Information Technology in Gaza Strip Construction Industry

Thesis · February 2010

DOI: 10.13140/2.1.3755.3446

4 authors, including:

Bélal Almassri
Palestine Polytechnic University
15 PUBLICATIONS **37** CITATIONS

SEE PROFILE

The Islamic University of Gaza

Faculty of Engineering

Civil Engineering Department

الجامعة الإسلامية – غزة

كليـــة الهندســة

قسم الهندسة المدنيـة

Graduation Project

Information Technology in Gaza Strip Construction Industry

Prepared by:

Ahmed Qudaih

Ali Al-Mosadar

Belal Al-Massri

Mosa Al-Akhras

Supervised by:

Eng. Khalid A. Al Hallaq

The Islamic University of Gaza - Palestine

February 2010

Dedication

We would like to dedicate this work to our parents …. for their generous, scarify and endless supports

Acknowledgements

We want to express our sincere gratitude to our supervisor, ***Eng. Khalid Al-Hallaq*** *for his valuable, professional supervising and guiding our research. In particular, we have appreciated that he have let us follow our own path during our research project.*

We are also grateful to our staff of Civil Engineering Department at the Islamic University of Gaza for their academic and scientific supervision through out our study.

Special thanks are given to ***Eng. Fayez Al-Massri****, for inspiration, valuable and fruitful collaboration.*

Finally, we want to express our gratitude to our parents; for their everlasting support, inspiration and encouragements.

Ahmed Qudaih
Ali Al-Mosadar
Belal Al-Massri
Mosa Al-Akhras

ABSTRACT

Construction is one of the most information-dependent industries compared to other sectors. Computers have been used to improve the efficiency of management in most businesses including the construction industry. Treating information efficiently is the key to maintaining an edge over competitors and for success in business.

This study presents findings of a research project that explored the current state of the information technology (IT) applications in Gaza strip construction industry. These findings are based on a questionnaire survey conducted between October and November 2009 among randomly 80 Gaza strip construction industry organization. A total of 55 valid responses were received, representing a response rate of 68.75 % of those delivered. The survey focused on how respondents use information technology in their daily operations, including information flows among business partners, the use of computer hardware and software, IT expenditure and training, management supports, benefits of IT applications, and problems encountered.

This research gives a general view of the current state of information technology applications among contractors, consultants, public owners and suppliers in Gaza strip, and provides first-hand information on how well respondents are aware of and have equipped themselves with this new technology. It also reveals that although information technology applications constitute what are probably the most visible technological changes in recent years, the local construction industry is quite conservative in their adoption and use.

The main results, indicated that all of the participating organizations are using computers and fax machines in their business operations; almost all participants own CD writers and photocopier. Almost (100%) of the organizations use Microsoft Project for project planning and scheduling and some of the organizations use Primavera with (16.4%). (100%) of the organizations are using Microsoft Excel software for estimating purposes. (50%) of the respondents use accounting software such as Al-Assel and Alsehree . MS word and Excel are the most popular software for general administration purposes. Software for structure design and water systems are

used more than others. In general, most of the software used for structure purposes is PROKON, and STAAD. AutoCAD software shows the highest percentage of (94.5%) among the drawing software currently used in construction industry within Gaza strip. Most of the software used for Water system purposes is BENTLEY, and Hydraulic Cad.

Microsoft operating systems with (100%) of the respondent contractors organizations use Microsoft Windows XP. The most important factors considered in selecting the software that all respondents select were user Simplicity in using program, Spread of the software, Availability of the software, and cost factors respectively. A large proportion of organizations do not have a web site on the Internet. 100% of the investigated public institutions, consultants, and contractors answered that they have a connection to the Internet. The most significant purpose of using internet is to send/ receive messages, which is (94.5%) and (83%) respectively of those with distribution of documentation to other organization that as a purpose.

The most significant factor restricting the use of internet by the organizations is fear of losing sensitive information, identified by (87.3%) of those responding which revealed the importance of security of information sent using internet. respondents tend to agree that information technology will improve profits in the next five years with (RII = 0.8) and ranked first either agree or strongly agree with this prediction.

It is suggested that construction industry organizations should have a more positive attitude toward using information technology; the industry as a whole should also take the initiative to promote IT - based communications among all professions within the industry; furthermore, the Palestine Government should take the initiative in promoting information technology applications in the local construction industry.

ملخص البحث

استخدامات تكنولوجيا المعلومات في صناعة المقاولات في قطاع غزة

تعتبر صناعة الإنشاءات من الصناعات التي تعتمد على المعلومات مقاومة بباقي الصناعات فالكمبيوترات مثلا تستخدم لزيادة كفاءة إدارة جميع الأعمال وخصوصا صناعة الإنشاءات ولهذا فان معالجة المعلومات هي مفتاح التنافس والنجاح في العمل.

جاءت هذه الدراسة لتبين نتائج مشروع تخرج يوضح الوضع الحالي لاستخدامات تكنولوجيا المعلومات في صناعة الإنشاءات في قطاع غزة، هذه النتائج جاءت بناء على استبانه مسحية تم عملها بين أكتوبر ونوفمبر 2009 من خلال حوالي 80 مؤسسة قام 55 منهم بتعبئة الإستبانة بنسبة 68.75% مما تم توزيعه.
لقد ركزت الإستبانة على تحديد كيفية استخدام تطبيقات تكنولوجيا المعلومات في العمليات اليومية من خلال تدفق المعلومات مع الشركاء في العمل بالاضافة لاستخدام الكمبيوتر والبرامج المتعددة. كما وركزت الإستبانة على تحديد مجالات استخدام تكنولوجيا المعلومات في دعم الإدارة والمعوقات التي تواجه استخدامها.

يأتي هذا البحث ليقدم معلومات أولية حول استخدامات كلا من المقاولين والاستشاريين والقطاع العام وكذلك الموردين وكيفية وعيهم حول تأسيس موئساتهم بالأجهزة. بالاضافة الى ذلك فإنها توضح انه وبالرغم من التطور السريع لتكنولوجيا المعلومات فان صناعة الإنشاءات المحلية ما زالت متحفظة على قبولها والتعاطي معها.

جاءت نتائج الدراسة لتوضح ان جميع المشاركين يستخدمون الكمبيوترات والفاكسات والقارئات الممغنطة والناسخات، كما ان معظم الشركات تستخدم برنامج ميكروسوفت بروجكت لأغراض تخطيط وجدولة المشاريع و 16.4% يستخدمون برنامج بريمافيرا، 100% يستخدمون ميكروسوفت اكسل في أغراض التقديرات ، 50% يستخدمون برامج المحاسبة كالأصيل والسحري. ميكروسوفت ورد وميكروسوفت اكسل هم من أهم البرامج لأغراض الإدارة العامة، برامج التصميم الإنشائي والأنظمة المائية تستخدم أكثر من غيرها فمثلا من أهم برامج التصميم الإنشائي بروكن وإستاد بينما جاء برنامج أوتوكاد كأعلى نسبة 94.5% في برامج الرسم الهندسي بينما الهيدروليك كاد والبنتلي لأغراض أنظمة المياه.
بالاضافة لذلك فان 100 % من المشاركين يستخدمون ميكروسوفت اكس بي كنظام تشغيل. كما جاءت سهولة الاستخدام كأهم عامل في اختيار البرامج ويليها انتشار البرامج وتوفرها وأخيرا يأتي سعر البرامج.

عدد كبير من الشركات لها موقع الكتروني وجميعهم يستخدمون الانترنت ومعظمهم يستخدمون الانترنت لاستقبال وإرسال الرسائل بنسبة 94.5% ولتوزيع المستندات لباقي المؤسسات بنسبة 83%. كما وجاء الخوف من فقدان معلومات مهمة كأهم عامل يمنع استخدام الانترنت 87.3% وهذا يعكس أهمية السرية في نقل المعلومات، بالاضافة لذلك فان جميع المشاركين يوافقوا على ان استخدام تكنولوجيا المعلومات يزيد من الربح.

وأخيرا جاءت الدراسة بالعديد من التوصيات والتي من أهمها اتخاذ موقف ايجابي باستخدام تكنولوجيا المعلومات بالاضافة الى ذلك فان صناعة الإنشاءات بأكملها يجب ان تأخذ المبادرة لنشر تكنولوجيا المعلومات والاتصالات في أعمالها وكذلك الحكومة الفلسطينية.

Table of Contents

List of Abbreviations

AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ASTM	American Society for Testing and Materials
BS	British Standards
C&D	Construction and Demolition
CBR	California Bearing Ratio
CWMG	Construction Waste Management Guidelines
EPA	Environmental Protection Authorty
GTZ	Gesellschaft Technische Zusammenarbeit
MSW	Municipal Solid Waste
NGOs	Non-Governmental Organizations
PECDAR Reconstruction	Palestinian Economic Council for Development and
PNA	Palestinian National Authority
UNDP	United Nations Development Program
UNDP/PAPP	United Nations Development Programme/Programme of Assistance to the Palestinian People
UNIDO	United Nations Industrial Development Organization
UNRWA	United Nations Relief and Works Agency

List of Tables

List of Figures

Information Technology in Gaza Strip Construction Industry

Chapter 1
Introduction

1.1 Research Background

The rapid development of computer and communication technologies provides the potential for inducing big changes in the use of data, information and knowledge in the construction industry. In particular, wireless technologies and the Internet make it increasingly possible to provide web access to construction managers in the field. Some construction firms have began to adopt the new technologies believing that it would improve the productivity and safety of their projects (Trefor et al., 2006).

Information technology (IT) has been widely applied in many industrial sectors in order to increase their profit, competitiveness, and to reduce unnecessary project costs. The Oxford Concise English Dictionary defines IT as: the study and use of systems for sorting, retrieving and sending information, (cited by Lee, 2003). Also, IT is defined as: the use of electronic machines and programs for the processing, storage, transfer and presentation of information (Rivard, 2000).

Applications of information technology in the construction industry have attracted increasing attention worldwide. A number of surveys have been conducted in the construction industry in recent years to investigate the status of information technology applications in the industry (Rivard H., 1999).

In the era of IT, Internet and World Wide Web (WWW, or Web) were commercially introduced at the mid of 1990s. Electronic Web pages are graphically based tool for sharing information. They are more accessible than printed pages; they can be accessed 24 hours and provide the fastest way to access information or to promote commercial services.
In construction industry, Issa et al. (2002) mentioned that, Internet and web-based

technology is changing the way business is done in construction, the web has become a source for information, goods and services, and a means of communication. Proper communication is vital a factor in the whole life cycle of any construction project.

1.2 Research problem

Although there has been some research into information technology applications generally in Gaza strip, no work has been done on a significant scale to investigate IT applications in the construction industry. Some fundamental issues relating to the full extent of IT applications in this industry have yet to be fully addressed, such as the types and sizes of business that use IT, the types of information technology used and their functions, and the future prospects for information technology in Gaza strip construction industry.

Information technology has already had some impact on organizations in Gaza strip and much more dramatic effects are anticipated for the years to come. Greater attention needs to be paid to the interaction of information technology with business methods, work patterns, employees and organizational culture.

1.3 Research objectives

This Project Research focuses on contractors' use of information technology in Gaza strip. The research aims to investigate the current state of IT in the construction industry, to obtain an up-to-date and general view of the state of IT applications, and to assist organizations in the industry to understand, design and manage their IT operations.

This research project provides first-hand information on how well the construction industry in Gaza strip is equipped with information technology.

The specific objectives of this research in logical sequence are:

1. To identify the awareness of IT in the construction industry,
2. To explore the opportunities offered by IT,

3. To provide solutions to Gaza strip construction firms for positioning themselves in the IT era,
4. To discover the extent of their current IT use,
5. To determine the level of their strategic approach to information technology and
6. To estimate the potential future IT among those surveyed and the total construction sector in general.

1.4 Research methodology

The methodology will be used in the research project is a questionnaire as a survey instrument in determining IT applications among Gaza strip contractors. The questionnaire attempts to investigate the factors affecting computer and IT use, the effecting of IT in achieving the strategic goals as quality, safety, business development and profit, and the effecting of IT in the future in construction industry. The factors will be measured and ranked under each group by the relative important index technique.

Although the construction industry consists of three primary sub-sectors, including owners, designers, and contractors, this particular research is confined to information technology applications among contractors, public owners and consultants only.

The targets groups list and its information such as address and classification to which the questionnaire survey was distributed was obtained from the Gaza strip Contractors Union database at their web site. Randomly organization address was selected from the list and recorded in a spreadsheet.

Ideas on the type of questions to be asked and the associated methods were generated and developed, based on the questionnaires presented in international journals. A draft version of the survey questionnaire was generated and distributed (via e-mail) to well known contractors, consultants, high level educational professionals, and IT private firms. The draft was distributed in order to examine the questionnaire validity based on the identified objectives. After comments and amendments, a final version of the questionnaire was produced. The first section of the questionnaire sought to identify

the organization's size and character in terms of the number of completed projects, annual turn over, type of business, number of personnel, and the contractors' classification. The questionnaire then asked for the types and software names in use in the organization and the most significant factors in selecting this software. The next questions related to the hardware in use by the organization. The fourth section sought to identify the Internet and communication technology applied by the organization. The last two groups of questions were about the factors restricting the use of IT and the prospects of IT implementation in Gaza. A cover letter was attached to the front page of the survey questionnaire for each organization in order to spot the objectives of the survey and to identify the meaning of IT in this research.

The questionnaire responses were entered into a spreadsheet for collation and analysis. The details of the response analysis are shown on the Data Analysis section.

1.5 Research layout

The research project consists of five chapters. Figure 1.1 represents the relationship between the chapters.

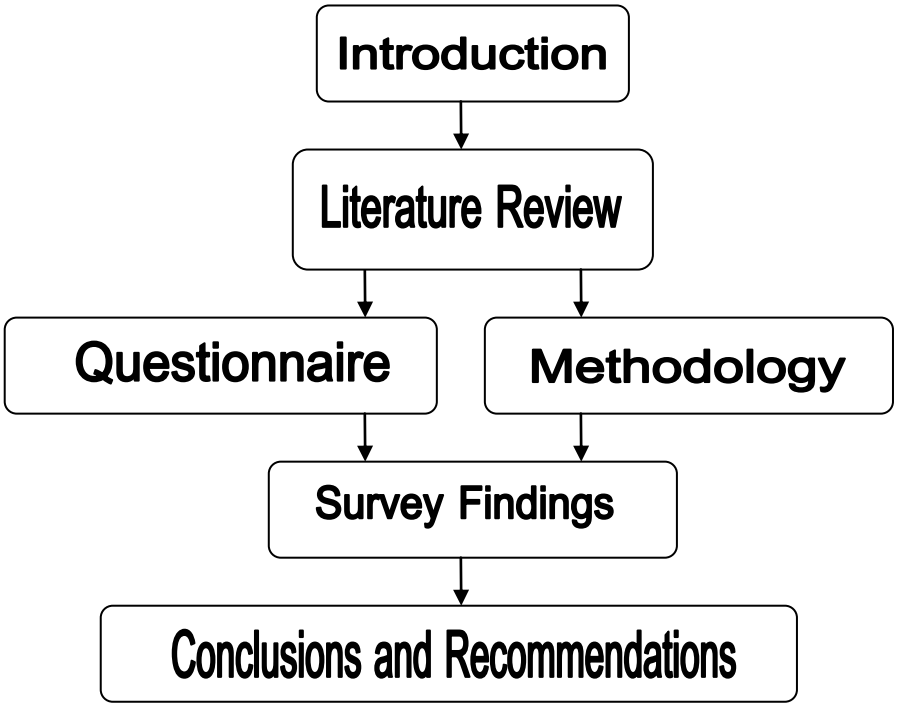


Figure 1.1 Research layout

The first chapter gives a general introduction and layout of the research.

The other chapters are as follows:

Chapter two is the literature review that covers the following areas:

- Definitions and Concepts
- Advantages and Important of using IT
- Applications of IT in Construction Industry
- Recent work and future directions of IT in construction industry
- Basic Obstacles in IT Applications
- Using IT in Project Construction Management (PMC)

Chapter three explains the methodology which covers the following areas:

- Sample Selection and Size
- Questionnaire Design
- Questionnaire analysis
    - Respondent's Profiles and Characteristics
    - Software selection and use
    - Factors considered in selecting computer software
    - Hardware selection and use
    - Internet and communication technology applied by the sampled:
    - Reasons hindering adopting IT solutions
    - Future Implementation
    - Factors or attributes causing the adoption of construction organization to IT

Chapter four illustrates the survey findings about the level of IT usage in construction industry in Gaza Strip.

Chapter five is the last chapter; it includes the conclusions and recommendations of the researcher.

Annex A contains the questionnaire structure.
Annex B contains Explanatory Letter of Validity Content.
Annex C contains Means, std. deviation t. value, and sig. level to know the difference between Contractor and Consultant

Chapter 2
Literature Review

This chapter reviews the theoretical background as well as the previous researchers of the use of IT in construction. In the first part main definitions of IT in construction will be presented as well as the advantages of using IT. In the second part the main researches conducted for the use of IT in construction will be illustrated. Future directions of using IT in construction as well as the problems incurred will also be presented in the second part of this chapter.

