be the cause of potential delays. Cost management activities include planning, estimating, budgeting, and controlling the costs of the project. All these activities ensure the lowest possible overall project cost consistent with the owner's investment objectives (Zeynep et al., 2008).

Health and safety management aims to reduce the number of accidents and accidents' effects on project costs such as the cost of insurance, inspection and conformance to regulations. Potential solutions to health and safety problems include providing safety booklets, safety equipment, and a safe environment; appointing a trained safety representative on site; training workers and supervisors; and using new technologies (Zeynep et al., 2008).

Labor requirements, by contrast, are often seen as not nearly so important. This derives from a lack of knowledge and appreciation of the true cost of labor, which has been defined as: the cost to the employer of having an operative on the books, having paid all legally laid down contributions for which the employee has no responsibility (Olomolaiye et al., 1999).

A quick and reliable method of estimating the labor resource requirements and cost is desirable at the project inception stage. Labor productivity estimates are often performed by individuals using combinations of analytical techniques and personal judgment (Aynur and Serdar, 2004).

By carrying out an accurate comparison with plant operating costs, it becomes clear that plant can be relatively inexpensive compared to labor some contracting firms may not employ any direct labor at all. In these circumstances, senior management may argue that all problems related to labor are subcontractors' concern. Then, in the planning stage, a proper assessment of the required (subcontract) labor force has been made, site management cannot assess and monitor the efficiency of subcontractors when the project commences. Where the labor force is directly employed, competent assessment

of output (productivity and quality) is crucial to cost effective working in a highly competitive environment (Olomolaiye et al., 1999).

The success of a construction company in today's competitive market largely depends on accurate estimation of productivity, and a reasonably correct assessment of the labor cost is fundamental to the accuracy of any estimate (Aynur and Serdar., 2004).

2.2.4 Labor productivity

A variety of definitions of productivity : (Lema, 1995; Pilcher, 1997; Oglesby, 2002 sited in Enshassi et al. 2007). Productivity has been generally defined as the ratio of outputs to inputs.

Labor productivity is also one of the most important risks in construction projects (Aynur and Serdar, 2004).

Due to its critical importance to the profitability of most construction projects, productivity is regarded as one of the most frequently discussed topics in the construction industry (Korb and sheriff, 2003).

Aynur and Serdar (2007) summarized the advantages of productivity improvement can be as follows:

- Decreased total cost and duration of production.
- Improved quality.
- Growth in market share of product.
- Increased employment and wages without inflationary pressures.
- Enhanced purchasing capacities among employees, employers, and customers.

With effective utilization of HR, the productivity of all other production inputs (such as materials and equipment) is simultaneously enhanced, and all of the benefits available through improved productivity are realized (Aynur and Serdar, 2007).

Unemployment continues to be a problem in most developing countries (such as Turkey), while a lack of qualified labor in these same countries ensures a continuation of poor productivity (Aynur and Serdar, 2007).

Most manufacturing industries, construction usually takes place in an open area and thus has the variation of the physical environment, including the thermal environment (Sherif and Korb, 2005).

It is acknowledged that the thermal environment affects labor efficiency and may reduce their productivity (Thomas et al., 1999 cited Sherif and Korb, 2005).

Existing knowledge about physiological and psychological effects of thermal conditions seems inadequate and does not provide construction planners or estimators with sufficient information and understanding to deal with the impact of thermal environment variations on productivity, especially during the planning stage (Mohamed and Srinavin, 2001 cited Sherif and Korb, 2005).

Certain climatic conditions seem to have a negative effect on labor productivity. Productivity gets reduced due to the discomfort associated with noticeable thermal environment variations. For example, strong radiation from the sun causes workers to feel exhausted and seek more rest under shelter. Working in very hot weather also has physiological and psychological effects on workers; it reduces their productivity, and increases their irritability and loss of their enthusiasm for their work (Hancher and Abd-Elkhalek, 1998 sited Sherif and Korb, 2005).

Improving productivity is a major concern for any profit-oriented organization, as representing the effective and efficient conversion of resources into marketable products and determining business profitability (Wilcox *et al.*, 2000 cited in Enshassi at el., 2007).

2.2.5 Labor organization

Zeynep et al. (2008) said that a company's resources and capabilities may be defined as its tangible and intangible assets. They include the company's financial resources technical competencies, leadership characteristics, experience, and image in the industry.

Construction companies should be cognizant of their strengths and weaknesses in order to overcome the challenges of increased competition. However, the intangible nature of corporate level characteristics makes it difficult to assign them as strengths/weaknesses (Arditi and Lee, 2003 cited in Zeynep et al., 2008) .

A company is an organization that supports the many projects undertaken by the company, generally in different geographical locations and administered by quite autonomous project managers but relying heavily on the support of the head office. In that sense, every project is somewhat influenced by the policies and culture of the central company organization (Zeynep et al., 2008).
Gwang et al. (2005) advised that construction companies must make more effort to improve productivity in high-rise building construction.

HR is recognized as a vital strategic resource for any organization in ensuring improved productivity and industry competitiveness (Aynur and Serdar, 2007).

2.2.6 Strategic decisions

Market, project client, and partner selection strategies are related to characteristics of such as market conditions, the location and complexity of the project the financial stability of the client, and potential partners that have capabilities that the company does not possess (Zeynep at el.,2008).

Organizational management strategies involve decisions pertaining to the company's reporting structure, planning, controlling and coordinating systems, as well as the management of the informal relations among the different parties within the company (Barney;1991sited in Zeynep et al., 2008).

2.2.7 Specific requirements for HRM in the project-oriented company

(Martina et al. (2007) suggests that project-oriented companies are ones in which the people of the organization:
-Define management by projects as their organizational strategy;
- Apply projects and programs for the performance of complex processes;
- Manage a project of different internal and external project types;
- View the organization as being project-oriented.
The ideal project-oriented company is often described as a flat organization with a strong project management culture. In essence, what defines a company as project-oriented is that these companies perceive themselves as being project-oriented and

shape their policies and practices for working, for organizational culture and for strategy towards the challenge presented by managing projects. Project-oriented companies may be found in many different industries including the public sector. Organizations can vary in the degree of their project-orientation, depending for example on the size, the number and the types of projects they carry out. These impact the relation between the stable line organization and the temporary organizations, carried out in the project-oriented company. Thus the project-oriented company is a construct. An organization may choose that project-orientation is the adequate working form for them as a whole (as in a construction company) or only for some of their organizational units (as in the product development department of a manufacturing company).

2.2.8 Strength of relationships with other parties

Zeynep et al. (2008) assert that the strength of a company's relationships with other parties constitutes a social dimension of project environment. The strength of relationships with the parties involved in typical construction project such as public or private clients, regulatory agencies, subcontractors, labor unions, material dealers, surety companies, and financial institutions constitute an important aspect of a company. Relationships with clients rely on the communication and negotiating skills of company executives. The difficulty of achieving strong relationships between clients and contractors has always been a matter of concern, but recently the importance of cooperation and trust between clients and contractors has been understood somewhat better. The awareness of the influence of good relationships on performance encouraged contractors to recognize clients' basic expectations relative to cost, time and quality.

2.2.9 Most common factors affect labors management

Aynur and Serdar (2007) advised that there are many factors affect the productivity of employee's. Among these factors, economic factors and socio psychological.

2.2.9.1 The economic factors are:

- Timeliness of remuneration;
- Amount of remuneration;
- Social insurance;
- Incentive payments;
- Job security; and
- Union membership.

2.2.9.2 The socio psychological:

-Work discipline;

- Health-and-safety conditions;

- Work satisfaction;

- Creating competition;

- Relations with workmates;

- Giving responsibility;

- Sharing problems and their results;

- Social activity opportunities;

- Cultural differences;

- Worker participation in decision-making;

- Distance from home; and

- Distance from population centers.

Heizer and Render (1990) cited Enshassi et al., (2007) classified factors influencing site productivity into three groups: labor characteristic factors; project work conditions factors; and nonproductive activities.

Gwang et al., (2005) the factors of construction productivity improvement are divided into headquarter-type factors and site-type factors. Headquarter-type factors include elements such as planning, scheduling, and estimating, and site-type factors include elements such as materials, labor, and methods. Among these site-type factors, construction method is a significant one, having impact on construction productivity.

Lim et al., (1995) cited in Enshassi et a.,l (2007) there are many factors affecting productivity in the construction industry in Singapore. Their findings indicated that the most important problems affecting productivity were: difficulty with recruitment of supervisors; difficulty with recruitment of workers; high rate of labor turnover; absenteeism from the work site; and communication problems with foreign workers.

Zeynep et al., (2008) the selection of these factors was based on their potential to impact the success of a project through the implementation process. Such as communication, control mechanisms, feedback capabilities, troubleshooting,

coordination, decision making, monitoring, project organization, planning and scheduling, and management experience.

Olomolaiye et al. (1996) sited in Enshassi et al. (2007) studied factors affecting productivity of craftsmen in Indonesia, with their findings indicating craftsmen in Indonesia spent 75 % of their time working productively. Five specific productivity problems were identified: ie lack of materials; rework; absenteeism; lack of equipment; and tools.

Korb and Sherif (2003) there are many factors influencing construction productivity such as:

Change orders, design complexity, design changes, site congestion, material management, sub-contractor, tools availability, site layout, equipment availability, construction method, learning effect, weather conditions, absenteeism, schedule overtime, skill, Crew size, labor supply, construction volume, unemployment, regulatory requirements, economic conditions, social factors.

Shahriyar and Fereydoun (2008) assert these factors may be divided to industry-level, company-level, and project level. Some of the productivity factors at industry-level include governmental interference, regulation burdens, local unions, and politics. Some of the factors that are at project level are labor-related and include motivation, experience, skill, and training. Some of the factors that are at company level are management-related and include planning and direction of project material availability.

Thomas et al. (2004) identifying factors that is likely to induce the demonization of workers and their effects on the productivity of workers in civil engineering projects are overcrowded work areas, crew interfacing, tool availability, inspection delays, foremen changes, foremen incompetence, and material availability.

2.2.10 Recent Studies of Effectiveness of labors management

Thomas et al. (2004) identify the main demotivators affecting civil engineering workers and their impact on productivity, a questionnaire survey was carried out in Hong Kong. This consisted of three parts. The first part concentrated on potential demotivators. The

second part, respondents were requested to estimate the time loss (expressed as hours per week) caused by each demotivator identified. The final part of the questionnaire aimed to elucidate the reasons for demotivation and time loss. This involved a total of 120 respondents, 15 foremen, 44 plant operators, 38 carpenters and 23 steel fixers .They concluded that the total time lost in the seven civil engineering projects surveyed due to demotivation of workers ranged from 5.1 to 13.6 man-hours/ week—the most significant time loss being caused by lack of materials availability, overcrowded work areas, and rework. These could be a result of ineffective management and poor communications on site.

Shahriyar and Fereydoun (2008) identify the major factors influencing productivity of construction projects. These factors are skills, experience of workforce, management, job planning, workers motivation, and material availability. The questionnaire utilized in the survey contained three categories. The first category intended to collect information about the construction contractors that participated in the study. The second category related to profile of respondents from the firm. The third category related to ranking of productivity factors. They conclude that improvement in productivity is achievable by changing the work practices in the field and directing attention to implementation of best practices at construction jobsites. Some of the best practices identified in relation to the major productivity factors in construction building were presented in this research.

Enshassi et al. (2007) investigated 45 elements affecting labor productivity within building projects, and to rank these factors according to their relative importance from a contractor's viewpoint. The analysis of 45 factors considered in a survey indicates that the main factors negatively affecting labor productivity are: material shortage**,** lack of labor experience**,** lack of labor surveillance**,** misunderstandings between labor and superintendent**,** and drawings and specification alteration during execution. They recommended that contracting companies should provide a materials supply schedule for each project.

Aynur and Serdar (2007) identified factors affecting productivity among members of the construction workforce in Turkey. A survey of 82 construction firms in Turkey is undertaken using a questionnaire of 54 questions directed to managers, engineers, architects, and other technical staff. Using the results of the survey, economic and

socio-psychological factors that affect labor performance are evaluated and discussed in detail. They found only a small difference between the significance accorded to economic factors and the significance accorded to socio-psychological factors in promoting improved productivity.

Aynur and Serdar (2004) investigation of construction labor productivity described as numerical values. First, a general knowledge is given about labor productivity. Then, the system which is the source of it is carried out. To this aim, labor productivity rates of 82 work items were obtained by a questionnaire applied to planning engineers, site managers, sub-contractors, architects and consultants of 32 large-scale construction firms in Turkey. The results were evaluated by one sample t-test. They concluded it could be benefited from skilled workers who are more knowledgeable concerning the causes of poor productivity than their managers and qualification of manpower might be improved by short training programmers or day release courses in educational establishments.

Zeynep et al. (2008) explore the factors that can enhance project management competencies. In this study, it was hypothesized that "project management competencies" are influenced by "corporate strengths/weaknesses". "Corporate strengths/weaknesses" was defined as a second-ordered construct composed of three latent variables including the company's resources and capabilities, its strategic decisions, and the strength of its relationships with other parties. The data obtained from a questionnaire survey administered to 73 contractors were analyzed using structural equation modeling (SEM). They suggested strong relationships (may be exploring partnering relationships) should be developed with prospective clients, unions, and government.

2.3 CONSTRUCTION EQUIPMENT MANAGEMENT

2.3.1 Introduction

The cost of equipment in projects varies from 10 to 30 % of the total cost of the project, depending upon the extent of mechanization. In modern fully mechanized project the cost of equipment goes up to 30%. Proper planning, selection, procurement, installation, operation, maintenance and equipment replacement police plays an important role in equipment management for the successful completion of the project. With the growing use of machinery it has become necessary for construction engineers to be thoroughly familiar with the construction application and upkeep of the wide range of the modern equipment. Since modern construction projects require a huge amount of capital, we have to adopt latest technology, modern equipment and modern management techniques to achieve economy, quality and quick results (Sharma, 1997).

2.3.2 Equipment planning

The purpose of equipment planning is to show the separate size and types of equipment required on rent, lease or outright purchase. Construction equipment and plant refers to the tools, instruments, machinery, and other mechanical implements required in performance of construction work. Construction plant is defined as concrete batch plants, aggregate-processing plants, conveying systems. And any other processing plants that are erected in place at job site and essentially stationary or fixed in place. Equipment is defined as items that are portable or mobile ranging from small hand tools through tractors, cranes, and trucks. For estimating purposes, plant and equipment are grouped together as equipment costs (Rajiv, 1994).

Sharma (1997) assert that the modern construction projects are complex in nature and success of a project depends greatly on proper and scientific planning. Before starting every project is done with great care, as the efficiency of the whole project largely depends should be worked out in anticipation and should be considered craftily.

Planning of a construction project involves deciding about the extent of mechanization equipment planning execution planning ect. While planning a project we must very carefully decide about the extent of use of construction equipments. On major construction projects mechanization is indispensable; while for middle and minor

construction projects a compromise between manual and mechanical means have to be made. In a country, like India where man-power is cheaply and easily available we can take advantage of this facility especially for the activities which can be easily carried out by the manpower. However, a combination of manual labor and machines is preferred (Sharma,1997).

2.3.3 Selection of equipment

Thomas et al. (2009) said about an important consideration in the preparation of an estimate is the selection of the proper equipment to perform the required tasks. The estimator should carefully consider number, size and function of equipment to arrive at optimum equipment usage.

2.3.4 Some factors to consider during the selection process are

Sharma (1997) summarized the factors which effect selection process such as: availability of space, mobility and availability of equipment, equipment capabilities, distances material must be moved, steepness and direction of grade, weather conditions, hauling restrictions & mobilization. Proper selection of equipment for a construction project is of vital importance for its speedy and economical completion. Problem of equipment selection has become more complicated, because large variety of equipments are being manufactured now-a-days.

Sharma (1997) said that the proper selection of equipment, a considerable experience in the operation and maintenance in the field is essential. Records kept for operation, maintenance and actual obtained under comparable conditions of previous projects will greatly help in taking decision for equipment selection.

