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A Cost Monitoring System for Gaza Strip Contractors

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To my wife and family, and many friends in the construction industry

Acknowledgements

Abstract

Cost monitoring is a main step of a project cost control process. Cost monitoring provides management with actual cost which is compared with the estimated cost to detect any cost overrun. Any deviation from the estimated cost alerts decision makers to a particular problem that may needs more attention and corrective action. This study aims at investigating the existing cost monitoring practice of Gaza Strip contracting companies, and suggesting recommendations to improve it. The proposed improvement is formulated in developing a computerized cost monitoring system.

To investigate the cost monitoring practice, a survey is conducted using a questionnaire which is also supported by interviews. Forty one contracting companies are interviewed to fill the questionnaires. The results indicate that the cost monitoring practice is primitive and unsatisfactory. It is not applied in a systematic, periodic and adequate way. The results also show that the contractors do not use any computer applications in cost monitoring.

These results give the researcher a thrust to design and develop a tailored cost monitoring software which is named "Cost Monitoring Software" (CMS). It is developed to support and improve the cost monitoring practice of Gaza Strip contractors. CMS is tested and evaluated in real projects by experienced contractors. The evaluation indicates that CMS in general functions well, and contractors are satisfied with it. It provides many reports including the actual item labor, materials, equipment, and subcontractors cost reports, and up-to-date direct cost of items. It also provides the mechanism to convert the entered executed quantities of item activities to equivalent quantity of finished item. This mechanism leads to easier, and more real and accurate cost monitoring process. Moreover, CMS makes provision to compute the item costs considering its location at different group of floors. This provides more accurate cost monitoring, because generally the cost of item differs from floor to floor.

نظام مراقبة التكلفة لمقاولي قطاع غزة

الملخص

تعتبر مراقبة التكلفة خطوة رئيسة في عملية التحكم في تكلفة المشروع، فهي تزود الإدارة بمعلومات عن التكلفة الفعلية التي يمكن مقارنتها مع التكلفة التقديرية لاكتشاف أي زيادة عن هذه التكلفة، و في الواقع إن أي تجاوز عن التكلفة التقديرية الأصلية ينبه صانعي القرار إلى وجود مشكلة ربما تستلزم زيادة في الاهتمام و اتخاذ إجراءات تصحيحية. إن هدف هذه الدراسة بالأساس هو معرفة واقع الممارسة الفعلية في مجال مراقبة تكلفة المشاريع، و ذلك من قبل شركات المقاولات في قطاع غزة، و أيضا اقتراح توصيات لتحسين تلك المراقبة، علما بأن هذا التحسين مصاغ بتطوير نظام محوسب لمراقبة التكلفة.

للقيام بالتحري عن تلك الممارسة، أجري مسح ميداني باستخدام طريقة الاستبيان مدعما بمقابلات شخصية. و قد أجريت مقابلات مع واحد و أربعين شركة مقاولات لتعبئة الاستبيانات، و دلت نتائج التحليل على أن ممارسة المقاولين في تطبيق مراقبة التكلفة بدائية و غير مرضية، حيث إنها لم تطبق بشكل نظامي و دوري و ملائم، و أظهرت النتائج أيضا عدم استخدام المقاولين لبرامج حاسوب في مراقبة التكلفة.

دفعت هذه النتائج الباحث للقيام بتطوير برنامج حاسوب خاص بمراقبة التكلفة سمي "برنامج مراقبة التكلفة" "Cost Monitoring Software" (CMS)، و الغرض منه هو تحسين ممارسة مراقبة التكلفة لدى مقاولي قطاع غزة. هذا و قد تم اختبار و تقييم البرنامج في مشاريع فعلية بواسطة مقاولين ذوي خبرة، و قد أظهرت نتائج التقييم أن البرنامج بشكل عام يعمل بصورة جيدة و أنه حاز على رضى المقاولين، فهو يزود المقاول بتقارير عديدة تشمل تقارير تكلفة العمال، و المواد، و المعدات، و مقاولي الباطن لكل بند، و كذلك بتقارير محدثة للتكلفة الفعلية لجميع البنود، كما يوفر أيضا آلية لتحويل كميات فعاليات البند الواحد المنفذة إلى كمية مكافئة من كميات البند باعتباره منجزا بصورته النهائية، و بالتالي تجعل هذه الآلية عملية مراقبة التكلفة سهلة، و أكثر دقة و واقعية. و علاوة على ذلك، يوفر البرنامج وسائل التمييز بين تكلفة البند بحسب موقعه في الطوابق المختلفة من المبنى، و هذه الميزة تجعل مراقبة التكلفة أكثر دقة، ذلك لأنه بالعادة تختلف تكلفة البند الواحد من طابق لآخر.

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List of Abbreviations

BMBOK   Project Management Body of Knowledge

CMS   Cost Monitoring Software

MOPWH   Ministry of Public Works and Housing

PECDAR   Palestinian Economic Council for Development and Reconstruction

PMI   Project Management Institute

PNA   Palestinian National Authority

SPSS   Statistical Package for Social Sciences

UNDP   United Nations Development Program

UNRWA   United Nations Relief and Works Agency

WB   World Bank

WBS   Work Breakdown Structure

The Software Abbreviations

CMS   Cost Monitoring Software

L   Labor

M   Materials

E   Equipment

S   Subcontractors

O.T.   Overtime

Reg.   Regular

CHAPTER 1
Introduction

1.1 General

In this research, the existing cost monitoring practice of Gaza Strip contracting companies is investigated, and an attempt to improve it is conducted. The proposed improvement is formulated in developing a computerized cost monitoring system.

In this chapter, the rational for the research, research objectives, outline methodology of the research, and study limitations are explained. The contents of this thesis is also summarized.

1.2 Rationale

Construction projects can be accomplished utilizing management processes. These processes include planning, organizing, executing, monitoring, and controlling (Ahuja et al. 1994). During any construction project the three inter-related factors of time, money and quality need to be controlled. Good control means that all three factors could be improved simultaneously. Managers on a project must decide on acceptable targets for each of these factors and take action to ensure they are achieved (Mawdesley et al. 1997).

After a project has been planned, it is the responsibility of management to execute it in such a manner that the project objectives are attained. This is obtained by monitoring progress and cost, comparing it with planned objectives, and if necessary, taking corrective action. The changing in environment of a project drives continuous efforts by management to control the project, or else, instead of management controlling the project, the project controls the management, and there is movement from problem to problem without any monitor and control (Ahuja et al. 1994).

Project control can be reduced to two basic components. The first, monitoring that consists of a means of understanding what is happening in a project, and obtaining information about the project by some means. The second component, control that consists of action taken in response to the information (Hinze 1999).

Before control action can be taken it is usual to have some evidence on which to act. This might take the form of such things as:

- Spotting mistakes.
- Recognizing lack of progress.
- Identifying areas of poor quality (Mawdesley et al. 1997).

Monitoring and controlling the cost is a recognized objective of most managers. A cost monitoring should enable a manager to observe current cost levels, and compare them with standard plan or norm. A cost control should enable a manager to institute corrective actions to keep cost within acceptable bounds (Harris and McCaffer 1993).

Cost monitoring enables the progress of the resource gangs used in the works to be examined and controlled; and the supply and use of material to be monitored. Also, it is possible to use financial information for control in short term, provided that the allowed costs can be determined from the project information (Mawdesley et al. 1997).

The political, social, cultural, and economic conditions in Gaza Strip have left their marks on the project management considerations. Also, the lack of planning, monitoring, controlling, and relatively poor performance of the local contractors have affected badly the construction industry. Actually, because of the weakness of many project management practices, a lot of failures have happened to numerous contracting companies during the last five years. According to the author's experience, the implementation of cost monitoring and cost control in construction projects by Gaza Strip contractors is still in its infant phase. El-Sawalhi (2002) has conducted a study that aimed at investigating the implementation of project management practices which are used by public owners and contractors in Gaza Strip. According to the results of this study, the cost control application is found the lowest used application. Also, he recommends that the researchers of project management in Gaza Strip have to develop a cost control models which takes into consideration the local trends. All these drive the author to investigate the current practice of cost monitoring and attempt to develop a cost monitoring software that suits the local contractors. To the researcher's knowledge, no research has been done to study and investigate the cost monitoring practice applied by the Gaza Strip contracting companies.

1.3 Research Objectives

This research aims at investigating the existing cost monitoring practice of Gaza Strip contracting companies, and suggesting recommendations to improve it. The proposed improvement is formulated in developing a computerized cost monitoring system.

The research objectives can be summarized as follows:

1. To investigate and examine the project cost monitoring practice of Gaza Strip contractors during construction phase.
2. To investigate the usage of computerized cost monitoring systems in the local construction projects.
3. To explore and determine the difficulties that are facing the contractors in using cost monitoring systems.
4. To conclude guidelines and recommendations that help in improving the existing cost monitoring practice.
5. To develop a cost monitoring software that aims at improving the cost monitoring practice in the construction projects that executed by local contractors.
6. To evaluate the developed cost monitoring software to assure that its performance, design, and features are satisfactory.

1.4 Outline Methodology of the Research

The method which is used to achieve the aim and objectives of this research begins with reviewing related literature in books, magazines, papers, etc. Also, relevant computerized packages are reviewed. In addition, skills of using Excel effectively are acquired to help in developing the cost monitoring software.

Based on the literature review and researcher experience in construction management practice, a questionnaire is designed to collect data about the cost monitoring practice of Gaza Strip contractors. The questionnaire is distributed to first, second and third class contracting companies according to Contractor Union classification. After gathering the data, the results are analyzed and discussed. A computerized cost monitoring system is developed which suits the contracting companies in Gaza Strip.

1.5 Study Limitations

The study covers the contractors who have the first, second, and third classes according to the classification of the Contractors Union. The contractors who have other classes are excluded from the survey. The study investigates the cost monitoring of project during the execution phase. It does not consider the cost monitoring during the other phases such as, planning, design, and maintenance.

The developed software concentrates only on monitoring the actual direct cost which includes labor, materials, equipment, and subcontractors costs. It excludes the indirect cost. Also, the developed software is dedicated for cost monitoring process. Other cost control processes such as comparing and forecasting are excluded.

1.6 Thesis Contents

This thesis is composed of six chapters and six annexes as follows:

Chapter 1: Introduction
This chapter is a general introduction to the thesis. It describes the rationale for the research, the objectives, outline methodology of the research. It also introduces the study limitations and outline contents of the thesis.

Chapter 2: Cost monitoring and control
This chapter introduces the background which is found in relevant literature. The main topics of this chapter are: project monitoring and control; data and information; and cost monitoring and control.

Chapter 3: Methodology
The research methodology, research strategy, and research design are described in this chapter. It discusses the techniques of the adopted methodology. The research methodology involves the following tasks: first, literature survey related to cost monitoring; second, field survey; third, developing and evaluating the software that suites Gaza Strip contractors.

Chapter 4: Results and discussions

In this chapter, the results of the survey are introduced and discussed. The chapter illustrates and discusses the characteristics of the study population, the applications of cost monitoring tools and techniques, the computer applications in cost monitoring, and the implementation of cost monitoring systems.

Chapter 5: Cost Monitoring Software CMS

This chapter introduces the software which the researcher develops to improve the cost monitoring practice of Gaza Strip contractors. The chapter discusses the general concepts on which the development of software is based. It provides a description for the software components and method of use. Also, the limitations of software, and software evaluation are discussed.

Chapter 6: Conclusions and Recommendations

In this chapter, the author introduces the research conclusions and his recommendations to improve the cost monitoring practice of Gaza Strip contractors.

Annexes

Annex 1: Field survey questionnaire (In Arabic).

Annex 2: Field survey questionnaire (English version).

Annex 3: Figures for the software reports.

Annex 4: Software evaluation questionnaire (In Arabic).

Annex 5: Software evaluation questionnaire (English version).

Annex 6: Overview for relevant cost monitoring computer packages.

CHAPTER 2
Cost Monitoring and Control

2.1 Introduction

This chapter focuses on subjects that are available in literature and related to the cost monitoring. The main topics that are included in the chapter are: project monitoring and control; data and information; and cost monitoring and control.

2.2 Project Monitoring and Control

2.2.1 Concepts

Control as defined by "A guide to the Management Body of knowledge" (PMBOK Guide 2000 Edition):

> "The process of comparing actual performance with planned performance, analyzing variance, evaluating possible alternatives, and taking appropriate corrective action as needed."

Hinze (1999 pp. 208) states:

> "Project control can be reduced to two basic components. The first, monitoring, consists of a means of understanding what is happening on a project, obtaining information about the project by some means. The second component, control, consists of action taken in response to the information."

Then, he comments that it is not sufficient to simply recognize what is happening on a project; knowledge carries with it the responsibility to respond to the available information.

He also states that monitoring consists of receiving or maintaining accurate reports of the events that have taken place on the project and the specific work items that have been implemented. Monitoring is fundamentally a means by which feedback is obtained on the progress on the project (Hinze 1999).

Fish (2002) defines monitoring and controlling as:

> "<u>Monitoring</u>: collecting, recording and reporting information concerning any and all aspects of project performance that the project manager or others in the organization wish to know.
> <u>Controlling</u>: uses the data supplied by monitoring to bring actual performance into approximate congruence with planned performance."

Harris and McCaffer (1993) summarize the elements of any control system as:

- Observation
- Comparison of observation with some desired standard
- Corrective action to take if necessary.

Martin (1992) says that project control, as envisioned by industry in nineties, is a reporting procedure for alerting project management of predictable directions in the project plan. In the case of adverse trends, it is an "early warning system" so that corrective action can be taken in a manner to avoid or minimize the projected consequences, without abruptness.

The purpose of project control is to identify and correct deviations from project objectives. Control is established for various dimensions of project performance; typically for cost, time and quality. When monitoring of actual performance against goal identifies a variance in any of these dimensions, that is an indication to provide management attention to determine the significance and cause of the variance, and if necessary, to act to minimize the negative impact on the project. The control act is to assure performance meets project objectives, usually through complying performance to plan, or occasionally through modifying the plan (Howell and Ballard ١996).

2.2.2 Monitoring and controlling process

Summarizing Howell and Ballard (1996), project control is a subject of "preventing bad change", and consists of two parts, corresponding to cost accounting (measurement) and managerial decision making; collecting and shaping the data, then doing something with it. Accounting or measurement consists of a) establishing cost and time budgets, b) monitoring actual against standards, and c) identifying variances. Figure 2.1 illustrate the control process.
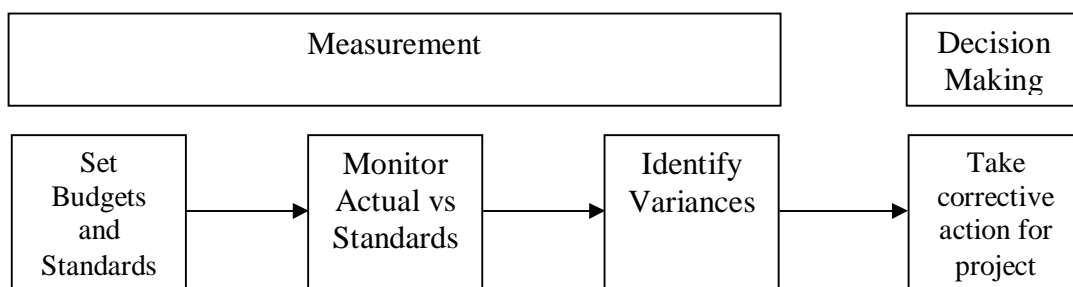
Figure 2.1: Controlling process

Source: Howell and Ballard (1996)

Control standards are often contractual or derived from contractual commitments, consequently the accounting task of controls is to monitor conformance of DID with SHOULD. Did we spend more money or time than was budgeted for that activity or time period? Did the work conform to drawings and specifications? Figure 2.2 illustrates Monitoring DID vs. SHOULD.
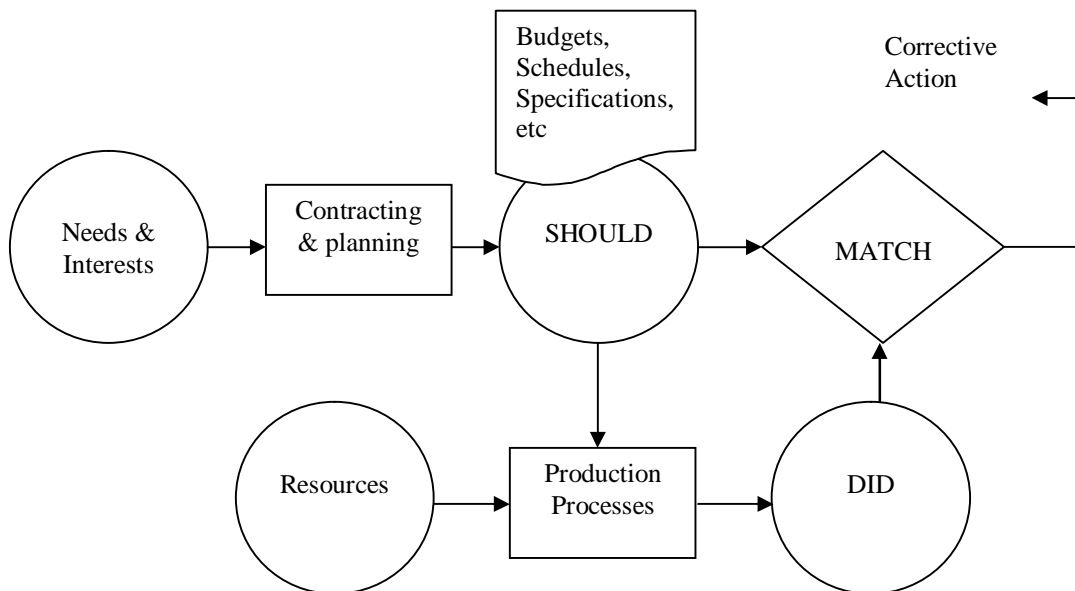
Figure 2.2: Monitoring DID vs. SHOULD

Source: Howell and Ballard (1996)

Of course, a large effort expended by control staff is spent assessing the validity of claims regarding progress and payment. Comparatively, little time is devoted to data analysis for management decision making. Indeed, the task of project control is essentially that of accounting. Control decisions, such as choosing to hasten a subcontractor, are made by others with little help from control reports other than the record of actual versus plan, and the identification of variances. In such a view, the virtues of project control are the virtues of accounting.

Rehberger (1998) states that:

control processes include:

- consistently monitoring projects.
- engaging the right people.
- documenting all actions and decisions.
- feeding lessons learned back into the selection phase.

Control data include:

- measures of interim results.
- updated analysis of each project's costs, benefits, schedule, and risks.

Control decisions include:

- deciding whether to cancel, modify, continue, or accelerate a project.
- aggregating data and reviewing actions taken to date.