2.1 Definitions and Concepts

Ang et al. (1997), defined IT broadly as "technologies dedicated to information storage, processing, and communications" that is, a combination of hardware, software, telecommunications and office equipment to transform raw data into useful information for speedy retrieval. On the other hand Turk, Z, (2000), said that Information technology is technology that is used to deliver data, information, and knowledge. It should not necessarily be affiliated with electronic computers, although today these provide the most powerful solutions. Technical drawings, descriptive geometry, copying machines, telegraph, telephone, fax etc. are information technologies as well. In the same study he informed that information technology in construction is equipment, applications, and services that are used by organisations to assist human communication, commitment negotiation, problem solving and decision making, and spans over several civil engineering disciplines.

Pamulu and Bhuta, (2004), said that the use of IT is prevalent at lower level, however top management of construction organizations should have strong commitment to develop strategic management of IT in their business processes at all level. The hardware, software and their applications should be utilized to enhance both core and supporting activities to gain competitive advantage in today highly global business environment. Secondly, The firm's management should give greater attention to IT support and training, by making sure that there is sufficient trained staff for the implementation of IT, and making greater effort in training staff on the correct and

efficient use of IT in the organization. Also Mentor, (1992), defined IT as the technology that is used to deliver data, information, and knowledge. It should not necessarily be affiliated with electronic computers, although today these provide the most powerful solutions. Technical drawings, descriptive geometry, copying machines, telegraph, telephone, fax etc. are information technologies as well

Five more studies also revealed main definitions on IT, Bjork, (1999), defined IT as "the use of electronic machines and programs for the processing, storage, transfer and presentation of information. Mentor, (1997), defined information technology as something which includes equipment, applications, and services that are used by organizations to deliver data, information, and knowledge to individuals and processes. Thomas (1999), studied the use of information technology in the Republic of Ireland construction sector. It was found that IT was increasingly used in the Irish construction sector by the leading organizations. The survey revealed that although there are some similarities in the extent to which each of the sub-sectors are currently using IT and their intended use of IT in the future, there are also some significant differences. Betts, (1999), said that IT is the various types of works, all quite generic and not related to any construction technology, discipline, or material that are used to structure the applicable information technologies. And Finally Pamulu and Bhuta (2004), surmised that IT is used mostly in administration and other supporting area, but not in strategic core and business enhancement processes.

Other Authors presented how much the IT is widespread and used in different fields. Elcin Tas and Pinar Irlayici (2006), said that information technology is widespread in different parts of the construction industry. As one of the most important parts of construction activities, the building product sector has been growing parallel to the technological developments in the construction industry. Although it can be seen that there are various usages of IT in construction activities, it is not like that when gathering building product information. While internet accessing and electronic source usage is quite common in the building product information sector, these technologies have not being used sufficiently. On the other hand McCreadie and Rice (1999), identified and categorized a range of information definitions: information as commodity or resource, information as data, information as representation of knowledge, and information as part of the communication process. Correspondingly.

2.2 Advantages and Important of using IT

Regarding the important of the use of IT, different researchers illustrated many benefits in which these results are going to be presented in this part.. Thong and Yap (1995), developed an IT adoption model for small business, and found that the companies with innovative CEOs had a more positive attitude to IT use. Hong Kong, Bum (1990), studied the strategic use of IT in small- and medium-sized organizations. She surveyed three medium-sized organizations and found that their IT strategy could be described by the Porter and Miller (1983) model of competitive advantage. Sohal et al. (1998), studied 530 Australian companies, and found IT use to be positively related to the organizations performance. Finaly Hugues Rivard (2000), studied the effects of IT on construction management and found the main benefits achieved by the use of IT is an increase in the quality of documents, an increase in the speed of work, a better financial control, better communications, simpler and faster access to common data as well as a decrease in the number of mistakes in documentation.

Farag et al.(2009), provided empirical evidence that information technology (IT) use has a positive impact on construction firm performance. The findings are relevant to both the construction and IT literature. It also identified and assessed the degree of IT use and investigated the factors that affected the performance of construction firms. The factors were Activities Computerized and Materials Digitally Sent at the Firm (Internally and externally) in IT use. Also Chee H. Wong. (2000), discussed the adoption of IT and its evolution in five large construction firms that chose to leverage the potential of the technologies for business advantage, he also said that IT challenges of low profit margins and intense competition. On the other hand through a study conducted by Schwegler et al.(2001), the following benefits were illustrated:

- Greater use of IT correlates with better project performance.
- Owners and contractors realize meaningful benefits.
- There is a pronounced IT learning curve, but the benefits outweigh the risks.
- IT affects schedule compression beneficially.
- Saving the costs of firm.

Also Nihan Kumas,(2004), suggested that technological IT enabling solutions will play major role in achieving major improvements in a traditionally fragmented design and construction process. He showed that many countries, recognizing the importance of the Information Industry, are moving quickly to strategically implement it within their construction industries as being a central sector for sustainable development of their whole nation. They also said that IT can only be effective if it is based on synchronized process development. For example, the full benefits of an optimized implementation cannot be realized when the IT development is still at the ad hoc stages, and vice-versa. While Marjan Sarshar,(2005), illustrated that the most important benefits of e-procurement will result from improved tender and supply chain efficiency, rather than increased price transparency.

Different researchers studied the use of IT in different countries. Pamulu and Bhuta (2004) survey shows that Indonesian construction industry has the latest in hardware and software, but does not have adequate and trained personnel to utilize the same. It can be summarized that IT is used mostly in administration and other supporting area, but not in strategic core and business enhancement processes. Technical and project use of IT is increasing and the benefits are recognized by the companies. On the other hand Trefor et al. (2006) studied the use of information technology in the U.S.A and Korea construction sector. It was found that construction managers in the U.S.A. seem to be more hesitant to embrace IT to improve their information logistics widely recognized as a key inhibitor to improving productivity. Also GOH et al. (2002), studied the developing of Standards for the Construction Information in Singapore and found that there is a need for a common language if IT is to be used as a means to better and more efficiently manage and exchange information. As such, unorganized information is difficult if not impossible to access and is therefore as good as lost. On the other hand, properly organized information store, based on a common language, guarantees timely access for users and speedier transmission and exchange. Finally Mui et al. (2002), made survey of internet usage in the Malaysian construction industry and listed some Benefits obtained from the usage of Internet and Disadvantages of this usage .

Many researchers said that IT increases efficiency. Peansupap and Walker, (2005). illustrated that emerging information and communication technology (ICT) introduces opportunities for improving communication to enhance effectiveness of many construction processes at each project phase as well as creating new business opportunities. Thus, perceived ICT benefits have motivated numerous construction organizations to adopt and invest in this technology. However, many construction organizations have found that the ICT investment has failed to meet their expectations. One significant problem is a lack of understanding of how to actually implement ICT into a construction organization. This may lead to ICT implementation failure or retardation by all users within a construction organization. In addition, a lack of focus on actual ICT implementation may explain why ICT implementation problems still occur. Before substantial progress can be made to remedy deficiencies in ICT implementation, a better understanding is needed about the context and influence of a range of workplace, organizational and personal factors on ICT implementation. Also McMahon (1996) suggests that the problems of communication associated with the CI could be improved through the use of information technology (IT). The idea of adopting IT to increase efficiency, communication and productivity is not new. Organizations within the banking, manufacturing, entertainment and motor industries have used IT strategically to achieve and maintain a competitive advantage. On the other hand the ever-growing attention given to information resources suggests that better management of these resources become critical to project success. Dutton et al. (1996) presented their views on future research concerning the Internet and knowledge-based systems for the construction industry. They emphasis the need for fast, efficient, peer-to-peer communications facilitating easy supply of information and knowledge when virtual teams through remote working require IT. Björk (1994) pointed out that, in establishing the infrastructure for data structuring and transfer standards for computer integrated construction (CIC) applications, digitized construction information services and changing patterns of organizing projects become critical issues. He also said that construction companies are occupied with a variety of research and development efforts toward the improvement of transformation processes. Executives address the need for intelligent integration of information in supporting decision making for effective management in all stages of design and construction. Krizel et al (1996) also said that In recent years, one of the most

common topics in the construction industry is multi-project analysis and reporting. Changes in the economy have resulted in fewer mega-projects, allowing organizations to take on the challenge of managing their own projects more effectively. To meet this challenge, there is a need to establish management information systems for multi-projects programs. Finaly Mohammed Amin Abdallah (2006), studied the advantages of IT usage and informs that the main advantages perceived due to the use of IT are, better quality work, work done more quickly, information and experience sharing, better financial control, team distribution, better communications and simpler and faster access to common data.

Some of researchers argued that Information must be available. Luiten et al. (1997) point out that application integration is only possible when information and knowledge are available electronically and further automation is only economically feasible when information and knowledge input is automated. Negroponte (1975) argued that "any (design) problem is a problem of lack of information". We may disagree with the word "any", however, in bureaucratic processes this is true. There are two possible reasons for this lack; (1) information does not exist and must therefore be created, or (2) the information exists and must be made available at the right time and place.

On the other hand (Kiviniemi 1999) (Aouad, 1997) (Alshawi, 1996) have acknowledged the limitations of current approaches to the management of information in projects, (cited by Sarshar et al. 2004). Most of these limitations are due to:

i. Most project information is stored in papers as drawings and written documents. This is frequently unstructured and difficult to use.
ii. This process (storing information in papers) leads to incomplete understanding of the planned construction, functional inefficiencies, inaccurate initial work or clashes between components.
iii. People responsible for collecting and archiving project data may not always understand the specific needs of those who will use it, such as those involved in building maintenance.

iv. The data is usually not managed while it is created, but instead it is captured and archived at the end of the construction stage. This means that people who have knowledge about the project are often likely to have left for another project by this time- so their input is not captured.
v. Lessons learned are not organized well and are buried in details. It is therefore difficult to compile and disseminate useful knowledge and best practice to other projects.

Another important European project named e-construct project was developed too; Tolman et al. (2001) mentioned that the project aims to develop, evaluate, and demonstrate how the next generation of internet can be used to improve meaningful communication in the European building and construction industry, supporting future eCommerce and e-Business.

In addition, STAR research program is another European project developed by the technical research center of Finland (VTT). Karhu et al. (1997) mentioned that the transfer towards computer-integrated construction also presupposes the systematization of operations. In this regard, the author managed a team to develop a report named (Construction process model, generic present-state systematization by IDEFO) as part of a three-year STAR research program that aims to build up a theoretical foundation, systematic methodology, tools and knowledge for continuous improvement of the construction process. The construction process model report has modeled the overall construction process systematically creating a generic state-of-the-art model that covers the design and construction of a building project from the conception of the project in the client's mind to its completion for hand over and use covering more than 300 construction activities.

Finally UNSW (1998) recommended that the government take a leading role in the development of IT in the CI. This can be achieved by bringing reform to, and re-engineering the structure of the industry particularly by addressing education and training issues.

2.3 Applications of IT in Construction Industry

Information technology has been on a long slow path of implementation in the construction industry. Many applications of using IT in construction have been gathered through the research process, some of these applications are novice and other are more sophisticated. We are going to present in this sessions some of these studies and researches. The use of CAD is now the industry standard as is the use of email, the World Wide Web, and a wide variety of personal computing software. The use of e-commerce services is growing and appears to be on the way to widespread commercial adoption, as are some data and document exchange standards. To explore some of the near and long term information technology challenges facing the construction industry, and suggest how new information technology tools will enable three crucial new capabilities with the potential to create the profound changes seen in these other industries. First, new tools like 4D have grown out of the tradition of engineering CAD design. These new tools allow simulations of construction processes as well as visual simulations of the individual components. Second, improved data sharing with flexible product model schemas will permit the development of new contracting relationships, more geographically dispersed teams, and more tightly integrated supply chain performance. (Schwegler1 et al., 2001). Also Howard et al. (1998), investigated surveys of IT in the construction industry and experience of the information technology barometer in Scandinavia, the IT barometer survey compares results from Denmark, Finland and Sweden on the use of computer hardware, software and communications. It is complementary to other surveys looking at the strategic use of IT within companies. They found that CAD is used in almost all design offices in Sweden, with AutoCAD as the dominant product and found also that Microstation is now more widely used by architects in Denmark. CAD data structures are becoming more advanced with objects being used by more firms in Finland and Sweden. On the other hand Richard Alexander,(2005), talked about one of the applications of IT in construction which is Digital Technology including CAD drawings and he said that "the digital technology prevent the risks in construction projects however still Non-invasive in all countries". On the other hand Samuelson (2002) studied the use of IT in the Nordic construction Industry; his study covered three countries namely: Sweden, Denmark, and Finland. The study found

that 88% of all employees work at workplaces with computers. The most common types of software are word processors, administration and e-mail. 54 % of the employees have their own computers at the workplace. The use of CAD in general has increased and the use of model based CAD software has increased among architects. Property owners are those who use computers most widely in their core business, while contractors do this the least. The documents that are most often sent digitally are minutes of meetings and construction drawings. 83 % of all employees work at workplaces with access to the internet and 45 % have access to internet from their own computer. The use of project webs and electronic trade in the industry has started but it is not widespread. Many companies are still increasing their investments in IT but the speed of increase is slowing down. The industry experiences that IT has increased productivity, mostly in general administration. Consultants experience a higher productivity rise than contractors. The greatest advantages with IT are stated as better financial control and faster access to information, while the greatest obstacles are costs, which are too high for investment and upgrading of systems. The motives and plans for IT investments are concentrated on well-tried techniques in the companies support business. The comparison between Sweden, Denmark and Finland shows that Finland and Denmark have a greater use of model based CAD and that more employers have their own computer at the workplace. Companies in Sweden think they get better financial control with IT and also priorities costing/cost control and accounting systems to a greater extent.

Chen et al. (2004) identified three types of IT applications for innovative construction management that involves:

i. Procurement: e-commerce system for procurement of construction material and equipments.
ii. Automatic identification: barcode and radio frequency identification system (RFID) for construction material and equipment management on site.
iii. Documentation: construction project information system and knowledge management.

Many researchers conducted surveys about computer usage. Doherty (1997), conducted a survey about the computer usage in the New Zealand building and

construction industry. He concluded that a large majority of the businesses either do not use computer or use them only casually; one of the author's suggestions was to develop guidance on how the industry can make best use of internet and data interchange technology. Also Carl T. Haas, et al, (2000), made a research about using computers in construction and they found that among the 179 foremen who responded, fifty-seven percent use a computer at work. Of the foreman surveyed who used a computer at work, seventy-seven percent reported that they were somewhat comfortable, comfortable, or very comfortable with computers, they talked also about the firms that must consider the results of their study when planning future implementation of foreman-level task automation. Moreover Shash and Al-amer (1996) investigated computer use in the Saudi Arabia building and construction industry.One of the conclusions reached is that a large minority of businesses either does not use computers or uses them only casually. A similarly large minority needs to upgrade their computers. Growth is expected in electronic information services, especially on the Internet. On the other hand Rivard, H (2000) conducted a survey on the impact of information technology on the Canadian architecture, engineering and construction industry. It was found that many business processes are now almost completely computerised and the tendency is toward a greater computerisation of the remaining processes. Although the Internet has been adopted by most firms surveyed, design information is still exchanged in its traditional form. Kamel S. Saidi, et al, (2002), made a paper about " The Value of Handheld Computers in Construction" and they found that that time savings at the task and activity levels do not translate directly into project-level time savings and that benefits are more likely to be achieved if HHCs (Hand Held Computers) are implemented in multiple activities and projects, This research also found that the barriers to HHC implementation in construction are a result of two factors: 1) the HHC technology's limitations and 2) the construction industry's characteristics. The construction industry barriers consist of the physical jobsite conditions (such as temperature, humidity, dust, etc.) as well as organizational issues such as the industry's fragmentation and low risk tolerance, Handheld computers have many benefits that can improve construction processes. The most significant benefit is perhaps the HHC's ability to provide workers with real-time access to relevant information at the jobsite, and to send real-time information back from the jobsite to the appropriate

decision makers. In addition, an HHC's ability to improve the accuracy of the information being exchanged is one of its primary added values in construction.

Moreover for graphical softwares Moesman, J, et al. (2004), concluded that technological advances of 3D software and hardware in recent years, it is now possible to create a computer generated simulation of an engineering project before construction. UC-win/Road allows the developers, planners and engineers to consult with the public and visually inspect the design and its impact on the neighboring environment at minimal cost. Marjan Sarshar,(2005), also concluded that Many construction organisations are currently grappling with the issue of what their vision of the future might be. He also talked about the critically chances of our work will be business relevant.

About using internet Mui, et al. (2002) investigated the internet usage in the Malaysian construction industry. The authors found that the respondents to their survey have accessibility to internet, comparable to countries such as the United States, but, the main use of internet is only for e-mails and information search. One third of the investigated firms use internet for marketing purposes, the authors foresee that this will be the trend in the future. The authors recommended that the Malaysian construction industry development board should ensure that firms in the construction industry providing opportunities for their workers to be trained in the skills of information technology. The training should upgrade the internet skills to include e-bidding and e-meetings in an effort to fully utilize the potential of internet. Also Al-Reshaid and Kartam (1999), suggests a web-based Information delivery Intranet Site as a complimentary communication tool that would enhance the delivery and exchange of information on the Special Projects Administration (SPA) of the Ministry of Public Work in the State of Kuwait construction projects. Finally Qi Zhou & Robert 1. Krawczyk (2000), make survey of internet application in the construction industry and found that It is difficult for web vendors to provide truly international services mainly because the diversity and complexity of national and regional differences in building technology and building codes, hence he recommends establishing an international industrial standards in that compatible for all world locations .