Following are the main points which should be considered in the process of equipment selection:

- Suitability for job conditions.
- Size of the equipment.
- Standardization.
- Availability of equipment in the market.
- Multipurpose equipments (versatility).

2.3.5 Equipment Cost

The actual charge against the project budget depends on whether the equipment is leased or rented for the job or is owned by the company. If it is leased for the project duration or some part thereof, the lease cost will directly change to the project. Time cards, similar to labor time cards, will be used to record the actual time spent by the equipment and operation personal; if the lease payment are based on fixed monthly charge plus an hourly rate, the recorded hours will become part of the payment basis. In the case of an hourly rental arrangement, the actual hours will be multiplied by the hourly rate to determine the payment (Clifford and Richard, 2003).

In management the cost aspects of jobsite equipment operation, the contractor records and works with two types of data, the time the equipment is operated and the rate to be charged for each hour of operation (Clifford and Richard, 2003).
Sharma (1997) said that a cost reduction in construction can be achieved adopting following ways:

- Proper planning
-Timely supply of funds, equipment materials, and personnel (i.e. men, material and machines)
- Proper equipment planning and selection. For this engineers should keep informed on the development of new construction equipment.
- Proper equipment operation, maintenance and utilization.
- Adopting proper inventory control.
- Engaging experienced operators.
- Monitoring progress and adopting scientific methods.
- Ensuring continuous supervision.
- Adopting innovations and latest techniques suitable for the job. If necessary, modify the design or construction methods to permit the use of economical equipment.
- Eliminate unnecessary construction requirements.
- Use local materials when they are satisfactory.

Equipment manager's main task is to reduce downtime, achieve optimum equipment utilization and increase production at minimum cost. The cost analysis and the will of

adopting proper techniques suited to the situation are the basic factors for the success and therefore, there is a need for a rational planning, proper selection, and judicious deployment of equipment in relation to the conditions so as to achieve optimum utilization. Equipment engineer should coordinate with various wings of the organization in discharging his job of equipment planning, balancing, selection of equipment and its utilization, personnel selection and training financial planning, preventive maintenance and general supervision. Thus equipment management integrates and continuously interacts with human, technical, financial and production system in order to achieve top efficiency and cost effectiveness (Sharma,1997).

2.3.6 Training equipment operators

Sharma (1997) assert that the best equipment of the world is valueless without the competent operator. A little thought is given as to who will run this equipment and how they will be trained to make maximum use of their capabilities. Most operators have acquired their skills by self-instruction or from other operators mostly by trial and error. Contractors have now begin to realize that such a haphazard approach is wasteful and can be dangerous. With equipment becoming more sophisticated each day, it is not desirable to have just any one learn how to operate machine on a trial and error basis. Such operators have little knowledge of the special features built into the equipment they drive. Realizing this problem, manufactures have started helping the users to make best use of the equipment. Following are the few methods out of which one or more methods are being adopted by most manufactures.

-Lecture.
-Study Booklets
-Work sessions
-Operator-trainer discussions.
-Practical- training on grounds resembling the work site.
-Training in the training center.
-Motion picture films in which an experienced demonstrator-operator helps to train new operators. These films are available and video-cassette form.

Thomas at el. (2009) summarized many factor affecting on equipments such as:

External factors: Government policy, Political situation, Interest rate and bond/loan terms, Insurance terms, Market condition, Project procurement method, Machine/plant/equipment price and size of project.

Internal factors: Cash flow, Profit, Relationship with main contractor/client/consultant, Number of contracts completed, Staff qualification/skill, Staff training, Staff performance, Adoption of new technologies/methodologies, Management level leadership, Company quality system, Company safety performance, Payment method, Number of contracts completed, Reputation and Company history, Machine/plant/equipment performance.

CHAPTER (3)

METHODOLOGY

3.1 Introduction

This chapter includes the methodology used in this research. It provides the information about the research strategy, research design, population, sample size, various approaches to data collection and data analysis. It also identifies the questionnaire design, pilot study, validity content, and reliability.

3.2 Research strategy

Research strategy can be defined as the way in which the research objectives can be questioned (Naoum, 2007). The explanation of mass behavior often requires mass attitude data that can only be obtained by a survey (Weisberg and Bowen, 1977). The people who provide information to the researchers are referred to as subjects, study participants, or respondents in quantitative research or as study participants or informants in qualitative research (Polit and Hungler, 1999). There are two types of research strategies, namely, .quantitative research and qualitative research. (Naoum, 2007). Data may take the form of narrative information (qualitative data) or numerical values (quantitative data), (Polit and Hungler, 1999). Quantitative research is objective in nature. It is defined as an inquiry into a social human problem, based on testing a hypothesis or a theory composed of variables, measured with members, and analysis with statistical procedures (Naoum, 2007). Quantitative researchers focus on the relationship between the independent variables and dependant variables (Polit and Hungler, 1999). Quantitative research is an objective measurement of the problem.

In this study, the questionnaire of this study is designed to get the factual information about local practices of contractors in managing construction resource in building projects as well as the opinions of contractors about these practices.

3.3 Research design

The purpose of this research is to explore the current practices of construction resources management of building projects and develop a computerized resources management

system to be used in resources management works. A structured questionnaire with closed personal interviews is used together in this research.

The structured questionnaire is probably the most widely used data collection technique for conducting surveys. Questionnaires have been widely used for descriptive and analytical surveys in order to find out facts, opinions and views (Naoum, 2007). It enhances confidentially, supports internal and external validity, facilitates analysis, and saves resources. The advantages of interviews as summarized
by Naoum (2007) are:

- The response rate is relatively high.
- Providing more accurate answers and
- Eliminating the tedium and idleness of the responds.

Data collected in a standardized form from samples of population. The standardized form allowed the researcher to carry out statistical inferences on the data, often with the help of computers. Using a questionnaire has some limitations such as: it must contain simple questions, no control over responds and respondents may answer generally (Naoum, 2007).

3.4 Literature Review

The literature review involves reading and appraising what other people have written about the subject area (Naoum, 2007). The literature review serves two purposes. First, it seeks systematic reading of previous information which is related to the area of investigation. The gathered information will develop issues and ideas and should drive to the next important stage, namely, research design. Second, the literature review helps the researcher to improve his research study by giving him some insights into how he can design his own study (Naoum, 2007).

A survey and a review for relevant books, journals and papers are conducted. In addition to these sources of data, a search in internet websites is carried out to get relevant information. The researcher also searches the websites to have information about software that are related to research topic.

3.4.1 Limitation of the research

The study is limited to Gaza strip contracting companies that are classified as first, second and third degrees, which have a valid registration in Palestinian Contractors Union (PCU). The subcontractors and contracting companies of fourth and fifth categories were excluded because these companies are too small to have specific arrangements for resources management.

3.4.2 Data collection and questionnaire design

In this research, few methods of data collection were used including observation, documentations, interviews and questionnaire and documentary analysis. The good design of the questionnaire is a key to obtain good results and warranting a high rate of return. The questions of the research questionnaire are constructed based on:

- Literature review.
- Several interviews with contractors to obtain different thoughts, which can be useful for creating questions.
- The experience of the researcher and some engineers in construction management in Gaza Strip.

The questionnaire was built mainly using closed questions, and it was divided into five sections as follows:

Section one: company profile, which includes 7 items.

Section two: construction materials management in construction projects, which includes 53 items.

Section three: construction labors management in construction projects, which includes 45 items.

Section four: construction equipments management in construction projects, which includes 12 items.

Section five: Computer applications in resources management systems in construction projects, which includes 21 items.

The questionnaire was developed in Arabic (Annex 1) to be more understandable by respondents. An English version is prepared (Annex 2) to help in documenting this research.

3.5 Field work research

The problem solving approach accompanied with a field survey was adopted for conducting this research.

A questionnaire was designed and constructed to survey the situation and reality of construction resource management practices of Gaza Strip contracting companies. The data which was collected by the questionnaire is analyzed and discussed.
Figure 3.1 illustrates the methodology flow chart.

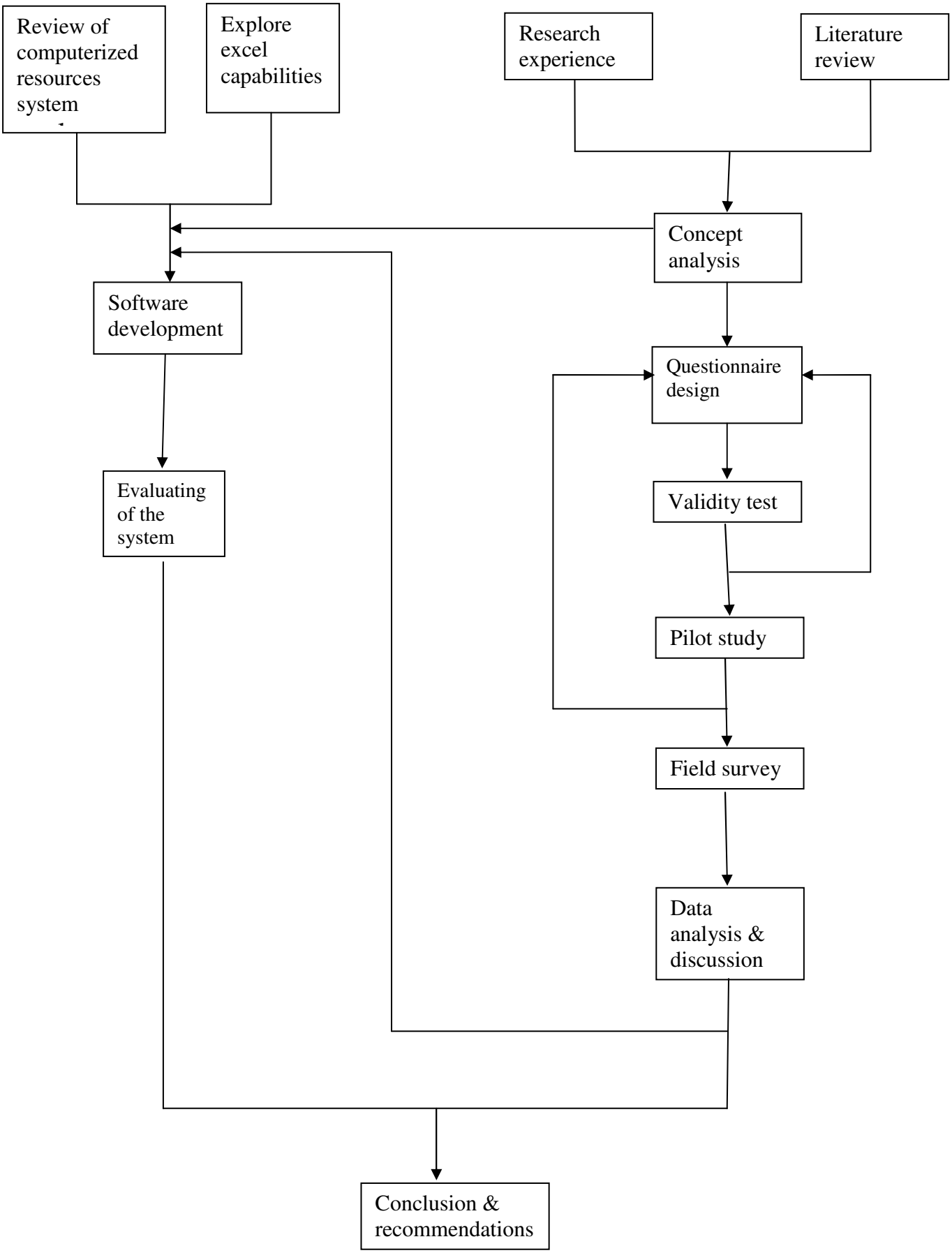

Figure (3.1): Methodology flow chart

3.6 Validity test

Using expert validity, the questionnaire may be sent to experts in a particular field of research across the area for their evaluation of the content (Burns and Grove 1995).
After preparing the questionnaire in its initial form, the researcher presents it to five experts to examine its validity. The five experts are two lecturers in a University, two contractors and one expert in construction management field. The experts generally manifest comforting complacence toward the questionnaire. However, they provide the researcher with some comments and suggestions which are taken into consideration while modifying the questionnaire structure.

3.7 Pilot study

A pilot study provides a trial run for the questionnaire, which involves testing the wording of questions, identifying ambiguous questions, testing the technique that used to collect the data, etc. (Naoum, 2007). After the preliminary testing, a pilot study was conducted to evaluate the questionnaire; the researcher distributed the questionnaire to a sample of five different contracting companies to fill them. The purpose of this step is to discover if the questions are well understandable or not, also to find out any problem that may raise in filling the questionnaire. Generally speaking, it appeared that respondents had no difficulty in understanding the items or the instructions to complete the questionnaire.

The validity content of the questionnaire was tested by the five contractors. Each of them has full information about the research objectives. Each of them was requested to evaluate validity content for each item based on rating the index of content validity.
The contractors were then requested to rate each item based on relevance on the four point ratings scale. The point scale developed by Yaghmaie (2003) as "1 = not relevant; 2 = item need some revision; 3 = relevant but need minor revision; 4 = very relevant". Based on comments of the contractors some minor changes, modifications, and addition were introduced to the questions.

3.8 Reliability of research

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

Chronbach's coefficient alpha (George and Mallery, 2003) is designed as a measure of internal consistency, that is, do all items within the instrument measure the same thing? Chronbach.s alpha is used here to measure the reliability of the questionnaire between each field. The normal range of Chronbach.s coefficient alpha value between
0.0 and + 1.0. The closer the Alpha is to 1, the greater the internal consistency of items in the instrument being assumed. The formula that determines alpha is fairly simple and makes use of the items (variables), k, in the scale and the average of the inter-item correlations, r:

$$\alpha = k\, r / 1 + (k - 1)\, r$$

As the number of items (variables) in the scale (k) increases the value α becomes large. Also, if the intercorrelation between items is large, the corresponding α will also be large.
Since the alpha value is inflated by a large number of variables then there is no set interpretation as to what is an acceptable alpha value. A rule of thumb that applies to must situations is:

$0.9 \le \alpha \le 1.0$ Excellent

$0.8 \le \alpha < 0.9$ Good

$0.7 \le \alpha < 0.8$ Acceptable

$0.6 \le \alpha < 0.7$ Questionable

$0.5 \le \alpha < 0.6$ Poor

$0.0 \le \alpha < 0.5$ Unacceptable

The Chronbach.s coefficient alpha was calculated for each field of the questionnaire. The most identical values of alpha indicate that the mean and variances in the original scales do not differ much, and thus standardization does not make a great difference in alpha.

Table 3.1: Alpha for each filed of the questionnaire and all the questionnaire

Field	Cronbach's Alpha
Materials waste	0.694
Implementation of construction materials management	0.721
Evaluate the importance of implementing materials	0.822
Factors increase waste on the construction site	0.896
Factors causes crease the productivity of the workers	0.842
Factors affect in reducing the productivity of the workers	o.784
The impact of the workers increasing the duration and cost of the project	0.755
Factors affect in 1ncresing duration and cost the project	0.857
The important of computer use in the management of	0.645
The obstacles effect for using computer in resource	0.581
Total	

3.9 Questionnaire distribution

The target groups in this study are contractors. According to the Palestinian Contractors Union in Gaza strip, there are 120 contractor organizations.

Kish (1965) showed that the sample size can be calculated as following equation for 94% confidence level.

$$n = n' / [1 + (n'/N)]$$

Where:

- N = total number of population
- n= sample size from finite population
- n' = sample size from infinite population = S^2/V^2; where S_2 is the variance of the population elements and V is a standard error of sampling population. (Usually S = 0.5 and V = 0.06) (Assaf et a.,l 2001, Israel, 2003, Moore et al., 2003).

So, for 120 contractor organizations:

- n= n'/ [1+ (n'/N)]
- n'= $S^2/V^2 = (0.5)_2/(0.06)_2 = 69.44$
- N = 120
- n= 69.44/ [1+(69.44 / 120)] = 46

This means that the questionnaire should be distributed to 46 contractor organizations in order to achieve 94% confidence level.