Figure 2.٣ illustrates corrective action process.
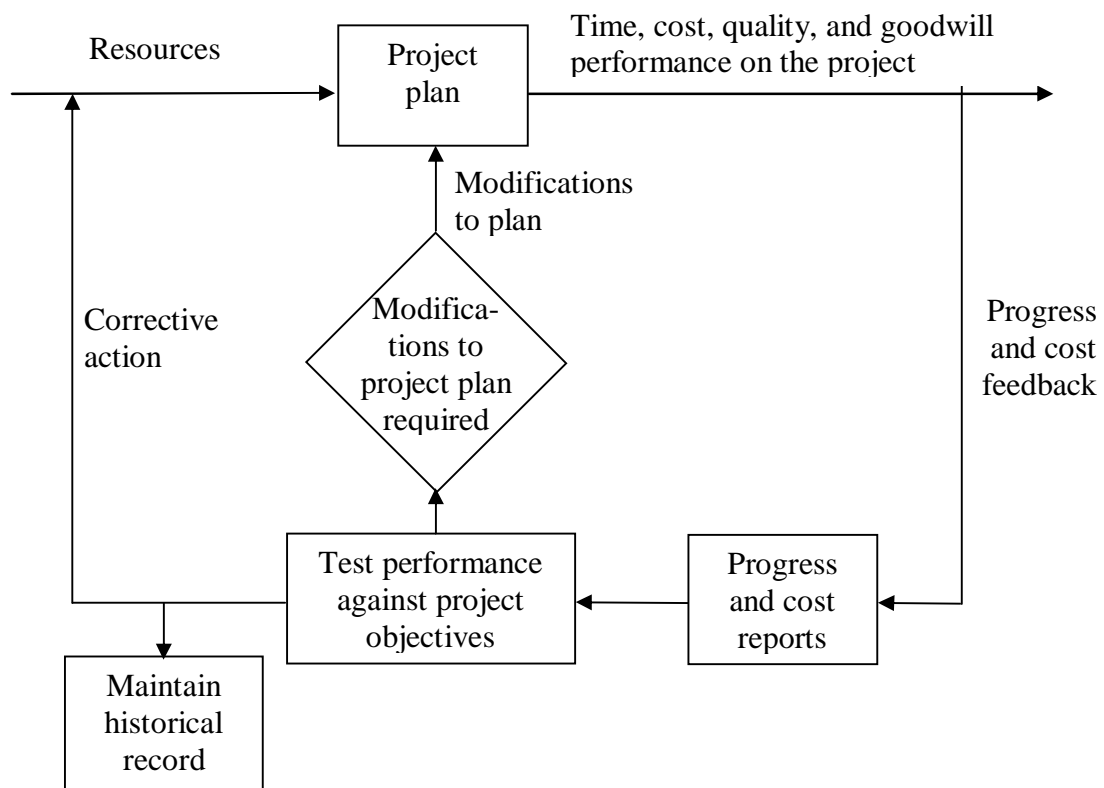
Figure 2.3: Corrective action process

Source: Ahuja et al. (1994)

2.2.3 Areas of the control

The main control areas which are developed in the project planning phase are:

- The money plan (the project budget).
- The time plan (the project schedule).
- Quality standards.
- Material resources and delivery.
- Labor supply and productivity.
- Cashflow projections.

By concentrating on control of these six areas, the project goals should be achieved successfully. Of course, there are numerous other areas of control, but most of them, with the exclusion of the human factors, are related to the above six areas (Ritz 1994).

2.2.4 Why are planning and control necessary?

Ahuja et al. (1994) summarize the necessity of the planning and control as follows:

1- To facilitate communication so that each person is working toward the same set of project goals.
2- To complete the project within the time.
3- To optimize the use of resources.
4- To make the investment productive as early as possible.
5- To reduce the elements of risk.
6- To track technical progress.
7- To face the environment effects on the plan.
8- To absorb information and make decisions.
9- To provide a unity of purpose to the members.
10- To minimize the learning period for a newcomer.

2.2.5 Common forms of project control

Fish (2002) reviews the common forms of project control as follows:

1. Schedule: schedule structure is based on a comparison between the planned schedule and actual performance.

2. Cost: cost control is achieved by comparing the actual cost of project activities to the planned budget.

3. Performance: performance control can be achieved by using the organization's quality control and quality assurance system.

2.2.6 Measurements for project control

Fish (2002) gives many measurements for control. These measurements are shown in table 2.1.

Table 2.1: Measurements for control

Measurement	Category affected
Critical tasks not started on time	Schedule
Critical tasks not finished on time	Schedule
Uncritical tasks becoming critical	Schedule
Milestones missed	Schedule
Due date changes	Schedule
Price changes	Cost
Cost overruns	Cost
Insufficient cash flow	Cost
High overhead rates	Cost
Long supply lead time for material required	Resources, schedule
Low utilization of resources	Resources, cost
Resources availability problems	Resources, schedule, cost
Changes in labor cost	Resources, cost
Changes in scope of project	Performance, cost, schedule, resources
Lack of technical information	Performance, cost, schedule
Failure in test	Performance, cost, schedule
Delay in client approvals of configuration changes	Performance, schedule
Errors in records (inventories, configuration, etc.)	Performance, cost, schedule

2.3 Data and Information

2.3.1 Distinction between data and information

Data, facts and figures, usually must be processed into information which is intelligible and, useful to people in making decisions. The determination of what information is needed is governed by the decision, so the data to be obtained , and the processing required to produce information from it, are driven by the decision. Therefore, the objective of providing information is to support decision.

It is rarely machines make decisions, but they do so based on rules given to them by people. The more usual situation is for the machines to supply information to help people in making decisions. People remain the active, thinking constituent (Langford et al. 2000). Figure 2. 4 illustrates a systems-based decision support model.
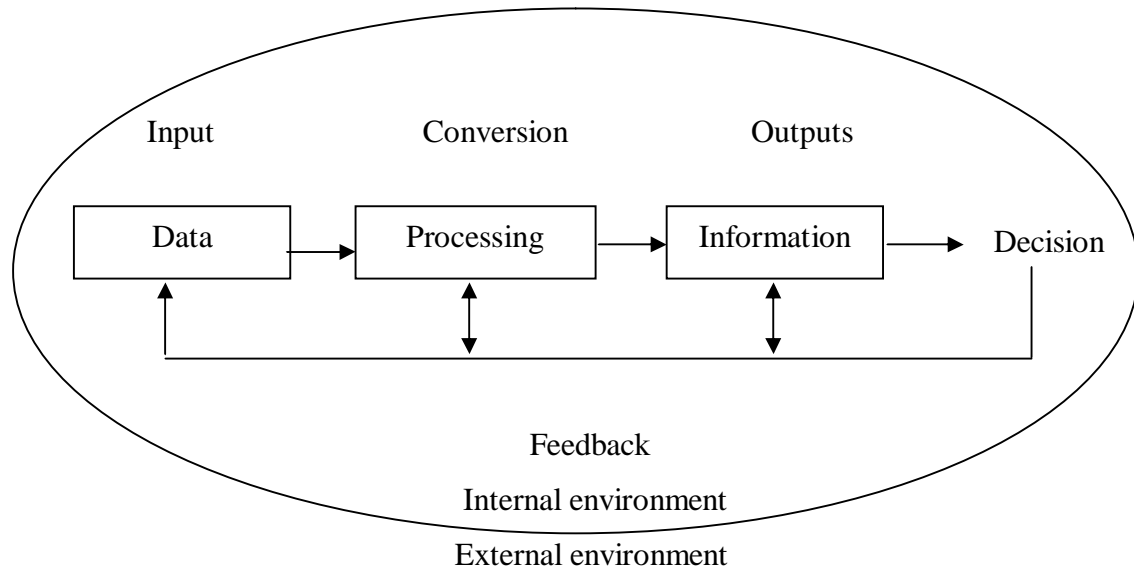
Figure 2.4: A systems-based decision support model

Source: Langford et al (2000)

2.3.2 Collecting data for project control

Reviewing Ahuja et al. (1994), project execution strategy must include procedures for collecting information on project performance which is essential for monitoring and control. Project elements must be monitored by the project manager, who is responsible for project control. Satisfactory feedback on the project have to be provided to the project manager so that he can apply corrective action. For example, if labor costs escalate, material deliveries are delayed, equipment or overhead costs increase, subcontractors fail to meet schedule, it may be necessary to modify project plans.

The benefits of free flow information are several: (1) remove misconception about the objective and policies of project management, (2) improve interpersonal relationships, (3) improve communication and cooperation between the various disciplines concerned, and (4) improve morale and attitudes leading to increased performance and productivity.

There are many sources from which scheduling and cost engineers can obtain their information. These are the project engineers, estimators, quantity surveyors, subcontractors and vendors. Cost engineers must also have up to date knowledge about the project and its environment. They must be involved in the analysis of

progress reports and have first-hand knowledge of bid data tabulations, material takeoff, and claims settlement. They must remain in contact with the accounting department and be informed about expenditures incurred. Contact with procurement staff is essential to find out about commitments made through purchase orders, work orders, contracts awarded, and contracts bound by letters of interest. All of this necessary for monitoring and controlling the project.

Mawdesley et al. (1997) also give various sources of records on a project:

- diaries;
- field books;
- time sheets;
- quantity surveying (QS) valuation;
- orders/invoices/delivery notes/receipts;
- job card and coding systems;
- general correspondence (letters and memoranda);
- requests for information (RFI), confirmations of verbal instruction (CVI), architect's instruction (AI), engineer's instruction (EI), variation (or change) orders, measurement memos, day work sheets, charge notes;
- drawing issue register;
- minutes of meetings;
- progress reports;
- progress charts;
- progress (or record) drawings;
- photographs;
- video tapes;
- memory.

2.3.3 Importance of feedback in plan implementation

Obtaining feedback from the output and comparing it with the planned performance is a vital feature of the control process. With adequate feedback on progress and expenditure, the project team can work together to apply control and design compensatory corrective action for any possible occurrence (Ahuja et al.1994).

Communication management is important if a project team is to act in unity for project control. Programs, policies, and procedures cannot work successfully unless all members of the group know about them and why they exist, and frequently get performance evaluation feedback. If the members are not kept entirely informed, there may be misinterpretations of the project objectives, affecting performance and productivity of the team. Information must be sent to the one who needs the information for a specific duty (Ahuja et al.1994).

2.3.4 updating plans

Ahuja et al. (1994) say that updating is carried out to accommodate configuration changes, to assign a new date instead of an earlier planned target date, and to reflect remedial action designed to correct deviations in order to predict their effect.

As work progresses on a construction project, it is predictable that there will be deviations from the original plans of work. Progress will not be as expected, alterations will be required either by the contractor or the client and more information will become existing. As the deviations get larger and the information becomes more definite, the manager must consider the value of the original plan and ask whether the plan need to be changed (Mawdesley et al. 1997).

2.3.5 Effect of delay

The time taken to collect and report information has an important bearing on the usefulness of control action. The time lag between control measurement and control action can make the effect of the action counter-productive. This is a really important factor in the control of a construction project particularly since formal reporting can often take weeks.

For day-to-day control action, considering such things as variability in morale, availability of work or labor and the need to ensure good working practice, a project manager must rely on enthusiastic and well informed site supervisors. The control system that they implement should minimize the need for a lot of formal control action but their knowledge of the direction of and need for informal control action often comes from the formal control mechanism (Mawdesley et al. 1997).

2.3.6 Historical data and record keeping

2.3.6.1 Historical data

Reviewing Ahuja et al. (1994), data collection is essential for use on future projects. If the construction engineer does not have a record of a preceding project and has to estimate from memory, the trend is to remember the worst experience and to use the most negative estimate. The planner may look for guidance from the past experience of others, as published in handbooks, but at best the planner obtains the mean estimate, which may not be related to the project. The most suitable data can be obtained from a record of the work actually performed by the organization.

The following data will aid the estimator greatly in estimating the cost and duration of similar work items on future projects:

1. Crew composition and man-hours per unit measure.
2. Equipment usage per unit measure.
3. Materials consumed per unit measure.
4. Overhead expenditure on various items as a percentage of the total job cost.

Historical data are collected on the assumption that the information will be used on a similar project. But every project is unique, and no project can be an example of perfect control. Important lessons can also be learned from a project's distinct nature. So an analysis should be carried out not later than one month after project completion, which should include the following:

1. An "as-built" CPM network.
2. An outline of problems encountered.
3. An evaluation of performances.
4. A statement comparing cost in the plan estimates with the actual.

This information is valuable for consistent schedule and accurate estimating of project in the future. Monitoring and control have no meaning without this information.

2.3.6.2 Monitoring and record keeping

Monitoring and record keeping are tasks for the present and the future. They are valuable if carried out correctly in that they provide essential information for project control purpose and for good office management of tasks such as invoicing, calculating bonus payments and preparing valuations.

Monitoring without record keeping means that record keeping is considered to the memory (which is not wholly dependable). Record keeping without monitoring means an imagination.

The possible uses of the information are:

- making managerial decision (taking short-term control action);

- assessing the effects of variations (preparing valuation and possible replanning);

- updating project resource output listing (for planning the next phase);

- updating company resource output listings (for estimating and future planning);

- calculating financial positions;

- evaluating contractual entitlements (preparing or assessing claims) (Mawdesley et al. 1994).

Wideman (2002) publishes the following typical set of records that might be kept on construction project:

- Original contract tender documents.
- Instructions to contractor.
- Contemplated change notices issued by the owner.
- Sub-contractor quotes, contracts, purchase orders and correspondence.
- Shop drawings, originals, all revisions and re- submissions.

- Daily time records.
- Daily equipment use.
- Daily production logs, e.g. concrete pours etc.
- Material delivery and use records, including expediting.
- Accounting records: pay-roll, accounts payable and receivable, etc.

- Progress payment billings under the contract.
- Daily force account records, pricing and billings.
- Contract milestone or master schedule, short term schedules and up-dates.

- Task schedules and analyses.
- Original tender estimate.
- Construction control budget.

- Actual cost reports, weekly or monthly, including exception reports.
- Forecast-to-complete.
- Productivity reports/analyses.

- Inter-office correspondence, including memos and faxes (all filed by topic).
- Contract correspondence.
- Minutes of contractual meetings.

- Minutes of site coordination meetings.
- Requests for information.
- Notice of claims for delays and/or extra cost by contractor.

- Government inspection reports.
- Consultant inspection reports.
- Accident reports.

- Daily diary or journal entries.
- Notes of telephone conversations.
- Progress reports, weekly, monthly or quarterly.
- Progress photographs.
- Any other reports, such as special consultant reports.

- A filing record of all the record files that are being maintained.

2.3.6.3 Computer use

It is very hard to find an essential piece of information among a jungle of papers which is now so urgently required. The micro-computers are now so inexpensive, and so influential that it seems impossible to do without them. However, the secret is to obtain data organized as early in the job as possible, then commit to steady maintenance, regular backup and off-site storage. If this is done strictly, the subsequent saving in time through search and find, or through spread sheet and database design and use, can be very useful (Wideman 2002).

2.4 Cost Monitoring and Control:

2.4.1 Concepts

Sha'at (1993 pp. 55) quotes the definition of cost from Cooke and Jepson (1997) as:

> "…Faced then with word 'cost' it is prudent to ask 'to whom and behalf of what?'"

Hughes (1991) states:

> "Cost control is the activity which compares cost performance against the cost plan. Adjusting one or the other dynamically by reference to the changing circumstances in the project's financial environment."

A guide to the Management Body of knowledge (PMBOK Guide 2000 Edition) provides a short definition of cost control as:

> "Controlling changes to the project budget."

Martin (1992 pp. 6) says:

> "As defined by the American Association of Cost Engineers, cost control (project control) is the application of procedures to monitor expenditures and performance against progress of projects and manufacturing operations with projected completion to measure variances from authorized budgets and allow effective action to be taken to achieve minimal costs (and acceptable timetables)."

Wideman (2001) gives two definitions for cost control as follows:

> 1- "Any system of keeping costs within the bounds of budgets or standards based upon work actually performed."
>
> 2- "The processes of gathering, accumulating, analyzing, reporting and managing the costs on an on-going basis. Includes project procedures, project cost changes, monitoring actual versus budget, variance analysis, integrated cost/schedule reporting, progress analysis and corrective action."

Sha'at (1993 pp. 85,86) states that from the project objectives' outlook, Austen and Neale (1984) define in brief the situation of cost control when they say:

> "There are three elements to be controlled in a construction project-progress against time; cost against tender or budget; quality against specification."

Clough (1986) states that project cost control is an information system designed to assist in controlling construction costs. It is a monitoring process that provides feedback to the manager concerning project expenses and how they compare to the estimated budget. The cost system identifies expenses as they occur and charges them against the project elements to which they apply. The actual costs are continuously compared with the budget. Keeping within the budget and knowing when and where job expenses are excessive are key factors of profitable operation.

To control cost is a recognized objective of most managers. A cost control should allow a manager to monitor existing cost levels, and compare them with standard plan, and to create corrective action to keep cost within acceptable boundaries (Harris and McCaffer 1993).

Mawdesley et al (1997 pp. 269) summarize the components of re-active financial control as follows:

- "a financial plan;
- a measure of project completion;
- measure of site cost;
- agreed methods of comparing performance with plan;
- methods to identify the areas of adverse performance;
- methods of improving future performance."

2.4.2 Cost control philosophy

Ritz (1994) institutes a comprehensive philosophy for cost control based on three principles as follows:

- The encouragement and promotion of cost-awareness in the performance of all phases of the work.

- The provision of accurate and timely data on cost status, and the highlighting of any unfavorable cost conditions or trends.

- The taking of successful action to correct problems and to supply positive feedback for nonstop valuation of those problem areas.

    Also he adds, the main problem area in most cost-control systems arises under the second point.

2.4.3 Cost control responsibilities

Wideman (1995) summarizes the responsibilities of cost control as:

> "project cost control is much more than just obtaining expenditures and providing reports. Sound cost control involves a number of tasks including:
> - Establishing a version of the project budget that is consistent with how the money will be spent.
> - Regularly collecting actual costs to date (including work-in-progress)
> - Examining cost trends.
> - Forecasting the cost of the remaining work.
> - Comparing the estimated total cost with the approved budget (including any approved budget changes, to determine the total budget cost variance, comparing that variance with the previous reported variance to arrive at the period variance, for management attention if not with bounds)."

2.4.4 Purpose of cost monitoring/control

Martin (1992) provides many purposes for cost control. The primary purpose, to monitor if the cost will exceed the available money. If the cost is greater than the existing fund, is there explanation for the additional expenditure? And, is there adequate warning to allow securing of additional funds? Or, should other actions be taken to reduce or eliminate items of work? Another purpose, to question how, where, and why money are spent, quantities are expended, and methods employed to complete tasks. Big saving comes from slight savings multiplied more and more. An additional consideration for monitoring, reporting, and evaluating budgets includes measurements of productivity to ascertain proper utilization of workpower and resources.

Pilcher (1992) summarizes the most important day-to-day use of a cost control system is that of providing immediate awareness to any task which seems to be uneconomic to the contractor. Site management should take the necessary action to put the matter right. In addition to providing a control facility over short operational periods for current work, the cost control system supplies the contractor with the monthly valuation for work completed that he can assess the financial situation at regular intervals. The cost control system provides feed-back to help in pricing new tenders more accurately. To make a better use of this feed-back, it should be accompanied by a relatively complete description of the environment pertaining to the particular costs.

The main reasons for cost control: to determine if the estimated profit is being done or not; to identify areas of inefficient functioning and provide information for reducing costs; and to serve as a basis for estimating (Singh 1999).

The main objectives of cost control are:
- to ensure that planned profit margins are maintained,
- to calculate the cost of each stage, operation, or unit, and to carry out a continuous comparison with the planned to know the gain or loss on each. This information must be available early enough for corrective action, and
- to supply cost information for use in future estimating (Oxley and Poskitt 1992).

2.4.5 Estimating and cost control

Hendrickson (2000) says that for control and monitoring purposes, the original detailed cost estimate is usually converted to a project budget, and the project budget is used consequently as a guide for management. Ahuja et al. (1994) states that if the estimate is not related to the schedule and converted into a project budget it is not very helpful for project cost control. He says that the main objective of cost control budgeting is to provide a baseline from which forecasts and trends can be developed.

Singh (1999) says that cost control is familiarly related to estimating because expenditure is regulated on the basis of the estimates of works. A summary of the cost of a construction project indicates the quantities of work involved in items of work, their rates and the estimated cost. The cost control is effected on the basis of the estimated costs of each item as provided in the estimates.

It is essential to make a 'cost analysis' from the cost estimates. This will separate all material and labor costs for ready reference and will also specify the quantities of materials to be bought with the unit price and total costs permitted. The cost analysis is also known as the 'work estimate' and forms the reference for buying materials, engaging labor and cost keeping (Singh 1999).

Both production rates and unit costs are obtainable from the project cost control system. To be of maximum value in the future estimating, however, it is important that such productivity data be accompanied by a description of the project work conditions that applied while the work was being done (Clough 1986).

2.4.6 Monitoring labor costs

Variances in labor budget can stem from three probable sources:

- An original hourly takeoff error.
- A variation in the assumed labor rates.
- A variation from standard in actual labor productivity.

Construction labor budgets usually are controlled in a monthly or weekly basis. Any error in the original estimate is evaluated by projecting the number of hours needed to complete the work during each reporting period. If overruns begin to appear early in the reports, it is a strong indication that the hours in that area may underestimated. The managers early investigation into such an indication is vital. It is very important that the estimates be based on true facts about how much work actually has been completed and how much is left to do (Ritz 1994). Ahuja et al. (1994) say that on all projects it is necessary to obtain the number of hours spent on each part of the job by each employee.