Saad (1999) discusses a new interactive multimedia system that can be used by different project members to document and report progress in construction projects as well as a tool to analyze the progress and help predict the final project outcome.

Office application is the most prevalent use of IT, that is, computers for word processing and spreadsheets for office and contract administration (Best et al 1996). It's meant building documents can be exchanged in digital form. The application of office automation may improve internal management efficiency, and control cost. CAD is used in almost all construction offices in China and most of architects have some CAD.

Recent works addressed the potential IT visions and practices in construction sector in which Amor, et al. (2002) analyzed the papers and reviewed the key research issues that have been addressed by the International Council for Innovation and Research in Construction (CIB). The papers were collected from twelve workshops covering the period from 1992 to 2002. From the analysis of past papers and the future synthesis of IT vision, Amor et al. (2002), identified three topics to be used for more discussions, these topics are:

i. The modeling of processes and products and the integration of this with visualization and standardization of information life cycles.
ii. Issues associated with implementation adoption and behavior and the management of technology, and
iii. Reengineering of processes and the search for integrated supply chains.

Moreover, Sarshar et al. (2004), mentioned that research in project information management can respond to some of these challenges by:

i. Examining a vision for the future of IT in construction.
ii. Identifying two key areas of research in construction IT namely: integration and collaboration.

In this regard, Sharhar et al. (2004) quoted that the ED developed a project called

Distributed Virtual Workspace for enhancing communication within the construction industry (DIVERCITY). This project developed virtual workspace that improves communication and collaboration. The project focused on three construction processes, i.e. client briefing; design reviews; and site operations and constructabi1ity. DIVERCITY allows users to produce designs and simulate them in a virtual environment. All stakeholders within the project team can view the designs.

2.4 Basic Obstacles in IT Applications

Using IT in construction sector addressed many problems, many researchers presented these problems, some of these researchers are presented in this section; Franklin (1997) mentioned that contractors have always been slow to adopt new technology, and there is no exception with CIT, especially when the perception of many construction companies is that IT is of use only in a supportive role. Moreover, Krizel et al (1996) pointed out the one of the main problems encountered within the contractual approach used and experiences accumulated from the multiphase reconstruction projects of the Technological Institute building on the Northwestern University Campus in Evanston, Illinois was the strong need for effective management at all levels with continuous communication among all parties and the authority to render timely decisions.

In 1999 Betts mentioned that the use of IT in construction industry is in beginning to expand rapidly. However, construction industry seems to make slow progress towards effective IT implementation for its unique features which distinguish it from other industries; namely one-off projects, industry fragmentation, low level of technology awareness and training, required up-front investment, on-going maintenance costs and resistance to change (Betts 1999).

On the other side, Beijing Jiaotong University declared that the application of IT in construction industry is not effective as in other industries. The most prominent problems occur in tools software and information communication. One type of tool software can solve one simple task. They are not project centered, so can't help in decision making. Information communication remains weak, and data can not be exchanged efficiently.

(Particularly specific barriers to developing countries include the lack of personnel skilled in the management, use and support of IT, poor quality and /or quantity of telecommunications infrastructure, web-based information primarily in English and the high rate of computer illiteracy amongst employees Montealegre and De Boer 1999

Managing IT effectively is becoming complex due to a number of well-documented barriers. Betts in 1999 pointed out these barriers include the nature of how the industry operates one-off projects, industry fragmentation, lack of client leadership, low level of technology awareness and training, required up-front investment, on-going maintenance costs and resistance to change. As in China, the most prominent IT implementation problem is also that managers are not sure if high levels of capital investment to computer systems and communication networks can yield significant gains in productivity and economic returns.

In order to overcome the problems that could face us while implementing the IT in construction, Miozza 1998, Pena-Mora1999 and Mark 2001 suggested some solutions which include:

- Increase government capital expenditure into telecommunications infrastructure.
- Promote IT education and the development of human capital.
- Utilize on-line/web-based information management systems to facilitate a common, efficient data flow systems.
- Publicize the advantages and quantify the benefits in adopting IT-based communication systems.
- Develop IT implementation policy and push for tax concessions to encourage the industry to invest in IT and conduct industry forums to raise IT awareness among small and medium enterprises.

2.5 Using IT in Project Construction Management (PMC)

The following researches have specifically focused on the implementation and use of IT in construction management, management is a wider range of such implantation, never less these studies has much more to add for construction management.

Ma and Qin (2004) studied information management systems for construction projects in China. They analyzed major aspects and the evaluation criteria for the information management systems. This method can be used to design and evaluate an effective information management system for construction projects. While, Tang (2003) studied management systems for the construction industry in the United Kingdom. A questionnaire survey was conducted. The study suggested a guideline which focuses on training and staff participation to adopt integrated management systems.

In addition, Broomfield (2003) edited "ISO 9001-2000 Interpretive Guide for the Design and Construction Project Team". He opined that establishing a construction management system is a challenging task. Tables including examples have been published to set up an ISO quality construction management system. Amor, Betts et al (2002) investigated the application of information technology (IT) in construction over the last 20 years. Data seems to indicate that there is little formal research in the Indian context in this field. They found that visualization and integration between processes and people is the most important area of current research.

Wetherill M, Rezgui Y et al. (2002) studied about development of tools for knowledge management in construction in Europe. They felt that it has not yet been properly developed. They identified several obstacles namely:

- Construction knowledge mainly resides in the minds of the individuals.
- Intent behind a decision is often not properly documented.
- Data is saved in details but is not properly compiled and collated.

They have recommended development of a web based standardized knowledge management system for the construction industry.

Mervi, Veli et al. (2002) studied the multidisciplinary aspect of information management in construction. They felt that finding information is not a problem but sorting it into a useful form is a major issue. They felt that construction is an intensively information processing industry due to the uniqueness of each building project. Considering that Matheu (2005) pointed out that the main feature of web based management is that the documents are stored in a central database. Effective communication helps to reduce errors and time loss. The limitations of this system are relatively less security, additional hardware and man power training. Moreover, Fallon (2003) used web based project management for Chicago's $2 billion transit project. She used Citadon which stored the data on their servers and users accessed it across the internet. She felt that the web service reduced the time and risk for in-house software deployment.

Breu et al. (2001) defined a virtual enterprise as a temporary network of independent companies with a goal to perform a common task. They proposed a web based software termed WORM (We Offer Real Modularity) to suit such a purpose. Jung & Bjornsson (2004) presented a real-time information visualization tool. They suggested a cluster where stakeholders can collaborate to improve the performance. A virtual work space as developed by the authors would be required to support such a concept.

Chan & Leung (2004) developed a conceptual model for data exchange for construction project management. The proposed system is better than the current web-based systems for it is able to intelligently search for relevant information to specific tasks and users, and display it in an integrated web page. Liston et al. (2002) proposed a new concept of construction information web space. They have prepared a 4 D model that enabled the team to visualize relationships between construction activities in different time and space. They found that the interactivity helps teams to more efficiently navigate through the information.

Pamulu and Bhuta (2004) , discussed the recommended ways to develop the usage in construction industry and decided that management of construction organizations should have strong commitment to develop strategic management of IT in their business processes. The hardware, software and their applications should be utilized

to enhance both core and supporting activities to gain competitive advantage in today highly global business environment. Secondly, the firm's management should give greater attention to IT support and training, by making sure that there is sufficient trained staff for the implementation of IT, and making greater effort in training staff on the correct and efficient use of IT in the organization. Thirdly, Government and public agencies should consider policies that encourage the use of IT in the construction industry thus making this industry sector more competitive, and encourage industry to make greater use of information system.

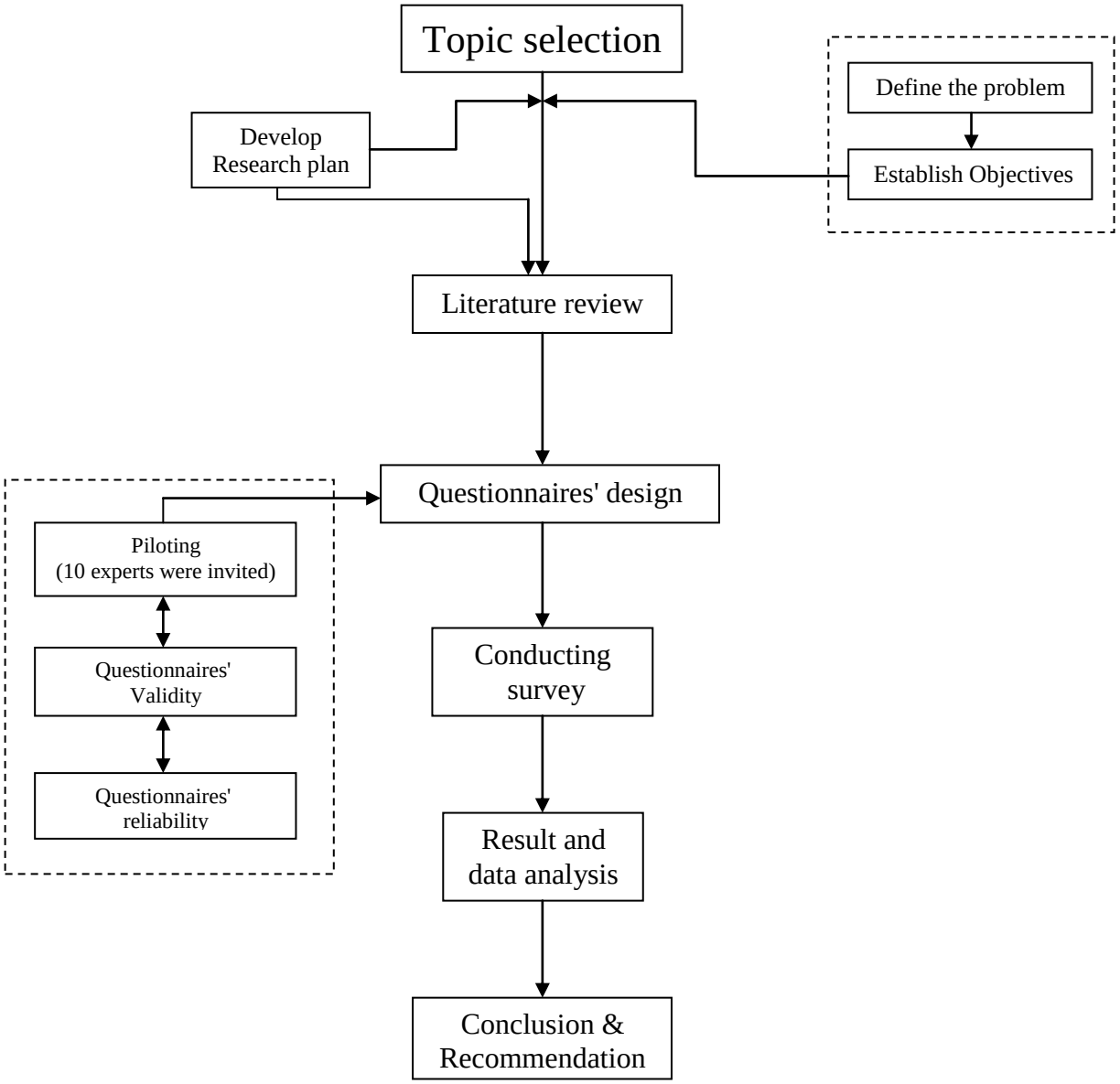
Chapter 3
Research Methodology

3.1 Introduction

Several researches conducted in the past few years to determine the applications of information technology at the construction industry in various countries. Such surveys were conducted in New Zealand (Doherty, 1997); Sweden, Denmark and Finland (Howard et al. 1998); Hong Kong (Futcher et al. 1999); and Saudi Arabia (O'Brien et al. 1999).

In Gaza Strip no work has been done (on a significant scale) to investigate IT applications in the construction industry. Some fundamental issues related to the full extent of IT applications in this industry have yet to be fully addressed, such as the types and sizes of construction organizations that use IT, the type of information technology used and its functions, the extent of utilizing internet and web-sites in project collaboration and document sharing among members of the organization and between organizations, the impact of internet on the organizations daily operations, and the future prospects for information technology in the construction industry in Gaza Strip.

This chapter presents the research methodology concerning IT utilization in Gaza Strip. The survey aims to appraise IT capacity among construction firms in Gaza Strip and its applications. In order to achieve the stated aim, a questionnaire was designed. Ideas on the type of questions to be asked and the associated methods were generated and developed, based on the questionnaires presented in international journals. A draft version of the survey questionnaire was generated and distributed (via e-mail) to well known contractors, consultants, high level educational professionals, and IT private firms. The draft was distributed in order to examine the questionnaire validity based on the identified objectives. After comments and amendments, a final version of the questionnaire was produced.



Methodology flowchart

3.2 Sample Selection and Size

Sample Size:

There are four factors that should be considered in determining the size:

- Sampling error.
- Population size.
- Variation in answers.
- Confidence level.

Sample size can be determined using the following formula:

$$SS = \frac{Z^2 P(1-P)}{C^2}$$

Where SS = sample size.

Z = Z value(e.g. 1.96 for 95% confidence level).

P = percentage picking a choice expressed as a decimal (0.5 used for sample size needed).

C = margin of safety(9%).

$$SS = \frac{1.96^2 \times 0.5(1-0.5)}{0.09^2} = 119 \text{ contractors}$$

Correction for finite population:

$$SS_{(new)} = \frac{SS}{1+(SS-1)/pop}$$

(Where pop is the population =139 match the proposed classes of contracting companies)

$$SS_{(new)} = \frac{119}{1+(119-1)/139} = 64 \text{ contractors}$$

POP(consultant) =35:

$$SS_{(new)} = \frac{119}{1+(119-1)/35} = 27 \text{ consultants}$$

The construction firms list and its information such as address and classification to which the questionnaire survey was distributed was obtained from the Gaza strip Contractors Union database at their web site. Randomly organization address was selected from the list and recorded in a spreadsheet. A total of 80 organization addresses were thus identified, and the questionnaire survey form for this research

(describe later), was sent to each contractor on the list. Among the questionnaire survey forms spread, fourteen were returned undeliverable. Out of the 80 questionnaire survey forms sent, 55 organizations (68.75 % of delivered) responded to this questionnaire survey form.

The questionnaire responses were entered into a spreadsheet for collation and analysis. The details of the response analysis are shown on the Data Analysis chapter.

The questionnaire was designed to achieve the stated objectives and to encourage a high response rate. Ideas on the type of questions to be asked and the associated methods were generated and developed over a two-weeks period, based on the questionnaires presented in the international journals found on the Internet web site. A draft version of the survey questionnaire was generated purposely for contracting organizations in Gaza Strip. After comments and amendments, a final version of the questionnaire was produced.

Prior to delivering the questionnaire, a cover letter was attached to the front page of the survey questionnaire for each construction organization in order to identify the most senior person in the organization with responsibility for information technology. Because of there is no Information Technology Manager in the construction organization in Gaza strip, the majority of cases this person had other responsibilities apart from information technology.

3.3 Questionnaire Design

The first part of questionnaire questions sought to identify the organization's size and character in terms of number of projects the organization completed in the past year, annual turnover, types of construction in which they specialize, and number of personnel. The second part of questionnaire questions asked for the use computers in the organization, the number of computers used, and the types and product names of software in use in the organization and the most significant factors in selecting computer software.

The next part questions related to the use of hardware and the influence on

information technology implementation in the organization, the use of company and project web sites and email and their primary purposes. The last part of questions sought to ascertain connections between information technology and business strategy and to predict trends in IT applications in construction in the next five years.

Each factor was written in a statement form, in which the questioner is asked to answer whether he highly affect, affect, is neutral, do not affect, or highly do not affect. This range used a 5-point scale. For example, a highly affect answer indicates the highest effect and a value of 5 was attached to it; while a highly do not affect answer has the lowest effect and a value of 1 was given to it. The factors and causes were measured and ranked under each group by the relative important index technique.

A cover letter (in Arabic and English) was attached to the front page of the survey questionnaire for each organization in order to spot the objectives of the survey and to identify the meaning of IT in this research.

3.4 Questionnaire analysis

3.4.1 Respondent's Profiles and Characteristics

As stated previously, the survey community was chosen to cover the abovementioned groups. In order to identify the number and type of the contractors group, a visit was made to the Union of the Palestinian Contractors in Gaza, the visit showed that 210 contractors were registered (at the time of preparing this research) to the union with different classifications, accordingly, about 35% of the registered contractors were randomly selected to be surveyed . The total number of the survey community was about 80 organizations among them, 10 were public institution and supplier, 15 were consultants, and 55 were contractors. Construction companies in Gaza classified as classes first A, first B, second, third, fourth and fifth.

The number of employees, annual turn over for the last three years, classification of the contracting firms, and the type of business were chosen as factors to identify the characteristics of the contracting firms under discussion.

3.4.2 Software selection and use

This section aims to identify the software used by construction stakeholders in Gaza. To facilitate our investigation, software was itemized into several packages; each package-enclosed a number of software dedicated to serve one area in the construction works.

- **Software for design purposes**
- **Software for planning, estimating, and accounting**
- **Software for general administration**
- **Operating systems**

3.4.3 Factors considered in selecting computer software

This is the last question in this group. It aims to identify the factors considered in selecting the software.