3.10 Data measurement

In order to be able to select the appropriate method of analysis, the level of measurement must be understood. For each type of measurement, there is/are an appropriate method/s that can be applied and not others. In this research, ordinal scales were used. Ordinal scale as shown in Table 3.2 is a ranking or a rating data that normally uses integers in ascending or descending order. The numbers assigned to the important (1, 2, 3, 4, 5) do not indicate that the interval between scales are equal, nor do they indicate absolute quantities. They are merely numerical labels. Based on Likert scale we have the following (Cheung et al., 2004; Iyer and Jha, 2005; Ugwu and Haupt, 2007):

Very high important	5
High important	4
Medium important	3
Low important	2
Very low important	1

The relative importance index is computed as (Cheung et al., 2004; Iyer and Jha, 2005; Ugwu and Haupt, 2007):

$$RII = \sum W/(A \times N)$$

Where:

- W is the weight given to each factor by the respondents and ranges from 1 to 5
- A = the highest weight = 5
- N = the total number of respondents

3.11 Interview

The researcher interviews the contracting companies representatives and asks them to fill the questionnaire during the interviews. The interview gives, to a far extent, accurate and clear answers due to the clarifications which are made by the researcher. The interviews have many advantages such as:

- Providing high percentage of responses.
- Decreases the possibility of understanding the question in several perceptions by the respondents. The interviewer introduces the questions by the same way for all respondents. This gives all respondents common ground for answering the questions.
- Providing clear replies.
- Eliminating the tedium and idleness of the respondents.

Of course, the interviews need much time to fill the questionnaires. This disadvantage is relatively minor compared with the above mentioned advantages.
Before carrying out an interview, the questionnaire is sent to the company and specific time and date are determined for interview.

This provides a chance for the contractors to study the questions before answering them. In the beginning of the interview the researcher introduces himself to the respondent to create a friendly atmosphere, and then he thanks the respondent and affirms that all the data to be collected would be used only for the research and would not be transferred to any other institution.

In the interviewing procedure, the researcher has been cautious not to be biased and not to direct a contractor to specific answers. In the end of the interview, the researcher expresses his deep thanks to the respondent for his effort and time. It is important to say that during the interviews many contractors show their interest in the subject matter.

3.12 Population and sample

The studied population includes the contracting companies in Gaza Strip who have a contractor's union valid registration in June 2011. As resource management is a somehow sophisticated activity, the researcher addressed his study towards the top contracting companies of the first, second, and third class according to the contracting Union classification.

3.13 Data coding and data analysis

The use of computers requires that answers given by the respondents be coded into numbers before the actual data analysis (Weisberg and bowen, 1977). The coding process for closed ended questions consists of recording the number of response. The response categories must be mutually exclusive, so no answer can fit more than one of the categories (Weisberg and bowen, 1977).

The returned questionnaire was numerically coded to enter the data systematically and efficiently. Data was entered using the statistical package for social sciences (SPSS) software. Double check, manually and by computer, was made to ensure data cleaning. Statistical analysis for the data was conducted using the SPSS as follows:

- Defining and coding of variables.
- Summarizing the data on raw data sheet.
- Entering data.
- Cleaning data (Double check).

After applying the above-mentioned steps, the descriptive statistic method has been used. The descriptive method is one of analysis method which provides a general overview of results. It gives an idea of what is happening (Naoum, 2007). In this study, frequency distribution and percentage were used to describe aspects of data.

The researcher uses this method because large amounts of data were gathered. It is often useful to distribute the data into categories and to determine the number of individuals or cases belonging to each category. This is called "category frequency"

(Naoum, 2007). In this research, the data were presented in forms of tabulation, bar charts, and pie charts

.

3.14 Developing and evaluating the computerized system

The researcher has developed tailored construction resources management software that suits Gaza Strip contracting companies. This software was developed depending on survey results, literature review, the experience of the researcher and other experts in construction resource management in Gaza Strip, and the relevant computerized packages that the researcher reviewed such as Navon study (2002). He developed and evaluated an automated model for management and control of materials ordering, purchasing, and supply and use. In order to evaluate the model under real conditions, the model was implemented in a prototype system and used in ongoing construction projects. The software was developed using PHP programming. These skills increased the capability of the researcher to develop the software.

Software initial frame work is illustrated in figure (3.2).

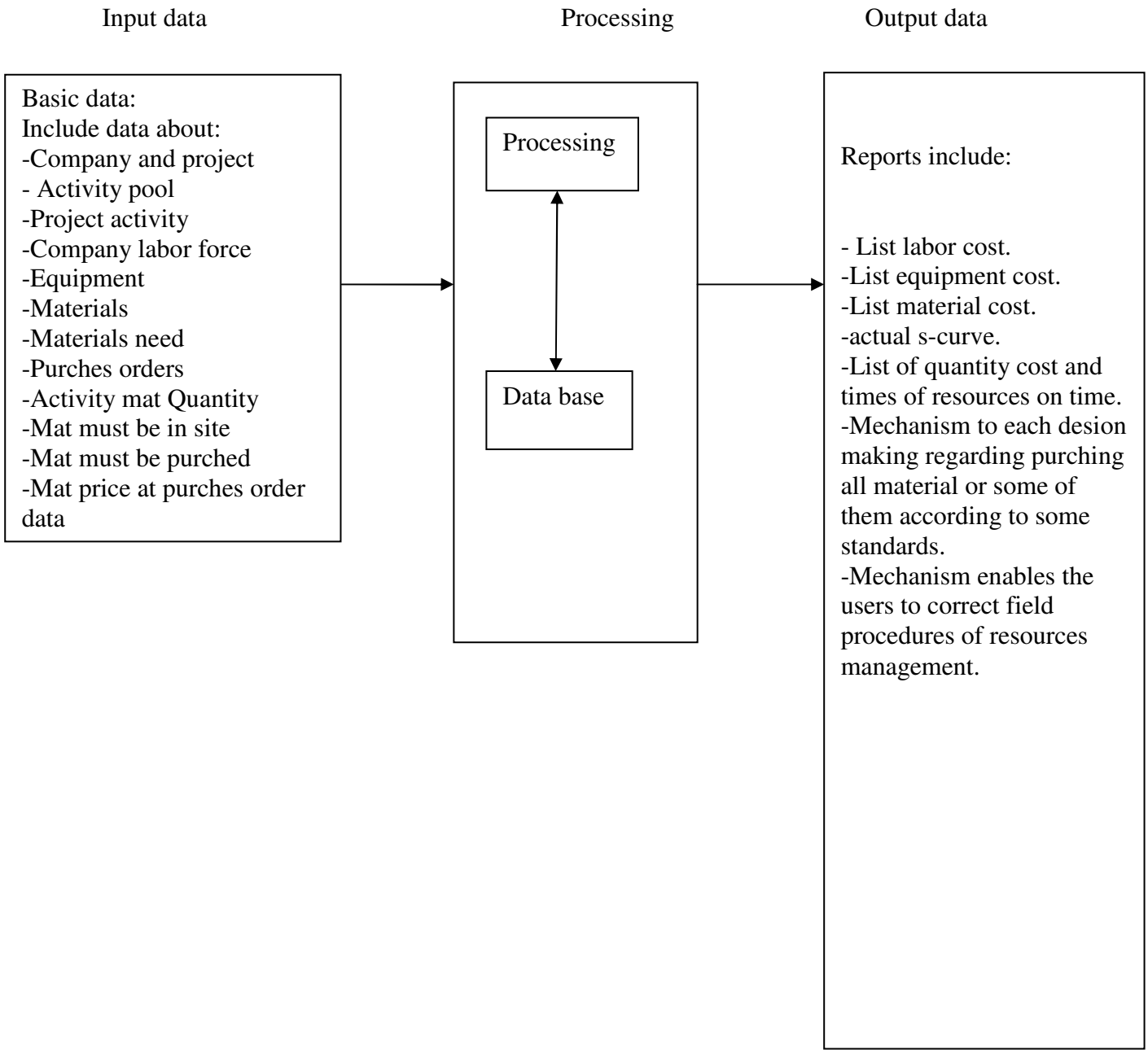

Figure (3.2) construction resources management system

CHAPTER (4)

SURVEY RESULTS

4.1 Introduction

In this chapter, the results of the field survey are presented and discussed. The chapter illustrates and discusses the characteristics of the study population, application of construction resources management tools and techniques in construction projects, computer applications in resources management systems in construction projects, and Implementation of construction resources management systems.

4.2 Study population characteristics

The general characteristics of the study population were investigated. They include the field of work, classification of contractors, experience of respondents**,** number of employees, values of executed projects during the last five years, and the person in-charge-of managing construction resources.

4.2.1 Year of establishment

Figure 4.1 shows that only (16.6%) of the contracting companies were established before 1994. (43.8%) of companies were established from 1994 to 2000, while (39.6%) of them were established after 2000. This indicates that most of companies are relatively newly established having less than 11 years of experience.

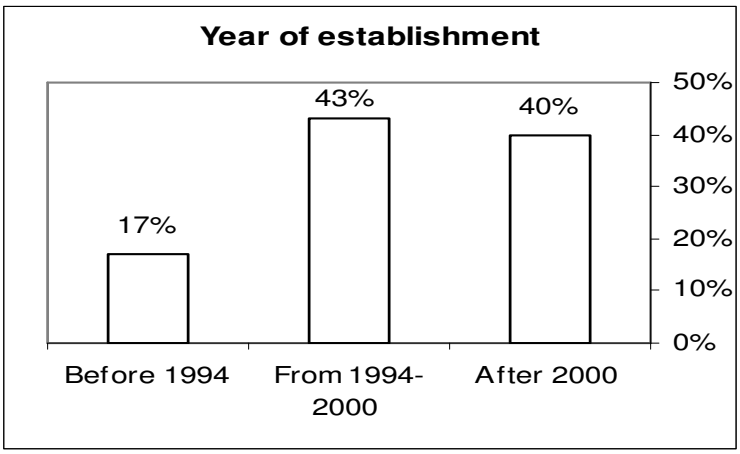

Figure 4.1: Year of establishment of contracting companies

4.2.2 Field of work

Table 4.1 demonstrates that the building represents the highest field of work for contractors with 95.8 % (46) in buildings, 79.2 % (38) of work was in roads, 66.7 % (32) in water and sewage and 18.9 % (9) of contractors work in electro mechanics projects.

Table 4.1: Field of company specialization

Company work field		Main
Building work field	*Frequency*	46
	Percentage%	95.8
Water and sewerage works	*Frequency*	32
	Percentage%	66.7
Roads works	*Frequency*	38
	Percentage%	79.2
Electro mechanics	*Frequency*	9
	Percentage%	18.9

4.2.3 Respondents designation

Figure 4.2 shows that 25 % (12) of contracting companies respondents were site engineers, 27.1 % (13) were projects managers, 37.5 % (18) were the owners of organization and 5 % (5) were office engineers.

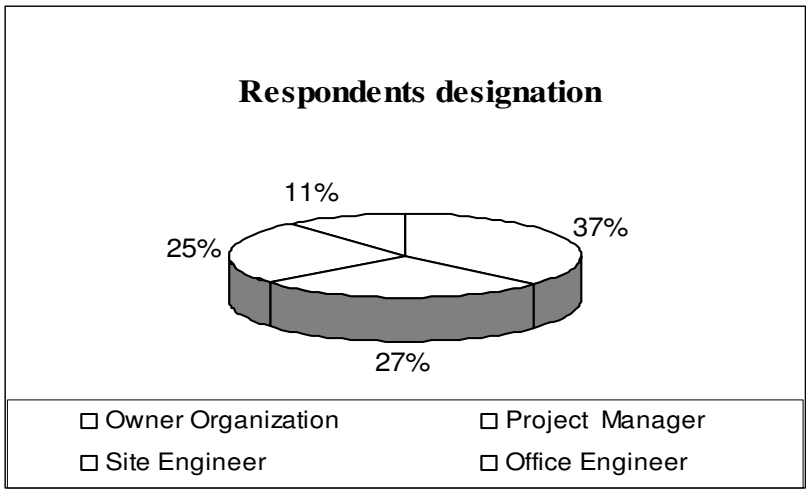

Figure 4.2: Respondents designation

4.2.4 Experience of respondents

Figure 4.3 shows that 18.8 (19%) have experience from one to three years, 10.4 (10%) of respondents have experience from 3 to 5 years, the percentage 20.8 (21%) of the respondents firm have experience between 5 to 10 years at construction works and 50 % (24) of respondents who have experience more than 10 years.

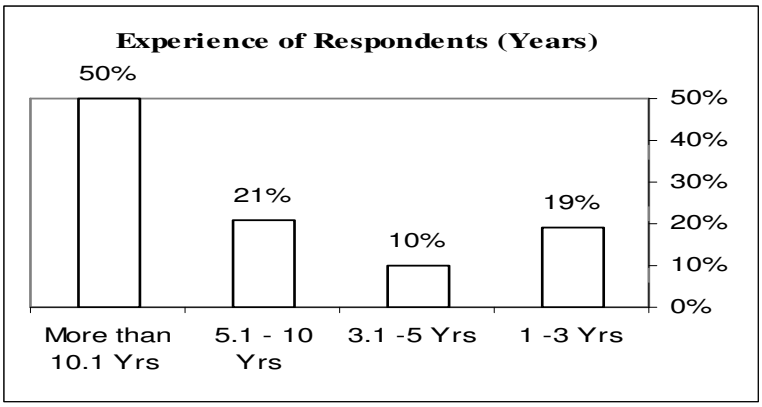

Figure 4.3: Experience of respondents (years)

4.2.5 Classification of contractors

Table 4.2 illustrates that about forty percent of contractors (37.5%) are classified as first class in building works. (27.1%) of them are classified in first class in sewage and water works and (31.2%) of the respondents are classified in first class in roads works.

Table 4.2: Degree of classification

Company classification according the contracting union for the following fields		First class	Second class	Third class	Others
Building works	*Frequency*	18	13	15	0
	Percentage%	37.5	27.1	31.2	0.0
Water and sewerage works	*Frequency*	13	7	12	0
	Percentage%	27.1	14.6	25	0.0
Roads works	*Frequency*	15	7	!6	0
	Percentage%	31.2	14.7	33.3	0.0

These results reveal that the organization size of contracting companies in Gaza strip are small. This means that most contractors execute their projects mainly using subcontractors. In fact, subcontracting is an essential component of almost any project.

4.2.6 The value of executed projects during the last five years

Table 4.3 shows that (37.5%) of respondents executed projects with a value between 0.5 to 1 million dollars, during the last five years. (12.5%) of contracting companies executed projects with a value between 1.1 to 2 million dollars, and (33.3%) of contractors executed projects with a value of more than 2 million dollars. This indicates that most of executed projects are of small size.

Table 4.3: Distribution of value of executed projects

Total amount of executed projects during the last five years (in million dollars)	*Frequency*	*Percentage%*
0.5 and lesser	8	16.7
0.51-1	18	37.5
1.1-2	6	12.5
More than 2	16	33.3
Total	48	100.0

4.2.7 Number of employees and their qualifications

Figure 4.4 demonstrates that (39.6%) of respondents have 10 employees or less, whilst (8.3%) of contractors have more than 20 employees, (35.4%) of contracting companies has from 10 to15 employees. This indicates that most of companies are of small size.

Figure 4.4: Distribution of respondents' number of employee.

4.3 Implementation of construction materials management systems

Implementation of construction materials management systems on construction projects provides the contracting company with many benefits and it can solve many problems that may face the contracting company.

4.3.1 The importance of knowing waste percentage for different building materials

As Table 4.4 indicates, most contractors think that knowing waste for different building materials help them to determine the exact quantities required for a project, help to price tenders more accurately, help to finish the project successfully and to prepare accurate bill of quantities.