2.4.7 Monitoring material costs

Ritz (1994) states that generally the philosophy for controlling the materials budget is much the same as for controlling human resources. We start with an estimate of the materials cost, and convert it into a budget that becomes our baseline for buying them. During the progress of project, we check the actual delivered cost against the estimated cost of each item. Any differences between "predicted" and "planned" are reflected in a variance column to control material costs.

Ahuja et al. (1994) say that the materials received on the site must be recorded on a material receiving report or in a similar method. Also, materials should be charged to work items by means of the costing code. And every order, invoice, and delivery ticket should bear both a job name and number and a costing code for the work item.

Summarizing Harris and McCaffer (1993), the factors which add to the difficulty of maintaining accurate control of material costs can be divided mainly into price and quantity variances. They include the followings:

1. Price variances:
   - Inflation.
   - Changes in the buying situation since the preparation of estimate.

2. Quantity variances:
   - Wastage and breakage.
   - Theft and loss.
   - Shortage in deliveries.
   - Corrective work.
   - Delays in the recording system.
   - Inaccurate site measurement of work done.

There is an inclination for cost control in construction to be directed more towards the control of labor and plant than to the control of materials. There is rising evidence, however, that losses caused by materials are often significantly higher than those due to other causes. Therefore, greater attention to materials control may pay important dividends in the form of increased profit. Some of methods available, in addition to the keeping of reliable records are:

1. Keep a neat site with adequate storage space and room for movement. Use mechanical handling equipment where possible.
2. Employ a dependable storekeeper; possessing clerical experience and well skilled in stores control.
3. Maintain a well-kept bookkeeping system. This often means employing a materials engineer to plan the flow of right quantity of material at the right time, to notice that all invoices fulfill the original order and to enact reordering when requirements are not met. This duty is in addition to that of keeping a 'goods received' book from which the invoice are checked.

4. A flow diagram representing a workable procedure.

5. Double signing of delivery notes.

6. Weighbridge spot checks for aggregate deliveries.

7. Spot checks on moisture content for sand deliveries.

8. Insist on palletized deliveries of bricks, etc.

9. Check carefully all deliveries against the delivery notes during the unloading.

Forster (1981) mentions the most common aspects that may cause problems relating to material supply, etc., as follows:

1. Taking-off and scheduling.

2. Requisitioning and ordering.

3. Receipt and checking of deliveries from supplier's or contractor's own yard.

4. Off-loading and handling.

5. Storing and protecting.

6. Issuing and distributing.

7. Use of materials.

8. Quality control and supervision.

9. Security.

2.4.8 Monitoring equipment costs

Equipment cost must be charged to work item just like man-hours and materials costs. To do this, a record of number of hours per work item and the hourly rate for each piece of equipment is required. The number of days that equipment is assigned to a project can be resulted from checking-in and checking-out procedures. Hours of operation can be accumulated from equipment time cards (Ahuja et al. 1994).

2.4.9 Monitoring subcontractors

Subcontractors are widely used all over the construction industry. Their use is considered useful for numerous reasons. However, employing subcontractors to carry out work has many drawbacks. With the persuasive arguments for and against the use of subcontractors, main contractors will continue to make their own decisions based on how they balance the arguments for and against. If subcontractors are used, it is vital for the main contractor to plan their work to integrate with all the other work on

the project. This requires at least as much detail to be included as for the planning and control of the main contractor's own work (Mawdesley et al. 1997).

2.4.10 Monitoring procurement costs

Procurement is particularly significant on construction work. Quick action is required to set orders for equipment, materials, and subcontractors within the validity dates on the bids used in the estimate. Also, these purchase orders must be accurately reviewed for scope, specifications, delivery, and price before the purchase order is issued. Effective cost control in procurement is instituted from good procurement procedures, which should include the following major factors:

- An excellent approved-vendors list.
- Ethical bidding practice.
- Sound negotiation techniques.
- Change-order controls.
- Control of open-ended orders and subcontractors.
- Control of procurement, expediting, and inspection costs.
- Preservation of purchasing status reports (Ritz 1994).

2.4.11 Sources of data for cost control

Reviewing Barrie and Paulson (1992), the major sources of data for site cost control are (1) labor and equipment time sheets; (2) field surveys of quantities of work in place; (3) any other fragments of information that will assist in forecasting cost trends; (4) data obtained from other parts of the project control system, including scheduling, procurement, and quality assurance. Comparison between these various measures are necessary to evaluate project status satisfactorily. The first two sources of data, time sheets and field quantity surveys, are the most essential sources of data for custom cost reports.

Labor and equipment time sheets are regularly filled out daily and submitted either daily or weekly by foremen, operators, superintendents, or timekeepers, depending on company policies. They usually contain the following information:

- Labor Time Sheets include:
    - Employee name(s) and/or number(s).
    - Date(s) worked.

- Craft or classification(s).

- Hours worked (straight time (ST) and overtime (OT)).

- Classification by cost code.

- Hourly rates (ST & OT).

- Total hours and dollars, by day and by code.

- Special conditions (weather, etc.).

- Equipment Time Sheets include:

  - Machine description(s) and/or number(s).

  - Date(s) worked.

  - Type of worked done.

  - Hours worked (ST & OT).

  - Classification by cost code.

  - Hourly rates (ST & OT).

  - Total hours and dollars, by day and by code.

  - Special conditions (breakdowns, etc.).

Mawdesley et al. (1997) say that job card system is used in manufacturing industry more than in construction. However, job card system is vital for control. For a job card system, a project is divided into tasks (which may be the planned activities) and a job card made up for each. This card contains data about the task including some or all of the following:

- The task name.

- The quantities of the main materials required.

- The resources designated to the task.

- The allowance for the work.

- The planned start and finish dates of the task.

- The actual start and finish dates of the task.

- The engineer/manager responsible for the task.

- Details of any variations influencing the task.

A job card is set up ahead of work on a task and is issued to a ganger or foreman. When work is carried out on the task, information is added to the card providing a continuous record of the work on it. The major problem with the job card system is the difficulty in ensuring that a card is completed in a timely and accurate manner.

Summarizing Forster (1981), a cost control system should enables management to adequately collect and produce information from which the monitoring of actual costs can be compared to the estimated costs. If the result for comparisons is significant, the information should be collected daily. The earlier details can be discovered about a process which is costing more than was estimated, the earlier decision can be taken to rectify or modify the process in an attempt to reduce its cost.

Any variance below, or in excess of, the estimated information would be recorded so that:

1. Items of work showing extreme costs may be adjusted by corrective action at site level in the way the work is done, or, if the opportunity for action has passed, then rates may be increased for later contracts.

2. Items of work showing lower actual costs than estimated costs would clearly be in profit but may later be adjusted for future contracts.

If monitoring costs shows up adverse trends, counter measure may then be taken using substitute materials allowable within the specified standards, alternative construction techniques, better motivation incentives, or even the replacement of the supervisor(s) with a more active one. Cost comparisons between actual and estimated costs must be made early. This required the close cooperation of the manager and his staff and the head office staff.

Forster (1981) provides many documents from which information concerning costs may be collected:

1. Material invoices.
2. Material issue sheets from main stores.
3. Plant hire firm invoice.
4. Plant issue sheets from own plant department.
5. Site wages sheets for direct labor.
6. Subcontractor invoices/claims.
7. Allocation sheets for labor, materials and plant.
8. Re-measurement figures from the quantity surveyor, and interim certificates.

2.4.12 Allocation of costs

The cost control system in general allocates costs against a gang of workers, e.g. concrete gang. It is therefore the responsibility of the charge-hand of the gang to fill in the daily allocation sheet, on which he records a short description of the operation upon which the gang was employed and the names and hours worked by each member of the gang. All costs of labor and plant should be allocated against the cost codes (Harris 1993).

Forster (1981) says that cost control systems need that allocation sheets for labors, plant, materials, and subcontractor should be prepared to decide the actual costs and unit costs of each area of work. The direct costs, being the first area of actual costs include the following:

1. the cost of materials (direct material) used in an activity of work;
2. the cost of wages (direct cost) of labor engaged on an activity;
3. plant hired charge (direct plant charge);
4. other costs such as subcontractors, etc.

2.4.13 Cost records

Records must be kept for monitoring work, future estimating, claims supports, and legal requirements. Retention of records carries a cost. Five questions should be considered in order to determine the extent of records:

1. What does the law require me to keep?
2. What does the contract require me to keep?
3. What is required to control the continuing work?
4. What historical data is required?
5. What do I need to protect my rights? (Ahuja et al. 1994).

2.4.14 Cost engineering and accounting

Hendrickson (2000) quotes the definition of cost engineering from the American Association of Cost Engineers as:

> "that area of engineering principles where engineering judgment and experience are utilized in the application of scientific principles and techniques to problems of cost estimating; cost control; business planning and management science; profitability analysis and project management; planning and scheduling."

Barrie and Paulson (1992) say that it is important that "cost engineering" not be baffled with the financial accounting functions on a project. Surely they are closely related, particularly where cost engineering provides information for the general and cost ledgers and for payroll purpose, but there are major differences. First , the word "engineering" in cost engineering is not mere window dressing. The reason for this is that in order to monitor and report costs correctly, and especially to forecast trends, one must be able to read plans and specifications cleverly and must have a solid technical understanding. Second is the emphasis on forecasting and trending in cost engineering. The accountant deals mostly in historical documented facts so that he can correctly pay the bills, make out invoices, prepare tax returns, compute the payroll, etc.

Patrascu (1978) says that cost engineering is unlike accounting in the sense of dealing with up-to-date costs and costs expected into the future rather than with costs that are sometime behind the fact. Accountants are trained to deal with financial conviction, payments due and invoices in hand. The cost forecasting requires engineering knowledge of the scope of the work, what was done, what remains to be done, and the project schedule.

2.4.15 Work breakdown structure (WBS)

Work Breakdown Structure (WBS) is the progressive breakdown of the project into smaller and smaller increments, to the lowest practical level to which cost is to be applied. The WBS graphically depicts the summary cost categories applicable to each major subdivision of the subsystem (Ahuja et al. 1994). Figure 2.5 illustrates a typical project WBS.

Hinze (1999) describes the WBS saying:

> "This is a systematic approach to defining the project so that each item can be readily identified and controlled. In a WBS, each work item has a unique identification number that is linked directly to the cost codes. Thus, the WBS helps to monitor progress in terms of both time and money."

Pilcher (1992) says that the WBS shows the hierarchy of a project. At the highest level is shown the facility to be achieved as the result of the construction activity. At the lowest level, as a result of consecutively breaking down the work at each level, is

the work package. A work package is a measurable and controllable unit of work to be executed. It could be a network activity, but more frequently a group of activities.

Hanna (2002) says that a WBS, as defined in the PMBOK Guide-2000, is:
> "A deliverable-oriented grouping of project elements that organizes and defines the total work scope of the project. Each descending level represents an increasingly detailed definition of the project work."
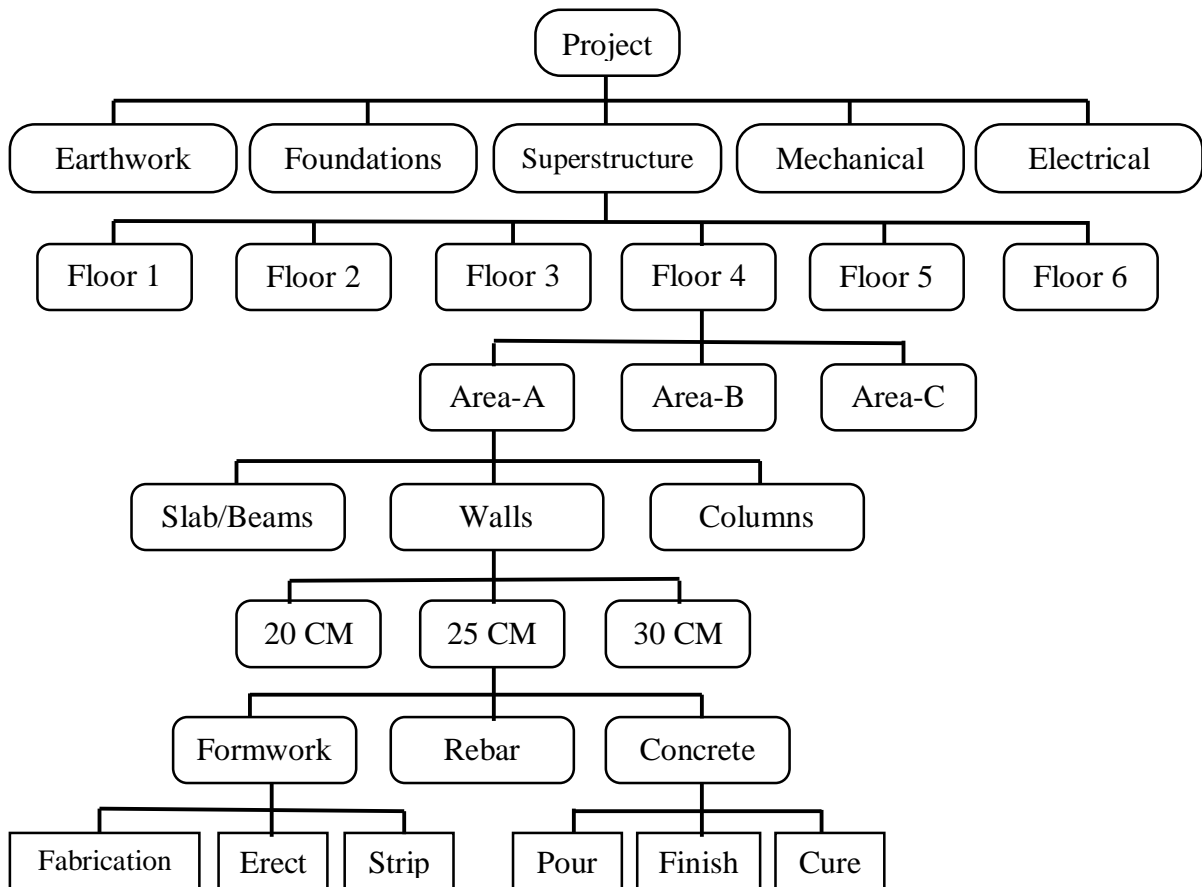
Figure 2.5: A Typical Work Breakdown Structure (WBS)   ⬭ A Work Package

Source: Sha'at (1993) quotes from Rasdrof & Abudayyeh (1991)   ▭ A Task (Activity)

2.4.16 Cost coding

A coding system is to identify the elements of a project to allow the sorting of information in order to produce reports for project monitoring and control. A code number can be allocated to each work item that identifies a variety of information, such as, phase of project, type of work, responsible person, or facility of which the work item is a part. (Oberlender1993). Cost codes provide the essential framework upon which a cost-engineering system is built. In a modern integrated control system,

they moreover provide a framework for the scheduling system and for other applications (Barrie and Paulson 1992).

Singh (1999) states that it is usual to give the various items emerging in the cost analysis and to which all expenditure is distributed, specific symbols or code numbers by which they can be identified without writing out the full description every time.

Coding systems are adopted to provide a numbering system to replace verbal descriptions of items. These codes reduce the length or complexity of the information to be recorded. They also help constancy in definitions and categories between projects and amongst the various parties involved in a project. Besides that they aid in the retrieval of historical cost records, productivity and duration on specific activities. Also, electronic data storage and retrieval operations are much more efficient with standard coding systems (Hendrickson 2000).

2.4.17 Cost control system

2.4.17.1 The system

Sha'at (1993 pp. 56,57) states that O'Brien (1989) defines the system as:

> "It is a set of elements with some perceived relationship between them."

Ahuja et al. (1994 pp. 11) quote the definition of the system from project management Institute (PMI, 1986) as follows:

> "A system is defined as an assemblage or combination of things or parts forming a complex unitary whole."

What do we mean when we speak of systems for construction project? It is through a system, which is an assemblage of things or parts, that the project manager is able to communicate cross functionally. A construction project management system consists of a numerous subsystems which are established to facilitate the implementation of the job. The main systems are organization, planning, management information, project control, and techniques and methodology, and they are usually computer based (Ahuja et al. 1994).

2.4.17.2 Cost control system definition

Wideman (2001) publishes a definition of cost control system as:

> "Any system of keeping costs within the bounds of budgets or standards based upon work actually performed. Cost control is typically a level in the budget element breakdown structure.'

Sha'at (1993 pp. 85) says that Abu-Hijleh (1991) quotes the definition of cost control

from the American Association of Cost Engineers as:

> "the application of procedures which attempt to limit project costs to those authorized, to focus control efforts where they will be most effective and to achieve maximum control at minimum cost."

2.4.17.3 Features of cost control system

Ritz (1994) states that to implement successfully the cost control system it must include these basic features:

- A simple but comprehensive code of accounts.
- Duty of specific responsibilities for controlling cost within the field organization.
- Use of standard forms and formats based on a standard code of accounts throughout estimating, procurement, design, construction, and cost-control groups.
- A sound budget (based on a sound estimate).
- An automated system for handling the data on medium-size and large projects.

Fish (2002) says, "the control system must be

- sensible
- Acceptable to those using it
- Standards must be achievable
- Control limits appropriate to needs of client
- Flexible
- Cost-effective
- Truly useful
- Operate in timely manner
- Sufficiently accurate
- Simple as possible
- Easy to maintain
- Capable of being extended
- Fully documented"

2.4.17.4 Types/Methods of cost control

Systems can vary from those which control the work on a section or stage basis to those which control it on a unit basis, and in some systems only specific sections of the project are selected for control (Oxley1992).

Singh (1999) classifies the cost control system into:

1. <u>Overall Profit or Loss:</u> The contractor waits till the work is finished and then compares the money he receives with the amount he has spent. Such a system is useful only in small contracts of short duration. In fact it is hardly a method of control as the information can only be used to avoid similar mistakes in later contracts.

2. <u>Profit or Loss with Reference to Part Payments:</u> The contractor is paid for the part of work done by him at regular intervals. The costs incurred by the contractor and the payments received can be compared to know the profit and loss situation for that part of the work. The problem, however, is that the measurements taken for preparing the running bills of contracts may not consider all the items of work done and the materials at the site not yet used in construction. Another disadvantage that is no breakup of the cost figures for different items of work. It, therefore, only indicates that the management of a job showing losses needs attention, but does not identify the area needing such attention.

3. <u>Unit costing:</u> The rate of cost of each item of work is calculated by dividing the expenditure on the item by the quantity of work done. The efficiency of work can be assessed by comparing the rate of cost with the rates in the cost estimates.

4. <u>Comparison with Standard Costs:</u> The cost record consists of details of the rate of cost labor, materials and equipment separately are compared with the rates of those items known as 'cost standards' as worked out when estimating costs. It is then possible to know at a glance the area of work in which there is inefficiency and scope for improvement. The method is ideal, it is a laborious and costly method.

5. <u>Combination with Other Administrative Functions:</u> It may sometimes be likely to relate the cost control function with other administrative functions, such as incentive payments to labor, hire charges of equipment, etc.

Froster (1981) says that Cost control systems are generally prepared to produce results for monitoring costs on contracts as follows:

1. Contract Account or Contract Job Cost Sheet: This type is conducted at the end of a contract period. It is used within a small contracting set-up to calculate if a job was successfully executed by earning profits.

2. At Interim Periods During a Contract (monthly basis): It is conducted by applying operations cost. summary of cost may be prepared which shows up adverse variances between actual costs and estimated costs; and where similar work still remains to be done.

3. At More Frequent Intervals (daily or weekly basis): It is carried out by applying unit costing on items and not whole operations: to determine the actual unit costs as a comparison with the planned unit rates.

CHAPTER 3
Methodology

3.1 Introduction

This chapter discusses the research strategy and research design. Also, it discusses the techniques of the adopted methodology. The research methodology involves the following tasks: reviewing relevant literature; fieldwork research (field survey), where the situation of cost monitoring practice in Gaza Strip is investigated; developing and evaluating a software that suites Gaza Strip contracting companies.