3.4.4 Hardware selection and use

This section aims to identify the hardware adopted by construction participants in Gaza in terms of type of hardware and the allocated budget for renewal if any.

3.4.5 Internet and communication technology applied by the sampled:

This section of the questionnaire is directly connected to this research. The purpose of this section is to investigate aspects related to the usage of Internet and web by the construction community in Gaza.
This section will cover the following areas:

- **Availability of the organization's web site.**
- **Purpose of having a home page at the web**
- **Availability of Local Area Network (LAN)**
- **Availability of Internet connection**

- **Number of employees connected to the Internet**
- **Purposes of using E-mail**
- **Factors restricting the use of e-mail**
- **Using Internet for e-procurement**

3.4.6 Reasons hindering adopting IT solutions

The participants have been asked to identify the reasons hindering the use of IT in their organizations. Reasons were divided into technology, human, and financial.

3.4.7 Future Implementation

This part of the questionnaire addressed the future implementation of IT in the construction industry in Gaza Strip.

3.4.8 Factors or attributes causing the adoption of construction organization to IT

Data analysis using a statistics package:

To determine the ranking of the different factors or attributes causing the adoption of construction organization to IT , the "Relative Important Index" (RII) was adopted. This method transforms the five-point scale mentioned earlier to determine the ranking of each factor using the following expression:

$$RII = \frac{\sum_{i=1}^{5} a_i x_i}{5 \times N}$$

Where ai is a constant expressing the weight of the ith response, xi is the frequency of the ith response of the total responses for each cause, i is the response category index where i = 1, 2, 3, 4 and 5 respectively, N is the total number of respondents. RII value is ranged between 0 to 1.(Tam et al,2000, cited in Tam et al, 2003).

The other parts of the survey were analyzed using descriptive statistical analysis to describe characteristics surrounding IT applications in Gaza strip construction organizations.

3.5 The validity of the questionnaire:

That valid questionnaire is the questionnaire that measures what it is designed to measure. The study used the referee validity and the internal consistency validity.

3.5.1 The referee validity

The questionnaire was introduced to a jury of specialists in Engineering and supervisor. The items of the questionnaire were modified according to their recommendations.

3.5.2 The internal consistency validity

The internal consistency validity indicates the correlation of the degree of each item with the total average of the test. It also indicates the correlation of the average of each scope with the total average. This validity was calculated by using Person Formula.

According to the coefficient correlation of each item within its scope is significant at levels (0.01) and (0.05). According to the correlation coefficient of each scope with the whole test, it can be concluded that the questionnaire is highly consistent and valid as a tool for the study

3.6 Reliability of the questionnaire

The questionnaire is reliable when it gives the same results if it is reapplied in the same conditions. The reliability of the test was measured by Alpha Cronbach and the Spilt- half techniques. Alpha Cronbach coefficient is (0.654) and the Spilt- half coefficient is (0.688). According to Alpha Cronbach and the Spilt- half coefficient of each scope with the whole test, it can be concluded that the questionnaire has a good reliability.

3.7 Statistical model:

- Frequencies and percent.
- T.test.
- One Way ANOVA.
- Scheffe post test.

Chapter 4

Result Analysis & Discussion

4.1 Questionnaire analysis

The collection of these questionnaires occurred during the period of October to November 2009. Most of the answers to the questionnaires were filled with conducting interviews with target groups (contractors, consultants, high level educational professionals, and IT private firms). A total of 80 organization addresses were thus identified, and the questionnaire survey form for this research was sent to each contractor on the list. Among the questionnaire survey forms spread, fourteen were returned undeliverable. Out of the 80 questionnaire survey forms sent, 55 organizations (68.75 % of delivered) responded to this questionnaire survey form.

4.1.1 Part 1: Organization's size and character

4.1.1.1 Classification of organizations

As stated previously, the survey community was chosen to cover the above mentioned groups. In order to identify the number and type of the contractors group, a visit was made to the Union of the Palestinian Contractors in Gaza, the visit showed that 210 contractors were registered (at the time of preparing this research) to the union with different classifications, accordingly, about 35% of the registered contractors were randomly selected to be surveyed . The total number of the survey community was about 80 organizations among them, 10 were public institution and supplier, 15 were consultants, and 55 were contractors. Table 4.1 shows the organization's profile.

Table 4.1 Organization's profile

Organization's profile	Total distributed	Total replies	Percentage from the total replies
Contractor (infrastructure works)	15	8	10
Contractor (building works)	40	28	35
Consultant	15	12	15
Public Institution	5	4	5
Supplier	5	3	3.75
Total	**80**	**55**	**68.75**

The surveyed clients included technical directorates of Ministry of Local Affairs, Ministry of Education, Ministry of Housing and Public Works, Palestinian Water Authority, Palestinian Industrial Estates and Free Zones Authority, Municipality of Gaza, Municipality of Khan-Younis. Figure 4.1 shows Organization's profile

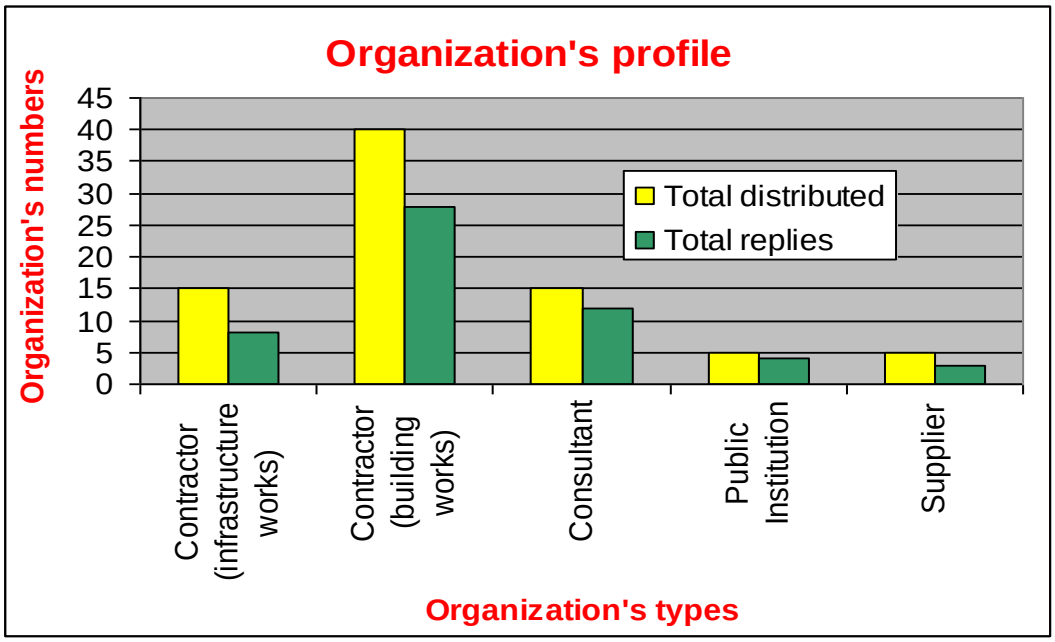


Figure 4.1 shows Organization's profile

4.1.1.2 Classification according to the NCC (for contractors)

For the purpose of understanding and explaining IT applications such as computer use in Gaza strip construction industry contractors were classified into many classifications. The first is the type of ownership of the participating contractors in Gaza strip construction industry such as family-owned, partnership, corporation, and joint venture. The second one is based on National Classification Committee such as first A, first B, second, third, fourth and fifth.

Table 4.2 shows the type of the participating contractors in Gaza strip construction industry according to the NCC.

Table 4.2 Type of the respondent contractors and class

Entity type	First A	First B	Second	Third	Fourth	Fifth
Number of firms	10	8	11	5	1	1
Percentage of total (%)	27.8 %	22.2 %	30.6 %	13.9 %	2.8%	2.8%

The results indicated that the majority of participating contractors with (30.6%) are second class contractors, with only (2.8%) involved in fourth and fifth class. However, most of the contractors were found to be working in more than one types of construction projects. Figure 4.2 shows the classification of companies that were under investigation.

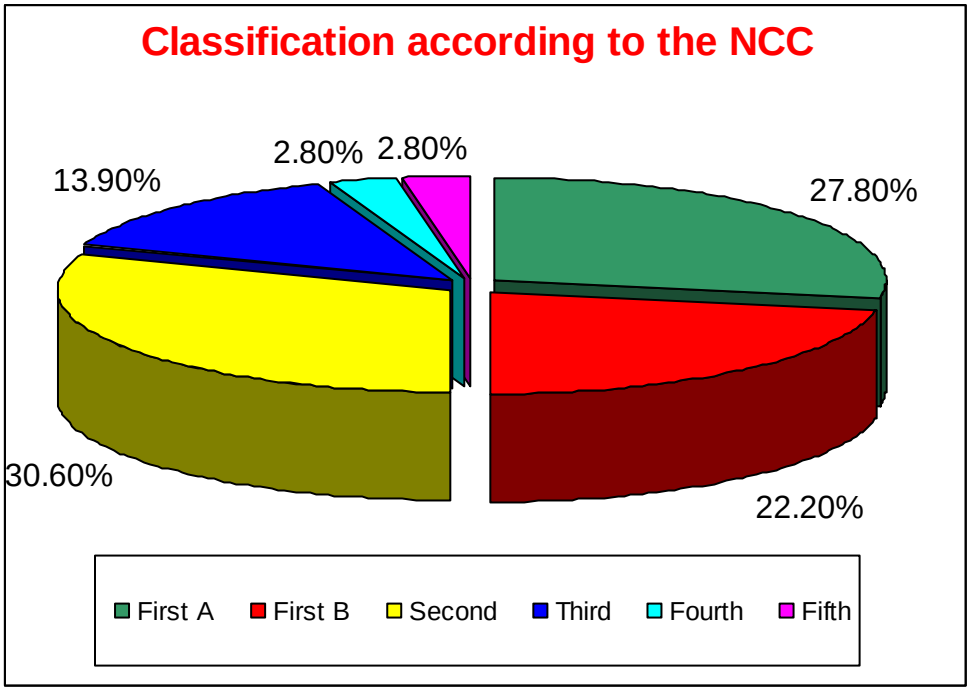


Figure 4.2 the classification of companies that were under investigation.

In the results, about half of the organizations tend to specialize in building, which is an indication of the importance of this construction in the Gaza strip economy. Apart from building, roading and waste water which classified as infrastructures projects was another type of construction that is of great interest to many contractors.

This emphasis reflects the Palestine government's recent focus on roads and bridges constructions, environmental problems, sewage treatment plants and water pollution due to the Israeli occupation politics of destroying the Palestinians infrastructures.

The results also reflect the types of contractors that are members of the Palestine Contractors Union. This sampling may not reflect accurately all of Gaza strip's contractors. Contractors for buildings also contribute to the development of the construction industry. More new buildings have been built in recent years, such as public buildings and multi-level residential in order to content more local residents

whom destroyed their building by Israeli occupation.

The results indicated also that the majority of respondent contractors are family-owned companies, and the minority is Joint venture. The result reflect the nature of construction companies in Gaza strip and the family dominate culture in Gaza strip and at the same time the weakness of the construction industry which there is littlie companies have joint venture relationship with local or regional companies.

4.1.1.3 Experience in the field of construction industry

The result of the number of years in business indicates that majority of the participated firms started business during the last decade. Minority of the participated firms started before the 1990s. These results might be related to the unemployment problems which increase the number of firms in the last decade due to Israeli occupation restrictions on the Palestinians people and their economy.
The results indicated that the majority of respondents with 53% are have 2 to 10 years of construction-related working experience, 47% have been working for more than 10 years. These findings reveal that the respondents are construction domain experts. They have sufficient working experience and construction related knowledge to understand the usefulness of IT as a tool for their work.

4.1.1.4 Region of operation in Gaza Strip

The results of region of operation in Palestine indicates that almost of all the participating firms with (75%) are operate in two or more regions in Gaza strip. The other with (25%) is only operating in one region in Gaza strip. At the same time there is no firms operate in west bank region at this time due to close and restriction of Israeli occupation in Gaza strip, at the other hand there were little firms operate in west bank before Al-Aqsa Intifada (2000).
About the number of area branch offices excluding main office and site offices, the results indicated that almost the great majority of the participating firms have no branch offices other than the head office. This result indicates the size of work in Gaza strip is small with comparison of other neighbor countries like Egypt, Jordan and Golf countries.

4.1.1.5 Number of employees in organization

The number of employees in the contracting firms depends on the availability of jobs. In general, 22 firms stated that they hired an average of 1-10 employees, 9 firms have 11-20 employees, while 3 firms stated that they have an average of 21-40 employees, and only 2 firms has more than 40 employees. Figure 4.3 represents these findings. In general more than 50% of contracting firms in Gaza hired less than 10 employees.

With the exception of the fifteen consultants, and management firms, all the respondents were prime and sub-contractors. The number of employees in the organizations that participated in the survey is summarized in the Table 4.3 as follows:

Table 4.3 Company size (Number of employees) of the respondent contractors

Number of employees	< 10	10 - 20	20 - 40	> 40
Number of firms	22	9	3	2

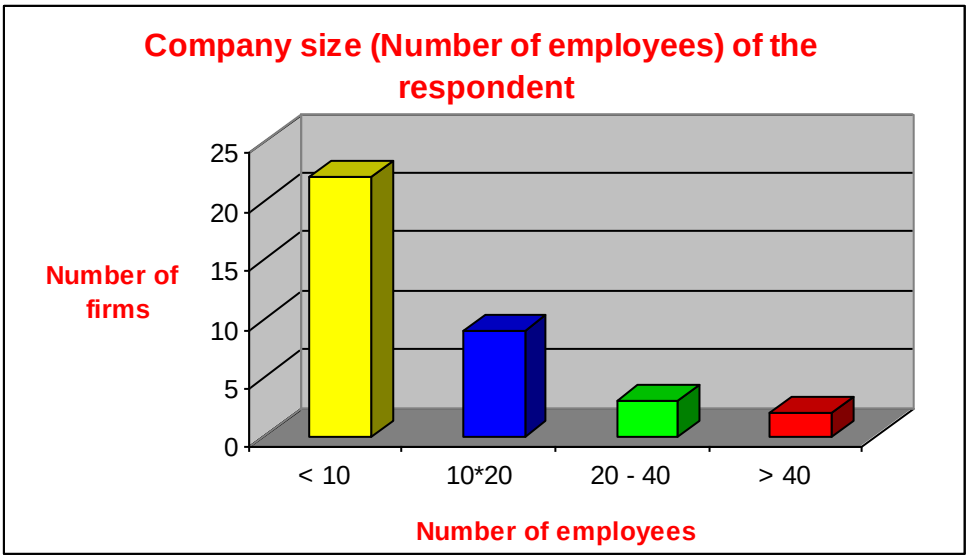


Figure 4.3 Company size (Number of employees) of the respondent contractors

4.1.1.6 Average annual Business volume (Millions of Dollars $)

Political situation in the last few years affected the construction business in Gaza; most of the construction companies stated that, their annual turn over is less than half a million.

Table 4.4 shows the average annual business volume of the participating contractors in Gaza strip construction industry.

Table 4.4 The average annual business volume of the respondent contractors

Annual turnover	<$500,000	$500,000 - $1,000,000	$1,000,000 - $5,000,000	>$5,000,000
Number of firms	24	9	2	1
Percentage of total (%)	66.6 %	25 %	5.6 %	2.8 %

The results indicated that the majority of the respondent contractor's organizations with (66.6%) had an annual turnover of less than $500,000. Only one organization had an annual turnover of more than $5,000,000. Thus, based on this sample, most contracting firms in Gaza strip have an annual turnover of at least $500,000.

The result also revealed that the construction firms in Gaza strip are marginal and small when compared with other neighbor countries like Egypt, Jordan and Golf countries; and the annual business volume is likelihood to be for sub-contractors than prime and general construction firms.

Figure 4.4 represents the annual turn over for the companies that were investigated.

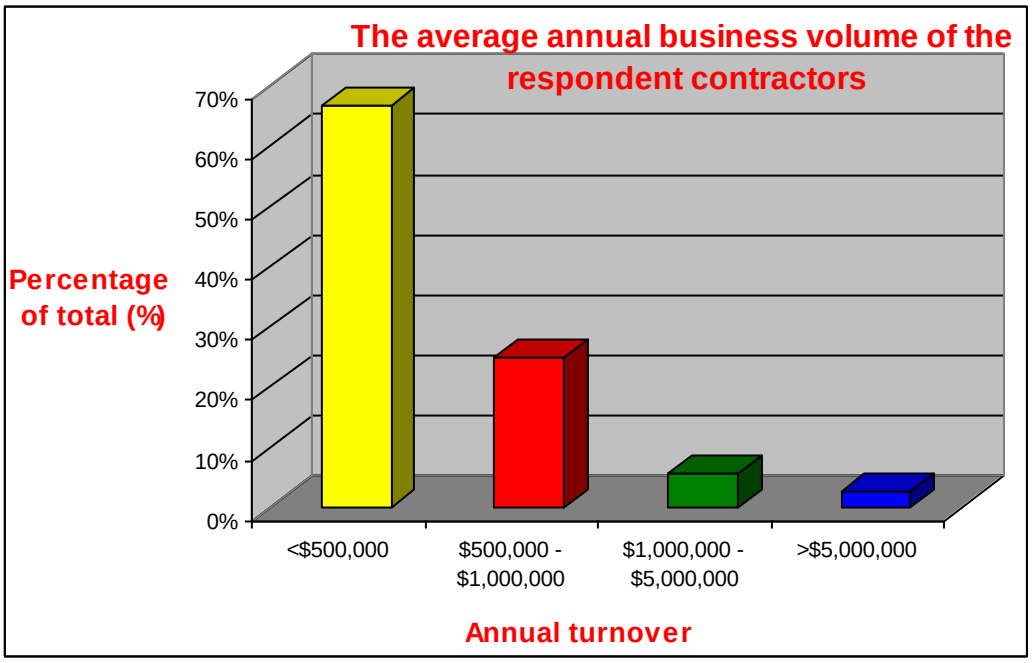


Figure 4.4 the annual turn over for the companies that were investigated.