Table 4.4: The importance of knowing materials waste percentage

No.	Importance	Strongly agree %	Agree %	∑ Strongly agree+ Agree %	Neutral %	Disagree %	Strongly disagree %	Mean	Weight percentage
1	Help to determine the exact required quantities.	39.6	52.1	91.7	8.3	_	_	4.31	.86
2	Increase the chance for obtaining the project finance.	12.5	31.9	44.4	27.1	22.9	6.2	3.2	.64
3	Help for preparing accurate bill of quantities.	27.1	54.2	81.3	16.7	_	2.1	4.04	.81
4	Help contractors to price tenders more accurately.	37.5	45.8	83.3	10.4	4.2	2.1	4.13	.83
5	Help the contractor to have a better chance to win the tender.	37.5	33.3	70.8	20.8	4.2	4.2	3.96	.79
6	Knowing the real requirements for the project (materials-time-cost)	25	54.2	79.2	16.7	4.2	_	4	.8
7	Help to finish the project successfully and have profits.	35.4	47.9	83.3	14.6	-	2.1	4.15	.83
8	Help in preparing a good schedule program including project resources.	27.1	39.6	66.7	20.8	10.4	2.1	3.79	.76

4.3.2 Benefits of implementation of materials management on construction projects

Table 4.5 outlines the benefits of construction materials management systems according to contractors' opinions and most of contractors (93.8%) believe that reducing the costs of project materials. From the information in table 4.5 it is clear that most of contracting companies (85.1%) consider that reducing duplication of materials orders, while (79.2%) consider that waste reduction.

On the other hand the benefits, which have lesser effect, better relationships with suppliers (58.3%), while (60.4%) complying to enhancement of quality control and Improving labour productivity.

Table 4.5: Benefits of implementation of materials management software on construction projects

No.	Benefit	Very high degree effect %	High degree effect %	∑ Very high+ High degree%	Mid degree effect %	Little degree effect %	Very little degree effect %	Mean	Weight percentage
1	Reducing the costs of project materials.	41.7	52.1	93.8	2.1	2.1	2.1	4.29	.86
2	Better handling of materials.	16.7	60.4	77.1	18.8	2.1	2.1	3.87	.77
3	Reducing duplication of materials orders.	33.3	43.8	77.1	18.8	-	4.2	4.02	.8
4	Materials are timely available on site with the right quantity.	41.7	33.3	75	18.8	6.2	-	4.1	.82
5	Improving labour productivity.	25	35.4	60.4	29.2	8.3	2.1	3.73	.75
6	Complying to time schedule.			60.5				3.77	.76
7	Complying to enhancement of quality control.	22.9	37.5	60.4	31.2	6.2	2.1	3.73	.75
8	Improving follow up and monitoring of construction materials.	31.2	39.6	70.8	20.8	4.2	4.2	3.89	.78
9	Better relationships with suppliers.	27.1	31.2	58.3	20.8	12.5	8.3	3.56	.71
10	Waste reduction.	35.4	43.8	79.2	12.5	4.2	4.2	4.02	.8
11	Reducing the space for materials on site.	27.1	39.6	66.7	20.8	8.3	4.2	3.95	.79
12	Obtaining better price for the construction materials.	37.5	39.6	77.1	14.6	2.1	6.2	4	.8
13	Help the contractor to have a better chance to win the tender.	31.2	37.5	68.5	16.7	6.2	8.3	3.77	.76

4.3.3 Importance of materials management systems to solve some problems

Table 4.6 lists the contractors` opinion about the extent of effect of implementing materials management system to reduce material problems on construction site. The results show that the majority of contracting companies believe that it's important to implement a construction materials management system to overcome most of material management problems. The results also show that the problems which have more conscious on its importance "Materials are not available" (81.2%), late delivery to the site (81.2%), and deliver materials with wrong quantities (79.2%).

Table 4.6: The importance of implementing a materials management system

No	Problem	Very important %	Important %	∑ Very important+ Important %	No difference%	Absolutely not important %	Absolutely never Important %	Mean	Weight percentage
1	Materials are not available.	33.3	47.9	81.2	14.6	4.2	-	4.1	.82
2	Materials are not available with required quantity.	20.8	54.2	75	22.9	2.1	_	3.94	.79
3	Late delivery to the site.	33.3	47.9	81.2	14.6	4.2	_	4.1	.82
4	Slow response from the consultant engineer about submittals.	27.1	47.9	75	18.8	6.2	_	3.95	.79
5	Deliver wrong materials.	20.8	58.3	79.1	16.7	4.2	_	3.95	.79
6	Deliver materials with wrong dimensions.	31.2	41.7	72.9	20.8	6.2	_	3.98	.8
7	Deliver materials with wrong quantities.	18.8	60.4	79.2	10.4	10.4	_	3.88	.78
8	Increase materials quantity in storages.	20.8	43.8	64.6	33.3	2.1	_	3.83	.77
9	Burglary, theft and vandalism	25	45.8	70.8	14.6	8.3	_	3.75	.75
10	Destroyed materials when deliver.	27.1	37.5	64.6	20.8	8.3	_	3.71	.74

4.3.4 Material waste on site

This section, was divided the factors that are causing increase in material waste on construction site into five groups. They are: on site practice; material handling; transportation; site management and supervision on site. The total numbers of factors are 22 factors.

a. On site practice

Table 4.7 represents the factors related to on site practice which cause increase waste on construction site. The results show that the majority of contracting companies believe that most of the factors, which are shown in Table 4.11, cause waste increase on construction site. They believe that the factors which have bigger effect on causing waste increase on construction site are improper cutting of material (87.5%), materials damage on site (81.4), and manufacturing defects (79.2%).

On the other hand, the factor which they believe has the lowest effect on causing waste increase on construction site is the existence of unnecessary materials on site (56.1%). This comes in line with Al-Mogany study (2006), who concluded that more than 70% of contractors consider that which factors causes waste on construction sites.

Table 4.7: Factors that increase waste on the construction site (Group a)

	No	Factors causes increase waste on site	Very high degree effect %	High degree effect %	∑ Very high degree effect + High degree effect %	Mid degree effect %	Little degree effect %	Very little degree effect %	Mean	Weight percentage
(A): On site practice	1	Materials damage on site.	56.2	31.2	81.4	10.4	-	2.1	4.39	.88
	2	Improper cutting of materials.	50	37.5	87.5	12.5	_	_	4.38	.88
	3	Existence of unnecessary materials on site.	22.9	33.3	56.1	22.9	14.6	6.2	3.52	.7
	4	Overproduction/Production of a quantity greater than required or earlier than necessary.	18.8	43.8	62.6	22.9	14.6	_	3.67	.73
	5	Manufacturing defects.	29.2	50	79.2	14.6	_	6.2	3.96	.79
	6	Burglary, theft and vandalism.	33.3	29.2	61.5	31.2	6.2	-	3.89	.78
	7	Lack of materials (due to closure).	37.5	20.8	58.3	27.1	8.3	6.2	3.75	.75
	8	Poor storage of materials.	29.2	41.7	70.9	20.8	8.3	_	3.92	.78

b. Materials handling

Table 4.8 represents the factors related to materials handling group which cause material waste increase on construction site. (72.9%) of the contracting companies think that *"duplication of transporting material on site"* causes waste increase, (75%) of them believe that "*insufficient instructions about handling materials on site"* causes waste increase, and (75%) of the respondents believe that *"improper handling of materials on site"* causes waste increase**.**

Table 4.8: Factors that increase waste on the construction site (Group b)

	No.	Factors causes waste increase on site	Very high degree effect %	High degree effect %	∑ Very high degree effect + High degree effect %	Mid degree effect %	Little degree effect %	Very little degree effect %	Mean	Weight percentage
(B):Materials handling:	9	Improper handling of materials on site.	22.9	52.1	75	25	-	-	3.79	0.76
	10	Duplication of transporting material on site.	22.9	50	72.9	18.8	6.2	2.1	3.85	0.77
	11	Insufficient instructions about handling materials on site.	16.7	58.3	75	10.4	10.4	4.2	3.79	0.76

c. Material transportation

Table 4.9 represents the factors related to transportation group which cause material waste increase on construction site. (85.4%) of the contracting companies believe that *"improper material transportation"* causes waste increase, and (75%) of them think that "*storing materials in far away stores"* causes waste increase.

Table 4.9: Factors that increase waste on the construction site (Group c)

	No.	Factors causes increase waste on site	Very high degree effect %	High degree effect %	∑ Very high degree effect + High degree effect %	Mid degree effect %	Little degree effect %	Very little degree effect %	Mean	Weight percentage
(C): Transportation	12	Improper materials.	39.6	45.8	85.4	12.5	2.1	-	4.23	0.85
	13	storing materials in far away stores	27.1	47.9	75	14.6	4.2	6.2	3.85	0.77

d. Site management

Table 4.10 represents the factors related to site management which cause waste increase on construction site. The results show that the majority of contracting companies believe that the factors which have bigger effect on causing material waste increase on construction site are "Lack of material and time waste management plan" (79.2%), " and " Shortage of technical professionals in the contractor's organization" (79.2%). On the other hand, the factors, which have lower effect on causing waste increase on construction site, are "Contractors slowness in taking decisions" (70.9%).

Table 4.10: Factors that increase waste on the construction site (Group d)

	No	Factors causes increase waste on site	Very high degree effect %	High degree effect %	∑ Very high degree effect + High degree effect %	Mid degree effect %	Little degree effect %	Very little degree effect %	Mean	Weight percentage
(D): Site management	14	Lack of material and time waste management plan.	39.6	39.6	79.2	18.8	2.1	-	4.17	0.83
	15	Poor qualification of the contractor's technical staff assigned to the project.	35.4	41.7	77.1	16.7	6.2	–	4.06	0.81
	16	Providing project team with insufficient information.	33.3	45.8	79.1	16.7	2.1	2.1	4.06	0.81
	17	Shortage of technical professionals in the contractor's organization.	35.4	43.8	79.2	18.8	2.1	–	4.13	0.82
	18	Contractors slowness in taking decisions.	29.2	41.7	70.9	25	2.1	2.1	3.94	0.78

e. Site supervision

Table 4.11 represents the factors related to site supervision group, which causes material waste increase on construction site. The results show that the majority of contracting companies believe all factors shown in Table 4.11, have a lowest degree effect on waste increase on construction site. This result shows the non adversely relationship between the contractor and the consultant.

Table 4.11: Factors that increase waste on the construction site (Group e)

	No	Factors causes increase waste on site	Very high degree effect %	High degree effect %	∑ Very high degree effect + High degree effect %	Mid degree effect %	Little degree effect %	Very little degree effect %	Mean	Weight percentage
Site supervision	19	Poor qualification of consultant engineer's staff assigned to the project.	33.3	39.6	72.9	4.2	14.6	8.3	3.75	0.75
	20	Delay in performing inspection and testing by the consultant team.	47.9	14.6	62.5	16.7	16.7	4.2	3.85	0.77
	21	Poor coordination and communication among the consultant, the owner and the contractor.	39.6	35.4	75	12.5	12.5	6.2	3.89	0.79
	22	Change orders.	31.2	25	56.2	27.1	14.6	2.1	3.69	0.74

4.4 Labor: Factors which affect the productivity of the workers:

Table 4.12 shows that the greatest percentage of the factors affecting on the increasing of labor productivity according to contractors' opinions, which requires that the program would facilitate the workers management process. The results show that majority of contracting companies believe that the most important factors which have a big effect on increasing the productivity of the workers are the workers discipline (93.8%), the stability of the work (89.6%), good management of the workers (89.5%), relation between workers (87.5%), incentive payments (83.4%), creating competition (83.4%) and limited time allowed for estimating process (80%).

On the other hand the factors affecting on the increasing of labor productivity according to contractors' opinions, which have lesser effect are health insurance (58.3%), distance from home (58.4%), the contribution of the trade union solving their problems and claims (52.1.4%), cultural differences (50%), and worker participation in decision-making (39.4%).

This result coincides with the results of Aynur and Sedra (2006). The suitable description for this consensus that the factors very necessary for contractors regardless of the location of research, economic level, or the culture of organization.

Table 4.12: Factors which affect the productivity of the workers

	Factors causes increase the productivity the workers	Very high degree effect %	High degree effect %	∑ Very high degree effect + High degree effect %	Mid degree effect %	Little degree effect %	Very little degree effect %	Mean	Weight percentage
1	The workers participation in organizing the company as well as caring about their personal status.	33.3	47.9	81.2	14.6	2.1	2.1	4.08	0.82
2	The contribution of the trade union solving their problems and claims.	22.9	29.2	52.1	35.4	8.3	4.2	3.58	0.71
3	Health insurance.	20.8	37.5	58.3	27.1	12.5	2.1	3.63	0.72
4	The stability of the work.	25	64.6	89.6	6.2	4.2	-	4.1	0.82
5	Relation between workers.	22.9	64.6	87.5	8.3	4.2	-	4.06	0.81
6	Good management of the workers.	56.2	33.3	89.5	10.4	-	-	4.46	0.89
7	Workers discipline.	43.8	50	93.8	2.1	2.1	2.1	4.31	0.86
8	Official concern.	41.7	35.4	77.1	18.8	-	4.2	4.1	0.82
9	Social insurance.	18.8	45.8	64.6	16.7	12.5	6.2	3.58	0.72
10	Health-and-safety conditions.	37.5	41.7	79.2	10.4	6.2	4.2	4.02	0.8
11	Work satisfaction.	58.3	22.9	81.2	14.6	2.1	2.1	4.33	0.87
12	Creating competition.	54.2	29.2	83.4	12.5	4.2	-	4.33	0.87
13	Sharing problems and their results	22.9	41.7	64.6	31.2	4.2	-	3.83	0.77
14	Cultural differences	16.7	33.3	50	29.2	12.5	8.3	3.75	0.75
15	Worker participation in decision-making	10.4	29.2	39.4	41.7	8.3	10.4	3.21	0.64
16	Distance from home	16.7	41.7	58.4	12.5	12.5	16.7	3.29	0.65
17	Incentive payments.	54.2	29.2	83.4	14.7	2.1	-	4.35	0.67
18	Giving responsibility.	22.9	45.8	68.7	18.8	12.5	-	3.79	0.76
19	Amount of remuneration	45.8	35.4	81.2	14.6	4.2	-	4.23	0.85
20	Assign contracts with workers.	27.1	39.6	66.7	20.8	4.2	8.3	3.73	0.75
21	Insurance for injury workers in the workplace.	41.7	37.5	79.2	12.5	4.2	4.2	4.08	0.82
22	Facilities of workplace (availability material & equip)	45.8	35.4	81.2	14.6	4.2	-	4.56	0.9

4.4.1Factors affect in reducing the productivity of the workers

Table 4.13 demonstrates the greatest percentage of factors which affecting the reduction of labor productivity 91.7% that is not satisfied with the workers and the lowest was to inspection delay is 37.6%. This requires that the program would provide some things that would alert the constructors in order to achieve satisfaction of workers. For example, allowances, health insurance and social insurance …. And so on.

Table 4.13: Factors affect in reducing the productivity of the workers

NO	Factors affect in reducing the productivity of the workers	Very high degree effect %	High degree effect %	∑ Very high degree effect + High degree effect %	Mid degree effect %	Little degree effect %	Very little degree effect %	Mean	Weight percentage
1	The workers are not satisfied.	62.5	29.2	91.7	6.2	2.1	-	4.52	0.9
2	Misunderstanding between workers.	29.2	58.3	87.5	12.5	-	-	4.17	0.83
3	The personal problems of the workers.	29.2	45.8	75	16.7	4.2	4.2	3.92	0.78
4	Construction volume.	18.8	39.6	58.4	20.8	16.7	4.2	3.52	0.7
5	Difficulty with recruitment of workers.	22.9	31.2	54.1	20.8	16.7	8.3	3.44	0.69
6	The complexity of the project.	35.4	31.2	66.6	16.7	14.6	2.1	3.83	0.76
7	New workers.	25	39.6	64.6	20.8	12.5	2.1	3.73	0.74
8	Dont distributes new workers with old.	27.1	35.4	62.5	25	6.2	6.2	3.71	0.74
9	Sycological pressure on workers.	29.2	50	79.2	8.3	10.4	2.1	3.94	0.78
10	Unqualified training for workers.	39.6	41.7	81.3	14.6	6.2	-	4.17	0.83
11	Inspection delay.	18.8	18.8	37.6	35.4	18.8	8.3	3.2	0.64
12	Formen change.	29.2	37.5	66.7	25	6.2	2.1	3.85	0.77
13	Absenteeism from the work site.	56.2	29.2	85.4	10.4	2.1	2.1	4.35	.087
14	Change order.	18.8	35.4	54.2	16.7	22.9	6.2	3.38	0.67
15	Management experience.	47.9	31.2	79.1	12.5	8.3	-	4.19	0.85
16	Unemployment.	29.2	29.2	58.4	12.5	18.8	10.4	3.48	0.69

4.4.2The mechanism of workers selection:

Table 4.14 shows that the greatest percentage of how are selected the companies workers 72.9%, which is by experience and lowest was though a contest, this also shows that the greatest percentage of way of fixing the salaries of workers is 93.4% that commonly in the market and this require from further studies to consider making periodic references for the wage of workers and their productivity in Gaza Strip.