3.2 Research Strategy

Research strategy can be defined as the way in which the research objectives can be questioned. There are two types of research strategies, namely, 'quantitative research' and 'qualitative research' (Naoum 1998). Quantitative approach seeks to collect factual data and to study relationship between facts and how these facts and relationships accord with theories and the findings of any previous research (Fellows and Liu 1997). Qualitative research is used to 'subjectively' evaluate the 'opinion', 'view', or the 'perception' of a person, towards a particular object. It is used when the amount of knowledge about the topic is limited. The data which is gathered under the qualitative research can later be 'quantified' to some extent but a qualitative approach tends to value the data as 'qualitative' (Naoum 1998 quotes Coolican 1993).

The strategy of this research have been built on both quantitative and qualitative researches, where the questions of the questionnaire are a mix of fact-finding and contractors-opinion. The data which is gathered under the qualitative research is quantified to be more interpretative and evaluative.

3.3 Research Design

Research design is an action plan for getting from 'here' to 'there' where 'here' may be defined as the initial set of questions to be answered, and 'there' is some set of conclusions (answers) about these questions. Between 'here' and 'there' may be found a number of major steps, including the collection and analysis of relevant data (Naoum 1998 quotes yin 1994). Researches in social science and management fields

involve asking and obtaining answers to questions through conducting surveys by using questionnaire, interviews and case studies (Fellows and Liu 1997).

A structured questionnaire with personal interview is used together in this research for their advantages. The structured questionnaire is probably the most widely used tool for data collection. Questionnaires have been usually used in order to find out facts, opinions and views (Naoum 1998). They enhance confidentiality, supports validity, facilitates analysis and saves resources (Pilot and hunger 1985). There are some limitations of questionnaires such as: they must include simple questions; there is no control over respondents and they may answer generally which can be overcome by complementing them with personal interviews (Naoum 1998). Figure 3.1 shows the research sequence (methodology flow chart).

3.4 Literature Review

The literature review involves reading and appraising what other people have written about the subject area (Naoum 1998 pp. 17). The literature review serves two purposes. First, it seeks systematic reading of previous information which is related to the area of investigation. The gathered information will develop issues and ideas and should drive to the next important stage, namely, research design. Second, the literature review helps the researcher to improve his research study by giving him some insights into how he can design his own study (Naoum 1998).

A survey and a review for relevant books, journals and papers are conducted. In addition to these sources of data, a search in internet websites is carried out to get relevant information. The researcher also search the websites to have information about software that are related to research topic, such as computerized packages of cost monitoring, cost control, cost tracking and construction accounting. Annex 6 describes a number of these software.

Literature Review
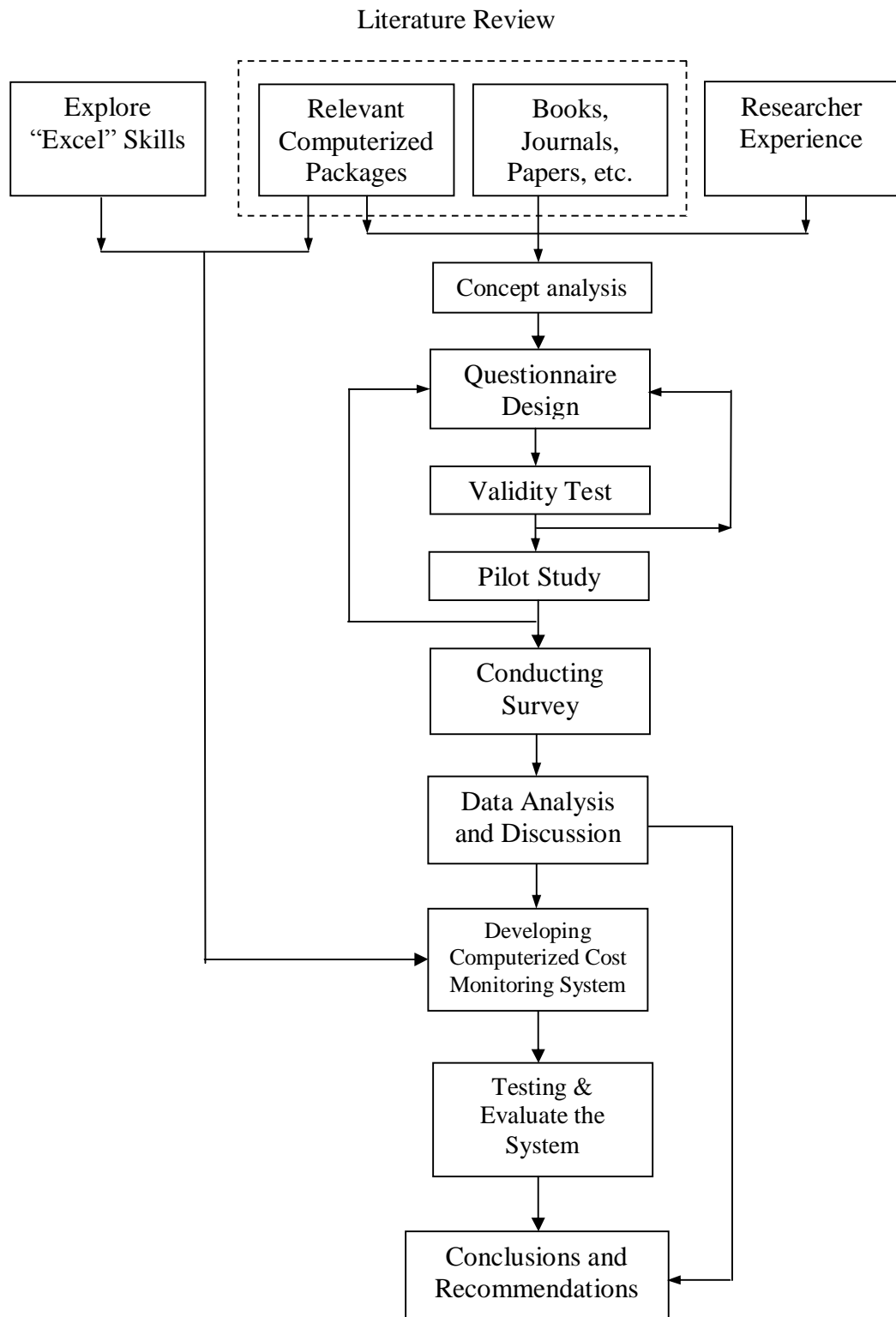
Figure 3.1: Methodology flow chart

3.5 Fieldwork Research

The problem-solving approach accompanied with a field survey has been adopted for conducting this research. In the problem-solving approach (also named action research), the researcher reviews the current situation, identifies the problem, gets involved in introducing some changes to improve the situation and, possibly, evaluates the effect of his/her changes. This type of research is more attractive to practitioners, industrialists and students from the professional background who have identified a problem during the course of their work and wish to investigate and propose a change to improve the situation (Naoum 1998).

A questionnaire is designed and constructed to survey the situation and reality of cost monitoring practice of Gaza Strip contracting companies. The data which is collected by the questionnaire is analyzed and discussed.

3.5.1 Questionnaire design and structure

The good design of the questionnaire is a key to obtain good results and warranting a high rate of return. The questions of the research questionnaire are constructed based on:

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

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

1- Company profile.
2- Applications of cost monitoring tools and techniques.
3- Computer applications in cost monitoring.
4- Implementation of cost monitoring systems.

The questionnaire is developed in Arabic (Annex 1) to be more understandable by respondents. An English version is prepared (Annex 2) for research purpose.

A draft questionnaire is discussed with a group of master's degree students and some contractors. They introduce some useful advices which have been taken into

consideration during the developing of the final revision of the questionnaire. Of course, the draft questionnaire is also discussed with the supervisor many times and amended according to his advice.

A covering letter accompanies the questionnaire aiming at explaining the purpose of the survey in order to encourage a high response. In addition, the letter assures the respondent that the information provided will be dealt with high confidentiality.

3.5.2 Validity test

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

3.5.3 Pilot study

A pilot study provides a trial run for the questionnaire, which involves testing the wording of questions, identifying ambiguous questions, testing the technique that is used to collect the data, etc. (Naoum 1998).

After modifying the questionnaire according to the notes of the supervisor and before collecting the final data from the whole sample, a pilot study is accomplished and five copies of the questionnaire are distributed to five different contracting companies to fill them. The purpose of this step is to discover if the questions are well understandable or not, also to find out any problem that may raise in filling the questionnaire. From the pilot study it appears that the questions are generally clear. However, it seems that some contractors find difficulties in understanding some questions. Therefore, the researcher modifies these questions to be more clear. Nevertheless, because of the particularity of the subject and because of most of the subject matters are new for the contractors, the questionnaires are filled during face-to-face interviews where any ambiguity is cleared up by the researcher.

3.5.4 Interview

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

The interviews have many advantages such as:

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

Of course, the interviews need much time to fill the questionnaires. This disadvantage is relatively minor compared with the above mentioned advantages.

Before carrying out an interview, the questionnaire is sent to the company and specific time and date are determined for interview. This provides a chance for the contractors to study the questions before answering them. In the beginning of the interview the researcher introduces himself to the respondent to create a friendly atmosphere, then he thanks the respondent and affirms that all the data to be collected would be used only for the research and would not be transferred to any other institution. In the interviewing procedure, the researcher has been cautious not to be biased and not to direct a contractor to specific answers. In the end of the interview, the researcher expresses his deep thanks to the respondent for his effort and time. It is important to say that during the interviews many contractors show their interest in the subject matter. Also, they manifest their willingness to have better practice in cost monitoring activities.

3.5.5 Population and sample

The studied population includes the contracting companies in Gaza Strip who have a Contractors Union valid registration in January, 2003. As cost monitoring is somehow a sophisticated activity, the researcher addresses his study towards the top contracting companies of the first, second or third class according to the Contractors Union

classification. The total number of these companies are 73 companies, and they are stratified as follows: the first class has 32 companies; the second class has 22 companies; and the third class has 19 companies.

Three lists of contractors are prepared to represent the first, second, and third classes. Random selection among the three lists is done by the researcher using non-replacement random selection method. 25, 14, and 12 companies are selected from the first, second, and third lists respectively to represent the total sample size. The respondents are 41, distributed as 18, 12, and 11 from first, second, and third categories respectively. Walpole et. al. (1998) say that if the size of random sample which is selected from normal distribution and equal or greater than 30, it will guarantees a good result of confidence degree. Consequently, our sample size (41 companies > 30) gives a good degree of confidence.

3.5.6 Data coding and data analysis

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

The returned questionnaires are numerically coded to enter the data systematically and efficiently. data is entered using the Statistical Package for Social Science (SPSS) software. Double check, manually and by computer, is made to ensure data cleaning.

Statistical analysis for the data is conducted using the SPSS as follows:
- Defining and coding of variables.
- Summarizing the data on raw data sheet.
- Entering data.
- Cleaning data (Double check).

After applying the above mentioned steps, the descriptive statistic method was used. The descriptive statistic method is one of analysis methods which provides a general overview of results. It gives an idea of what is happening (Naoum 1998). In this study, frequency distribution and percentage are used to describe aspects of data. The

researcher uses this method because large amounts of data are gathered. It is often useful to distribute the data into categories and to determine the number of individuals or cases belonging to each category. This called 'category frequency' (Naoum 1998). In this research, the data are presented in forms of tabulation, bar charts, and pie charts.

3.6 Developing and Evaluating the Computerized System

The researcher has developed a tailored cost monitoring software that suits Gaza Strip contracting companies. This software is developed depending on the survey results, literature review, researcher experience in construction management in Gaza Strip, and the relevant computerized packages that the researcher reviewed in websites. The software is made using *Microsoft Excel* platform. This is because contracting companies are familiar with Excel and find it easy to use. To increase the capability and the skills of the researcher in *Microsoft Excel* package, he reviews some books explaining the use of Excel, internet Excel publications, and the internal instruction in Excel package. These skills increases the capability of the researcher to develop the software. The developed software is tested by four contractors asking them to try it on real ongoing projects. They are asked also to fill a questionnaire for evaluating the software (see Annex 5).

CAPTER 4

Results and Discussions

4.1 Introduction

In this chapter, the results of the field survey are presented and discussed. The chapter illustrates and discusses the characteristics of the study population, the applications of cost monitoring tools and techniques, the computer applications in cost monitoring, and the implementation of the cost monitoring systems.

4.2 Characteristics of the Study Population

Table 4.1 outlines the characteristics of the contracting companies which respond to the questionnaire. Most of the companies (82.9%) were established in the Palestinian National Authority (PNA) era, i.e. after 1994.

Table 4.1: Summary of the main characteristics of the study population

Variance			No.	%
Year of company establishment	Before 1994		7	17.1
	1994-1995		15	36.6
	After 1995		19	46.3
Company work field	Building works	Main	37	90.2
		Secondary	4	9.8
		Unspecialized	0	0
	Water and sewerage works	Main	13	31.7
		Secondary	19	46.3
		Unspecialized	9	22
	Roads works	Main	11	26.8
		Secondary	18	43.9
		Unspecialized	12	29.3
Number of employees	5 employees or less		3	7.3
	6-10 employees		29	70.7
	More than 10 employees		8	19.5
Employees according to their educational qualifications	MSc. and higher		11	26.3
	BSc.		41	100
	Intermediate institute		39	95.1
	Baccalaureate (Tawjihi)		37	90.2
	Under baccalaureate		34	82.9
Technical employees according to the engineering specialization	Civil engineer		41	100
	Architect		21	51.2
	Electrical engineer		15	36.6
	Mechanical engineer		12	29.3
	Other specialist engineer		2	4.9
	Technician		38	92.7

90.2% of contracting companies have building construction as their main field of work, while 9.8% of them have it as a secondary field of work. Few contracting companies (7.3%) have 5 employees or less, whilst most of them (70.7) have 6-10 employees, and 19.5% of the contractors employ more than 10 employees (see Figure 4.1).
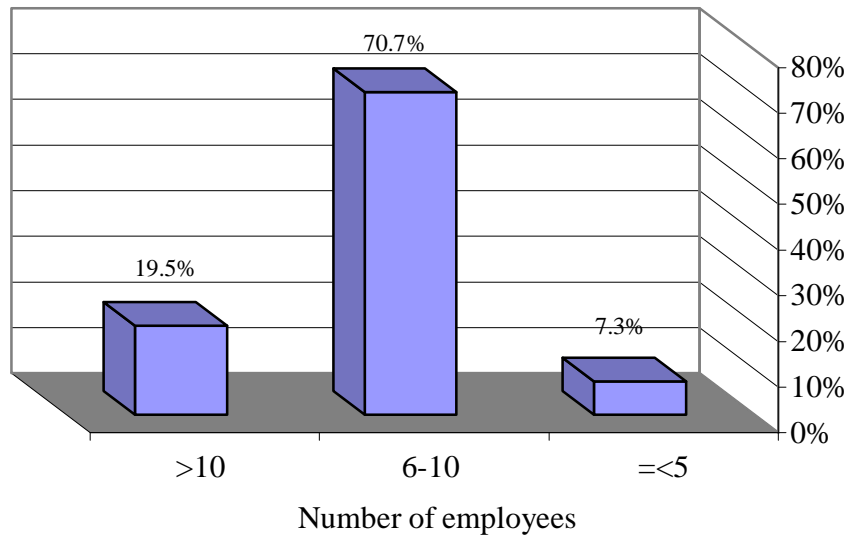
Figure 4.1: Distributions of respondents by number of employees

All contractors employ people holding BSc. degree, while about one-fourth of contractors (26.3%) employ people holding MSc. degree or more. Nearly all contractors employ persons who have intermediate institute or Baccalaureate (95.1% and 90.2% respectively). Figure 4.2 shows employees of the contracting companies according to their educational qualifications.

All contracting companies employ civil engineers, while almost half of them (51.2%) employ architects. Also, about one-third of the contractors employ electrical and mechanical engineers (36.6% and 29.3% respectively). Again, most of contractors (92.2%) employ technicians, whilst only 4.9% of contractors employ other specialist engineers.
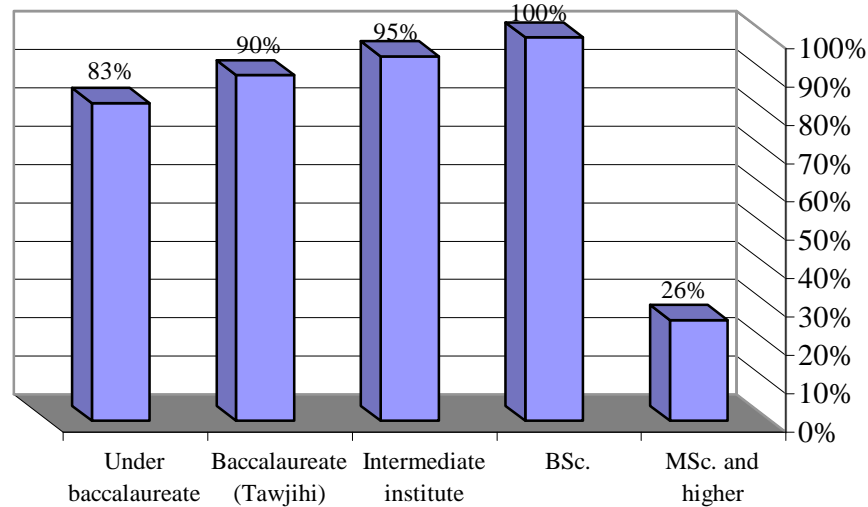
Figure 4.2: Employees according to their educaional qualifications

Table 4.2 illustrates that more than three-fourths of the respondent contractors (78%) have executed 30 projects or less during the last five years and 17.1% of them have completed 31-50 projects, whilst only 4.9% of the contractors have accomplished more than 50 projects. On the other hand, about two-thirds of the contractors (65.8%) have executed projects of total value of 4.5 million dollar or lesser during that period, and 73% of the contractors have executed projects of total value of 4.6-7.5 million dollar, while about one-fourth of the contractors (26.8%) have completed projects of more than total value of 7.5 million dollar.