4.1.2 Part 2: Hardware used by the organization

4.1.2.1 Computers currently in use by organization

From the literature review, it was appearing that all construction contractors are using computers in their firm's management and operation process. This opinion result from

the importance of computers and their applications in construction industry and because of the cheap cost of hardware and software of computers used in construction industry business, and specially the availability of software programs with very low cost in Gaza strip due to the absence of developer rights in selling and spreading.

4.1.2.2 Computers and printers currently in use by organization

The results of type of computer used such as Laptop, Desktop computer, and Mini Laptop indicated that the majority of anticipated firms with (90%) are use Desktop computer (PC) and printers due to low cost of micros compared with other systems and features that can offered and that can not be offered by other systems might be the reasons for the high level of utilization.

On the other hand mainframe computers were the minor system utilized in the anticipated construction firms with (2%) due to most of construction firms in Gaza strip are small and have little of manpower but mainframe computers are for many users at the same time and need to large memory to run big programs at the same time.

4.1.2.3 Information technology (I.T) hardware currently in use

The results indicated the hardware adopted by construction participants in Gaza in terms of type of hardware. It is clear that almost all participants of all categories own fax machines. Almost all participants own CD writers and photocopier. 65% of consultants own plotters, participants are rarely own Video conference equipments. In general, Public clients own hardware equipments more than consultants and contractors.

4.1.2.4 Budget for hardware renewal

The results identified the allocated budget for hardware renewal by construction organizations in Gaza. The result shows that 75% of the consultants allocate an annual budget for this purpose with an average amount of $ 2,800. 33% of the contractors allocate an average annual amount of $ 3,500 for this purpose. 81% of the Public owners allocate an average amount of $ 9,800/year for hardware renewal.

4.1.3 Part 3: Software used in the organization

Computer applications results of the investigated study were indicated that different applications of computers in construction firms are using them. The anticipated contractors lists the functions that have to do with possible uses of computer in construction company management, such as accounting, spreadsheets, planning and scheduling, estimating, word processing, database .

This section aims to identify the software used by construction stakeholders in Gaza. To facilitate our investigation, software was itemized into several packages; each package-enclosed a number of software dedicated to serve one area in the construction works.

4.1.3.1 Software for project planning, cost estimating, and finance

Table 4.5 represents the number and percentage of consultants, contractors, and public clients who use software for planning, accounting, and cost estimating in their jobs. Trade names of famous software in Gaza were suggested, in addition to that, participants have the choice to select and identify others if they have.

Software selection and use for the previous computer functions which currently in use of the respondent contractors results indicated in table 4.5.

Table 4.5 Planning, scheduling and estimating, finance software currently in used

Software	MS Project	Microsoft Excel	Primavera	Accounting Al-Aseel and Alsehree	Others
Contractors	36	36	1	5	0
Consultants	12	12	7	15	1
Public owners	4	4	1	4	0
Supplier	3	3	0	3	0
Number of responses	55	55	9	27	1
Percentage of use (%)	100%	100%	16.4%	49.1%	1.8%

Table 4.5 shows that, almost hundred percent (100%) of the organizations use Microsoft Project for project planning and scheduling and some of the organizations use Primavera with (16.4%). The results indicated the most popularly of Microsoft Project in Gaza strip construction firms because of most of the engineers are qualified to deal with it easily and due to its high and multi features such as planning and scheduling for projects time, manpower, materials, and equipments and cash flows of the projects.

On the other hand almost hundred percent (100%) of the organizations are using Microsoft Excel software for estimating purposes because of its high features of it such as programming and graphs charts for cash flows and spreadsheets. Overall, the percentage of the use of computer software for planning, estimating and finance in Gaza strip construction industry is quite satisfactory.

About 50% of the respondents use accounting software. The results show that the consultants are using these packages of software more than others due to the types of duties they are involved in. Most of the respondents mentioned that they use local software for accounting purposes such as Al-Assel and Alsehree. Two of the consultants mentioned that he uses Quicken application for his accounting purposes.

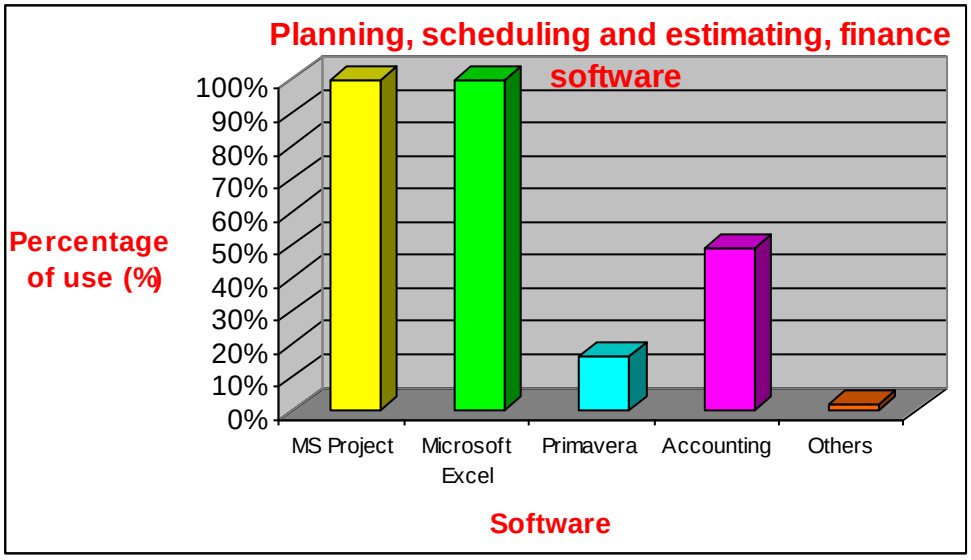


Figure 4.5 Planning, scheduling and estimating, finance software currently in used

4.1.3.2 Software for general administration

This package intends to identify the software used for administration purposes. Table 4.6 show the percentage of companies using this software.

Table 4.6 General administration/ business software currently in used

Software	MS-Word	MS Excel	MS-Access	Personnel system
Number of responses	55	55	27	8
Percentage of use (%)	100%	100%	49%	14.5%

The survey results show that MS word and Excel are the most popular software for general administration purposes. 49% of the owners use MS Access as a data base for their administration programs. Only 13% of the owners adopt personal systems in their daily works. Most of the respondents from contracting and consulting firms mentioned that the numbers of employees they employ don't need such software. Two of the consultants stated that they use Lotus notes, Visio, and Front page software for general administration purposes.

Table 4.6 revealed that Microsoft Office software is dominated in general administration and business in the respondent contractors. Overall conclusion that, the use of computer software in the Gaza strip construction industry has been well implemented. The use of computer software in administration will enhance the efficiency of the organizations in construction projects.

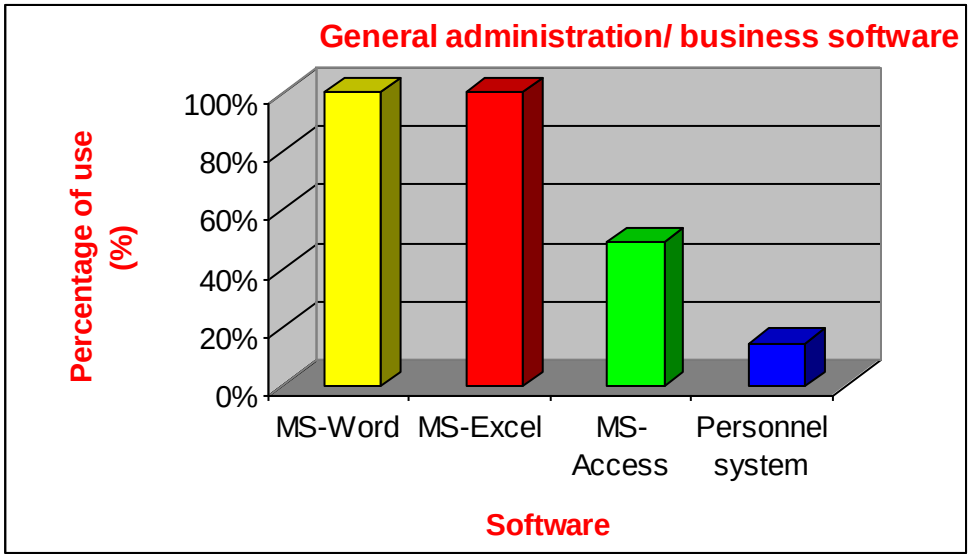


Figure 4.6 General administration/ business software currently in used

4.1.3.3 Software for design purposes

Software for designing purposes is the third package. As noticed in Table 4.7, ETABS seems to be the most usable software by the three categories (consultants, contractors, and public owners). The consultants depend on software in their jobs more than public owners and contractors. Software for structure design and water systems are used more than others. In general, most of the software used for structure purposes is PROKON, and STAAD. The consultants used to outsource the surveying and air conditioning works, so software regarding these two items is seldom found.

Table 4.7 Design software currently in used in the participating contractors

Software	ETABS	PROKON	STAAD	Micro Station
Number of responses	51	12	18	25
Percentage of use (%)	92.7%	21.8%	32.7%	45.0%

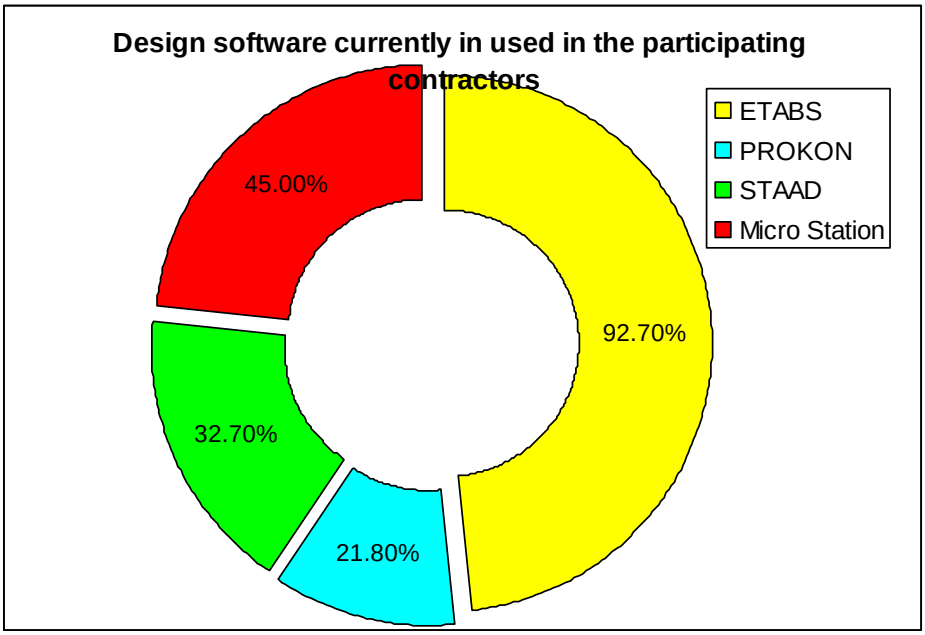


Figure 4.7 Design software currently in used in the participating contractors

4.1.3.4 Software for drawing purposes

Table 4.8 Design graphics software currently in used in the participating contractors

Software	AutoCAD	Adobe Photoshop	Arch Cad	Others(Arc view ,GIS, 3D Max)
Number of responses	52	25	11	1
Percentage of use (%)	94.5%	45.5%	20%	12.7%

Table 4.8 shows that, the AutoCAD software shows the highest percentage of

(94.5%) among the drawing software currently used in construction industry within Gaza strip. The result indicated that AutoCAD software is the biggest software in the design graphics of structural and architectural graphics and AutoCAD software is the most popularly in Gaza strip engineers. Apart from that, Adobe Photoshop is another popular software that is currently in use for design purposes.

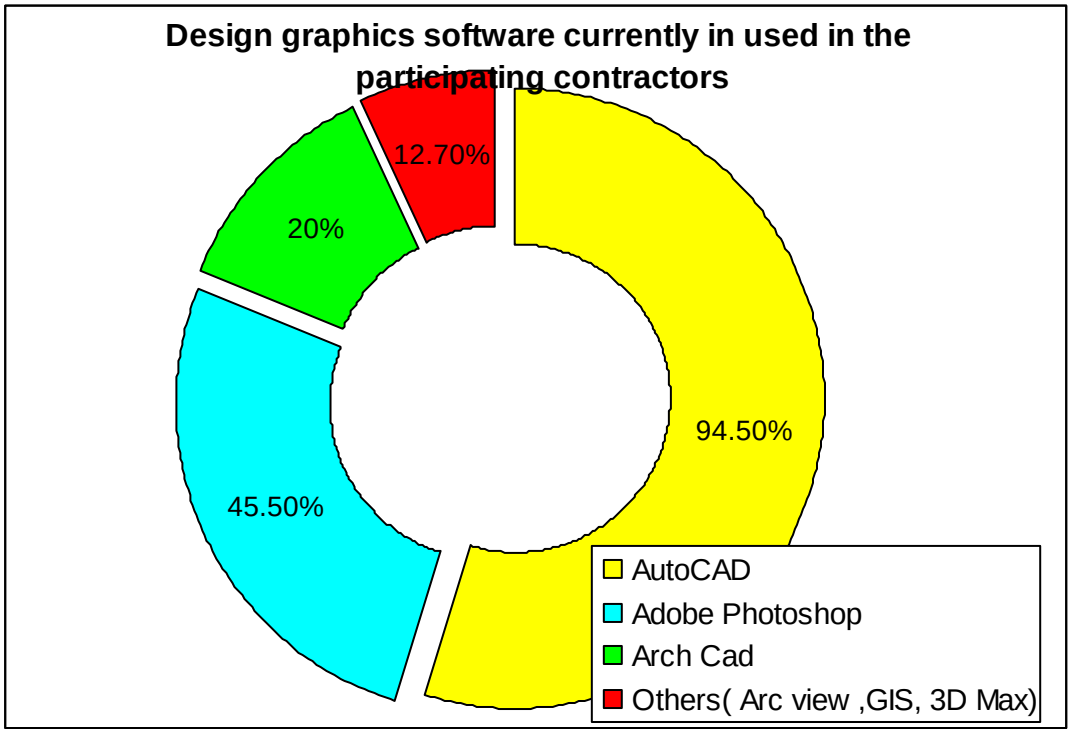


Figure 4.8 Design graphics software currently in used in the participating contractors

4.1.3.5 Software for Water system

Software for designing purposes is the fifth package. As noticed in Table 4.9, Water Cad seems to be the most usable software by the three categories (consultants, contractors, and public owners). The consultants depend on software in their jobs more than public owners and contractors. In general, most of the software used for Water system purposes is BENTLEY, and Hydraulic Cad.

Table 4.9 Water system software currently in used in the participating contractors

Software	Water Cad	BENTLEY	Hydraulic Cad	Others (Epanet)
Number of responses	48	22	14	3
Percentage of use (%)	87.3%	40%	25.5%	5.5%

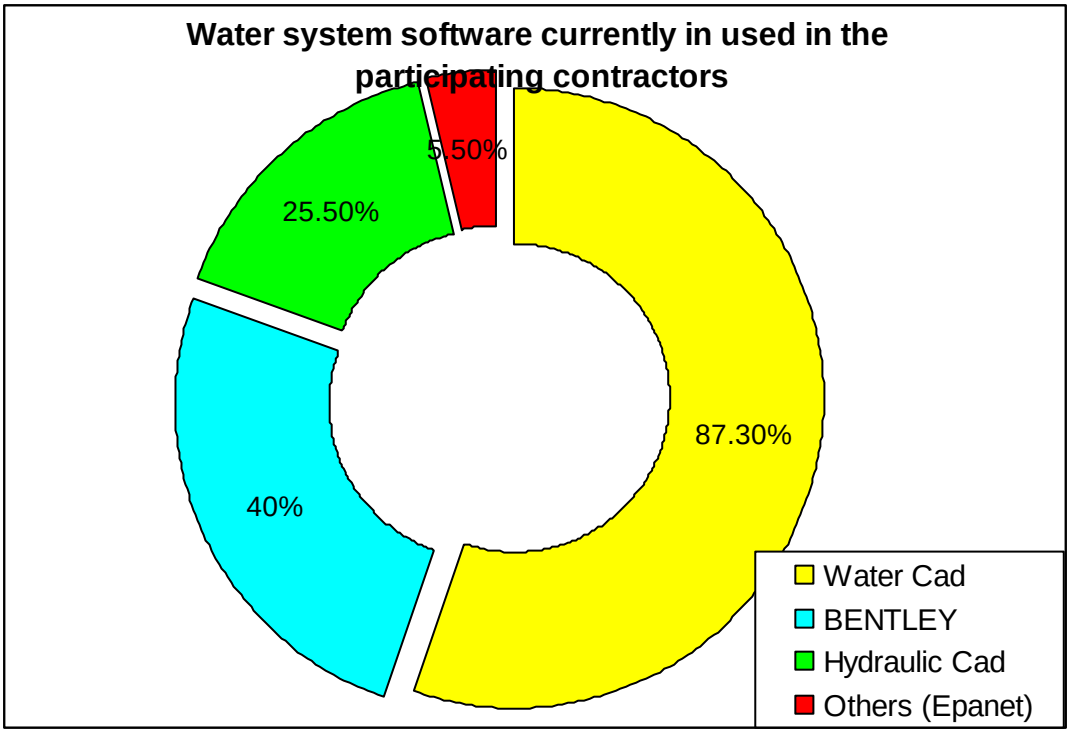


Figure 4.9 Water system software currently in used in the participating contractors

4.1.3.6 Operating systems

This question was added after the validation of this questionnaire by one of the IT vendors in Gaza. It aims to find answers for the question whether construction participants in Gaza update there operating systems or not? As noticed from table 4.10, most of the participants use MS Windows XP. That means the participants follow the technology and update their operating systems.