Table 4.14: The mechanism of workers selection

Question	Percent
How do you select your workers?	
Experience	72.9
Fame	27.1
Contest	0.0
	100.0
What is the criterion of determining the wage of the workers?	
Previous Contracts	4.2
What is common in the trade	93.8
The minimum which is specified by the Ministry of Labor	2.1
	100.0

4.4.3 The impact of the workers increasing the duration and cost of the project:

Table 4.15 shows the wast proportion of the degree of the influence factors which related to the workers in increasing the duration and the cost of the project, the limited number of the workers is 91.6% and absence of worker is 85.4%. The lowest as 25%, which is factor of difference in political affiliation and party for workers, and this requires that the program helps the project manager to find alternatives in the limited number of the workers absence of workers and also helps to know the requirements of each working day of the days of the project.

Table 4.15 The impact of the workers increasing the duration and cost of the project

NO	Factor	Very high degree effect %	High degree effect %	∑ Very high degree effect + High degree effect %	Mid degree effect %	Little degree effect %	Very little degree effect %	Mean	Weight percentage
1	The limited number of the workers.	45.8	45.8	91.6	8.3	_	_	4.38	0.88
2	Aging workers in the project.	25	52.1	77.1	16.7	4.2	2.1	3.94	0.79
3	The absence of the workers.	45.8	39.6	85.4	14.6	_	_	4.31	0.86
4	The differences of workers in political affiliations and parties.	10.4	14.6	25	29.2	20.8	25	2.65	0.53
5	Imprecise prediction concerning the productivity of the workers.	12.5	45.8	58.3	27.1	12.5	2.1	3.54	0.71

4. 5 Factors which related to equipment that impact on the duration and cost of the project

The below table 4.16 shows that the most influential factors which related to the equipment on the duration and cost of the project is the quality of construction equipment (93.7%), the availability of construction equipment in the market (89.6%) and how to use of construction equipment (79.2%). This requires the computerized to facilitate the worker of project manager in the management and requires companies rehabilitate workers to the right way to deal with the equipment.

Table 4.16: Factors which related to equipment and impact on the duration and cost of the project

NO.	Factors affect in 1ncresing duration and cost the project	Very high degree effect %	High degree effect %	∑ Very high degree effect + High degree effect %	Mid degree effect %	Little degree effect %	Very little degree effect %	Mean	Weight percentage
1	Availability of construction equipment in the market.	37.5	52.1	89.6	10.4	_		4.27	0.85
2	The quality of construction equipment.	47.9	45.8	93.7	6.2	-	-	4.12	0.82
3	Lifetime of construction equipment.	18.8	47.9	66.7	22.9	10.4	-	3.75	0.75
4	Price of construction equipment.	18.8	47.9	66.7	27.1	6.2	-	3.79	0.76
5	How to use of construction equipment.	27.1	52.1	79.2	14.6	6.2	-	4	0.8
6	Size of equipment.	20.8	35.4	56.2	22.9	20.8	-	3.56	0.71
7	Weather condition.	18.8	25	43.8	39.6	12.5	4.2	3.42	0.68
8	Availability of space	14.6	45.8	70.4	29.2	8.3	2.1	3.63	0.73
9	Proper equipment planning and selectin	35.4	37.5	72.9	16.7	6.2	4.2	3.94	0.70

4.5.1 The taken procedures in case of unexpected actions which disagree with the planning:

Table 4.17 proves that the most constructors are resorting to the available equipment in their company or subcontractors in the event of an emergency such as lack of equipment or sudden failure. This requires the program to help the project manager in determining the daily needs of the project equipment.

Table4.17: The taken procedures in case of unexpected actions which disagree with the planning

Question	Percent
The late arrival of materials to the work site.	
Change the supplier	58.3
Rely on the equipment of the company	35.4
Continue with the supplier	6.2
The arrival of materials which contradict the specification.	
Change the supplier	77.1
Continue with the resource	8.3
Rely on subcontractor	14.6
Sudden breakdown of the equipment which affect the schedule	
Purchase new equipment	27.1
Change the time line	16.7
Rely on subcontractor	56.2

4.6 USING COMPUTER IN RESOURC MANAGEMENT

4.6.1 Respondents' Efficiency of Using Popular Computer Software

Table 4.18 shows the respondents efficiency of using popular computer software. These results illustrate that the most of companies (97.9%) are using computer in the company. Ms-Excel Spreadsheet, where 97.9% of respondents have using Ms-Excel Spreadsheet and 97.9% of them have capabilities in using Ms-Word. 74.5% of contractors have capabilities in using Ms-Project. While only 14.9% of respondents have very good capabilities in using Ms Access and 68.1% of them have capabilities in using AutoCAD. The distinguishing place of Excel may be referred to its advantages which are stated by:

Christofferson (1999) as the following:

- it is inexpensive.
- it is easy to use.
- it can be customized to the company style of doing business.
- it is very powerful.

Table 4.18: Efficiency of respondents in using popular computer software

Question	Percent
Do use the computer in the company?	
Yes	97.9
No	2.1
	100.0
What are computer program that you use in your company?	
MS-PROJECT	74.5
EXCEL	97.9
WORD	97.9
ACCESS	14.4
AUTOCAD	68.1
OTHER(specify)	

4.6.2 Benefits of using software packages and the important of computer use in the management of resources

Table 4.19 shows the benefits obtained by using computerized in the management of resources. The results indicate that most of contractors surveyed believe that using of computer software will be very beneficial in general. These benefits are

- Building archive for previous projects about the cost of resources.
- Save the effort and Minimizing errors.
- Building general prices database.
- Fast cost and saving time.

Table 4.19: Benefits obtained by using construction resources management system

NO.	Factor affect of computers in the manageme resources	Very high degree effect %	High degree effect %	∑ Very high degree effect + High degree effect %	Mid degree effect %	Little degree effect %	Very little degree effect %	Mean	Weight percentage
1	Ensure archive of all projects about the cost of resources.	60.4	33.3	93.4	_	4.1	2.1	4.38	0.88
2	Save the effort.	35.4	54.2	89.6	8.3	2.1	-	4.19	0.84
3	Save the time.	43.9	47.9	92.8	4.2	2.1	2.1	4.23	0.85
4	Save the cost.	43.8	31.2	75	20.8	4.1	2.1	4.1	0.82
5	Ensure the credibility.	22.9	27.1	50	22.9	18.8	8.3	3.35	0.67
6	Ensure proper taken procedures at the right time.	27.1	33.3	60.4	18.8	12.5	8.3	3.56	0.71
7	Facility of updating of resource prices.	37.5	27.1	64.6	16.7	14.6	4.2	3.71	0.74
8	Provides an opportunity for communication between the project team.	41.7	27.1	68.8	14.6	10.4	6.3	3.85	0.77
9	Contribute to updating the resource data continuously.	39.6	27.1	66.7	22.7	6.2	4.1	3.89	0.78
10	Assist in selection of suppliers.	35	25	60	20.8	12.5	6.2	3.67	0.73
11	Reducing the opportunities to commit errors.	41.7	22.9	64.8	27.1	6.2	2.1	3.92	0.78
12	Ensure that resources are not forgotten any	31.3	37.5	68.8	25	6.2	-	3.83	0.76
13	Contribute to saving the cost of the communications.	33.3	29.2	62.5	25	8.3	4.2	3.71	0.74

4.6.3 Obstacles that are facing the local companies in using construction resources management software

Table 4.20 represents the obstacles, which are facing the contractors in using construction resources management software. These results show that the majority of respondents (95.8%) consider absence of understanding of construction resources management software is the most important obstacle that affects the using of computerized resources management packages. (95.8%) of the respondents think that Shortage of user friendly computer programs by the contractor has big effect on using computerized resources management packages. Another observation noted from Table 4.14, (54.1%) of the contractors believe that difficulty of dealing with available programs.

Table 4.20: The obstacles which are facing contractors in using construction resourcesmanagement systems .

NO.	Obstacle	Very Important%	Important	∑ Very Important+ Important%	Medium%	Low important%	Very low Important%	Mean	Weight percentage
1	No understanding for importance of computer program.	60.4	35.4	95.8	2.1	2.1	_	4.5	0.9
2	Shortage of user friendly computer programs.	60.4	35.4	95.8	2.1	2.1	_	3.77	0.75
3	The high cost computer programs.	25	54.2	79.2	10.4	4.2	6.2	2.81	0.56
4	Difficulty of dealing with available programs.	8.3	45.8	54.1	35.4	4.2	6.2	3.35	0.67
5	Shortage of qualified persons in using computer programs.	16.7	47.9	64.6	22.9	4.8	8.3	3.5	0.7
6	The need for training on computer program.	33.3	43.8	77.1	10.4	10.4	2.1	3.94	0.79

4.7 Hypotheses Testing

4.7.1 Testing the correlation between groups

This section discusses the relationship between the different groups of resource management factors. The Personal Correlation Test was conducting to find out the different agreement and disagreement for contractors. This test based on assuming null hypotheses (Ho) of existence of no significant relationship between the different groups of resources management factors. The null hypotheses (Ho) is rejected if they obtained significance is less than $\alpha = 0.05$.

4.7.2 Correlation between groups affecting in resources management

Table 4.21 presents the Personal correlation coefficient between all groups affecting in resources management. As shown in Table 4.21 most of the P-Values were below $\alpha = 0.05$, which means the rejection of (Ho). This means the existence of significant relationship between the most groups, while the correlation coefficient between importance of material waste related factors and factors increase duration and cost of project equals to 0.146 with P-value (Sig.) = 0.323. The P-value is greater than the level of the significance $\alpha = 0.05$, so there is no significance relationship between client related factors and external environment factors.

Table 4.21: Correlation between groups affecting in resource management system

		Importance of material waste	Benefit of material waste	Problem of material waste	Factor increase Waste on site	Factor crease productivity of the workers	Factor reduce productivity of the workers	Factor increase duration and cost of project	Importance of using computer	Obstacle of using computer
Importance of material waste	Person Correlation		.403	.461	.465	.440	.312	.146	.233	.115
	Sig. (2-tailed)		.005	.001	.001	.002	.031	.323	.111	.436
	N	48	48	48	48	48	48	48	48	48
Benefit of material waste	Person Correlation	.403		.577	.582	.369	.369	.269	.272	.058
	Sig. (2-tailed)	.005		.000	.000	.01	.01	.065	.062	.696
	N	48	48	48	48	48	48	48	48	48
Problem of material waste	Person Correlation	.461	.557		.688	.542	.471	.465	.256	.115
	Sig. (2-tailed)	.001	.000		.000	.000	.001	.001	.079	.435
	N	48	48	48	48	48	48	48	48	48
Factor increase Waste on site	Person Correlation	.465	.582	.668		.588	.639	.498	.443	.258
	Sig. (2-tailed)	.001	.000	.000		.000	.000	.000	.002	.076
	N	48	48	48	48	48	48	48	48	48

Table 4.21: Correlation between groups affecting in resource management system (cont)

Factor crease productivity of the workers	Person Correlation	.440	.369	.542	.588		.645	.695	.203	.267
	Sig. (2-tailed)	.002	.01	.000	.000		.000	.000	.167	.067
	N	48	48	48	48	48	48	48	48	48
Factor reduce productivity of the workers	Person Correlation	.312	.368	.471	.639	.645		.462	.266	.135
	Sig. (2-tailed)	.031	.01	.001	.000	.000		.001	.068	.361
	N	48	48	48	48	48	48	48	48	48
Factor increase duration and cost of project	Person Correlation	.146	.269	.465	.498	.695	.462		.203	.280
	Sig. (2-tailed)	.323	.065	.001	.000	.000	.001		.167	.053
	N	48	48	48	48	48	48	48	48	48
Importance of using computer	Person Correlation	.233	.272	.256	.443	.23	.266	.203		.618
	Sig. (2-tailed)	.111	.062	.079	.002	.167	.068	.167		.000
	N	48	48	48	48	48	48	48	48	48
Obstacle of using computer	Person Correlation	.115	.058	.115	.258	.267	.135	.28	.618	
	Sig. (2-tailed)	.436	.696	.435	.076	.067	.361	.053	.000	
	N	48	48	48	48	48	48	48	48	48

CHAPTER 5

Construction Resources Management Software (CRMS)

5.1 Introduction

This Chapter presents the computerized system which the researcher developed to help the Gaze Strip contractors to improve their practice in construction resources management. The software was named "Construction Resources Management Software" (CRMS). It also discusses the general concepts on which the development of software was based. The chapter describes the software components, the software evaluation and limitations are also discussed.

PHP (PHP: Hypertext Preprocessor) is a reflective programming language originally designed for improving web cites. PHP is used mainly in server- side scripting, but used from a command line interference or in standalone graphical applications.

Usage :PHP generally runes on a web server, taking PHP code as its input and creating a web pages as output, however it is also popular for command-line scripting and client-side GUI applications.

PHP can be deployed on most web servers and in almost every OS platform free of charge. The PHP Group also provides the complete source e code for users to build, customize and extend their own use site.

5.2 Concepts

The system of management construction resources is the one which works as web page and do a lot of functions that helps the contractor to manage his project in successful way.

He can make financial and time plain which the contractor in work site such as materials, equipments and machine . It can also account its costs and analyze the prices for each project activity.

The researcher reviewed the current situation of construction resources management in Gaza strip by interviewing forty-eight contractors. He found out that the construction resources management practices are generally inadequate and in the first stages. In addition, he concluded that construction resources management practices are not done

in a systematic way. The researcher aims, by introducing CRMS, at improving the common practices of local contractors.

Ahuja et al. (1994) summarize the criteria for selection a software system as follows:

1. The software must be relatively easy to install and operate. The input data must be easy to prepare, and the output reports must be understandable.
2. Data sorting is one of the base uses of computers.
3. It must be a fully tested system and should have a proven record.
4. The program should be flexible and have capacity for handling many types of application.
5. The database must contain all the necessary elements so it can be managed to generate the desired information reports.
6. The program should be compatible with other programs and systems in use in the company.
7. The system must be economical in terms of installation, operation, and maintenance.

The author tries his best to accommodate, as much as possible, the above mentioned criteria in development of CRMS.

5.2.1 Computerized system

Figure 5.1open the program through any internet browser, where we put the program then click inter.

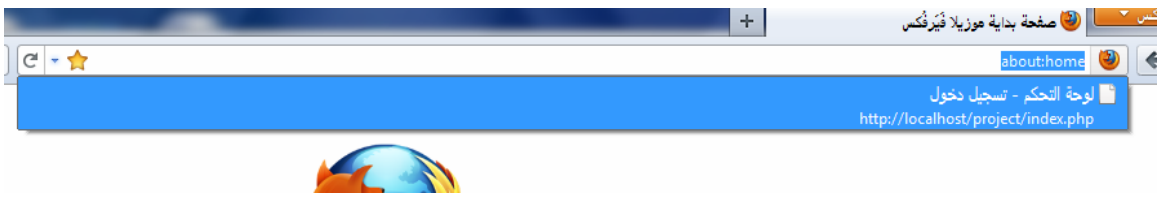

Figure 5.1: The first step

5.2.2 Start sheet

Figure 5.2 illustrates the control panel appears which shows the user name and password. This must be made established in advance to insure the privacy of the company itself and protect it from information stealing.