Table 4.2: Distribution of number and amount of projects

Number and amount of projects		No.	%	Total
Number of executed projects during the last five years	30 projects or less	32	78	41
	31-50 projects	7	17.1	
	More than 50 projects	2	4.9	
Total amount of executed projects during the last five years	4.5 million $ or less	27	65.8	41
	4.6-7.5 million $	3	7.3	
	More than 7.5 million $	11	26.8	

Figure 4.3 illustrates the distribution of managerial position of persons who filled the questionnaire. In about two-thirds of contractors (63.4%), the person who filled the questionnaire is the director or vice director, and in about one-third of cases (34.2%), the questionnaire was filled by project manger. This indicates that the contracting companies are interested in the research subject and gives better feeling of confidence of the survey results.
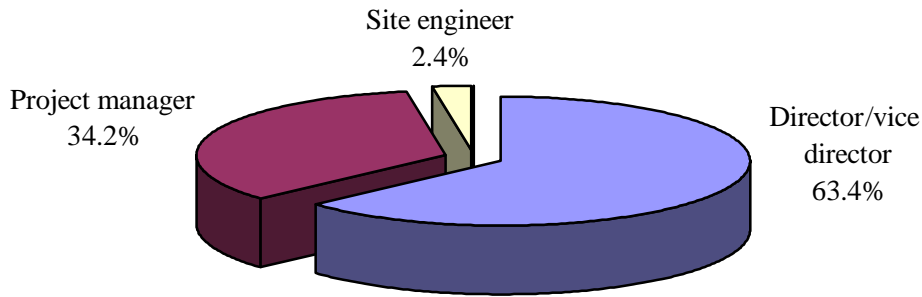
Figure 4.3: Postion distribution of person who filled the questionnaire

Figure 4.4 shows the distribution of equipment ownership. It is noted that hired equipment are prevailing, where 41.5% of the contractors use hired equipment completely and 34.1% of them use a mix of owned and hired equipment but most of them are hired. On the other hand, only one contractor (2.4%) relies completely on his own equipment. Also, about one-fifth of contractors (22%) use owned and hired equipment but most of them are owned.
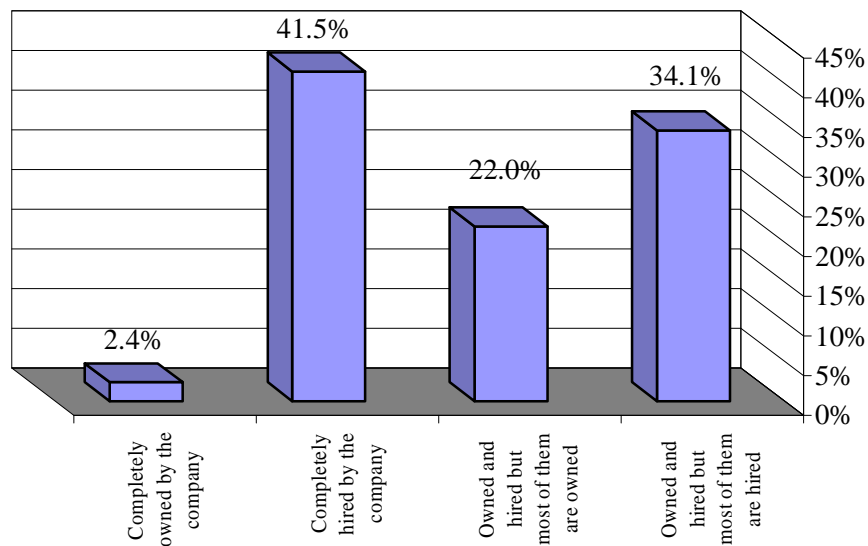
Figure 4.4: Distribution of equipment ownership

Figure 4.5 illustrates that more than one-fourth of the companies (26.8%) use entirely unit price. Also, about three-fourths of them (70.8%) use a mix of unit price and lump sum contracts with the majority of unit price contracts. On the other hand, no

contractor use exclusively lump sum contracts and only one company (2.4%) uses a mix of unit price and lump sum contracts with the majority of lump sum contracts. The results indicate that the unit price contract is the most used type of contracts.
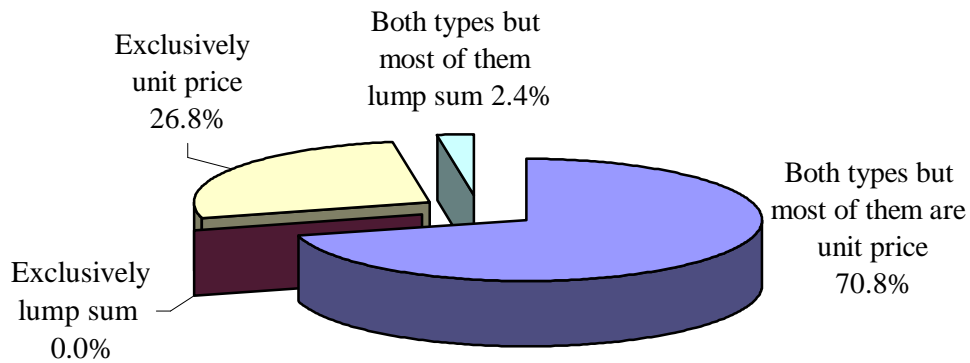
Figure 4.5: Types of engineering contracts

4.3 Applications of Cost Monitoring Tools and Techniques

4.3.1 Project in general

Table 4.3 lists general tools and techniques of project cost monitoring. It outlines the contractors' responses about the degree of necessity of these tools, techniques and activities. It also shows the extent and method of using these tools and techniques.

Most of the contractors (87.8%) believe that having cost code at the level of item is necessary for monitoring the project cost. More than one-half of the contractors (58.5%) think that using cost code at the level of sub-activity of item is needed. However, less than one-half of them (41.5%) believe that cost code at the level of sub-activity of item according to its location in the stories is necessary. Also, 43.9% of contractors believe that cost code at the level of a set of minor items which can be executed together is required. These results indicate that the contractors may not want to go in cost monitoring in more details. Regarding the extent of use of the above mentioned tools, all the contractors do not use the cost code at any level. This points to the absence of systematic usage of cost monitoring, where the cost code is a basic tool for any cost monitoring system.

Table 4.3: Degree of necessity, extent and method of use of cost monitoring tools and techniques (General group)

Tools and Techniques		Degree of Necessity			Extent of Use			Method of Use			
		Unnecessary	Optional	Necessary	Not used	Sometimes used	Usually used	Without recording (in memory)	Recording without a form	Recording by using a form	By using a computerized form
Using the cost code at the level of item.	No.	1	4	36	41						
	%	2.4	9.8	87.8	100						
Using the cost code at the level of sub-activity of item, for example (first face for plaster/ reinforcement work for concrete columns).	No.	8	9	24	41						
	%	19.5	22	58.5	100						
Using the cost code at the level of sub-activity of item according to its location in the stories.	No.	8	16	17	41						
	%	19.5	39	41.5	100						
Using the cost code at the level of a set of minor items which can be executed together.	No.	11	12	18	41						
	%	26.8	29.3	43.9	100						
Monitoring the resources allocation of various working items. (resources include labor, materials, equipment and subcontractors).	No.	1	6	34	34	7			7		
	%	2.4	14.6	82.9	82.9	17.1			17.1		
Using the S-curve of actual cost.	No.	4	11	26	41						
	%	9.8	26.8	63.4	100						
Keeping the cost records (archiving).	No.		3	38	1	12	29		33	3	4
	%		7.3	92.7	2.4	29.3	70.7		80.5	7.3	9.8
Making use of resulting information from cost monitoring system in the next stage which is the cost control.	No.		1	40	3	11	27	27	11		
	%		2.4	97.6	7.3	26.8	65.9	65.9	26.8		
Benefiting of resulting information from cost monitoring system in updating the cost database which is required for pricing future projects.	No.		3	38	4	13	24	28	8		
	%		7.3	92.7	9.8	31.7	58.5	68.3	19.5		

Most of the contractors (82.9%) consider monitoring the allocation of resources of various working items is necessary for cost monitoring. Regarding the extent of using this tool, most of the contractors (82.9%) do not apply it, and some of them (17.1%) occasionally utilize it without using a form. This is another evidence which indicates that the current cost monitoring application is not adequate.

About two-thirds of the contractors (63.4%) think that the S-curve of actual cost is needed. This percentage is not high, perhaps because the contractors do not recognize the benefit of having this tool in the cost control process. Surprisingly, none of the respondents use this tool.

With regard to keeping of cost records, Most of the contractors (92.7%) support this technique. Also many contractors (70.7%) usually apply it, and about one-third of them (29.3%) sometimes use it. But most of those who were using the technique (80.5%) keep the records without using manual or computerized forms. However,after reviewing samples of these cost records, the researcher has an impression that they are kept for accounting purpose, reviewing the accounts of labor, suppliers, subcontractors, etc. and not for cost control purpose.

Almost all the participants (97.6%) believe that making use of resulting information from cost monitoring system in the next stage of cost control is necessary. About two-thirds of them (65.9%) usually make benefit from cost monitoring in controlling the cost of their projects, and about one-fourth of them (26.8%) sometimes use this tool. This indicates that there is a kind of cost monitoring practice. But by looking at the method of use, it appears that it is inadequate. None of conractors use computerized or non-computerized forms and the majority (65.9%) rely on memory.

Most of respondents (92.7%) believe that the resulting information from cost monitoring system is necessary and beneficial in updating the cost database which is required for pricing future projects. 58.5% of the contractors usually use the technique, and 31.7% of them sometimes apply it. These percentages are quite satisfactory. But the method of updating is generally without recording (in memory) or by recording without forms.

4.3.2 Project items

Table 4.4 demonstrates the tools and techniques of item cost monitoring. It outlines the contractors' responses about the degree of necessity of these tools and techniques, extent of use, and the adopted method of use.

It is clear that nearly all the contractors (97.6%) support the daily recording for data of in-progress items (e.g. cost code- description- executed quantity). However, only 9.8% of contractors usually use this technique and about two-thirds of them (65.9%) do not use it at al. On the other hand, the method of use is often done by recording without using a manual or computerized form, where 9 contractors out of the 14 contractors who apply this technique record the in-progress items without using a form. This indicates that the cost monitoring practice is somehow superficial.

Table 4.4: Degree of necessity, extent and method of use of cost monitoring tools and techniques (Project item group)

Tools and Techniques		Degree of Necessity			Extent of Use			Method of Use			
		Unnecessary	Optional	Necessary	Not used	Sometimes used	Usually used	Without recording (in memory)	Recording without a form	Recording by using a form	By using a computerized form
Daily recording of in-progress items, the record declares for example (cost code-description- executed quantity).	No.		1	40	27	10	4	2	9	2	1
	%		2.4	97.6	65.9	24.4	9.8	4.9	22	4.9	2.4
Calculating the actual cost of resources (labor, materials, equipment and subcontractors) for each item periodically, for example (daily/weekly/monthly).	No.		1	40	34	7		1	6		
	%		2.4	97.6	82.9	17.1		2.4	14.6		

Approximately all contractors (97.6%) believe that periodical calculation of actual cost of resources (labor, materials, equipment and subcontractors) for each item is important and necessary. This belief is not applied, where most of the contractors (82.9%) do not use this technique and only 17.1% of them occasionally use it. Furthermore, those who sometimes use the technique, they do not use any paper or computerized forms to calculate or record the costs. These results imply that the

prevailing cost monitoring practice is weak and does not achieve the minimum requirements of adequate cost control system.

4.3.3 Labor

Table 4.5 summarizes the applications of tools and techniques of labor cost monitoring. The percentage of the contractors who believe in the necessity of having a labor list is very high (97.6%). Consistently, the percentage of the contractors who possess a list of labor is also high (92.7%). However, the method of use is mostly (65.8%) without recording and depending on the memory or by unorganized recording (without forms). The users of a computerized form are very little (9.8%). This implies that the contractors do not utilize this tool in a systematic way. This tool is a multi-purpose one, it serves accounting, site supervision, administration, cost monitoring and cost control. During the interviews the contractors have clarified that they use the labor list for accounting purpose.

Table 4.5: Degree of necessity, extent and method of use of cost monitoring tools and techniques (Labor group)

Tools and Techniques		Degree of Necessity			Extent of Use			Method of Use			
		Unnecessary	Optional	Necessary	Not used	Sometimes used	Usually used	Without recording (in memory)	Recording without a form	Recording by using a form	By using a computerized form
Providing a list of the available labor which the contractor possess, the list illustrates for example (labor name- labor number- craft- regular rate- overtime rate).	No.		1	40		3	38	11	16	10	4
	%		2.4	97.6		7.3	92.7	26.8	39	24.4	9.8
Daily recording of labor, the record shows for example (labor name- labor number- number of regular hours- number of overtime hours- the item in which a labor works).	No.	1	3	37	6	11	24		30	4	1
	%	2.4	7.3	90.2	14.6	26.8	58.5		73.2	9.8	2.4
Providing a card for every labor in which the regular hours and the overtime hours are registered, also it is signed for example by the foreman.	No.			41	10	3	28			31	
	%			100	24.4	7.3	68.3			75.6	

Most of the contractors (90.2%) believe that daily recording of working labor is necessary (e.g. labor name- labor number- number of regular hours- number of overtime hours- the item in which a labor works). The percentage of the contractors who are usually use this tool is not very high (58.5%). The majority of the contractors who use this technique are recording the data without a manual or computerized form.

All contractors support having a labor card. Nearly three-fourths of contractors utilize this tool, where 68.3% of the contractors usually use the tool, and 7.3% of them use it occasionally. Again, in interviews many contractors declare that labor card is used mainly for accounting purposes.

4.3.4 Materials

Table 4.6 outlines the applications of tools and techniques of materials cost monitoring. 90.2% of the contractors believe that having a list of materials is necessary. Also, most of them actually use it, where 82.9% of contractors usually use this technique, and 12.2% of them sometimes use it. On the other hand, very few contractors record the data of material by using a manual or computerized form, and most of them (75.6%) depend on memory for recording. These results emphasize the need for persuading the contractors to use cost monitoring tools more effectively.

Most of the contractors (95.1%) consider the daily recording of used materials is necessary. However, more than one-half of them (56.1%) do not use it at all. As for method of use, most of the contractors record without using a form.

The necessity of the store card for each material have a relatively low percentage of supporters (56.1%). In fact, very few of contractors (9.8%) use this tool. This may be referred to the fact that most of projects in Gaza Strip are relatively small, and they do not need a high level of storing system.

Most of the contractors (95.1%) support the need of materials purchase order form. However, less than one-third of contractors (29.3%) usually use this technique, and more than one-half of them (51.2%) do not use it at all.

Table 4.6: Degree of necessity, extent and method of use of cost monitoring tools and techniques (Materials group)

Tools and Techniques		Degree of Necessity			Extent of Use			Method of Use			
		Unnecessary	Optional	Necessary	Not used	Sometimes used	Usually used	Without recording (in memory)	Recording without a form	Recording by using a form	By using a computerized form
Providing a list of materials, it includes for example (material name- material number- unit- price).	No.		4	37	2	5	34	31	5	1	2
	%		9.8	90.2	4.9	12.2	82.9	75.6	12.2	2.4	4.9
Daily recording of used materials, the record illustrates for example (material name- material number- unit- used quantity- the item in which the material is used).	No.		2	39	23	13	5		14	3	1
	%		4.9	95.1	56.1	31.7	12.2		34.1	7.3	2.4
Providing a store card for each material, it contains for example (input- output- balance).	No.	7	11	23	37	3	1			4	
	%	17.1	26.8	56.1	90.2	7.3	2.4			9.8	
Providing materials purchase order form, it includes for example (order number- material description- required quantity- price).	No.		2	39	21	8	12			20	
	%		4.9	95.1	51.2	19.5	29.3			48.8	
Recording the received materials on site, the record shows for example (delivery number- material name- material description- quantity).	No.		1	10	10	9	22		27	3	1
	%		2.4	97.6	24.4	22	53.7		65.9	7.3	2.4
Reporting the situation of materials in the store, the report illustrates for example (supplier name- order number- quantity input- quantity output- balance).	No.	2	8	31	35	6			4	2	
	%	4.9	19.5	75.6	85.4	14.6			9.8	4.9	
Reporting the problems, for example (wastage and breakage, theft and loss, shortage in deliveries, etc).	No.		2	39	1	7	33	24	16		
	%		4.9	95.1	2.4	17.1	80.5	58.5	39		
Following up the prices in the market and recording the variation of prices.	No.		3	38	3	14	24	30	5	1	2
	%		4.9	95.1	7.3	34.1	58.5	73.2	12.2	2.4	4.9

Almost all the contractors (97.65%) think that recording the received materials on site is necessary. The percentage of contractors using this technique is intermediate, where 53.7% of them usually use it and 22% of them sometime use it. A poor method of recording is mostly used, where only about 10% of contractors use a form and 65.9% of them record without using a form.

Three-fourths of the contractors (75.6%) believe that reporting the situation of materials in the store is necessary. Yet, most of the contractors (85.4%) do not apply this technique.

95.1% of the contractors believe in the necessity of reporting the problems (e.g. wastage and breakage, theft and loss, shortage in deliveries, etc). Percentage of users is high, where 80.5% of contractors usually use this technique, and 17.1% of them sometimes use it. But non of contractors use a form in handling this technique.

Most of contractors (92.7%) support the necessity of following up the material prices in the market and recording the variation of prices. Also, many of them apply this technique, where 58.5% of the contractors usually use it and 34.1% of them sometimes use it. But the method generally is depending on memory, and very few contractors use a form or a computer for recording.

4.3.5 Equipment

Table 4.7 illustrates the applications of tools and techniques of equipment cost monitoring. Most of contractors (95.1%) find it is necessary to have an equipment list. Also, most of them use this technique, where 70.7% of the contractors usually use the technique and 26.8% of them sometimes use it. But most of the users record the data of equipment without using manual or computerized forms, or depending mainly on memory.

The daily or weekly recording of data of the used equipment is supported by most of the contractors (92.7%). Also using this tool is popular as 85.4% and 9.8% of the contractors usually and sometimes use it respectively. However, most of them record without a form.

Table 4.7: Degree of necessity, extent and method of use of cost monitoring tools and techniques (Equipment group)

Tools and Techniques		Degree of Necessity			Extent of Use			Method of Use			
		Unnecessary	Optional	Necessary	Not used	Sometimes used	Usually used	Without recording (in memory)	Recording without a form	Recording by using a form	By using a computerized form
Providing a list of equipment that includes for example (equipment name- equipment number- rate).	No.		2	39	1	11	29	19	16	3	2
	%		4.9	95.1	2.4	26.8	70.7	46.3	39	7.3	4.9
Daily/Weekly recording of used equipment in the project, the record illustrates for example (equipment name- equipment number- unit- hired quantity- the item in which it is used).	No.		3	38	2	4	35	1	34	4	
	%		7.3	92.7	4.9	9.8	85.4	2.4	82.9	9.8	

4.3.6 Subcontractors

Table 4.8 summarizes the applications of tools and techniques of subcontractors cost monitoring. Approximately all contractors (97.6%) believe that having a list of subcontractors is necessary. Many contractors apply this technique, where 70.7% of the contractors usually use the technique and 29.3% of them sometimes use it. This may be related to the fact that most of Gaza Strip contractors depend on subcontractors to execute their projects. It appears that very few contractors use a manual or computerized form. Most of them depend on the memory or on recording manually without using a form.

The daily recording of data of the subcontractors working in the project is vital for any cost monitoring system. Most of contractors believe that this technique is necessary. However, only one-fourth of them (24.4%) usually use it and 61% of them do not use it at all.

Almost all contractors (97.6%) consider it is necessary to have a summary of subcontractor payments periodically. Most of them (73.2%) usually use it. However, most of them use a randomly recording for this technique, and few of them utilize manual or computerized forms.

Table 4.8: Degree of necessity, extent and method of use of cost monitoring tools and techniques (Subcontractors group)

Tools and Techniques		Degree of Necessity			Extent of Use			Method of Use			
		Unnecessary	Optional	Necessary	Not used	Sometimes used	Usually used	Without recording (in memory)	Recording without a form	Recording by using a form	By using a computerized form
Providing a list of subcontractors, it includes for example (subcontractor name- his number- his craft).	No.		1	10		12	29	20	16	3	2
	%		2.4	97.6		29.3	70.7	48.8	39	7.3	4.9
Daily recording of the subcontractors working in the project, the record declares for example (subcontractor name- his number- his craft- the item in which he worked).	No.		4	37	25	10	6	10	5	1	
	%		9.8	90.2	61	24.4	14.6	24.4	12.2	2.4	
Summarizing the payments of every subcontractor periodically (for example every month), Progress Payment Summary Report, the report declares for example (contract amount- completed value to date- paid to date- retaining to date).	No.		1	40	2	9	30		30	6	3
	%		2.4	97.6	4.9	22	73.2		73.7	14.6	7.3

4.4 Computer Applications in Cost Monitoring

All contracting companies are not using software for supporting the cost monitoring. Few contractors (12.2%) declare that they are using spreadsheets for supporting the cost monitoring. But after questioning the contractors during the interview, the researcher concludes that they are used for accounting purposes. From results of the survey, the most used software by the contracting companies is MS Excel. This encourages the researcher to use Excel as the basis for developing a cost monitoring system.

4.5 Implementation of Cost Monitoring Systems

Table 4.9 lists the contractors' opinion about the extent of effect of obstacles on using a cost monitoring system. The average percentage of effect of each obstacle is recorded in the "Average" column. The results shows that all the obstacles have a strong effect against applying efficient cost monitoring system. The main obstacles which have the most strong effect are:

- Non-realization of importance of cost monitoring system by the contractor.
- Absence of commitment of top management to implement the system.
- Absence of understanding of cost monitoring system.
- Inability of the system implementation.

Consequently, avoiding these obstacles is necessary in developing any cost monitoring system.