Operating systems currently in used in the organizations results indicates as follows in table 4.10.

Table 4.10. Operating systems currently in use by the respondent contractors

Operating systems	MS-Windows XP	LINUX	MS-Windows Vista	Others Windows Seven
Number of firms	55	5	15	3
Percentage of total (%)	100 %	9%	27.3%	5.5%

Table 4.10 shows that, the overwhelming preference for Microsoft operating systems

with (100%) of the respondent contractors organizations use Microsoft Windows XP as their current operating systems. Microsoft Windows XP is a common operating system and is likely to increase in use in the future for operating processes in the organizations because of its features offered and which is more efficiently in using software programs related to construction and engineering process; in addition to more easily use of it and fitting for all uses. The second in popularity with (27.3%) using Microsoft Windows Vista. Construction is not alone in its preference for these two popular operating systems.

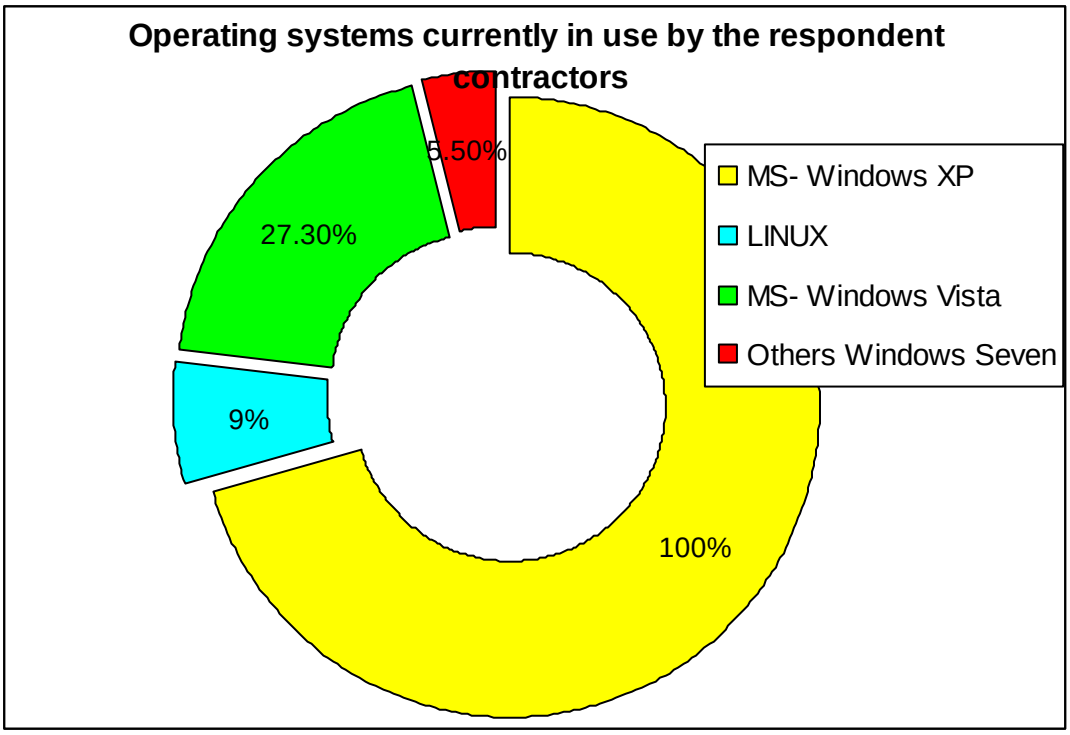


Figure 4.10 Operating systems currently in use by the respondent contractors

4.1.3.7 Factors considered in selecting computer software

This is the last question in this group. It aims to identify the factors considered in selecting the software. As noticed in table 4.11, the most important factors that all respondents select were user Simplicity in using program, Spread of the software, Availability of the software, and cost factors respectively.

In general, past experience with the software seems to be important factors in selecting any product.

Table 4.11 Factors considered in selecting software

Operating systems	Simplicity in using program	Spread of the software	Availability of the software	Cost	Others past experience
Number of firms	55	52	35	8	23
Percentage of total (%)	100 %	94.5%	63.6%	1.4%	41.8%

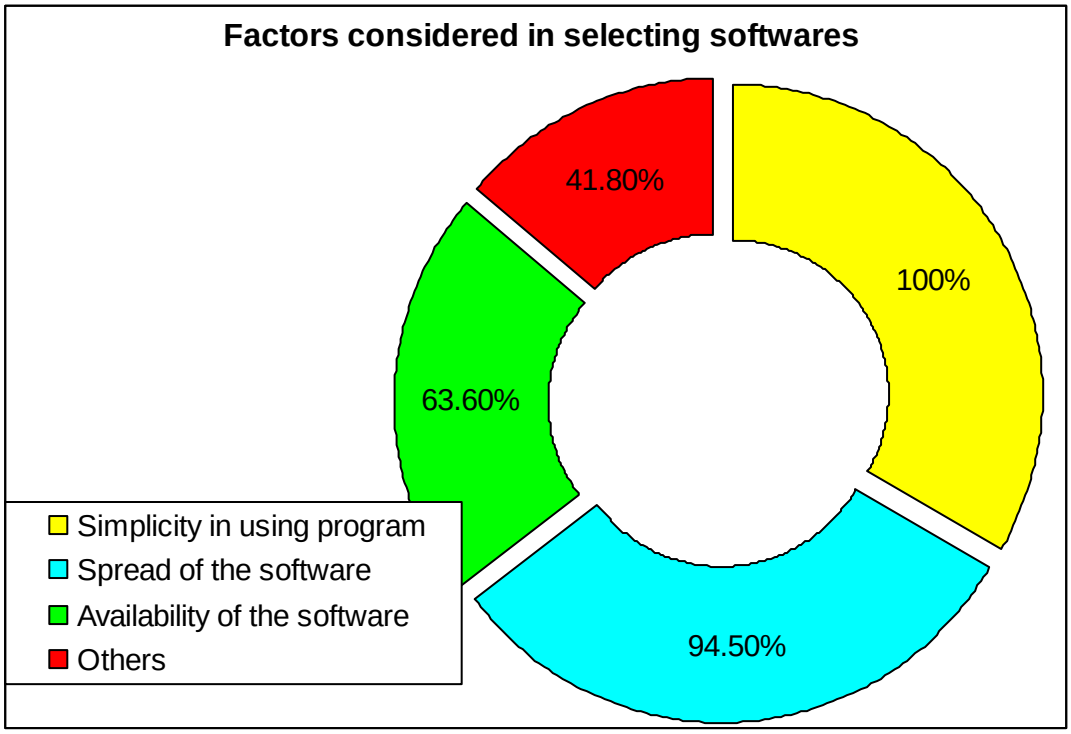


Figure 4.11 Factors considered in selecting software

4.1.4 Part 4: Internet and communication technology

This section of the questionnaire is directly connected to this research. The purpose of this section is to investigate aspects related to the usage of Internet and web by the construction community in Gaza. This section will cover the following areas:

4.1.4.1 Availability of the organization's web site.

Table 4.12 Number of companies with web sites on the Internet

Responses	Number of responses	% of total responding to this question
Yes	15	27.3%
No	40	72.7 %

Table 4.12 shows that, a small, though significant, proportion of (27.3%) has a

presence on the Internet via a company web site. A large proportion of organizations do not have a web site on the Internet, probably because their organizations are small and do not have a staff who are knowledgeable about web site operation. Unfortunately the results do not revealed the right things, it was clearly found from authors experience that (100%) of the organizations have not a web site on the Internet, whereas no one organization in the Gaza strip construction industry and respondents firms has a web site on the Internet.

Figure 4.12 represents the research findings regarding this issue. About 90% of the investigated public institutions' answers confirmed that they have a web site for their organizations (it is understood that the owners' web sites belong to the institution and not dedicated for the technical directorate in the institution). 65% of the consultants have a web site for their organizations. 15% of the investigated contractors mentioned that they have web sites.

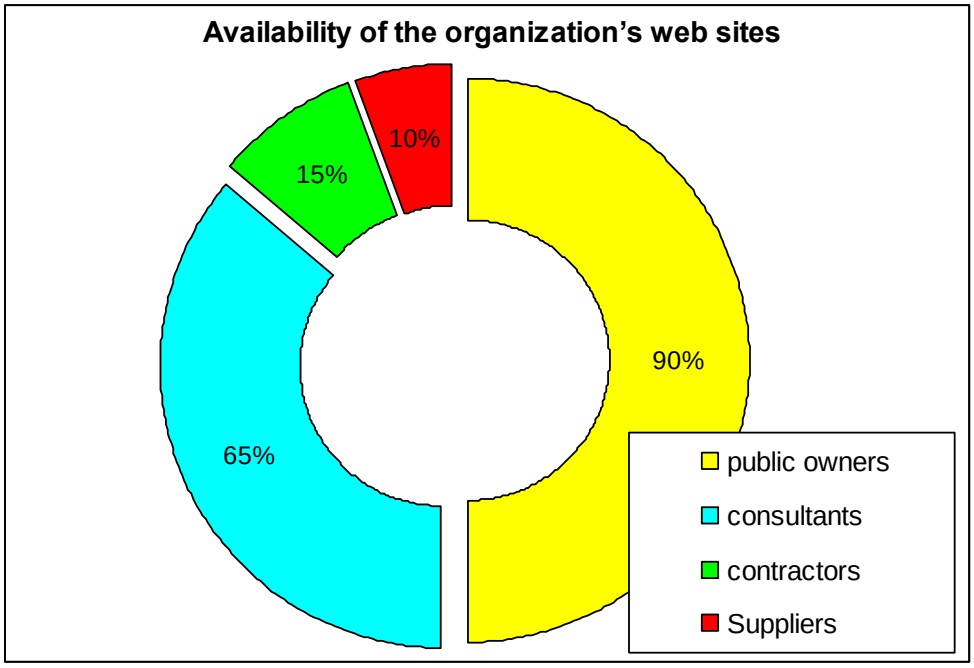


Figure 4.12 Availability of organizations web sites

4.1.4.2 Purpose of having a home page at the web

This was the second question within this group of questions. Table 4.13 shows the responses to this question. Using web pages for information regarding the organization and projects is the highest among the three categories. Only 9% of the contractors who have a web site are using it for Material purchasing/ marketing.

Table 4.13 Primary purposes of having a company web site

Primary purposes	Number of responses	% of respondents with company web sites
General company information	15	100 %
Project information	6	40 %
Public feedback	1	6.6 %
Material purchasing/ marketing	2	13.3 %
Others (Personnel recruitment, Shareholder information)	4	26.7 %

Figure 4.13 shows that, the most significant primary purpose of having a company web site on the Internet is to show general company information with (100%). Apart from that, (40%) of the organizations use their company web sites for project information such as description of the projects implemented by the firms as history of experience. The other primary purposes are for shareholder information with (26.7%), and personnel recruitment with (26.7%). Figure 4.13 Primary purposes of having a company web site.

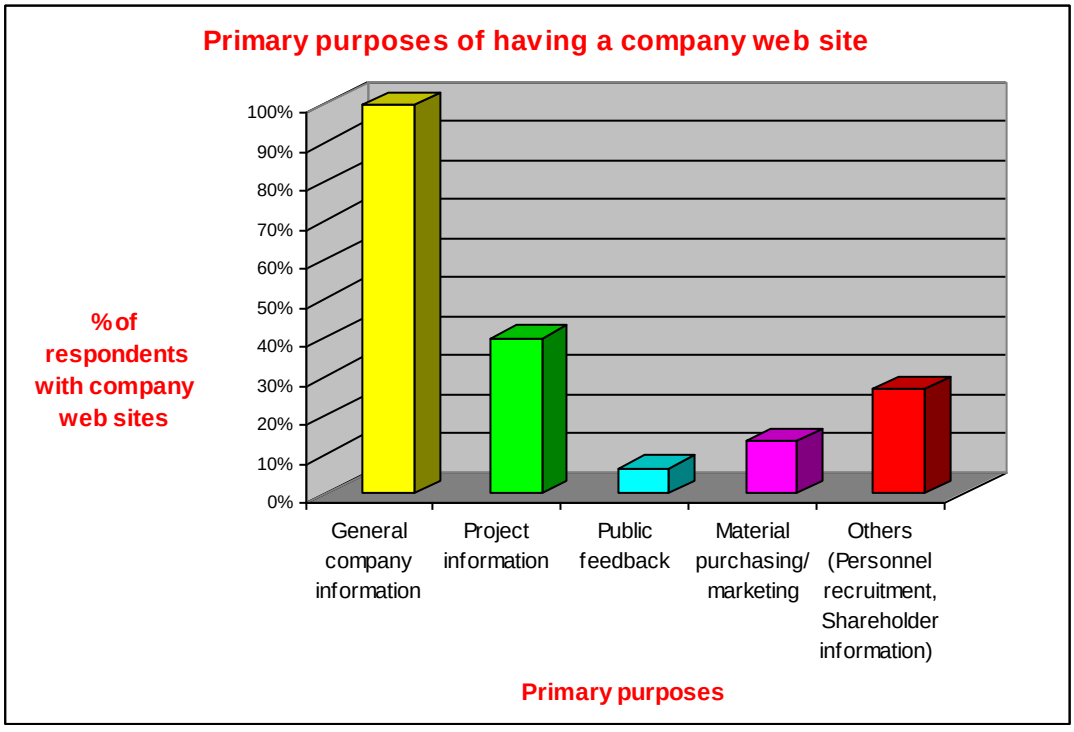


Figure 4.13 Primary purposes of having a company web site.

4.1.4.3 Availability of Local Area Network (LAN)

This feature is important for electronic document sharing. 100% of the public institutions surveyed have a LAN. 100% of suppliers and consultants have such facility. While only 88% of the contractors have it. Figure 4.14 represents these results.

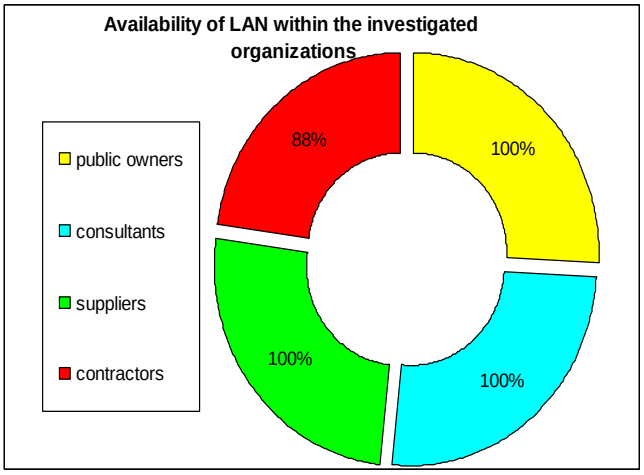


Figure 4.14 Availability of LAN within the investigated organizations

4.1.4.4 Availability of Internet connection

100% of the investigated public institutions, consultants, and contractors answered that they have a connection to the Internet.

4.1.4.5 Purposes of using internet

This section aims to identify the reasons for using internet by the construction organizations in Gaza. Table 4.14 represents the percentage of responses, Analysis of the answers to this question shows that the public institutions use internet for purchasing/procurement or to send and receive bidding documents, while contractors and consultants use it less than public institutions. 100% of the investigated consultants use internet for document distribution to other organizations. 85% of the public institutions use this facility as a carrier for formal massages and documents rather than bidding documents. The three categories use internet for informal massages too.

Table 4.14 Purposes of using internet by the organizations

Purpose of internet	Number of responses	% of 55 respondents with company
Sending/ Receiving messages	52	94.5 %
Distribution of documentation to other organization	46	83.6 %
Purchasing/ procurement	23	41.8 %
Sending/ receiving bidding documents	25	45.5 %
Update information and soft wares	3	5.4 %
Others (Sending formal messages)	1	1.8 %

Table 4.14 shows that, the most significant purpose of using internet is to send/ receive messages, which is (94.5%) and (83%) respectively of those with distribution of documentation to other organization that as a purpose.