Figure 5.2: Username and Password

5.2.3 After that, we are registered to enter the page of the main program which consists of: insert the new project and the project added such as Figure 5.3.

Figure 5.3: The page of a new project

5.2.4 Company and project information

Figure 5.4 illustrates to assume that we have no added projects, so we can include a new project through clicking on (insert a new project) which shows us a new page to inter the information of the project that is composed of : the mane of the project, the name of the owner, the name of the financier, the date of beginning and ending the project, and other information belonging to the contractor in analysis of price, such as the preparation of risks, the proportion of profits, the proportion of the administrative expenses. After entering all the foregoing click a button of submit.

Figure 5.4: General information of the project

5.2.5 After that we've been automatically moved to the list of added projects to choose from there the project which named in advance.

Figure 5.5: The page of a added project

5.2.6 After click on the name of the project, for example (add one floor for training center) we're moved to the page of the project which is consisting of several links, namely : company workers, company equipments, company materials, events, reports of events, daily reports, and holydays as Figure 5.6.

Figure 5.6: Resources Sheet

5.2.7 "Workers Pool" sheet

Labors pool sheet contains labors code, labors name and unit price. Most of labors used in building works entered in the sheet for one time. Labors unit can be typed or chosen from a list as shown in Figure 5.7.

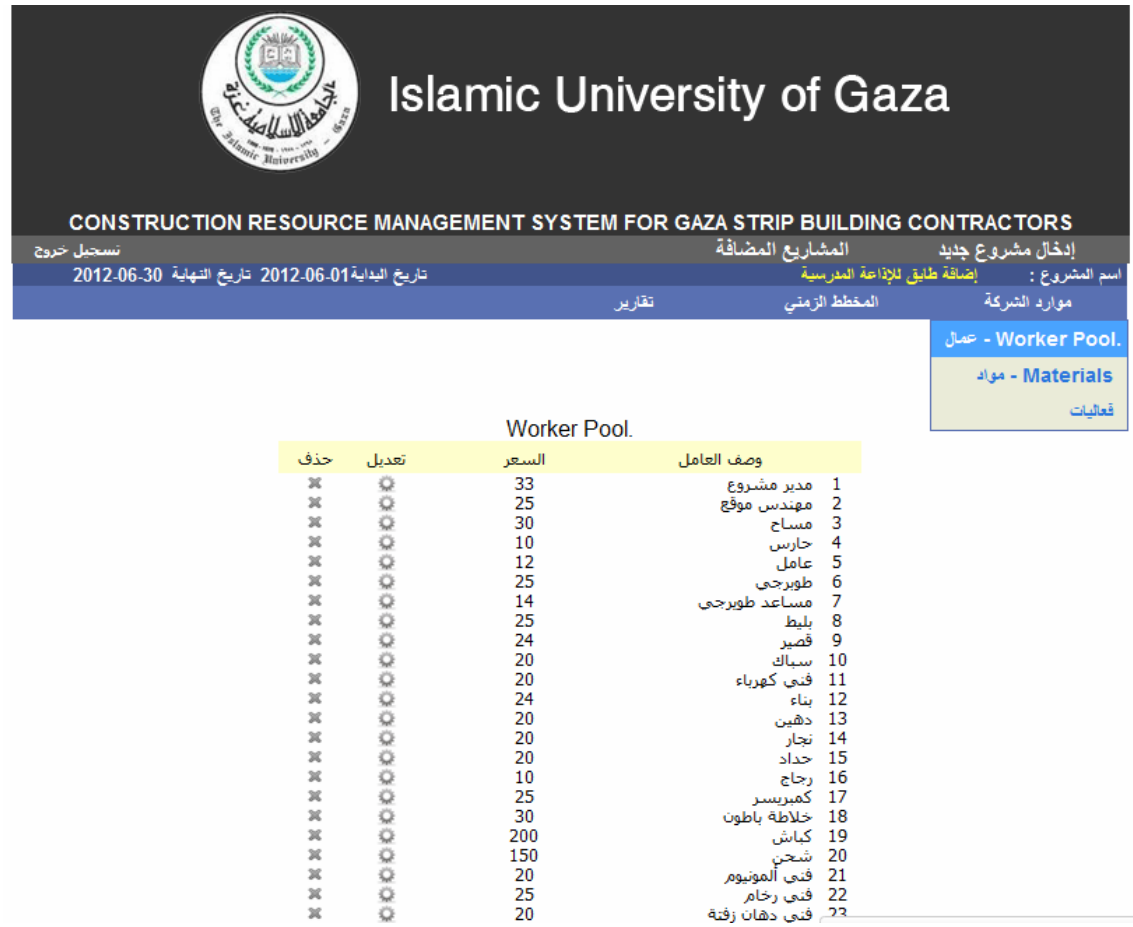

Figure 5.7: "workers Pool" sheet

5.2.8 "Materials Pool" sheet

Materials pool sheet contains materials code, material name, material unit and unit price. Most of materials used in building works entered in the sheet for one time. Material unit can be typed or chosen from a list as shown in Figure 5.8.

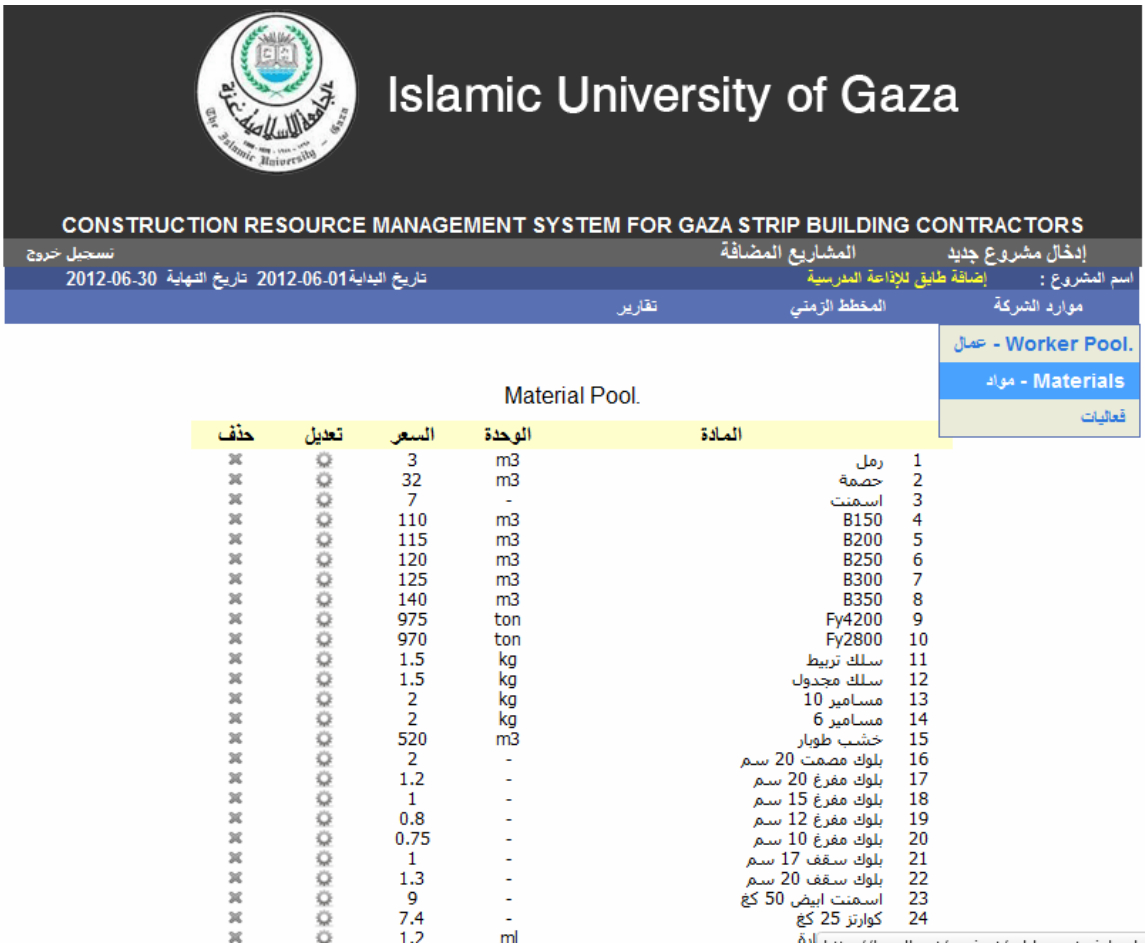

Figure 5.8: "Materials Pool" sheet

5.2.9 Figure 5.4 illustrates the days of holydays, we click on (holydays) to move to the page of holyday and determine the date we went as a holyday and then click an addition, where contractor or the engineer is able to add unlimited days of holydays.

Note : This program consider Friday as a public holyday.

Figure 5.9: Holiday Page

5.2.10 Schedule time

After that we turn to event by click on (schedule)(which is important part in the project), in this page all activities of the project are added consisting of: the name of activity, the percentage of waste, the amount, the period of activity, the type of relationship, whether SS, FS, SF, FF With the possibility of linking activity with each of non-Limited numbers of relations through insert number of relations and click on added relations as shown Figures5.10 and 5.11.

Figure 5.10: Schedule Page

Figure 5.11: Relationship Page

5.2.12 After inserting all the activates and linking them to each other, we will entered the necessary resources of the activity, then click on the activity of any one we want to introduce their own resources such as figure 5.12.

Figure 5.12: Example of added activities

5.2.13 After that, we have got the report of the activity consists of the resources (materials, equipments, and workers), as well as the required cost for such activity, and then turn to the other activity to insert their own resources such as Figure 5.13.

تقرير فعالية : 105 - أعمال تجهيز وصب السقف

	مواد الفعالية | عمال الفعالية			
أعمال تجهيز - 105 وصب السقف	تاريخ البداية : 10-06-2012	تاريخ النهاية : 14-06-2012	المدة:5	الكمية : 120
		سعره باليوم	العدد	الاجمالي
عمال	طوبرجي	25	3	375
	مساعد طوبرجي	14	4	280
	حداد	20	3	300
	مضخة	20	1	100
	رجاج	10	2	100
		سعر الوحدة	الكمية	الاجمالي
مواد	B250	120	24	2880
	Fy4200	975	2.04	1989
	بلوك سقف 17 سم	1	5	5
	سلك تربيط	1.5	5	7.5
	سلك مجدول	1.5	10	15
	مسامير 6	2	5	10
	مسامير 10	2	2	4
تكلفة مباشرة		6065.5		
الربح:		606.55		
المخاطرة:		121.31		
مصاريف إدارية:		121.31		
مجموع تكلفة غير المباشرة		849.17		
المجموع الكلي:		$ 6914.67	"السعر المدخل "التقديري:7800	

Figure 5.13: Activity Report

5.3 CRMS Evaluation

5.3.1 Evaluation objectives

Face validity is used as a test for model evaluation. Face validity is asking well-experienced people about the system whether the model and or its behavior are reasonable (Sargent, 2000). CRMS was evaluated by this method, where fifth contractors were approached to apply CRMS in five different on going projects. Then they were asked to fill a questionnaire to evaluate the performance of CRMS.

The objectives of CRMS evaluation are: (1) to assess the performance of construction resources management CRMS tools and techniques; (2) to check the suitability of CRMS design and structure; (3) to know the difficulties that faced the users during applying CRMS; (4) to recognize the contractors` criticisms or comments on the software and (5) to explore CRMS advantages.

5.3.2 Evaluation methodology

CRMS was tested in five under-construction projects belonging to five different contractors. All the five projects were in Gaza. The first and second project is a one-story building for the ministry of health (surgery department). The third project is a tow floor building in Jablia area. The fourth and fifth buildings are for two and three floor building in (south and middle Gaza).

5.3.3 Evaluation result and discussions

Table 5.1 illustrates the contractors` responses to the features of CRMS design and structure. The results illustrate that all contractors companies agreed that the reports and outputs are clear, and easy to read and understand.

Also it is noted that three of contractors companies strongly agreed that the software is flexible, the data can be updated easily, text and numbers shown are concise, and their sizes are suitable and readable, the information can be inquired easily and the method of use is understandable. Not that some of the respondents did not answer some questions.

Table 5.1: The contractors` responses to the features of CRMS design and structure.

No.	Techniques	Strongly agree	Agree	Intermediately agree	Weakly agree	Very weakly agree
1	The software is flexible, and the data can be updated easily.	3	2			
2	In general, it is easy to use.	4	1			
3	It saves time and effort.	2	3			
4	Method of entering data is easy and clear.		4			
5	The reports and outputs are clear, and easy to read and understand.	1	4			
6	Method of sorting data is easy.	1	3			
7	Text and numbers shown are concise, and their sizes are suitable and readable.	3	1			
8	The information can be inquired easily.	3	2			
9	The method of use is understandable.	3	1			
10	It is easy to handle as it is developed within Excel environment.	2	2			
11	Training to use the CRMS is easy and it does not need much time. In addition, it does not need a professional user to deal with it.		3			
12	It can be applied for most of Gaza strip projects. (It is suitable for Gaza strip contractors).	3	1			
13	It contributes in improving the construction resources management practice in Gaza strip.	2	3			

Regarding the difficulties that the contractors were facing during the use of CRMS, almost all contractors said that they had not faced real difficulties.
As for the criticisms or comments of the contractors, there are main comments that materials quantities per one unit in the "materials pool" and "workers pool" sheet have to be determined by experience.

On the other hand, the main advantages expressed by contractors are:
CRMS is easy to use and flexible; it helps the management staff in managing the construction resources in future projects; also, it helps the management staff to decide when and how much of materials quantities to be bought; and CRMS input-output relationships are reasonable.

Overall, the results of evaluation indicate that CRMS tools and techniques are encouraging. Also, the contractors are generally satisfied with the design and structure of CRMS. Moreover, the contractors mention that a CRMS suite the Gaza strip contracting companies and has the potential to contribute in improving the construction resources management practice in Gaza strip.

CHAPTER 6
CONCLOUSION AND RECOMMENDATIONS

6.1 Introduction

Construction Resources Management Software (CRMS) was developed to satisfy some needs of Gaza strip contracting companies in managing construction resources. This chapter introduces the research conclusions and recommendations for many parties involved in the construction process to improve the local practices in construction resources management. Recommendations for further studies are also included.

6.2 Conclusions

From the results obtained, analyzed, and discussed, the researcher concludes that:

- The contracting companies in Gaza strip are:
  - Relatively newly established.
  - Involved mainly in building works.
  - Small size organizations.
  - Depending heavily on subcontractors.

- Some obstacles that face the contractors in using computerized resources management systems are:
  - Non- realization of importance of construction resources management system by the contractor.
  - Absence of understanding of construction resources management system.
  - Shortage of user friendly of construction resources management system.
  - The high cost of a construction resources management system.

- Many Benefits of implementation of materials management software on construction projects such as reducing the costs of project materials, waste reduction and Reducing duplication of materials orders.

- Many Benefits of knowing the importance of waste percentage for different building materials like help to determine the exact required quantities, help contractors to

price tenders more accurately and help to finish the project successfully and have profits.

- Many problems can be reduced when contractors implement construction materials management systems such as materials not available, late delivery to the site and Deliver materials with wrong quantities.

- The many factors that cause increase to material waste on site practice are manufacturing defects, materials damage on site and improper cutting of materials.

- The many factors that cause increase to material waste on materials handling are duplication of transporting material on site, insufficient instructions about handling materials on site and improper handling of materials on site.

- The many factors that cause increase to material waste on material transportation are improper materials and storing materials in far away stores.

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- The many factors that cause increase to material waste on site management are lack of material and time waste management plan, poor qualification of the contractor's technical staff assigned to the project and shortage of technical professionals in the contractor's organization.

- The many factors that cause increase to material waste on site supervision are slow response from the consultant team to contractor inquiries and Poor coordination and communication among the consultant, the owner and the contractor.

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- There are many factors that affecting on the increasing of labor productivity like workers discipline, the stability of the work, good management of the workers, incentive payments and relation between workers.

- There are many factors that affecting on the reducing of labor productivity such as the workers are not satisfied, misunderstanding between workers, unqualified

training for workers, absenteeism from the work site and sycological pressure on workers.