Table 4.9: Distribution of contractors' opinion about the effect extent of obstacles on using efficient cost monitoring system- Average percentage of effect

Obstacle		Very Strong	Strong	Inter Medi ate	Weak	Very Weak	Ave- Rage %*
Non-realization of importance of cost monitoring system by the contractor.	No.	25	11	4	1	0	
	%	61	26.8	9.8	2.4	0	89.2
Absence of understanding of cost monitoring system.	No.	19	17	4	1	0	
	%	46.3	41.5	9.8	2.4	0	86.3
Inability of the system implementation.	No.	19	16	5	1	0	
	%	46.3	39	12.2	2.4	0	85.9
Absence of convincing of the system implementation.	No.	15	18	6	1	1	
	%	36.6	43.9	14.6	2.4	2.4	82
Absence of ability to implement the system.	No.	16	14	8	3	0	
	%	39	34.1	19.5	7.3	0	81
Absence of commitment of top management to implement the system.	No.	25	10	5	1	0	
	%	61	24.4	12.2	2.4	0	88.8
Absence of expert consultant who can help in the system implementation.	No.	15	10	5	1	0	
	%	36.6	51.2	7.3	4.9	0	83
The thinking that implementing the system wastes away the time of project supervisors.	No.	16	17	5	2	1	
	%	39	41.5	12.2	4.9	2.4	81.5
The belief that desired benefit from the system is little comparing with its cost.	No.	15	15	7	4	0	
	%	36.6	36.6	17.1	9.8	0	80

Average %: average % =[Σ(weight * its number of contractors)/(total number of contractors*5)]*100. where the weights: very strong = 5, strong = 4, intermediate = 3, weak = 2, very weak = 1. Example: Average of non-realization of importance of cost monitoring system by the contractor = [(25*5 + 11*4 + 4*3 + 1*2 + 0*1) / 41*5]*100 = 89.2%.

Table 4.10 outlines the benefits of cost monitoring system according to contractors' opinions. It also lists the average percentage of each benefit. According to the average column, it is observed that all mentioned benefits are generally considered important. The most important benefits are listed below in descending order:

- Reducing project cost.

- Increasing pricing accuracy of future projects.

- Providing cost information which is vital for project cost control.

- Accuracy of determining the productivity of labor and equipment.

- Maintaining droits of contractors, labor, suppliers and subcontractors.

It is notable that the above mentioned benefits, especially the first three ones, are considered the main objective of cost monitoring. Fortunately, the contractors believe that these benefits are very important which means that they are prepared to react positively in developing a cost monitoring system that address the local practice.

Table 4.10: Benefits of cost monitoring system according to contractors' opinions-Average percentage of importance.

Benefit		Very impo-rtant	Impo-rtant	No Defe-rence	Not Impo-rtant	Not at all Impo-rtant	Ave-Rage %*
Reducing project cost.	No.	29	11	1	0	0	
	%	70.7	26.8	2.4	0	0	93.7
Increasing pricing accuracy of future projects.	No.	29	11	1	0	0	
	%	70.7	26.8	2.4	0	0	93.7
Keeping cost records.	No.	15	24	2	0	0	
	%	36.6	58.5	2.4	0	0	86.3
Maintaining droits of contractors, labor, suppliers and subcontractors.	No.	25	13	3	0	0	
	%	61	31.7	7.3	0	0	90.7
Accuracy of knowing the cash flow which is needed for future projects.	No.	14	25	2	0	0	
	%	34.1	61	4.9	0	0	85.9
Accuracy of determining the materials waste amount.	No.	22	17	0	2	0	
	%	53.7	41.5	0	4.9	0	88.8
Accuracy of determining the productivity of labor and equipment.	No.	25	16	0	0	0	
	%	61	39	0	0	0	92.2
Providing cost information which is vital for project cost control.	No.	27	14	0	0	0	
	%	65.9	34.1	0	0	0	93.1
Increasing of the earned value.	No.	20	17	4	0	0	
	%	48.8	41.5	9.8	0	0	87.8
Maintaining contractor droits of the additional works.	No.	17	22	2	0	0	
	%	41.5	53.7	4.9	0	0	87.3

Average %: average % =[Σ(weight * its number of contractors)/(total number of contractors*5)]*100. where the weights: very strong = 5, strong = 4, intermediate = 3, weak = 2, very weak = 1. Example: Average of reducing project cost = [(29*5 + 11*4 + 1*3 + 0*2 + 0*1) / 41*5]*100 = 93.7%.

Table 4.11 summarizes the contractors' opinion about the factors which affect the success and effectiveness of the cost monitoring system. The table also shows the average percentage of each factor. From this column, we conclude that all factors are considered important for the success and effectiveness of cost monitoring implementation. The most important factors are listed below in the descending order:

- Commitment of top management.
- Encouraging of institutions which are concerned with the construction sector, such as the Contractors Union, and organizing training programs. .
- Computerizing the system.
- Easiness of implementing the system, in addition to its effectiveness.

The first two factors have to be considered to encourage an implementation of cost monitoring system. The second two factors have to be taken into account in developing any cost monitoring system.

Table 4.11: Distribution of contractors' opinion about factors which affect the success and effectiveness of cost monitoring system- Average percentage of importance

Factor		Very impo-rtant	Impo-rtant	No Defe-rence	Not Impo-rtant	Not at all Impo-rtant	Ave-Rage %*
Commitment of top management.	No.	32	9	0	0	0	
	%	78	22	0	0	0	94.6
Availability of appropriate monetary resources.	No.	18	22	0	1	0	
	%	43.9	53.7	0	2.4	0	87.8
Flexibility of the system.	No.	24	17	0	0	0	
	%	58.5	41.5	0	0	0	87.3
Easiness of implementing the system, in addition to its effectiveness.	No.	24	17	0	0	0	
	%	58.5	41.5	0	0	0	91.7
Computerizing the system.	No.	28	11	1	1	0	
	%	68.3	26.8	2.4	2.4	0	92.2
Possibility of benefiting from the previous experiences.	No.	15	25	1	0	0	
	%	36.6	61	2.4	0	0	86.8
Encouraging of institutions which are concerned with the construction sector, such as the Contractors Union, and organizing training programs.	No.	28	11	2	0	0	
	%	68.3	26.8	4.9	0	0	92.7

Average %: average % =[Σ(weight * its number of contractors)/(total number of contractors*5)]*100. where the weights: very strong = 5, strong = 4, intermediate = 3, weak = 2, very weak = 1 Example: Average of commitment of the top management = [(32*5 + 9*4 + 0*3 + 0*2 + 0*1) / 41*5]*100 = 94.6%.

4.6 Field Survey Conclusions

The results indicate that almost all the contractors believe that all tools and techniques which are stated in the questionnaire are necessary for monitoring the project costs. However, most of these techniques are rarely applied adequately. The contractors do not apply cost coding and S-curve of actual cost. Also, most of them do not apply many other tools and techniques of cost monitoring. These tools and techniques include: monitoring the resources allocation; daily recording in-progress items; calculating the actual cost of resources periodically; daily recording of used materials; providing a store card for each material; providing materials purchase order form; reporting the situation of materials in the store; and daily recording of the acting subcontractors in the project. As for the few contractors who use the mentioned techniques to some extent, they apply them generally without recording, or with unsystematic recording which does not depend on manual or computerized forms. These results imply that the current cost monitoring practice is incompetent.

On the other hand, there are techniques imply that there is a cost monitoring application, and they are commonly used by the contractors. These techniques include for example: making use of resulting information from cost monitoring system in the next stage 'cost control'; benefiting of resulting information from cost monitoring system in updating the cost database which is required for pricing future projects; and following up the material prices in the market and recording the variation of prices. Also, there are other cost monitoring techniques which are used for accounting purpose, and for keeping the droits of contractors, labor, suppliers, and subcontractors. These techniques include for example: keeping the cost records (archiving); Providing a labor card; recording the received materials on site; daily/weekly recording of used equipment in the project; and summarizing the payments for every subcontractor periodically. Again, by looking at method of use of the mentioned techniques, it is noticed that recording is usually in unsystematic way without using manual or computerized forms.

From the results, the researcher concludes that the current cost monitoring practice does not reach to be called really a system. What we have is fragmented applications of some tools and techniques.

Regarding the computer applications in cost monitoring, the results indicate that the contractors do not use any computer program for supporting the cost monitoring. However, the results illustrate that Excel is the most generally used software by the contracting companies. These results encourage the researcher to adopt Excel as a platform for development of a cost monitoring system to improve the contractor's practice in this field.

The contractors think that most effective obstacles to apply a cost monitoring system are: non-realization of importance of cost monitoring system by the contractor; absence of commitment of top management to implement the system; absence of understanding the system; and inability of the system implementation. When applying any cost monitoring system, care should be taken to avoid, as much as possible, these obstacles.

The contractors believe that the most important benefits of a cost monitoring system are: reducing project cost; increasing pricing accuracy of future projects; providing cost information which is vital for project cost control; accuracy of determining the productivity of labor and equipment; and maintaining droits of contractors, labor, suppliers and subcontractors.

Majority of the contractors suppose that most of the factors that affect the success of cost monitoring implementation are: commitment of top management; encouraging of institutions which are concerned with the construction sector; computerizing the system; and easiness of implementing the system, in addition to its effectiveness. These factors have to be considered in applying any cost monitoring system in Gaza Strip construction projects.

CHAPTER 5
Cost Monitoring Software (CMS)

5.1 Introduction

This chapter presents the computerized system which the researcher develops to improve the cost monitoring practice of Gaza Strip contractors. The author names this software "Cost Monitoring Software" (CMS). It also discusses the general concepts on which the development of the software is based. The chapter describes the software components, and the method of use. The software evaluation, and limitations of software are also discussed.

5.2 Concepts

The researcher reviews the current situation of cost monitoring in Gaza Strip by interviewing forty one contractors. It is found out that the cost monitoring practice is primitive and inadequate. Also, it is concluded that the cost monitoring practice is not done in a systematic way. By introducing CMS, it is aimed to improve the common practice of local contractors.

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

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

The author tries his best to accommodate, as much as possible, the above mentioned criteria in developing CMS.

5.2.1 Computerized system

The "system" is defined as a set of elements with some perceived relationship between them (Sha'at 1993 quotes O'Brien 1989). As shown in Figure 2.4, the input data is processed and converted to output information. Figure 5.1 illustrates a schematic diagram for a computerized cost monitoring system. The system consists of three parts: input data; processing; and output data. They are detailed as follows:

Input data:

The input data can be classified into two parts:

1- <u>Basic inputs:</u> include data about company and project, items pool, project items, activities of items, company labor force, materials, equipment, and subcontractors.

2- <u>Daily inputs:</u> includes a daily recording for in-progress items, their quantities and the resources (labor, materials, equipment, and subcontractors) used for them.

Processing:

In this part input data is processed utilizing Excel functions and macros developed by the researcher. Project database is created from the data entered in the basic inputs and daily inputs. With interaction of the user, different sheets are produced.

Output data:

The output data comprises of reports created from the database after processing. These reports include the up-to-date item cost, daily cost, item labor cost, item materials cost, item equipment cost, item subcontractors cost, actual S-curve, and cost per floor group.

5.2.2 Excel environment

The software is built within Excel environment. It includes spreadsheets processed by numbers of macros which automate the repetitive steps. These macros make CMS easier, faster, and more effective. Excel has many advantages such as:

1. It is wealthy by many operations; 90 % of those know about Excel deal only with 10 % of Excel capabilities.

2. It includes electronic spreadsheets which have many benefits such as:

    * they are inexpensive.

    * they are easy to use.

COST MONITORING SYSTEM DIAGRAM

Input Data   **Processing**   **Output Data**

Basic data

include data about:

- Company and project.
- Items pool.
- Project items.
- Activities of items.
- Company labor force.
- Materials.
- Equipment.
- Subcontractors.

+

Daily inputs includes:

a daily recording for in progress items, their quantities and the resources (labor, materials, equipment, and subcontractors) used for them.

Processing

Database

Reports includes:

- Up-to-date item cost.
- Daily cost.
- Item labor cost.
- Item materials cost.
- Item equipment cost.
-Item subcontractors cost.
- Actual S-Curve.
- Cost per floor group.

Figure 5.1: Cost monitoring system diagram

- they can be customized to your style of doing business.
- they are very powerful.
- they provide a clear and complete picture of inputs and outputs (Christofferson 1999).

3. It has an advantage of macros which are responsible of repetitive operations. These macros have the ability of automating and controlling the spreadsheets.

The field survey illustrates that most of the companies use Excel more than other programs such as Word, MS Project, and Access. For this reason and for the previous mentioned advantages of Excel, the researcher has chosen the Excel environment for building CMS. This will make the user more comfortable and confident in using CMS.

Raffensperger (2001) provides many tips to improve spreadsheet style. The researcher has tried to follow them when he designs CMS. These tips include:

1. The "write like English" rule. Since we read from left to right and top to bottom, the spreadsheet will be easier to understand.
2. The close to the numbers rule. As with text and graphics, readers want to see related information close together, in context. If related cells are far apart, the context is broken up. Put related cells together.
3. The three crayon rule. Spreadsheet must has not many numbers of colors. The reader will not memorize the meanings of many different colors.
4. The grid-is-good rule. Leave Excel's default grid on. By showing where the cells are, the reader is helped to see the spreadsheet's structure.
5. The blank look rule. Make blank cells look blank. Make cells with data look like they have data.
6. Be concise.

5.3 Software Description and Components

CMS is built within Excel environment. Template sheet with embedded formulas are also utilized to make CMS more user friendly. The user will deal with spreadsheets where he needs only to enter numbers, and click on icons, then the results appear.

The following is a description of CMS components:

5.3.1 Start sheet

Figure 5.2 illustrates the start sheet. It provides a summarized identification of the software. Also, it summarizes the software benefits as follows:

- It provides an economical and convenient way to receive and compute daily Job site cost information.

- It tracks actual costs and quantities.

- It reports total cost-to-date. All labor, materials, equipment, and subcontractors are reported for each item.

- It develops and maintain a database of labor, materials, equipment, and subcontractors costs.

5.3.2 Menu

This sheet contains many icons which represent the sheets and components of the software. By clicking on any icon, the sheet related to this icon will open automatically. The user can return back to the start sheet by clicking on *BACK* icon at the lower part of the menu sheet. The basic topics of the menu are: basic data; daily inputs; reports; new project; database; and method of use. Figure 5.3 illustrates the menu sheet.

The followings are more detailed description for these icons of the menu:

5.3.2.1 Basic data

It includes basic inputs about the company and project, items pool, project items, activities, labor, materials, equipment, and subcontractors. This data can be either directly entered or electronically transferred. The followings are details of the basic input sheets:

Figure 5.2: Start sheet of CMS
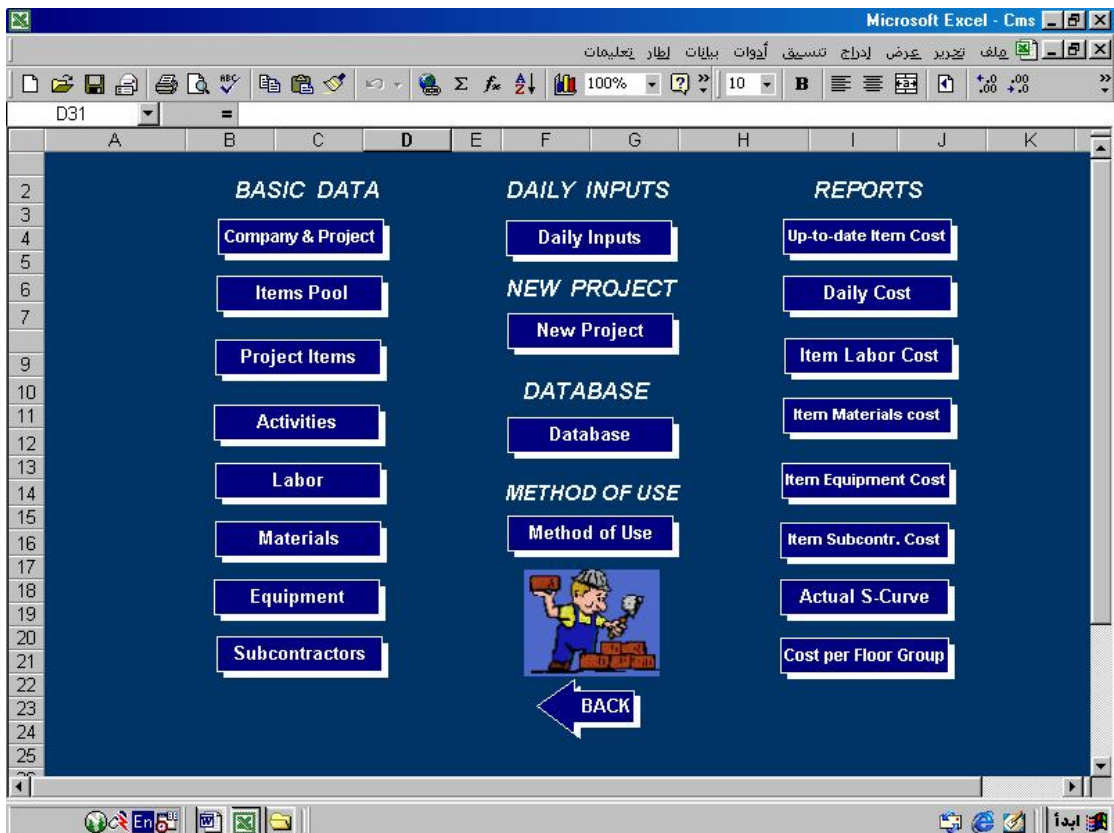
Figure 5.3: Menu sheet of CMS

A. Company and Project Sheet:

Company and project sheet involves data about the company like the company name, address, city, phone number, and fax number. It also includes data about the project like the project name, number, location, contract value, and planned finish date. This sheet can be opened by clicking on the *Company and Project* icon in the menu. The data of company and project has to be entered by typing or electronic transmission. This data automatically appears on the other sheets or reports to identify the company and the project. The user can turn back to the menu by clicking on *Menu* icon at the upper right side of the sheet. Figure 5.4 illustrates the company and project sheet.
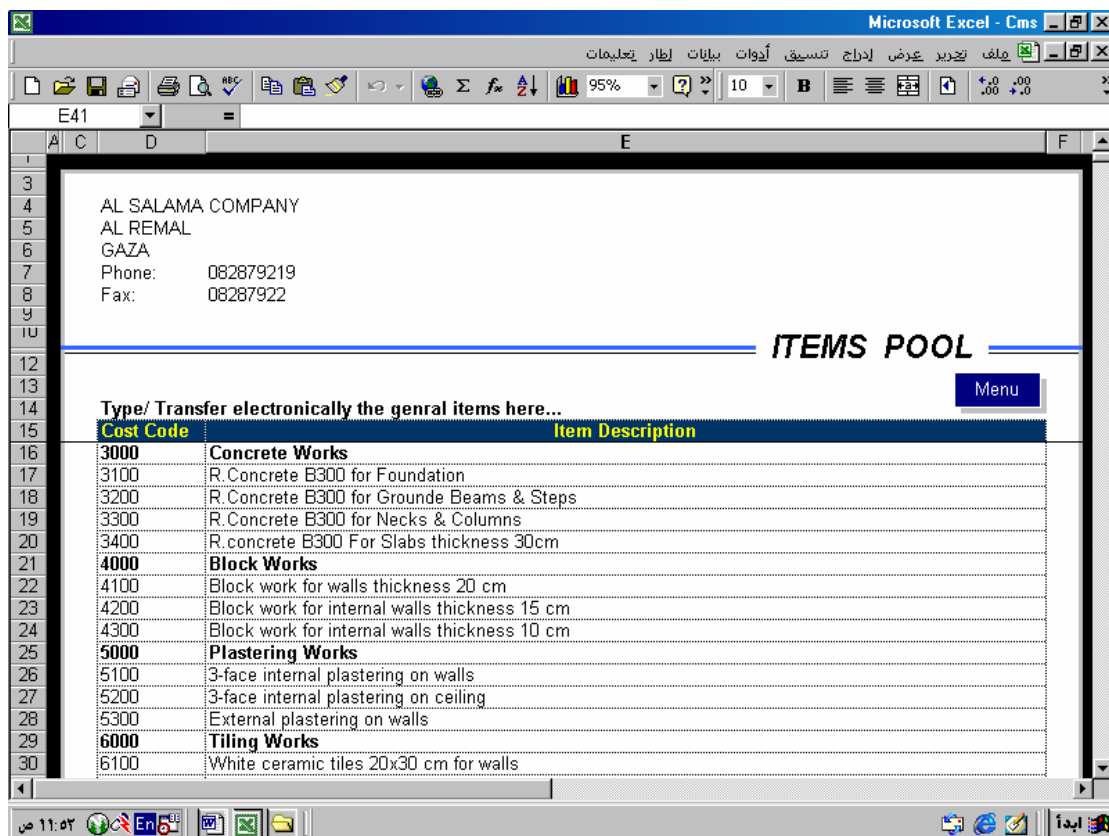
Figure 5.4: Company and project sheet

B. Items Pool Sheet:

Items pool sheet can be opened by clicking on the *Items pool* icon in the menu. This sheet includes data about items of the pool and their cost code. Items pool is a comprehensive list of all items that may exist in a project. For illustration purpose, the author introduces some of these items. This list can be edited, expanded or diminished. This sheet is linked to the project items sheet, where a list of project items that their costs should be monitored can be constructed. Figure 5.5 illustrates the items pool sheet.