Two other important purposes are to purchasing/ procurement and to Sending/ receiving bidding documents (41.8%) and (45.5%) respectively which is the significant purpose of using e-mail in developed countries which made procurement and bidding by email but certain security tools are satisfied to obtain more efficient process. (5.4%) of the organizations use email to Update information and soft wares Unfortunately, in Gaza strip construction industry and any other sectors even service sectors do not use e-mail in sending formal messages which may computerize the document and e-mails.

4.1.4.6 Factors restricting the use of internet system

Answers of this question may justify previous answers. As noticed in the results, 50% of the investigated public institutions mentioned that internet has legal standing in legal proceedings, so they use it for official documents such as bidding documents.

Table 4.15 shows that, the most significant factor restricting the use of intrernet by the organizations is fear of losing sensitive information, identified by (87.3%) of those responding which revealed the importance of security of information sent using internet .

Table 4.15 Factors restricting the use of internet system by construction organizations in Gaza

Factors restricting use of internet	Number of responses	% of total respondents with company
Afraid of losing information	48	87.3 %
Lack of experience in using internet	20	36.4 %
Lack of management support	15	27.3 %

Furthermore, (36.4%) of the organizations believe that internet use is restricted because of a lack of user training in useing the internet and (27.3%) identify a lack of management awareness and support.

4.1.4.7 Using of E-Mail

100% of the investigated public owners, consultants, and contractors answered that they use E-Mail.

4.1.4.8 Communication means currently in use

Table 4.16 Communication means currently in use

IT hardware	Number of responses	% of use respondents with company
Telephone	55	100 %
Wireless phones	43	78.2 %
Mobile phones	55	100 %
Email	55	100 %
Fax machine	50	90.9 %

As expected, on overwhelming proportion, with (100%) of the respondents have wires phones, and (100%) have cellular phones. Table 4.16 also shows that (100%) of the organizations have Emails. These three information technology devices are very important in order to communicate and enhance the progress of the business and construction process such as the linkage between the home office and field office and between the different levels of management from bottom to top and from top to bottom levels. Only 50 of the 55 respondents organizations with (90.9%) uses a Fax machine which is more recent and may developed in the future to cancel all other

computers outputs by developing a flash memory and CD with high capacity and small volumes.

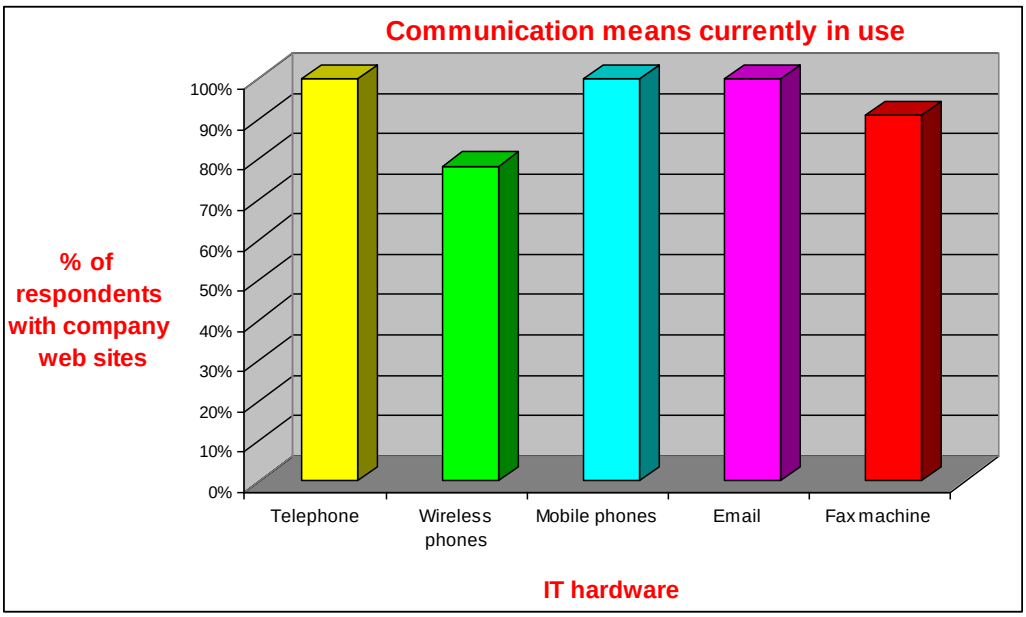


Figure 4.15 Communication means currently in use

4.1.5 Part5: Influences on Information technology Implementation

The participants have been asked to identify the reasons hindering the use of IT in their organizations. Reasons were divided into technology, human, and financial.

The survey asked to identify reasons for resistance to the implementation of information technology. What reasons are restricting the use of IT in the organization?

Table 4.17 Reasons hindering the use of IT

Reasons	Number of responses	% of use respondents with company
Rapid changes in technology	47	85.5 %
Software problems	2	3.6 %
Lack of knowledge	35	63.6 %
Hardware problems	12	21.8 %
Poor Leadership	8	14.5 %
Security problems	5	9.1 %
Lack of available funding	25	45.5 %

Table 4.17 shows that, the primary technological reason hindering the use of information technology is the rapid changes in technology with (85.5%) which revealed that the IT changes are momentary and to be up-to-date for all new in IT, more investments must occurs. The secondary technological reasons hindering the use of information technology are software problems with (3.6%) and security problems with (9.1%). These problems insist to recruitment of computer engineer or programmer to do all maintenance process any time and to be securing the organization information.

The primary human reasons hindering the use of information technology are lack of knowledge and lack of training programs with (63.6%). Poor management and leadership with (24.2%), is the secondary human reason hindering the use of information technology.

Lack of available funding is the primary financial reason hindering the use of information technology with (45.5%).

4.1.6 Part 6: The future of I.T implementation in construction industry in the next five years.

To what extent do you agree with the following predictions about information technology applications in construction in the next five years? (1- Strongly agree, 2- Agree, 3- Neutral, 4-Disagree, 5- Strongly disagree)

Table 4.18 The future of I.T implementation in construction industry

Areas	Most enabled ---------- Not enabled					RII	Rank
	1	2	3	4	5		
IT will improve profits	5	5	7	10	28	0.80	1
IT will improve procurement/purchasing function	6	6	7	11	25	0.78	2
IT will improve project control	7	5	10	10	23	0.76	3
IT will improve project communication	8	6	9	8	24	0.75	4
IT will require extensive training	11	5	9	13	18	0.73	5
IT will become prohibitively expensive	5	9	11	13	17	0.72	6
IT will benefit construction research	9	10	7	7	22	0.72	6

Table 4.18 shows that, respondents tend to agree that information technology will improve profits in the next five years with (RII = 0.8) and ranked first either agree or strongly agree with this prediction. The second most positive prediction relates to agree or strongly agree that IT will improve procurement/purchasing function, wherein (RII = 0.78) and ranked second.

On the negative side, with (RII = 0.76) agree or strongly agree that IT will enhance project control and ranked third. The largest neutral response related to future communication, with (RII = 0.75) neither agreeing nor disagreeing that communication will improve due to information technology and ranked fifth.

At the other hand the respondents tend to disagree that information technology will benefit construction research in the future, which ranked last. This result is representing the sample respondents and indicated that there is no one interests in research and development.

Chapter 5
Conclusion And Recommendation

5.1 INTRODUCTION

This chapter discusses major conclusions of the research, findings, research limitations, and recommendations.

5.2 GENERAL FINDINGS

As discussed in the first chapter, this research aims to determine the level of IT utilization by construction industry stakeholders in Gaza. The study of current situation of IT applications in Gaza strip construction industry identifies serious weaknesses in these areas.

The survey enriches the research with major findings such that:

- Consultants and public owner are more familiar with IT applications than supplier and contractors.
- Contractors and consultants practiced buying material though the web site in minor margin.
- Financial difficulties, lack of managerial support are important reasons that hinder respondents of improving their IT capacity.
- User friendliness, and past experience are significant factors in selecting new software.
- The respondents recognized the importance of IT in construction industry in the future.

5.3 DISCUSSIONS ON THE VALIDITY OF THE FINDINGS

No efforts were spared to boost the response rate of the survey. Methods adapted included an easy-to-complete questionnaire, a personalized cover letter to each contractor. With these efforts, the response rate in this questionnaire survey was 68.75 % of delivered, somewhat higher than expected for similar surveys. A higher response would have been desirable, but there are many reasons for not returning such requests, as follows:

- In Gaza strip, people, especially top management, are always fully occupied by their work; they can seldom spare any time to fill in questionnaires or to be interviewed.

- Some Gaza strip contractors tend to ignore all sorts of questionnaire surveys. They may assume their contributions will not make any difference to the results.

- Some people try to avoid exposing themselves to outsiders regarding what they are doing or not doing: One example is that some contractors do not want to be identified as not using information technology. They feel less vulnerable to their competitors by not filling in the questionnaire.

- The questionnaire may be too long for busy top management people to complete.

5.4 LIMITATIONS OF THE SURVEY

There are many limitations of this research due to data unavailability. Six limitations are discussed in this section.

The survey was confined to only one sub-sector (contractors) of the Gaza strip construction sector. Other sub-sectors such as architecture, quantity surveying, details suppliers and clients were not included in this survey.

A sampling of 80 leading organizations in the construction sub-sector were targeted, based on selecting randomly from the construction organization addresses listed in the Gaza strip contractors federation database from their web sites. It should be emphasized that the Gaza strip contractors federation may not completely representative of all the entire Gaza strip construction organization community.

It is possible that there are Gaza strip construction organizations that were not included in the survey who are exploiting information technology to a greater extent than some of those that were included. The results therefore do not necessarily reflect

the general use of IT in the construction sub-sector studied or of the construction sector as a whole. They do however show how many of the current leaders in the construction sub-sector are using and are likely to use information technology.
It was acknowledged that this sampling technique would be likely to produce a biased result. Despite the inclusion of a stamped envelope and the use of an easy to complete form, those who actually used computers were probably more likely to fill in the questionnaire survey form.

The primary purpose of the survey was to identify non-users, casual users, and regular users, but it is still unknown how representative these respondents are of the general population in Gaza strip's building and construction industry. This survey is limited to the construction sector as the sampled population, and leaves out such sectors as designers and project principals. Although the intent was to obtain an indication of the use of information technology throughout the entire construction industry, the results are based on a sampling of contractors only.

The fact that there may be a number of construction organizations who are involved in construction activities but are not registered with any of the recognized representative bodies is also acknowledged. Also, the public sector bodies involved in the management, design and construction of public projects (e.g. The Municipals, Corporations) was included in this survey.

5.5 CONCLUSION

This research illustrated the current state of information technology applications among Gaza strip contractors by way of a questionnaire survey. Unlike many other industries, information technology has not received adequate attention from top management in the construction industry.

The survey revealed that the level of IT applications among contractors in the industry is relatively low in comparison with other developed countries. A possible reason is that many organizations rely on their staff to do repetitive works, and are not willing to invest in information technology – related technologies.

While the theme of much of today's information technology research is convergence; there has been a steady divergence in development and practice in the construction industry. It is envisaged that this research this would contribute in bridging the gap between researchers and information technology engineers on the one hand, and building industry professionals and practitioners on the other.

The success of IT applications to a large extent relies on the industry's attitude towards information technology. The rapid growth of personal computing may soon bring about a significant change in the industry's attitude towards information technology.

Information technology - based communication methods are considered by the contractors as a better way to improve the quality, accuracy, time management and usability of information.

The survey revealed that the current use of information technology among many contractors is still at a low level, despite the fact that almost all of them have considerable experience in using computers. Information technology expenditure and training are also inadequate.

This problem is probably associated with the lack of management support for IT applications which puts a serious threat to the appropriate use of information technology in the construction industry.

As a result, this part of the questionnaire concluded the following:

- The percentage of consulting firms depend on software are more than others
- Construction industry is a good market for local software.
- Construction participants are familiar with the technology and they use to update the operating systems of their computers.
- User friendliness and simplicity in using program and past experience are the most important factors in selecting software.

5.6 RECOMMENDATIONS

Many recommendations have derived from the research findings of this study.

Some of the most important are as follows:

A serious mismatch between beliefs and behaviors of the contractors in the use of information technology in their daily operations, which can only be solved by changing the attitudes of these organizations towards IT applications.

Given the competitive nature of the construction industry in Gaza strip, contractors must do whatever they can to make the most out of information technology and to make IT a strategic contributor to the success of their business.

It is suggested that contractors should have a more positive attitude toward using information technology and move away from the traditional wait and see conservatism. Information technology professionals must address the existing problems of information technology - based communication methods such as quality of the scanned documents and their illegibility. The industry as a whole should also take the initiative to promote IT - based communications among all professions within the industry.

Top management of construction organizations must face these problems and change their attitude to maintain their competitive edge in today's highly competitive environment. The recent economic slowdown in Palestine puts a serious challenge to all contractors. They must do whatever they can do to enhance their competitiveness.

Furthermore, the Palestine Government should take the initiative in promoting information technology applications in the local construction industry.

As far as the research is concerned, it is envisaged that follow-up interviews should be carried out to further investigate particular interesting cases and to explore people's views and experiences in greater depth.

It is planned to undertake a comparative study to identify how well the local

construction industry stands among other developed countries in the information technology era, and to reveal differences between these countries and what the local industry can learn from its counterparts in other countries.

In the future, studies similar to that reported herein should be conducted; they will provide conclusions about the extent of IT use and the rate with which contractors are adopting the new technology.

REFERENCES

Ahmad, I. And Nunoo, C. (1999), Data Warehousing in the Construction Industry: Organizing and Processing Data for Decision-making, Proceedings of International Conference on Durability of Building Materials and Components 8 – Service Life and Asset Management, Information Technology in Construction, CIB W78 Workshop, Vancouver, Canada, Vol.4, pp. 2394-2406

Al-Reshaid, K. and Kartam, N. (1999), Improving Construction Communication: The Impact On-line Technology, Proceedings of International Conference on Durability of Building Materials and Components 8 – Service Life and Asset Management, Information Technology in Construction, CIB W78 Workshop, Vancouver, Canada, Vol.4, pp. 2270-2276.

Amor R., Betts M et al. (2002) "Information Technology for Construction: Recent Workand Future Directions" in *ITcon* 7, 245-258.
Source: http://www.itcon.org/2002/16/paper.pdf

Ball A., Patel M., McMahon C., Culley S., Green S., Clarkson J., A Grand Challenge: Immortal Information and Through-Life Knowledge Management (KIM) ,Piesse D. September 2006,The Role Of IT In 21st Century Insurance

Björk, B. C. (1999). "Information Technology in Construction: Domain Definition and Research Issues.", International Journal of Computer Integrated Design and Construction. 1 (1): 3-16.

Breu C, Noebert M & Sametinger J (2001) "WORM: Web-based Communication and Project Management" University of Regensburg *Conference on Internet Multimedia Systems and Application*
Source: http://www.swe.uni-linz.ac.at/publications/pdf/TR-SE-01.05.pdf

Broomfield J.R. et al (2003) _"ISO 9001-2000 Interpretive Guide for the Design and Construction Project Team" ASQ Quality Press, Milwaukee, WI, USA
Source: http://www.asq.org/chapters/E1204.pdf

Chan, S. and Leung, N. (2002) State-of-the art internet technology in Singapore's construction industry. http://itc.scix.net/data/works/att/w78-2003-378.

Chan S.L. & Leung N. (2004) "Prototype of Web-based Construction Project Management System" Journal of construction engineering and management 130(2004) 935-943 Source: http://plaza.ufl.edu/nnleung/mspapers/prototype.pdf

Chen, Z., Kong, S., Li, H., Xu, Q., (2004) Evaluating IT applications for innovative construction management. http://www.uni-weimar.de/icccbe/late/icccbe-x.

David M. Dutton, Robert W. Amor, David P. Bloomfield ,KNOWLEDGE-BASED SYSTEMS AND THE INTERNET: A FUTURE PERSPECTIVE.

Doherty, J.M.;1997; A Survey of Computer Use in the New Zealand Building and construction Industry. www.itcon.org/1997/4.

Fallon K (2003) “Keys to Success in Web-Based Project Management: The Technology Implementation Perspective” 2003 Rail Transit conference American Public transport Association Source: http://www.kfa-inc.com/articles/APTApresentation2003.PDF

FENG Y. The CRIOCM 2006 International Symposium on“Advancement of Construction Management and Real Estate”APPLICATION OF INFORMATION TECHNOLOGY INCONSTRUCTION MANAGEMENT.

Gaith H. F., Khalim A. R. Ismail A., AN EMPIRICAL INVESTIGATION FOR EXPLORING INFORMATION TECHNOLOGY FACTORS AND FIRM PERFORMANCE IN MALAYSIAN CONSTRUCTION SECTOR.

Heng Li; Irani, Z.; Love, P.E.D. System Sciences, 2000. The IT performance evaluation in the construction industry Proceedings of the 33rd Annual Hawaii International Conference on, Volume , Issue , 4-7 Jan. 2000 Page(s): 9 pp. vol.1

Howard, R., Kiviniemi A., and Samuelson O. “ *Surveys of IT in the Construction Industry and Experience of the IT Barometer in Scandinavia*.” Information Technology in Construction. Vol. 3, pp. 45 – 55, 1998.

Jung U & Bjornsson H (2004) “Construction Supply Chain Visualization through Web Services Integration” CIFE Technical Report #149, Center for Integrated Facility Engineering, Stanford University Source: http://cife.stanford.edu/online.publications/TR149.pdf

Karhu, V. Keitila, M. and Lahdenpera, P. (1997) Construction process model- Generic present-state systematization by IDEFO. VTT research notice 1845. Technical research center of Finland ESPOO 1997.