- There are many factors which related to equipment and impact on the cost of the project like availability of construction equipment in the market**,** the quality of construction equipment and unqualified training for workers.

- The Israeli closure has big effect on equipments availability and cost.

- Most contracting companies are interested in using some techniques of managing construction resources such as building archive for previous projects about the cost of resources creating and save the effort and minimizing errors.

- The study shows that most of contracting companies are considered the main obstacles in using computer in construction resources management are shortage of user-friendly computer program and the lack of understanding for importance of computer program.

- Gaza strip contractors did not use any software to support project resources management. This gave the researcher a thrust to develop a computerized construction resources management system that supports and improves this practice. The software was named this software "construction resources management software"

- CRMS suits Gaza strip contracting companies and has the potential to contribute in improving the construction resources management practice in Gaza strip. It has a good performance and adequate accuracy.

- CRMS provides the mechanism to decide when to buy construction resources and what quantities of construction resources the contractor need in the project.

6.3 Recommendations to the parties involved in construction

Top management of contracting companies is invited to encourage development and using construction resources management systems. They can make incentives for their staff members to attend training courses in construction resources management and its applications. They should be encouraged to actually use computerized construction resources management systems to save effort and time, and to achieve more accurate results.

Public employers can contribute in improving the current construction resources management practices of the contractors by requesting them to implement construction resources management systems during construction. This could be done by adding relevant clauses in the project conditions of contract.

Universities, contractors union, and engineering association have to do more efforts to improve the existing construction resources management practices, which may include:

- Encouraging the contractors to use construction resources management systems by addressing the importance of these systems.
- Helping the contractors to understand the system by initiating training courses, lectures, seminars, and workshops.
- Transferring of technology and experiences of other countries in the construction resources management field and adapting them to suit Gaza strip contractors.

6.4 Recommendations for further studies

CRMS is a step along the way to establish a systematic construction resources management practice amongst Gaza strip contractors. Of course, it needs continuous modification and enhancement. The followings are some points, which need further research efforts:

- CRMS does not deal specifically with materials waste on the construction site. So, researchers are invited to put more effort to handle this aspect.

- Action is required to provide the system of Gant Chart.

- Benefit more from the system as a web page to achieve the greatest benefit from telecommunication service.

- Further efforts are required to make for achieving additional reports regarding S-Curve.
- Different construction processes need more attention for study and research in order to determine more realistic waste percentage for construction materials. The resulting information will be helpful in determining required quantities for each activity.

- CRMS divides all construction resources required for each activity equally at the duration of the activity on "materials quantities of activities" sheet. This is not realistic in all cases, and the user may want to modify these quantities. Therefore, researchers are invited to handle this case.

- Provide the system with some rules that can show reports in the form of graphs.

- Researchers are invited to develop integrated packages that include CRMS. Integration can be approached at various levels such as:
    - Integrating resources management, resources control and monitoring functions.
    - Integration with a scheduling application packages such as MS-Project.
    - Integration with other software programs such as the software which is used in the construction storages.

Researchers are invited to develop a new version of construction resources management software (CRMS) with probabilistic capabilities.

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.

LIST OF ANNEXES

Annex 1

The Questionnaire (In Arabic)

بسم الله الرحمن الرحيم

استبان عن

ممارسة إدارة موارد البناء في مشاريع التشييد بواسطة مقاولي قطاع غزة

السادة المقاولون المحترمون /

نشكر تعاونكم ومساهمتكم في تعبئة هذه الاستبيان الذي يعتبر جزء من البحث التكميلي لنيل درجة الماجستير في إدارة المشاريع من خلال الإستبان نرجو التعرف علي الواقع المحلي في إدارة الموارد في مشاريع التشييد لدى مقاولي قطاع غزة ومن ثم محاولة حل مشاكل هذا النظام من خلال استخدام برنامج متخصص لعمل إدارة الموارد لمشاريع التشييد بقطاع غزة .

يتكون الاستبيان من الأجزاء التالية:

الجزء الأول: معلومات عن الشركة.

الجزء الثاني: المواد.

الجزء الثالث: العمال.

الجزء الرابع: المعدات.

الجزء الخامس : استخدام الحاسوب في إدارة الموارد.

جميع المعلومات و البيانات الواردة في الاستبيان ستستخدم فقط لتقييم نظام إدارة الموارد المتبع في المشاريع، والمعلومات الشخصية و الخاصة الواردة لن تنقل إلى أي جهات أخرى.

سوف نطلعكم بإذن الله علي نتائج البحث للاًستفادة منها .

إشراف :

د.م نبيل الصوالحي

الباحث

م . محمود محمد أبو الكاس

الجزء الأول : معلومات عامة عن المؤسسة :

1. اسم الشركة:..... سنة تأسيس الشركة.....

2. نوع الأعمال التي تقوم بها الشركة: □ مباني □ طرق
□ مياه ومجاري □ كهروميكانيك □ غير ذلك.....

3.وظيفة من يقوم بتعبئة الاستبيان: □ صاحب الشركة □ مدير مشاريع
□ مهندس موقع □ مهندس مكتب □ غير ذلك.....

4. عدد سنوات الخبرة لمن يقوم بتعبئة الاستبيان:
□ من 1-3 سنوات □ من 3.1-5 سنوات
□ من 5.1-10 سنوات □ أكثر من 10.1سنوات

5. درجة تصنيف الشركة حسب اتحاد المقاولين أو نقابة المهندسين لمجالات العمل التالية:
- أعمال أبنية □ درجة أولى □ درجة ثانية □ درجة ثالثة
- أعمال طرق □ درجة أولى □ درجة ثانية □ درجة ثالثة
- أعمال مياه وصرف صحي □ درجة أولى □ درجة ثانية □ درجة ثالثة

6. معدل قيمة المشاريع التي يتم تنفيذها سنويا خلال الخمس سنوات الماضية (بالدولار):
□ أقل من 0.5 مليون □ من 0.51 إلى 1 مليون
□ من 1.1 إلى 2 مليون □ أكثر من 2 مليون

7. عدد العاملين الثابتين بالشركة: □ أقل من 10 □ من 10إلى 15
□ من 15 إلى 20 □ أكثر من 20

الجزء الثاني: المواد

- الفاقد في مواد البناء

8. حدد مدى أهمية تأثير معرفة الفاقد في المواد للعوامل التالية :

مسلسل	الأهمية	مهم جداً	مهم	متوسط	أقل أهمية	غير مهم
1	يساعد في معرفة الكميات المطلوبة بالضبط لتنفيذ المشروع.					
2	يزيد فرصة الحصول علي تمويل للمشروع.					
3	يساعد في إعداد جدول كميات دقيق.					
4	يساعد المقاولين علي تسعير العطاءات بشكل دقيق.					
5	تحسين فرصة الفوز بالعطاء.					
6	معرفة المتطلبات الحقيقة للمشروع المراد تنفيذه والمتمثلة في الموارد والزمن والتكاليف.					
7	يساهم في نجاح المشروع وتحقيق الأرباح.					
8	**يساعد المقاول في إعداد جداول زمنية دقيقة لتوريد المواد.**					

- تطبيق نظام إدارة مواد البناء علي مشاريع التشيد

- أهمية تطبيق نظام إدارة المواد

9. بين مدى أهمية تأثير تطبيق نظام إدارة مواد البناء للحصول على الفوائد التالية :

مسلسل	الفائدة	يؤثر بدرجة كبيرة جداً	يؤثر بدرجة كبيرة	يؤثر بدرجة متوسط	يؤثر بدرجة قليلة	يؤثر بدرجة قليلة جدا
1	تقليل تكاليف مواد البناء اللازمة للمشروع.					
2	تحسين طرق مناولة المواد.					
3	التقليل من تكرار طلبات المواد.					
4	توفير المواد في موقع العمل في الوقت المناسب والكمية المناسبة .					
5	تحسين في إنتاجية العمال.					
6	الالتزام بالجدول الزمني للمشروع.					
7	التحكم في الجودة.					
8	تحسين متابعة المواد والسيطرة عليها.					
9	العلاقات الجيدة مع الموردين.					
10	التقليل من الفاقد.					
11	التقليل من ساحات تخزين المواد في موقع العمل.					
12	الحصول علي أسعار أفضل للمواد.					
13	تحسين فرصة الفوز بالعطاء.					

10. بين مدى أهمية استخدام إدارة المواد للتقليل من المشاكل التالية :-

مسلسل	المشكلة	مهمة جداً	مهمة	لا يوجد فرق	غير مهم	غير مهم بتاتاً
1	عدم توفر المواد كلياً.					
2	عدم توفر المواد بالكميات المطلوبة.					
3	وصول المواد بشكل متأخر .					
4	تأخر الموافقة علي العينات المقدمة.					
5	استلام مواد غير صحيحة.					
6	استلام المواد بمقاسات مختلفة عن المطلوب.					
7	استلام المواد بالكميات الغير مطلوبة.					
8	تكدس المواد في المخازن.					
9	سرقة المواد.					
10	تلف المواد أثناء الاستلام.					

– الفاقد في مواد البناء

11– بناءا على خبرتك حدد مدى تأثير العوامل التالية في زيادة نسبة الفاقد في مواد التشييد في موقع العمل:

مسلسل	العامل	يؤثر بدرجة كبيرة جداً	يؤثر بدرجة كبيرة	يؤثر بدرجة متوسط	يؤثر بدرجة قليلة	يؤثر بدرجة قليلة جدا
	في الوقع					
1	تلف مواد البناء في الموقع.					
2	القص الغير مناسب لمواد البناء.					
3	وجود مواد غير ضرورية في الموقع.					
4	إنتاج كميات أكثر مما هو مطلوب أو قبل الحاجة إليها.					
5	المواد بها عيوب من التصنيع.					
6	السرقة أو التخريب.					
7	نقص المواد المطلوبة بسبب الإغلاقات والطلب المتزايد عليها.					
8	عدم تخزين المواد بشكل صحيح.					
	مناولة المواد					
9	سوء مناولة المواد داخل الموقع.					
10	النقل المتكرر لمواد البناء داخل الموقع.					
11	التعليمات غير كافية عن كيفية مناولة المواد داخل الموقع.					
	النقل					
12	نقل المواد بطريقة غير صحيحة مما يؤدي إلى تلفها.					
13	عدم تخزين المواد في مكان قريب من موقع الإنشاء.					
	إدارة الموقع					
14	الافتقار إلى خطة لإدارة المواد والوقت.					
15	تزويد فريق العمل في المشروع بمعلومات ضئيلة .					
16	عدم كفاءة طاقم المقاول في التنفيذ.					
17	نقص المهنيين والمشرفين في طاقم المقاول.					
18	البطئ في اتخاذ القرار من قبل المقاول.					
	الإشراف علي الموقع					
19	طاقم الاستشاري الذي تم تعينه في المشروع غير مؤهل .					
20	تأخر مهندس الاستشاري في الموافقة علي تنفيذ أوتفتيش أو فحص أعمال المقاول.					
21	سوء الاتصال والتنسيق بين المالك والمهندس الاستشاري والمقاول.					
22	الأوامر التغيرية.					

الجزء الثالث : العمال

– العوامل التي تؤثر علي إنتاجية العمال :-

12. بناء خبرتك في مجال قطاع الإنشاءات، الرجاء حدد درجة الموافقة علي العناصر التالية المؤثرة في إنتاجية العمال في قطاع الإنشاءات في قطاع غزة.

مسلسل	العوامل التي تسبب زيادة إنتاجية العمال	يؤثر بدرجة كبيرة جداً	يؤثر بدرجة كبيرة	يؤثر بدرجة متوسط	يؤثر بدرجة قليلة	يؤثر بدرجة قليلة جدا
1	مشاركة العمال في تنظيم الشركة والاهتمام بأحوالهم الشخصية .					
2	مدى مساهمة نقابة العمال من حل مشاكلهم ومطالبهم.					
3	التأمين الصحي .					
4	استقرار العمل .					
5	العلاقات بين العمال .					
6	حسن إدارة العمال .					
7	انضباط العمال.					
8	الاهتمام في المسئولين.					
9	التأمين الاجتماعي.					
10	شروط السلامة والصحة المهنية.					
11	رضا العمال.					
12	خلق المنافسة.					
13	مشاركة العمال في المشاكل ومعرفة النتائج.					
14	الثقافة المختلفة.					
15	مشاركة العمال في اتخاذ القرار.					
16	بعد مسافة الموقع عن البيت.					
17	دفعات الحوافز.					
18	اعطاء العمال المسئولية.					
19	كمية التعويضات والمكافئات.					
20	توقيع عقود مع العمال.					
21	تأمين الإصابة في موقع العمل.					
22	تسهيلات في موقع العمل(توفير الاحتياجات الضرورية مثل المواد والمعدات).					

مسلسل	العوامل التي تسبب في تقليل إنتاجية العمال	يؤثر بدرجة كبيرة جداً	يؤثر بدرجة كبيرة	يؤثر بدرجة متوسط	يؤثر بدرجة قليلة	يؤثر بدرجة قليلة جدا
1	عدم رضا العمال.					
2	سوء الفهم بين العمال.					
3	المشاكل الشخصية للعمال.					
4	حجم الإنشاء أو العمل.					
5	صعوبة توظيف العمال.					
6	درجة تعقيد المشروع.					
7	العمال الجدد.					
8	عدم توزيع العمال الجدد مع القدامى.					
9	الضغوط النفسية للعاملين.					
10	عدم تأهيل العمال وتدريبهم.					
11	تأخير الفحوصات.					
12	تغير الفنيين.					
13	غياب العمال عن موقع العمل.					
14	الأوامر التغيرية					
15	خبرة الإدارة.					
16	البطالة.					

- **آلية اختيار العمال:**
- **كيف تختارون عمالكم :**

عن طريق: الخبرة□ السمعة□ مسابقة□

- **ما هو معيار تحديد أجور العمال**
- **عقود سابقة□ المتداول في السوق□ الحد الأدنى الذي تحدده وزارة العمل□**

13- تأثير العمال في زيادة مدى تكلفة المشروع

اعتمادا علي خبرتك في مجال قطاع الإنشاءات الرجاء تحديد درجة تأثير العوامل التالية والمتعلقة بالعمال علي زيادة مدة وتكلفة المشروع.

مسلسل	العامل	يؤثر بدرجة كبيرة جداً	يؤثر بدرجة كبيرة	يؤثر بدرجة متوسط	يؤثر بدرجة قليلة	يؤثر بدرجة قليلة جدا
1	نقص عدد العمال.					
2	كبر سن العاملين في الموقع.					
3	غياب العمال.					
4	الاختلاف في الانتماءات السياسية والحزبية للعمال .					
5	التنبؤ الغير دقيق في إنتاجية العمال .					

الجزء الرابع:المعدات

14- العوامل المتعلقة بالمعدات وأثرها علي مدة وتكلفة المشروع

مسلسل	العوامل التي تؤثر علي زيادة تكلفة المشروع	يؤثر بدرجة كبيرة جداً	يؤثر بدرجة كبيرة	يؤثر بدرجة متوسط	يؤثر بدرجة قليلة	يؤثر بدرجة قليلة جدا
1	وفرة معدات الإنشاء في السوق.					
2	جودة معدات الإنشاء.					
3	العمر الافتراضي لمعدات الإنشاء.					
4	أسعار معدات الإنشاء.					
5	طريقة استخدام معدات الإنشاء.					
6	حجم المعدة.					
7	ظروف الطقس.					
8	توفر المساحات للآلات.					
9	التخطيط والاختيار المناسب للمعدات.					

15- الإجراءات المتخذة في حال حدوث أحداث مخالفة للتخطيط

- تأخر وصول المعدات إلى موقع العمل

تغير المورد□ الاعتماد علي معدات الشركة□ الاستمرار مع المورد□

- وصول معدات مخالفة للمواصفات

تغيير المورد□ الاستمرار مع المورد□ الاعتماد علي مقاولي الباطن □

- حدوث عطل مفاجئ للمعدات يؤثر علي الجدول الزمني

شراء معدات جديدة□ تغيير في المخطط الزمني□ الاعتماد علي مقاولي الباطن □

الجزء الخامس : استخدام الحاسوب في الشركة

16- هل تستخدمون الحاسوب في الشركة ؟ نعم ..... لا .....