Figure 5.5: Items pool sheet

C. Project Items Sheet:

Project items sheet can be opened by clicking on the *Project Items* icon in the menu. This sheet includes data about project items description, unit, quantity, unit price, and amount. By using the *Vlookup* function of Excel, each item description appears automatically in the sheet by typing the cost code of this item. The data of cost code and item description are linked to the template (daily inputs sheet). By typing the cost code in the corresponding cell in the daily input sheet, the required information related to the cost code of item will appear in the daily input sheet by effect of *Vlookup* function. Figure 5.6 illustrates the project item sheet.
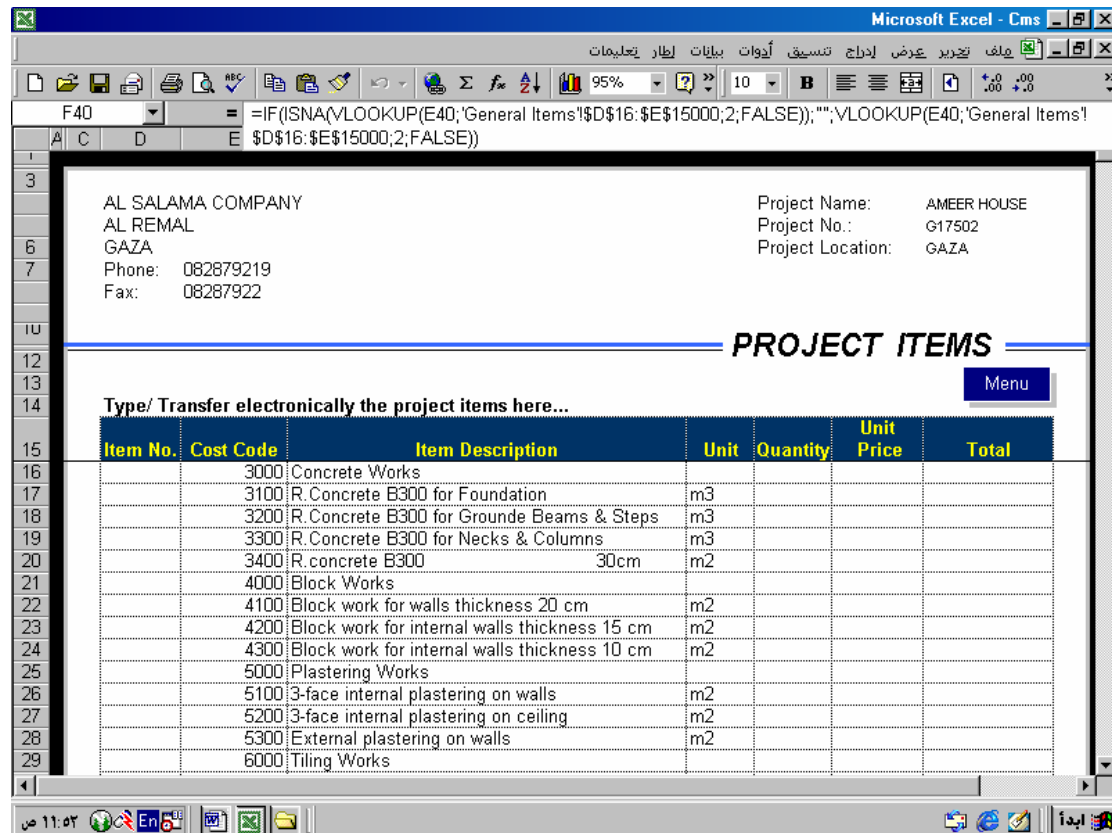
Figure 5.6: Project items sheet

D. Activities Sheet:

Activities sheet is a table having columns for cost code, item description, unit, activities and their proportions. Activities sheet is linked with the project item sheet, where the project items, cost codes, and units automatically appear. Figure 5.7 illustrates this sheet. The project supervisor enters a specific proportion for item activity representing its share of workmanship cost. For example, shuttering workmanship proportion for concrete footing is 45% and proportion of reinforcement workmanship is 25%, etc. Of course it is possible to update and modify these proportions for each project. This sheet is linked to the daily inputs sheet, and by inserting the cost code of item, all data related to the activities of the item will appear there.

Figure 5.7: Activities sheet

E. Company labor force sheet:

This sheet includes data about labor such as labor number, labor name, trade, trade number, and rate. It is possible to update the labor names and their rates. Of course, the user can enter labor force who are involved in the project rather than entering all company labor force. It is possible to use a macro for sorting the labor according to their crafts to ease the searching procedure of numbers or names of labor when a daily monitoring is applied. Also, the macro of sorting can be used when a new labor is engaged, as this new labor is added to his trade group. The macro of sorting can be run by clicking on the *sorting according to the trade* icon. This sheet is linked to the daily inputs sheet, and by inserting the labor number, all data related to the labor appears there. Figure 5.8 illustrates the company labor force sheet.

Figure 5.8: Company labor force sheet

F. Materials Sheet:

Materials sheet contains data about material number, material name, unit, and unit rate. Figure 5.9 illustrates this sheet. It is possible to update the material names and their prices. Materials of project can be entered instead of all materials used for all projects. It is possible to use a macro for sorting the materials according to their group to ease the searching procedure of material numbers or names when a daily recording of used materials is taken place. Also, the macro of sorting can be used when a new material will be used, as this new material is placed in its group. The macro of sorting can be run by clicking on the *sorting according to the group* icon. This sheet is linked to the daily inputs sheet, and by inserting the material number, all data related to the material appears there.

Figure 5.9: Materials sheet

G. Equipment Sheet:

Equipment sheet involves data of equipment number, equipment name, unit, hired rate, and equipment group. Figure 5.10 illustrates this sheet. It is possible to update the equipment names and their rates. Equipment of project can be entered instead of all equipment used for all projects. It is possible to use a macro for sorting the equipment according to their group to ease the searching procedure of equipment numbers or names when a daily recording of used equipment is taken place. Also, the macro of sorting can be used when a new equipment will be used, as this new equipment is added to their group. The macro of sorting can be run by clicking on the *sorting according to the group* icon. This sheet is linked to the daily inputs sheet, and by inserting the equipment number, all data related to the equipment appears there.

Figure 5.10: Equipment sheet

K. Subcontractor Sheet:

The subcontractors sheet includes data of subcontractor number, name, trade, trade number, unit, and unit rate. Figure 5.11 illustrates this sheet. It is possible to update the subcontractor names and their rates. The subcontractors of a project can be entered instead of all subcontractors engaged in all projects. It is possible to use a macro for sorting the subcontractors according to their trade group to ease the searching procedure of subcontractor numbers or names when a daily recording of subcontractors is taken place. Also, the macro of sorting can be used when a new subcontractor will be engaged, as this new subcontractor is inserted into their trade group. The macro of sorting can be run by clicking on the *sorting according to the trade* icon. This sheet is linked to the daily inputs sheet, and by inserting the subcontractor number, all data related to the subcontractor appears there.

Figure 5.11: Subcontractors sheet

5.3.2.2 Daily inputs

This sheet is a template in which the daily data is entered. When the user hit the SAVE command, all these data, item costs, and other related data are transmitted to a database which is linked to the template by a function in Excel called *Template Wizard with Data Tracking*. Figure 5.12 illustrates the daily inputs sheet. The data is entered into this template from a data collection form which is filled manually by the foreman at the end of the working day. Figure 5.13 illustrates a proposed form for the daily data collection. The daily inputs includes a data about in-progress items, their activities and the resources used for them. The white cells are the cells where the numbers like the cost code and labor numbers are to be typed. By typing these numbers, a data like item description and labor name will appear automatically in the colored cells. This is done by using *Vlookup* function in Excel, where this sheet is linked to all sheets of basic data. In this sheet no need to type the daily date because the date appears automatically in the upper right side of the sheet by a formula linked to the computer timer. The daily total cost of the item is calculated by many Excel formulas and functions. The daily item cost is transmitted to a database after applying the SAVE command.

From this database many built-in reports are created by the Excel function called *Pivot Table*. The daily input sheet is preferred to be printed for each in-progress item and kept in a physical file.

The main components of daily inputs sheet are:

A. <u>Items:</u> The purpose of this part of the daily inputs sheet is to compute the gross amount of the item. This part includes data about the item description, unit, activities and their proportions, floors group, equivalent executed quantity, and gross amount of item. By entering the quantities of activities which are executed by the company labor and/or by the subcontractors, the equivalent quantities represent the quantity of item as if it is a ready executed item. For example, if 30 cubic meter of shuttering for a concrete footing is executed and the proportion of this activity is 45% of the item, the equivalent quantity will appear automatically as 13.5 cubic meter (30*0.45 = 13.5). The equivalent quantity of item leads to actual, easy and more accurate monitoring of costs. In this method, the manager will have a more objective measure of executed quantities that provide more accurate comparison and control.

Figure 5.12: Daily inputs sheet

Figure 5.13: A proposed form for the daily data collection

The item costs according to its floors group is considered, where the user has to determine the floor of the in-progress item. This provide a more accurate cost monitoring, because generally the cost of item differs from floor to floor. For example, the cost of one cubic meter of reinforced concrete columns located in the tenth floor is more than the cost of one cubic meter of columns of the same size in the ground floor.

B. Labor: The labor part is designed to compute the labor cost of the item. This part includes data about labor name, trade, trade number, rate, and overtime rate. The number of regular hours and the overtime rate of labor can be altered by changing the red numbers at the top of the this part. By entering the labor number and his regular hours, the labor cost will be automatically calculated and transferred to the gross amount cell in the item part.

C. Materials: The purpose of this part is to calculate the materials cost of the item. The data related to this part includes material name, unit and unit rate. By entering the material number and its quantity, the materials cost will be automatically calculated and transferred to the gross amount cell in the item part.

D. Equipment: The equipment part is formed to compute the equipment cost of the item. This part includes data about the equipment name, unit, hired rate, and overtime hired rate. The number of regular hours and the overtime rate of labor can be altered by changing the red numbers at the top of the this part. By entering the equipment number and its daily hired hours, the equipment cost will be automatically calculated and transferred to the gross amount cell in the item part.

E. Subcontractors: The purpose of this part is to calculate the subcontractors cost of the item. The data which is involved in this part includes subcontractor name, trade, trade number, unit and unit rate. By entering the subcontractor number and the quantity he executes, the subcontractors cost will be automatically calculated and transferred to the gross amount cell in the item part.

All inputs can be cleared by clicking on the *Clear* icon existing at the upper right side of the template. At the lower right side of the sheet there are three icons as follows:
-*Top*: to return to the top of the sheet.

-Gray: to change the color of the sheet to gray.

-Blue: to change the color of the sheet to blue.

The daily inputs sheet must be filled day by day in the end of the working day for each in-progress item. It is preferred to print the sheet and keep the print out in a physical file.

5.3.2.3 Reports

All reports are produced by processing database information by using the *Pivot Table* function in Excel. The database contains 98 cells of data in one record (row) which is transmitted from the *daily inputs* template by using the *Template Wizard with Data Tracking* Excel function. Every row (record) represents the data related to one entry of an item. Reports can be shown by clicking on the corresponding icons of reports on the menu, and they can be printed by PRINT command in the standard toolbar or in the file command list. Annex 3 illustrates figures for these reports.

The following is a summary for these built-in reports:

1- Up-to-date item cost report:

This report provides the up-to-date cost of each in-progress item. It gives the labor, materials, equipment, subcontractors costs of each item in each floor group. It also provides the total actual cost of the project (see Figure A3.1).

2- Daily cost report:

This report provides the daily labor, materials, equipment, subcontractors expenditures of each date for each in-progress item. Also it shows the executed quantity of each item and in any floor group (see Figure A3.2).

3- Item labor cost report:

This report gives the up-to-date labor cost of each item in more details. It provides the regular, overtime and total worked hours, and their amounts. Also, it shows the total labor cost of the project (see Figure A3.3).

4- Item materials cost report:

It provides the up-to-date materials cost of each item, and the total materials cost of the project (see Figure A3.4).

5- Item equipment cost report:

This report gives the up-to-date equipment cost of each item in more detail. It provides the regular, overtime and total worked hours, and their amount. Also, it shows the total equipment cost of the project (see Figure A3.5).

6- Item subcontractors cost report:

This report provides the up-to-date subcontractors cost of each item, and the total subcontracts cost of the project (see Figure A3.6).

7- Actual S-curve:

It is a graph which shows the cumulative actual cost of the project against the time (see Figure A3.7).

8- Cost per floor group report:

It provides the labor, materials, equipment, and subcontractors costs of each floor group (see Figure A3.8).

5.3.2.4 New project

The '*New Project*' icon is introduced for starting a new project. By clicking on this icon in the menu, an instruction sheet of starting a new project appears. Figure 5.14 illustrates this sheet.

5.3.2.5 Database

It is a sheet which consists of records of all data which is transmitted from the template (daily inputs) when the SAVE command is applied. From these records, all built-in reports are produced. Database sheet can be shown by clicking on the icon (database) from the menu. Figure 5.15 illustrates a partial database sheet.

5.3.2.6 Method of use

The '*Method of Use*' icon is responsible for displaying the method of use sheet which explains how the user can use CMS (See Figure 5.16). Section 5.3.3 of this chapter also clarifies the method of use.
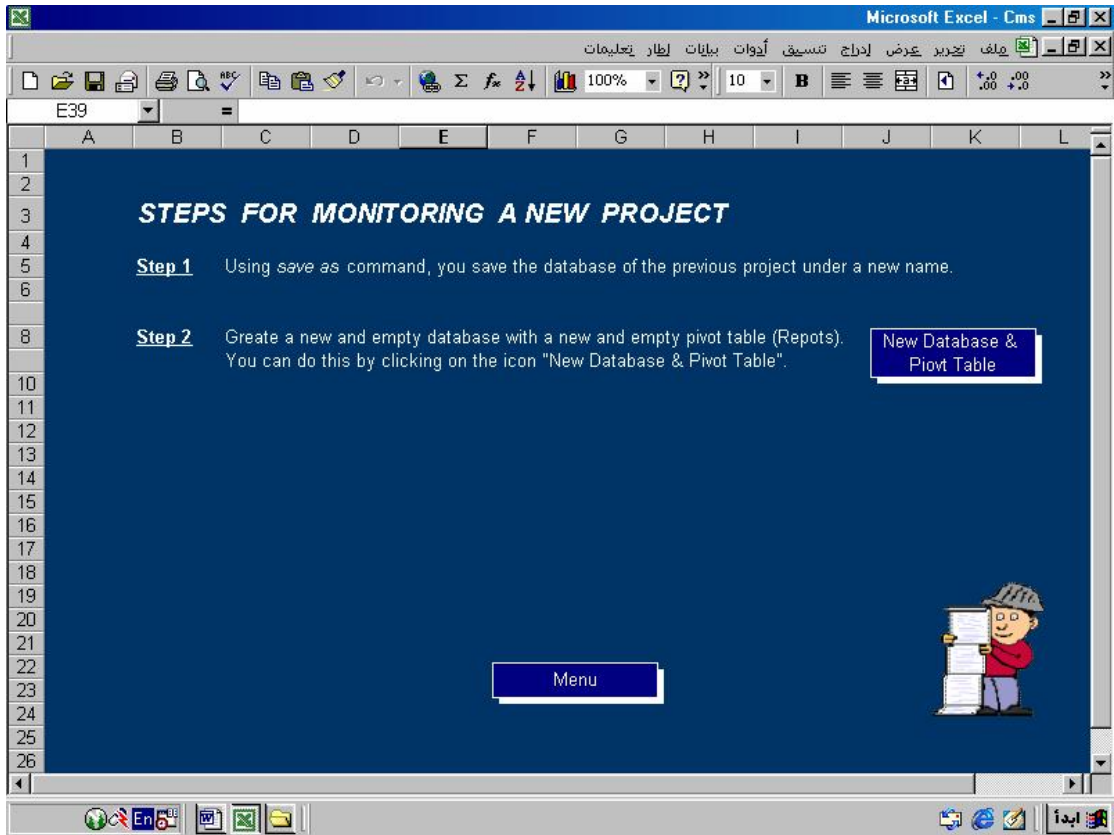
Figure 5.14: Steps for monitoring new project

Figure 5.15: Partial database sheet

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Figure 5.16: Partial sheet for method of use instruction

5.3.3 Software method of use

5.3.3.1 Software setup

CMS consists of three files (books) called CMS, Daily Inputs and Daily Database. These files are included in a folder entitled "CMS". The total volume of the three files is 4.57 Megabytes, and approximately 800 Kilobytes if they are compressed. You can setup the software by copying it from a floppy disk, unzipping, and posting it in the C part of the hard desk. By opening the file CMS you can run the software. You can create CMS icon on the desktop or you can add it to the list of programs in the start running list.

5.3.3.2 Method of use

After setting up CMS as described before, The user has to open the file CMS to run the software. In the beginning, the start sheet of the software will appear (Figure 5.2). By clicking on the *ENTER* icon at the lower part of the start sheet, the menu sheet (Figure 5.3) appears. You start entering the basic data in the company and project, Items, activities, labor, material, equipment, and subcontractors sheets (Figures 5.4 to

5.11). These sheets can be opened by clicking on their corresponding icons. To turn back to the menu, click on *Menu* icon at the upper right of the corresponding sheet. The data is entered in every sheet as follows:

Company and Project Data: In the company and project sheet (Figure 5.4), enter the data of company name, address, city, phone, and fax by typing them. Also enter the data of project name, project number, project location, contract value, and finish date.

Items Pool Data: Type the cost code, and description of each item in the general items sheet (Figure 5.5). You can enter the same data electronically by copying it from other source and paste in their place in the sheet. However, the sheet contains a list of general items as an example for illustration.

Project Items Data: Type the cost code in the project items sheet (Figure 5.6), as the item description appears automatically. Then enter the unit, unit rate or you can enter the same data electronically by copying it from other source and paste in their place in the item sheet. To turn back to the menu, click on *Menu* icon at the upper right side of the sheet.

Activities Data: Enter the activities of each item and their specific workmanship proportions in the activities sheet (Figure 5.7). For example, proportion of shuttering for concrete footing is 45% and proportion of reinforcement is 25%, etc.

Labor Data: In the company labor force sheet (Figure 5.8), enter the labor number, labor name, trade, trade number, and rate by typing or by electronically pasting. After entering these data, click on the *Sorting According to the Trade* icon to sort the list.

Materials Data: In the materials sheet (Figure 5.9), enter the materials number, material name, unit, unit rate, and group by typing or by electronically pasting. You can sort the materials according to their groups by clicking on the *Sorting According to the Group* icon.

Equipment Data: Type or paste the number, name, unit, hired rate, and the group of each equipment in the equipment sheet (Figure 5.10). Sort the equipment according to their groups by clicking on the *Sorting According to the Group* icon.

Subcontractor Data: In the subcontractors sheet (Figure 5.11), enter the subcontractor number, subcontractor name, trade, trade number, unit, and rate by typing or by electronically transferring. You can sort the subcontractors according to their trades by clicking on the *Sorting According to the Trade* icon.

After you finish entering the basic data, you can enter the daily data in the daily inputs sheet (Figure 5.12). You can open the template of the daily data (daily inputs sheet) by clicking on the *Daily Inputs* icon in the menu. The procedure of entering the daily data is summarized as follows:

A. Items: Type the cost code of item in the white cell, and press ENTER. Soon you will see all the data related to this item. This data includes the item description, unit, and activities and their proportions. Choose the floors group, enter the quantities of activities which are executed by the company labor and/or by the subcontractors, and press ENTER. You will see the equivalent quantity which represents the quantity of item as if it is completely executed. For example, when you enter 30 cubic meters as a quantity of shuttering for a concrete footing and the proportion of this activity is 45% of the item, the equivalent quantity appears automatically as 13.5 cubic meter.