Kiviniemi A. (1999). IAI and IFC - State-of-the-Art. 8th International Conference on Durability of Building Materials and Components, Volume 4 - Information Technology in Construction, CIB W78 Workshop, (Lacasse M. A. and Vanier D. J., Editors), NRC Research Press, National Research Council of Canada, Ottawa, Canada, pp. 2157-2168

Lim Yoke Mui, Abdul Rashid Abdul Aziz, Ang Cheng Ni, Wong Chee Yee, and Wong Shiau Lay, 2002. A Survey of Internet Usage in the Malaysian Construction Industry, ITcon Vol. 7;259

Malhotra Y. Integrating knowledge management technologies in organizational business processes: getting real time enterprises to deliver real business performance.VOL. 9 NO. 1 2005, pp. 7-28, Emerald Group Publishing Limited, ISSN 1367-3270

Martin N. Baily 2003, The Role of Information Technology and Other Innovations

Matheu N (2005) “Life Cycle Document Management System for Construction” Doctoral Thesis, Universitat Politecnica De Catalunya, SpainSource: http://www.tdx.cbuc.es/TESIS_UPC/AVAILABLE/TDX-0518105-155912//05Nfm05de12.pdf

Ma Zhiliang and Qin Liang, (2004) “A Framework of Information Management System for Construction Projects” Department of Civil Engineering, Tsinghua University, Beijing 25 Source: http://jobfunctions.bnet.com/whitepaper.aspx?docid=119733

McCreadie, M., and Rice, R. E. (1999). “Part I: cross-disciplinary conceptualizations of access.” Information Processing and Management, 35(1), pp. 45-76.

Mentor Group (1997). The role of IT in business process re-engineering, http://mentorgrp.com/pubs/mrrison.html

Mervi L, Veli H et. al. (2002), “Multidisciplinary Information Management in Const-Ruction Industry, Example of Facilities Management” *ITcon* 7, 213-244 Source: http://www.itcon.org/2002/14/paper.pdf

Mui, L.Y. et al. 2002. "A Survey of Internet Usage in the Malaysian Construction Industry." ITcon, 7: 259-269.

Pamulu M. and Bhuta Ch. “*Managing Information Technology in Construction Industry: The Indonesian Experience*.” CIB World Building Congress, Canada, May 2 - 7, 2004.

Pamulu M. Bhuta Ch. and Sapri M., "*Chandra (2004) Strategic management of information technology in construction industry: the Indonesian perspectives. In Ogunlana, Stephen and Charoenngam, Chotchai and Pannapa Herabat, Pannapa and Hadikusumo, B. H. W., Eds*".

Peansupap V. and Walker D." *Factors Enabling Information and Communication Technology Diffusion and Actual Implementation in Construction Organisations.* ” Information Technology in Construction Vol. 10, pg. 193, 2005.

Porter, M. and Millar V.E., 1985. How Information Gives you Competitive advantage, Harvard Business Review, 63(4), 149-160

Rivard, H. “*A Survey of Information Technology in the Canadian Construction Industry.*” , 1999, Retrieved at Construction Informatics Digital Library http://itc.scix.net., 15/10/2006.

Samuelson O. (2002). “IT-Barometer 2000 – the use of IT in the Nordic construction industry.” Electronic Journal of Information Technology in Construction (ITcon), Vol. 7, http://itcon.org, 1-25.

Sarshar, M. & Isikdag, U. 2004. "A survey of ICT use in the turkish construction industry." Engineering, Construction and Architectural Management, 11(4): 238-247

Schwegler B., Fischer M., O’Connell M., Hänninen R., and Laitinen J. “*Near, Medium, & Long-Term Benefits of Information Technology in Construction.*”

Retrieved at Center for Integrated Facility Engineering, 2001, http://michael.oconnell_swec.com., 15/10/2006.

Scott S. Robinson.The Potential Role of IT in International Remittance Transfers? VINCULART, A.C. and Autonomous Metropolitan University, Mexico

Seow Wei L.L. Mohammed A.H.,THE DEVELOPMENT OF KNOWLEDGE SHARING CULTURE IN ONSTRUCTIONINDUSTRY

Shash A. and Al-Amir M. "*Information Technology in the Contractors firms in Saudi Arabia.*" Construction Management and Econimics. Vol. 15, pp. 187 – 200, 1996.

Sohal, C., Yap, C. S., and Raman, K. S. 1998. Factors Contributing to Successful Computerization in Small and Medium Enterprises in Singapore, In: Proc of the ENDEC International Entrepreneurship Conference on Entrepreneurship; A Spectrum of Possibilities 74-81

Tang Jia, (2003) "Corporate Culture and Integrated Management Systems: - A case study of the UK construction Industry" Masters of Science Thesis, University of East Anglia Source: http://www.uea.ac.uk/env/all/teaching/eiaams/pdf_dissertations/2003/Tang_Jia.pdf

Thomas, K (1999). "A Study of The Use of Information Technology in the Republic of Ireland Construction Sector." International Journal of Construction Information. 7 (1): 21– 34.

Thong, J.Y.L and Yap, C. S. 1995. CEO Characteristics, Organizational Characteristics and Information Technology Adoption in Small Business, Omega, International Journal of management Science 23(4), pp. 429-442.Thousand Oaks, Calif.

Tolman, F., Bohms, M., Lima, C., Rees, R., Fleuren, J., and Stephens, J. (2001) Econstruct: Expectations, solutions, and results. http://www.itcon.org/2001/13/.

Trefor W., Lu H., Bernold L. " *The State-of-Practice and the Future of Information Technology Construction*." ASCE-CI Committee on Wireless Construction, 2006.

Turk, Z., and T. Cerovsek (2000) Prototype internet desktop for engineers. Proceeding for ECPPM, 2000- European conference on product and process modeling in the building industry.

Turk, Ž. (2000). Construction IT: Definition, Framework and Research Issues, M. Fischiner (ed.) Faculty of Civil and Geodetic Engineering on the doorstep of the millennium : on the occasion of its 80th anniversary. ISBN 961-6167-33-, pg. 17-32.

Turk Z .1998 .Limits of Information Technology in Engineering(Or Why Computers Might Not Replace the Engineers) in: Proceedings of the 4th Symposium on Intelligent Systems, Croatian Systems Society

UNIVERSITY OF NEW SOUTH WALES SUBMISSION Building on Strength AUSTRALIAN HIGHER EDUCATION REVIEW 2008

Wetherill M, Rezgui Y et al. (2002), "Knowledge Management for the Construction Industry: The E-Cognos Project" in *ITcon* 7 (2002) 183-196. Source: http://www.itcon.org/2002/12/paper.pdf

Annex A:

الجامعة الإسلامية – غزة

كلية الهنـــدسة

قسم الهنـدسة المدنية

الأخ الكريم

السلام عليكم ورحمة الله وبركاته

الموضوع :استبيان بخصوص تطبيقات تكنولوجيا المعلومات في صناعة الإنشاءات في قطاع غزة

نضع بين أيديكم هذا الاستبيان الذي ستستخدم نتائجه في معرفة مدى الاستفادة من تطبيقات تكنولوجيا المعلومات لدى المعنيين في قطاع الانشاءآت في قطاع غزة) ملاك, مقاولين ,استشاريين, هذا من ناحية ومن ناحية أخرى يهدف الاستبيان إلى معرفة مدى استعداد العاملين في قطاع الإنشاءات في غزة لتطبيق هذه التكنولوجيا في مجال صناعة الانشاءات.

سيتم استخدام نتائج هذا الاستبيان لأغراض البحث العلمي فقط وستكون هذه النتائج جزء من مشروع تخرج وذلك لاستكمال متطلبات الدراسة لنيل درجة البكالور يس في الهندسة المدنية من كلية الهندسة - الجامعة الإسلامية – غزة.

إن مشاركتكم معنا في هذا العمل هو إثراء له ونشكركم جزيل الشكر على هذه المشاركة القيمة.

والسلام عليكم ورحمة الله وبركاته.

الباحثون

Please answer the following questions:

Section 1: This section collects basic information needed to identify the organization's size and character:

1.1 Organization's name: ☐

1.2 Phone no. (Optional): ☐

1.3 E-mail address: ☐

1.4 How would you classify your organization?

☐ Contractor (infrastructure works) ☐ Public Institution

☐ Contractor (building works) ☐ Supplier

☐ Consultant ☐ Others (please specify):

1.5 Classification according to the National Classification Committee (for contractors) :

☐ First A ☐ First B ☐ Second ☐ Third

☐ Fourth ☐ Fifth

1.6 Experience in the field of construction industry: ☐ Years

1.7 Region of operation in Gaza Strip:

☐ North Region ☐ Gaza Region ☐ Middle Region

☐ Khan-Younis Region ☐ Rafah Region

1.8 Number of employees in your organization:

☐ Less than 10 ☐ 10 - 20

☐ 20 - 40 ☐ Over than 40

1.9 Number of completed projects in the past five years. ☐ projects.

1.10 Average annual Business volume (Millions of Dollars $) : ☐

Section 2: This section intends to identify the hardware used by the organization

2.1 How many computers currently in use by your organization?
(For public owners please identify the number of computer units used by the staff related

to the construction project designs and implementation). ☐

2.2 What type(s) of computer system does your firm use?

☐ Laptop ☐ Desktop computer

☐ Mini Laptop ☐ Others (identify)

2.3 How many printers currently in use by your organization? ☐

2.4 Information technology (I.T) hardware currently in use

☐ Plotters ☐ Videoconference equipment

☐ Photocopiers / Large Photocopiers ☐ Servers

☐ Scanners ☐ Others (identify)

2.5 Does your organization allocate budget for hardware renewal / maintenance?

☐ Yes ☐ No

Section 3: This section intends to identify the software used in the organization

3.1 Software for project planning, cost estimating, and finance are currently used by the

organization (select the ones used)

☐ MS project ☐ Primavera ☐ Microsoft Excel

☐ Accounting (identify) ☐ Others (Identify)

3.2 Software for general administration are currently used by the organization (select the
used ones)

☐ MS-Word ☐ MS-Excel ☐ MS-Access

☐ Personnel system (identify) ☐ Others (identify)

3.3 Analysis and design software currently in use by the organization (select the ones used)

☐ Micro Station ☐ STAD

☐ ETABS ☐ SAP

☐ SAFE ☐ PROKON

☐ Others (identify)

3.4 Drawing software currently in use by the organization (select the ones used)

☐ Auto Cad ☐ 3D Sketch Up

☐ Photoshop ☐ Arch Cad

☐ 3D Max ☐ Others (identify)

3.5 Water system software currently in use by the organization (select the ones used)

☐ Water Cad ☐ BENTLEY ☐ Sewer Cad

☐ Hydraulic Cad ☐ Others (identify)

3.6 Operating systems currently in use by the organization

☐ LINUX ☐ MS- Windows 2000

☐ MS- Windows 98 ☐ MS- Windows Vista

☐ MS- Windows XP ☐ Others (identify)

3.7 The most significant factors considered in selecting computer software

☐ Cost ☐ Simplicity in using program

☐ Availability of the software ☐ Spread of the software

☐ Others (identify)

Section 4: This section intends to identify the Internet and communication technology applied by the organization.

4.1 Do you have a web site for your Company / Organization?

☐ Yes ☐ No

4.2 If the answer is yes what are the organization primary purposes of having an organization web site?

☐ General organization information ☐ Projects information

☐ Material purchasing/ marketing ☐ Public feedback

☐ Others (identify)

4.3 Does your organization have a Local Area Network?

☐ Yes ☐ No

4.4 Is your organization connected to the Internet?

☐ Yes ☐ No

4.5 Purpose of using internet by the organization

☐ Sending/ Receiving messages ☐ Purchasing/ procurement

☐ Distribution of documentation to other organization

☐ Sending/ receiving bidding documents

☐ Update information and softwares ☐ Others (identify)

4.6 Factors restricting the use of internet system by the organization

☐ Afraid of losing information ☐ Cost

☐ Afraid of leakage of information ☐ Lack of management support

☐ Lack of experience in using internet

☐ Others (identify)

4.7 Does your organization use e-mail?

☐ Yes ☐ No

4.8 Communication means in your organization

☐ Telephone ☐ Wireless phones

☐ Mobile phones ☐ Email

☐ Fax machine ☐ Others (identify)

Section 5: This section intends to identify the different reasons restricting the implementation of Information Technology (I.T) in the organization.

5.1 What reasons are restricting the use of IT in the organization?

☐ Rapid change in technology ☐ Integration problems

☐ Software problems ☐ Lack of knowledge

☐ Hardware problems ☐ Poor Leadership

☐ Security problems ☐ Lack of available funding

☐ Others (identify)

Section 6: This section intends to identify the future of I.T implementation in construction industry in the next five years.

6.1 To what extent do you agree with the following predictions about information technology applications in construction in the next five years?

	1	2	3	4	5
	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
IT will improve project communication					
IT will improve project control					
IT will improve procurement/purchasing function					
IT will improve profits					
IT will become prohibitively expensive					
IT will benefit construction research					
IT will require extensive training					

6.2 If you have any additional comments, please feel free to add them below:

Thank you for your cooperation.

Annex B: Explanatory Letter of Validity Content

بسم الله الرحمن الرحيم

Date: / / 2009

السيد: ..... حفظه الله ،،،

الموضوع: بخصوص تقييم صدق محتوى الاستبانة الخاصة بمشروع تخرج بعنوان " استخدامات تكنولوجيا المعلومات بصناعة المقاولات في قطاع غزة "

السلام عليكم ورحمة الله وبركاته،

أرجو من سيادتكم التعاون في تقييم صدق محتوى الاستبانة الخاصة بمشروع تخرج بعنوان " استخدامات تكنولوجيا المعلومات بصناعة المقاولات في قطاع غزة " ومدى مطابقة أهداف البحث بالأسئلة الواردة في الاستبانة. وذلك بمستوى الدقة والأمانة العالية المعهودة في عملكم وخبرتكم الواسعة والعميقة.

مرفق طية الاستبانة مع ملخص عن أهداف بحث التخرج.

تقديرات مؤشر صدق المحتوى (Index of Content Validity):

1. المحتوى مناسب وموجز.
2. المحتوى مناسب ولكنه يحتاج إلى تغييرات ثانوية.
3. المحتوى غير مناسب إلا إذا تم تعديل أساسي في هيكلية ومحتوى الاستبانة.
4. المحتوى غير مناسب.

بالإضافة إلى ذلك يرجى من سيادتكم تقييم صدق المحتوى من خلال إمكانية قراءة الاستبانة (Readability) ويرجى إضافة أي معلومات أو تعديلات على الأسئلة كما ترونها مناسبة.

ولكم جزيل الشكر والتقدير على مساهماتكم في دعم البحث العلمي.

الباحثون

Annex C:

Means, std. deviation t. value, and sig. level to know the difference between Contractor and Consultant

Reasons hindering the use of IT

Field	type	Mean	Std. Deviation	T value	Sig. level
Rapid changes in technology	Contractor	21.500	1.694	4.788	sig. at 0.01
	Consultant	23.917	2.048		
Software problems	Contractor	19.250	1.751	1.966	Not sig.
	Consultant	20.500	2.762		
Lack of knowledge	Contractor	19.625	1.527	0.399	Not sig.
	Consultant	19.917	3.350		
Hardware problems	Contractor	34.000	2.284	2.908	sig. at 0.01
	Consultant	35.917	2.634		
Poor Leadership	Contractor	24.000	2.284	2.148	sig. at 0.01
	Consultant	34.917	2.634		
Security problems	Contractor	19.625	1.527	0.399	Not sig.
	Consultant	19.917	3.350		
Lack of available funding	Contractor	34.000	2.284	2.908	sig. at 0.01
	Consultant	35.917	2.634		
Total	Contractor	94.375	4.241	3.370	sig. at 0.01
	Consultant	100.250	7.791		

"t" table value at (58) d f. at (0.05) sig. level equal 2.00

"t" table value at (58) d f. at (0.01) sig. level equal 2.66

Means, std. deviation t. value, and sig. level to know the difference between Contractor and Consultant

The future of I.T implementation in construction industry

Field	type	Mean	Std. Deviation	T value	Sig. level
IT will improve profits	Contractor	34.000	2.284	4.788	sig. at 0.01
	Consultant	35.917	2.634		
IT will improve procurement/purchasing function	Contractor	19.250	1.751	1.966	Not sig.
	Consultant	20.500	2.762		
IT will improve project control	Contractor	19.625	1.527	0.399	Not sig.
	Consultant	19.917	3.350		
IT will improve project communication	Contractor	34.000	2.284	2.908	sig. at 0.01
	Consultant	35.917	2.634		
IT will require extensive training	Contractor	24.000	2.284	2.148	sig. at 0.01
	Consultant	34.917	2.634		
IT will become prohibitively expensive	Contractor	19.625	1.527	0.399	Not sig.
	Consultant	19.917	3.350		
IT will benefit construction research	Contractor	34.000	2.284	2.908	sig. at 0.01
	Consultant	35.917	2.634		
Total	Contractor	95.375	5.241	3.370	sig. at 0.01
	Consultant	100.000	7.891		

"t" table value at (58) d f. at (0.05) sig. level equal 2.00

"t" table value at (58) d f. at (0.01) sig. level equal 2.66