- **إذا كانت الإجابة (نعم) استكمل ،إذا كانت(لا)انتقل إلى السؤال رقم 18**
- **ما هي برامج الحاسوب التي تستخدمونها في شركتكم؟**

□MS_PROJECT □EXCEL □ACCESS

□WORD □AUTOCAD غير ذلك □

17- أهمية استخدام الحاسوب في إدارة الموارد

مسلسل	درجة أهمية استخدام الحاسوب في إدارة موارد التشييد	يؤثر بدرجة كبيرة جداً	يؤثر بدرجة كبيرة	يؤثر بدرجة متوسط	يؤثر بدرجة قليلة	يؤثر بدرجة قليلة جدا
1	ضمان وجود أرشيف لجميع المشاريع المنفذة حول تكلفة الموارد.					
2	توفير الجهد المبذول.					
3	توفير الوقت.					
4	توفير التكلفة.					
5	ضمان الشفافية.					
6	ضمان اتخاذ الإجراءات المناسبة في الوقت المناسب.					
7	سهولة تحديث أسعار الموارد.					
8	توفير فرصة للتواصل .					
9	المساهمة في تحديث بيانات الموارد بشكل مستمر.					
10	المساعدة في اختيار الموردين.					
11	تقليل فرص ارتكاب الأخطاء .					
12	ضمان عدم نسيان موارد من الفعاليات .					
13	تساهم في توفير تكلفة الاتصالات.					

18المعوقات التي تواجه استخدام الحاسوب في إدارة الموارد:-

مسلسل	العامل	مهم جداً	مهم	متوسط	أقل أهمية	غير مهم
1	عدم ادارك أهمية استخدام برامج الحاسوب.					
2	عدم توفر برامج حاسوب سهلة الاستخدام.					
3	التكلفة المالية المرتفعة لبرامج الحاسوب.					
4	صعوبة التعامل مع البرامج المتوفرة.					
5	عدم وجود أشخاص مؤهلين لاستخدام برامج الحاسوب المتخصصة .					
6	الحاجة إلى تدريب على برامج الكمبيوتر .					

Annex 2

The Questionnaire (English Version)

ISLAMIC UNIVERSITY-GAZA

CIVIL ENGINEERING DEPARTMENT

Construction Management

Questionnaire about

A Construction Resources Management System for Gaza Strip Building Contractors

Brothers and sisters,

After Greetings,

We are pleased if you help us to make this study achieved. The study is about resources management in constructing projects. This study does relate to a thesis for master degree at university' and the outcomes of this study is just for the matter of research.

This research aims to develop the resources management at constructing projects.

QUESTIONNAIRE FOR RESEARCH THESIS

SECTION A: GENERAL ORGANIZATION INFORMATION

1. Name of company:_____

   Year of company establishment:_____

2. Major type of work involved:

☐ Buildings ☐ Roads
☐ Water and Sewage ☐ Electro mechanics ☐ Others. Determine_____

3. Respondents designation:

☐ Owner of organization . ☐ Project manager
☐ Site Engineer ☐ ffice Engineer ☐ Others. Determine_____

4. Relevant working experience (Years):

☐ 1-3 Yrs ☐ 3.1-5 Yrs ☐ 5.1-10 Yrs ☐ >10.1Yrs

5.Company classification according the contracting union for the follwing field:

- Building works:	☐ First class	☐ Second class	☐ Third class
- Water and sewerage works:	☐ First class	☐ Second class	☐ Third class
- Roads works:	☐ First class	☐ Second class	☐ Third class

6. Average of projects executed per year ($):

☐ Less than .5 million ☐ .51-1 million ☐ 1.1-2 million ☐ More than 2.1 million

7. No. of constant employees:

☐ Less than 10 ☐ 10-15 ☐ 15-20 ☐ More than 20

SECTION B: MATERIALS

Materials waste:

8- To which extent you evaluate the important degree on knowing materials waste for the following factors:

NO.	Importance	Importance degree				
		Very Important	Important	Medium	Low important	Very low Important
1	Help to determine the exact required quantities.					
2	Increase the chance for obtaining the project finance.					
3	Help for preparing accurate bill of quantities.					
4	Help contractors to price tenders more accurately.					
5	Help the contractor to have a better chance to win the tender.					
6	Knowing the real requirements for the project (materials time- cost)					
7	Help to finish the project successfully and have profits.					
8	Help in preparing a good schedule program including project resources.					

Implementation of construction materials management systems on construction projects

Important of implementation a construction materials management system

9- To which extent you evaluate the effect of the following benefits when implement a construction materials management system:

NO	Benefit	Very high degree effect	high degree effect	Mid high degree effect	Little degree effect	Very little degree effect
1	Reducing the costs of project materials.					
2	Better handling of materials.					
3	Reducing duplication of materials orders.					
4	Materials are timely available on site with the right quantity.					
5	Improving labor productivity.					
6	Complying to time schedule.					
7	Complying to enhancement of quality control.					
8	Improving follow up and monitoring of construction materials.					
9	Better relationships with suppliers.					
10	Waste reduction.					
11	Reducing the space for materials on site.					
12	Obtaining better price for the construction materials.					
13	Help the contractor to have a better chance to win the tender.					

10. To which extent you evaluate the importance of implementing materials management to reduce the following problems:

NO	Problem	Very Important	Important	Medium	Low important	Very low Important
1	Materials are not available.					
2	Materials are not available with required quantity.					
3	Late deliveries to the site.					
4	Slow responses from the consultant engineer about submittals.					
5	Deliver wrong materials.					
6	Deliver materials with wrong dimensions.					
7	Deliver materials with wrong quantities.					
8	Increase materials quantity in storages.					
9	Burglary, theft and vandalism					
10	Destroyed materials when deliver.					

Factors increase waste on the construction site:

11. Explain the degree of effect for the following factors which increase waste on the construction site:

(1) Very high degree affect (2) High degree affect (3) Mid degree affect (4) Little degree affect (5) Very little degree affect

Factors causes crease waste on site	**Effects' Degree**				
	1	**2**	**3**	**4**	**5**
On site:					
1 .Materials damage on site.					
2 Improper cutting of materials.					
3. Existence of unnecessary materials on site.					
4. Overproduction/Production of a quantity greater than required or earlier than necessary.					
5. Manufacturing defects.					
6. Burglary, theft and vandalism.					
7. Lack of materials (due to closure).					
8 .Poor storage of materials.					
Handling:					
9 Improper handling of materials on site.					
10 Duplication of transporting material on site.					
11 Insufficient instructions about handling materials on site.					
Transportation:					
12 Improper materials.					
13 storing materials in far away stores					
Site management and practices:					
14 Lack of material and time waste management plan.					
15Poor qualifications of the contractor's technical staff assigned to the project.					
16 Providing project team with insufficient information.					
17 Shortage of technical professionals in the contractor's organization.					
18 contractor's slowness in taking decisions.					
Site supervisor:					
19Poor qualification of consultant engineer's staff assigned to the project.					
20Delay in performing inspection and testing by the consultant team.					
21Poor coordination and communication among the consultant, the owner and the contractor.					
22Change orders.					

SECTION C: LABOR

Labor: Factors which affect the productivity of the workers:

12. Explain the degree of effect for the following factors which increase the productivity of workers depending on your experience in the construction project: (1) Very high degree affect (2) High degree affect (3) Mid degree affect (4) Little degree affect (5) Very little degree affect.

Factors causes crease the productivity of the workers	Effects' Degree				
	1	2	3	4	5
1. The workers participation in organizing the company as well as caring about their personal status.					
2. The contribution of the trade union n solving their problems and claims.					
3. Official concern.					
4. Relation between workers.					
5. The stability of the work.					
6. Good management of the workers.					
7. The confidence of the contractor in the future.					
8. Workers discipline.					
9. Health-and-safety conditions					
10. Work satisfaction					
11. Creating competition					
12. Giving responsibility					
13. Sharing problems and their results					
14. Cultural differences					
15. Worker participation in decision-making					
16. Distance from home					
17. Social insurance					
18. Health insurance					
19. Incentive payments					
20. Asign contracts with workers.					
21. Insurance for injury workers in the workplace.					
22.Facilitiees of workplace(availability material&equip)					
23.Number of training courses					
24. Amount of remuneration					

Factors affect in reducing the productivity of the workers	Effects' Degree				
	1	2	3	4	5
1. The workers are not satisfied.					
2. Misunderstanding between workers.					
3. Formen change.					
4. The personal problems of the workers.					
5. The complexity of the project.					
6. New workers**.**					
7. Construction volume.					
8 .Inspection delay.					
9. Change orders.					
10 Difficulty with recruitment of workers.					
11. Management experience.					
12. Unemployment.					
13. Absenteeism from the work site.					
14.Unqualified training for workers					
15. Sycological pressure on workers.					
16. Dont distributes new workers with old.					

The mechanism of workers selection:

How do you select your workers? By:-

Experience	Fame	Contest

What is the criterion of determining the wage of the workers?

By:-

Previous Contracts	What is common in the trade	The minimum which is specified by the Ministry of Labor

13. The impact of the workers increasing the duration and cost of the project:
Depending on your experience in the construction project, please limit how can the following factor affect of duration and cost of the project.

NO	Factor	Very high degree effect	high degree effect	Mid high degree effect	Little degree effect	Very little degree effect
1	The limited number of the workers.					
2	Aging workers in the project.					
3	The absence of the workers.					
4	The differences of workers in political affiliations and parties.					
5	Imprecise prediction concerning the productivity of the workers.					

SECTION D: EQUIPMENT

14. Factors which related to equipment and impact on the duration and cost of the project? Depending on your experience in the construction project, please select the degree influence from the following factors concerning the equipment which increase duration and cost for the project.

Factors affect in 1ncresing duration and cost the project	**Effects' Degree**				
	1	**2**	**3**	**4**	**5**
1. Availability of construction equipment in the market.					
2. The quality of construction equipment.					
3. Lifetime of construction equipment.					
4. Price of construction equipment.					
5. Size of equipment.					
6.How to use of construction equipment.					
7. Proper equipment planning and selection.					
8. Weather condition.					
9. Avalaability of space.					

15. The taken procedures in case of unexpected actions which disagree with the planning:

The late arrival of materials to the work site.

Change the supplier	Rely on the equipment of the company	Continue with the supplier	Other (specify)

The arrival of materials which contradict the specification.

Change the resource	Continue with the resource	Other (specify)

Sudden breakdown of the equipment which affect the schedule

Purchase new equipment	Change the time line	Rely on subcontractor	Other (specify)

SECTION E: USING COMPUTER IN RESOURCE MANAGEMENT

16. Use the computer in the company

Do you use the computer in your company?

Yes	No

If your answer yes, please complete; if your answer no skip to the question#18:
What are computer program that you use in your company?

MS-PROJECT	EXCEL	WORD	ACCESS	OTHER(specify)

17. The important of computer use in the management of resources:

Depending on your experience in the construction project, please select the degree from the following factor affect of computers in the management of resources.

factor affect of computers in the management of resources	**Effects' Degree**				
	1	**2**	**3**	**4**	**5**
5. Ensure archive of all projects about the cost of resources.					
2. Save the effort.					
3. Save the time.					
4.Ensure the credibility					
5. Ensure the archive of all projects about the cost of resources.					
6. Ensure proper taken procedures at the right time.					
7. Facility of updating of resource prices.					
8. Provides an opportunity for communication between the project team.					
9. Contribute to updating the resource data continuously.					
10. Assist in selection of suppliers.					
11. Reducing the opportunities to commit errors.					
12. Ensure that resources are not forgotten any events.					
13. Contribute to saving the cost of the communications.					

18. What opinion in the next obstacles effect for using computer in resource management.

NO.	obstacle	Importance degree				
		Very Important	Important	Medium	Low important	Very low Important
1	No understanding for importance of computer program.					
2	Shortage of user friendly computer programs.					
3	The high cost computer programs.					
4	Difficulty of dealing with available programs.					
5	Shortage of qualified persons in using computer programs.					
6	The need for training on computer program.					

THANK YOU!!

Annex 3

System Evaluation Questionnaire (In Arabic)

استبيان تقيم برنامج الحاسوب

(CRMS) "Construction Resources Management Software"

السادة شركة / .....

نشكر لسيادتكم للمساهمة في أوقاتكم وجهودكم في تطبيق برنامج الحاسوب CRMS الخاص بإدارة موارد البناء في مشاريع التشييد والمقدم لسيادتكم لتجريبه في مشروع حقيقي.

يرجى من سيادتكم تعبئة هذا الاستبيان, وذلك من أجل التحقق من فعالية البرنامج المذكور. إن رأيكم وملاحظاتكم علي البرنامج مهمة جدا.

ولكم جزيل الشكر

الباحث

م. محمود محمد أبو ا

أولا/التصميم والتركيب:

بين مدى موافقتك على الخصائص والميزات التالية المتعلقة بتصميم وتركيب البرنامج.

الرقم	الخصائص/الميزات	موافق جدا	موافق	موافق بدرجة متوسطة	موافق بدرجة ضعيفة	موافق بدرجة ضعيفة جدا
1	البرنامج مرن ويمكن تحديث البيانات فيه بسهولة.					
2	استخدامه بصورة عامة سهل.					
3	يوفر الوقت والجهد.					
4	طريقة إدخال البيانات سهلة وواضحة.					
5	التقارير والمخرجات واضحة وسهلة القراءة والفهم.					
6	طريقة فرز البيانات سهلة.					
7	الجمل والأرقام الواردة فيه مختصرة ومفيدة وحجمها مناسب ومقروءة.					
8	يمكن إستخراج المعلومات منه بسهولة.					
9	طريقة الاستخدام المرفقة مفهومة.					
10	يوفر سهولة وارتياح في التعامل معه لأنة يعمل ضمن بيئة Ms Excel.					
11	التدريب عليه سهل ولا يحتاج لوقت كبير, كما انه لا يحتاج لموظف محترف للتعامل معه.					
12	يمكن تطبيقه في معظم المشاريع بأنواعها في قطاع غزة (مناسب لمقاولي قطاع غزة).					
13	يساهم في تطوير إدارة موارد البناء في مشاريع التشييد في قطاع غزة.					

ثانيا / أذكر الصعوبات التي واجهتك في استخدام البرنامج.

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ثالثا / إذا كان لديك انتقادات أو تعليقات على البرنامج, يرجى ذكرها.

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رابعا/ في رأيك, ما هي مميزات البرنامج.

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Annex 4

System Evaluation Questionnaire (English Version)

Questionnaire about evaluation of

Construction Resources Management Software (CRMS)

Sire/……..

I strongly thank you for your contribution of time and effort to apply and test the CRMS software in a real project.

Please fill this questionnaire which aims to verify the construction resources management software (CRMS).

The researcher
Eng. Mahmoud M. Abu Al Kass

First / The design and structure

Clarify your extent of agreeing with the following features of CMMS design and structure.

No	Techniques	Strongly agree	Agree	Intermediately agree	Weakly agree	Very weakly agree
1	The software is flexible, and the data can be updated easily.					
2	In general, it is easy to use.					
3	It saves time and effort.					
4	Method of entering data is easy and clear.					
5	The reports and outputs are clear, and easy to read and understand.					
6	Method of sorting data is easy.					
7	Text and numbers shown are concise, and their sizes are suitable and readable.					
8	The information can be inquired easily.					
9	The method of use is understandable.					
10	It is easy to handle as it is developed within Excel environment.					
11	Training to use the CRMS is easy and it does not need much time. In addition, it does not need a professional user to deal with it.					
12	It can be applied for most of Gaza strip projects. (It is suitable for Gaza strip contractors).					
13	It contributes in improving the construction materials management practice in Gaza strip.					

Second / Declare the difficulties that you faced during the use of CRMS.

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Third / If you have any criticism or comment on the software, please state them.

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Fourth / According to your opinion, what are the CRMS advantages?

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