B. Labor: Type the labor numbers who are engaged in the item in the white cells, and press ENTER. You will see all the data related to these labor. This data includes labor names, trades, trade numbers, rates, and overtime rates. Then enter the worked hours of each labor and press ENTER. You will see the regular hours and their amount, overtime hours and their amount, and total amount of hours. The labor cost will be automatically calculated and transferred to the gross amount cell in the item part. You can modify the regular hours from eight hours to any number adopted by the company by changing the red number in the top. Also, you can modify the overtime rate in the same way.

C. Materials: Type the material numbers which are used for the monitored item in the white cells, and press ENTER. You will see all data related to these materials which include material names, units and unit rates. Then enter the used quantities of materials and press ENTER. You will get the cost of materials for this item. The materials cost will be automatically computed and transferred to the gross amount cell in the item part.

D. Equipment: Type the equipment numbers which are used for the monitored item in the white cells, and press ENTER. You will see all data related to these equipment which include equipment names, units, hired rates, and overtime hired rates. Then, by entering the hired quantities of equipment and pressing ENTER, you will get the total amount. Also, if the unit of hired quantity is in hours you will get the regular hours and their amount, overtime hours and their amount, and total amount of hours. The equipment cost will be automatically calculated and transferred to the gross amount cell in the item part. You can modify the regular hours from eight hours to any number adopted by the company by changing the red number in the top. Also, you can modify the overtime rate by the same way.

E. Subcontractors: Type the subcontractor numbers that are involved in the monitored item in the white cells, and press ENTER. You will see all data related to these subcontractors; namely subcontractor names, trades, trade numbers, units and unit rates. Then enter the quantities which are executed by the subcontractors and press ENTER. You will get the cost of subcontractors for this item. The subcontractors cost will be automatically computed and transferred to the gross amount cell in the item part.

After completing the daily inputs of an item, you can print the sheet to keep it in a physical file. You can save it to the database by clicking on *SAVE* command in the standard toolbar or in file command list. Before entering data of a new item you can delete all inputs of the previous item by clicking on the *Clear* icon which exists at the upper right side of the template.

To see the built-in reports, in the menu sheet, click on the icon which related to the report you wish to see (Typical figures of the reports are shown in annex 3). After finishing the project, you have to save the database under a new name.

5.3.3.3 Monitoring a new project

In the beginning of a new project click on the *New Project* icon in the menu, and follow the instructions in the sheet which will appear. Figure 5.14 illustrates the sheet that shows steps to be followed for monitoring a new project. After saving the database of the previous project under a new name you can click on the *New Database* icon in the mentioned sheet to run a macro that clear out all data in the

database sheet to be ready to receive the data of the new project. Also, you have to modify all the data of the basic data of project, items, activities, labor, materials, equipment and subcontractors.

5.3.3.4 Printing

A copy of any sheet or report of the software can be printed easily by the *print* command in the standard toolbar or from file list. The sheets will be printed in only white and black colors. If you want to print a colored sheet you can do this after canceling (white and black) from (page) in the page setup in the file command list.

5.4 Software Evaluation

5.4.1 Evaluation objectives

Face validity is used as a test for model evaluation. Face validity is asking well experienced people about the system whether the model and/or its behavior are reasonable (Sargent 2000). CMS is evaluated by this reasonable method, where four contractors are approached to apply CMS in their corresponding projects. Then, they fill a questionnaire to evaluate the performance of CMS.

The objectives of the CMS evaluation are: (1) to assess the performance of CMS cost monitoring tools and techniques; (2) to check the suitability of CMS design and structure; (3) to know the difficulties that face the user during the use of CMS and try to overcome these difficulties; (4) to recognize the contractors' criticisms or comments on the software; and (5) to explore the CMS advantages.

5.4.2 Evaluation methodology

CMS is tested in four under construction projects belonging to four different contractors. The first, in Gaza, nine-story building of ministry of finance. The second, in Khan Younis, five-story building of Khan Younis municipality. The third, in Dair Al Balah, 700 meter tunnel for rainwater drainage. The fourth, in Gaza, two-floor building of Tal Al-Hawa rehabilitation hospital. The test takes 9 working days in the first project, 7 days in the second and the third project, and 5 days in the fourth project.

In each project, the researcher presents practically the CMS method of use to the site engineer or supervisor with illustrating examples. The basic data is entered in the specified space provided by CMS. This data includes in-progress items and their proposed cost codes, and proposed number for labor, materials, equipment and subcontractors. The proposed form of data collection (Figure 5.13) is given to the foreman to fill it daily during the test period. The data is collected by the foreman and entered into the computer by the supervisor in the end of every day. The actual costs of the tested items are calculated manually and compared with the results of the CMS reports. During the test period the researcher follows up the CMS implementation to ascertain that there is no problem facing the supervisors. After conducting the tests, a questionnaire is filled by each supervisor to evaluate CMS. Annex 4 and annex 5 illustrate, respectively, the questionnaire and its English version. The questionnaire consists of five sections. The first section, includes questions related to the performance of cost monitoring tools and techniques which are provided by CMS. The second, includes questions about the features of CMS design and structure. The third, includes a declaration of the difficulties encountered by contractors during the use of CMS. The fourth, includes any criticisms or comments that are given by the contractors on the software. The fifth, includes the advantages of CMS according the contractors' opinions. The data of the questionnaires are collected, analyzed, discussed, and evaluated. Then, the author provides conclusions about CMS evaluation.

5.4.3 Evaluation results and discussions

Table 5.1 illustrates the contractors' responses to performance of CMS tools and techniques. Almost all contractors agree or strongly agree with the performance of CMS techniques. The percentage of general average is 87.3%. These results indicate that the respondents are satisfied with performance of CMS tools and techniques.

As shown in table 5.2, almost all contractors agree or strongly agree with features of CMS design and structure. The percentage of general average of these features is 85.4 %. Therefore, the design and structure of CMS can be considered suitable and satisfactory.

Table 5.1: The contractors' responses to performance of CMS tools and techniques

No.	Tool/ Technique	Strongly Agree	Agree	Intermediately Agree	weakly Agree	Very Weakly Agree	% of Average*
1	Lists of available resources (labor, materials, equipment, subcontractors) which the contractor possesses. The lists includes data about these resources.		4				80
2	Monitoring the sub-activity of item, for example (first face for plaster/ reinforcement work for concrete columns). Also, converting the subactivity quantity to the item quantity.	4					100
3	Up-to-date actual cost report for each item, the cost is allocated on the resources (labor, materials, equipment and subcontractors).	2	2				90
4	Actual cost report for each item at any date.	1	3				85
5	Up-to-date labor cost report for each item, the report includes for example (the item- its quantity- number of regular hours and their amount- number of overtime hours and their amount- number of total hours and their amount).	3	1				95
6	Up-to-date materials cost report for each item, the report includes for example (the item- its quantity- amount of materials used for it).	3	1				95
7	Up-to-date equipment cost report for each item, the report includes for example (the item- its quantity- number of regular hours and their amount- number of overtime hours and their amount- number of total hours and their amount).	2	2				90
8	Up-to-date subcontractors cost report for each item, the report includes for example (the item- its quantity- the executed amount by the subcontractor).	1	3				85
9	S-curve for actual cost.	1	2	1			80
10	In the multistory buildings, a report provides the cost of item at each group of stories.		4				80
11	Keeping a database and providing a cost records.		4				80
Percentage of General Average							**87.3**

% of average are computed according to the weights: Strongly Agree = 5, Agree = 4, Intermediately Agree = 3, Weakly Agree = 2, Very Weakly Agree = 1

Table 5.2: The contractors' responses to the features of CMS design and structure

No.	Feature	Strongly Agree	Agree	Intermediately Agree	weakly Agree	Very weakly Agree	% of Average*
1	The software is flexible, and the data can be updated easily.	2	2				90
2	In general, its use is easy.	1	3				85
3	Save time and effort.	1	3				85
4	Method of entering the data is easy and clear.		4				80
5	The reports and outputs are clear, and easy to read and understand.	1	3				85
6	Method of sorting the data is easy.	1	3				85
7	The sentences and numbers of its context are concise, and their sizes are suitable and readable.	1	2	1			80
8	The information can be inquired easily.		4				80
9	The method of use is understandable.	2	2				90
10	Because CMS is built under Excel environment, it provide an ease and comfort dealing.	1	3				85
11	Training to use the CMS is easy and does not need for a great time. Also, it does not need for a professional user to deal with it.	2	2				90
12	It can be applied for the most of Gaza Strip projects. It is suitable for Gaza Strip contractors.	1	3				85
13	It contributes in improving the cost monitoring practice in Gaza Strip.	2	2				90
Percentage of General Average							**85.4**

% of average are computed according to the weights: Strongly Agree = 5, Agree = 4, Intermediately Agree = 3, Weakly Agree = 2, Very Weakly Agree = 1

Regarding the difficulties that the contractors face during the use of CMS, almost all contractors say that they do not face real difficulties. Only one contractor emphasizes the necessity of providing new user with enough training.

As for the criticisms or comments of the contractors on CMS, one of the contractors have no criticism or comment. The others have two considerable comments. The first, the activities and their proportions of an item in the *Activity* sheet have to be determined by experience. The author believes that CMS does capitalize on the contractor's experience and not a replacement of it. By and large, each item in a project is not standard and it is physically different from the same item in other projects. Therefore, it has not the same activity proportions. However, the experience

to determine the activities and their proportions is needed only in the beginning of the project. The second, CMS formulas are not secured, so it may be damaged. and the results may be affected. This comment is reasonable, and securing of CMS' formulas is one of improvements that CMS needs in future.

The four contractors mention several advantages of CMS. The main advantages are: CMS is easy to use and flexible; it helps the management staff in pricing the future projects and computing actual labor productivity; it monitors the cost of item through monitoring its sub-activities; it gives a report of item cost at each group of stories; and it provides the management with more accurate results and adequate documentation.

Overall, the results of the evaluation indicate that CMS tools and techniques are encouraging. Also, the contractors are generally satisfied with the design and structure of CMS. Moreover, the contractors mention that CMS suits the Gaza Strip contracting companies and contributes in improving the cost monitoring practice in Gaza Strip. During the test period, The contractors do not face any serious difficulties in applying CMS. This implies that the method of using CMS is reasonably easy. Almost the contractors do not present any significant criticism or comment on the software. The contractors mention many advantages of CMS. These advantages indicate that CMS is suitable and acceptable.

5.5 Software Limitations

There are some limitations belonging to the Excel environment upon which CMS is designed. First, as CMS is developed under Excel 2000, it needs as a minimum requirement to run. Second, the two add-in functions of Excel which are called *Pivot Table* and *Template Wizard with Data Tracking* have to be activated before using CMS. This is because CMS is basically built on these two functions. Third, because CMS includes many macros, the security level in Excel have to be medium or low. Fourth, the number of cells in one record of the database is limited to 98.

In the *Daily Inputs* sheet, there are restrictions in the following cells:
- Number of activities of one item is eight.
- Number of labor of one item is twenty.
- Number of materials of one item is twenty.

CHAPTER 6

Conclusions and Recommendations

6.1 Introduction

Cost monitoring is a fundamental component of a project cost control system. Cost monitoring helps in reducing the project costs, improving the accuracy of pricing of future projects, providing the necessary information for cost control, increasing the accuracy of determination of labor and equipment productivity, and maintaining the droits of contractors, labor, suppliers, and subcontractors. The study investigates the extent of applying the cost monitoring tools and techniques by Gaza Strip contractors. It explores the level of computer applications in supporting cost monitoring. Also, it aims at improving the cost monitoring practice. The proposed improvement is formulated in development of a computerized cost monitoring system (CMS).

In this chapter, the conclusions of the research are presented. Also, the research recommendations to construction industry stakeholders and recommendations for further studies are introduced.

6.2 Conclusions

• There is almost consensus amongst the surveyed contracting companies that all tools and techniques which are included in the field survey questionnaire are necessary for monitoring the project costs. Conversely, most of these techniques are not often applied adequately. Moreover, all the contractors never use cost coding and S-curve of actual cost.

• Most of contractors do not apply many tools and techniques of cost monitoring such as:
    - Monitoring the resources allocation.
    - Daily recording in-progress items.
    - Calculating the actual cost of resources periodically.
    - Daily recording of used materials.
    - Providing a store card for each material.
    - Providing materials purchase order form.

Even the few contractors who use the above mentioned tools and techniques, they apply these tools either without recording at all, or with recording but in an unsystematic way without using manual or computerized forms.

- Many contractors apply techniques which somehow imply that there is a cost monitoring application. These techniques include for example:
  - Making use of resulting information from cost monitoring system in the next stage 'cost control'.
  - Benefiting of resulting information from cost monitoring system in updating the cost database which is required for pricing future projects.
  - Following up the materials prices in the market and recording the variation of prices.

However, those contractors do not apply these techniques in a systematic way, where they neither depend on manual nor computerized forms in recording the data.

- There are other cost monitoring techniques which are used by many contractors. Yet, these techniques are not used for the cost monitoring purpose. They are used for accounting purposes, and for keeping the droits of contractors, labor, suppliers, and subcontractors. These techniques include for example:
  - Keeping the cost records (archiving).
  - Daily recording of labor.
  - Recording the received materials on site.
  - Reporting the problems related to the materials wastage and breakage, theft and loss, and shortage in deliveries, etc.
  - Daily/Weekly recording of used equipment in the project.
  - Summarizing the payments of subcontractor periodically.

Unfortunately, method of use of the above mentioned techniques usually does not depend on recording with typical forms or using computer. It generally depends only on the memories of contractor staff, or on a random recording without using manual or computerize forms.

- In general, Gaza Strip contractors apply a kind of cost monitoring practice in a way or another. But this practice is primitive, random, unsystematic, and inadequate.

Also, this practice is not applied periodically. In a few words, the cost monitoring practice of Gaza Strip contractors can not be considered as an effective system. It depends on the intuition and experience of the contractors. So it is in real need for improvement.

- The results indicate that Gaza Strip contractors do not use any software to support project cost monitoring. This gives the researcher a thrust to develop a computerized cost monitoring system that supports and improves this practice. This system is a tailored software to suit Gaza Strip contractors. The author names this software "Cost Monitoring Software" (CMS). It is designed within MS Excel environment where the results show that MS Excel is the most used software by the contracting companies in Gaza Strip. The software is tested in real projects and evaluated by experienced contractors. The evaluation indicates that the software is satisfactory and have the following features:

1. CMS suits Gaza Strip contracting companies and contributes in improving the cost monitoring practice in Gaza Strip. It has a good performance and an adequate accuracy.

2. CMS provides many reports including the actual item labor, materials, equipment, and subcontractors cost reports, and up-to-date direct cost of items.

3. CMS provides the mechanism to convert the entered executed quantities of item activities to equivalent quantity of finished item. This mechanism leads to easier, and more real and accurate cost monitoring.

4. CMS makes provision to compute the item costs considering its location at different group of floors. This provides more accurate cost monitoring, because generally the cost of item differs from floor to floor.

6.2 Recommendations

To Contractors:

Top management of contracting companies are invited to encourage developing and using cost monitoring systems. They can make incentives for their staff to attend training courses in cost monitoring and its applications. They should be encouraged also to attend courses covering different aspects of computer applications in construction management. They are encouraged to actually use computerized cost monitoring systems to save effort and time, and to achieve more accurate results.

To Public Employers:

The public employers include the governmental institutions such as PECDAR and Ministry of Public Works and Housing, and other public entities like UNRWA, UNDP, and World Bank. The public employers can contribute in improving the current cost monitoring practice of the contractors by requesting them to implement a cost monitoring system during construction. This could be done by adding a clause in the conditions of contract. Contractor's cost monitoring practice can be considered a criterion in contractor's pre-qualification requirements. For settlement of claims, disputes and variation orders, they can insist on having actual records to support the contractor case.

To Universities, Contractors Union, and Engineering Association:

These institutes have to do efforts to improve the existing cost monitoring practice which may include:

- Encouraging the contractors to use cost monitoring systems by clarifying the importance of these systems.
- Helping the contractors to understand the system by implementing training courses, lectures, seminars, and workshops.
- Transferring of technology and experiences of other countries in the cost monitoring field and adapting them to suit the Gaza Strip contractors.

6.3 Recommendations for Further Studies

CMS is a step along the way to establish a systematic cost monitoring practice amongst Gaza Strip contractors. Of course, it needs continuous modification and enhancement. The following are some points which needs further research efforts:

- CMS does not deal with the indirect costs. So, researchers are invited to cover this aspect.

- The list of items included in the *Items Pool* sheet of CMS is entered only for illustration. The author does this as there is no standard itemization for bill of quantities. Developing a standard bill of quantities suitable for contracting practice in Gaza Strip is very crucial for applying CMS and the like software. So, researchers are

encouraged to adopt this point. They are also invited to build a cost coding system that identifies these items.

- Researchers are invited to develop integrated packages that will include CMS. Integration can be approached at various levels such as:
  - Integrating estimating, monitoring and control functions.
  - Integration with a scheduling application packages such as MS Project.
  - Integration with other accounting administrative functions such as payroll, store keeping, etc.

- CMS can be improved by adding to it some communication features that enable it to be used on-line between the site and the headquarter.

- There is a chance to alter the method of gathering site data. The proposed method depends on collecting the data by using an electronic device instead of a paper form. Also, now there are global researches studying automating the monitoring process to calculate the in-progress quantities. These researches use cameras, electronic sensors and other devices to capture the data of progress and transfer them to computer electronically.

References

Ahuga, H.N., Dozzi, S.P. & Abourizk, S.M. (1994) *Project Management Techniques in Planning and Controlling Construction Procects*, 2nd ed, John Wiley & Sons, Inc., New York.

Barrie, D.S. & Paulson, B. (1992) *Professional Construction Management: Construction Management, Design-Construct, and General Contracting*. McGraw-Hill, New York.

Burns, N. & Grove, S.K. (1987) *The Practice of Nursing Research*, W.B. Saunders Company, Philadelphia.

Christofferson, J.P. (1999) Using Powerful Spreadsheet Application Tools to Increase the Efficiency and Effectiveness of Estimating, *ASC Proceedings of the 35th Annual Conference* California Polytechnic State University- San Luis Obispo, California April 7-10, 1999, pp. 197-204.

Clough, R.H. (1986) *Construction Contracting*, 5th ed, John Wiley & Sons, Inc. New York.

Contractors Union (2003) *Contractors Union Database*, Gaza.

El-Sawalhi, N. (2002) *Project Management Practice by Public Owners and Contractors in the Gaza Strip*, Msc. thesis, The Islamic University of Gaza, Palestine.

Fellows, R. & Liu, A. (1997) *Research Method for Construction*, Blackwell Science Ltd, UK.

Fish, L.A. (2002) *Progress and Performance Measurement & Evaluation*. Retrieved June 3, 2002, from http://www2.canisius.edu/~fishl/pmperformmeasure.html.

Forster, G. (1981) *Construction Site Studies-Production administration and Personnel*, Longman, Inc. UK.

Hanna, A.S. (2002). Retrieved August 15, 2002, from
http://www.cae.wisc.edu/~cee492/note/L09_wbs9811.ppt

Harris, F. & McCaffer, A. (1993) *Modern Construction Management*, 3rd ed, BSP Professional Books, London.

Hendrickson, C. (2000) *Project Management for Construction Fundamental Concepts for Owners, Engineers, Architects and Builders*, 2nd ed, prepared for world wide web publication www.ce.cmu.edu. Retrieved August 1, 2002 , from http://www.ce.cmu.edu/~cth/pmbook/05_Cost_Estimation.html

Hinze, J.W. (1999) *Construction Planning and Scheduling*, Prentice Hall, Columbus, Ohaio

Howell, G. & Ballard, G. (1996), *Can Project Controls Do Its Job?* Retrieved June 15, 2002, from http://cic.vtt.fi/lean/conferences.htm.

Hughes, W.P. (1991) *Effective Control of Construction Projects.* Paper to 7th Annual ARCOM conference, University of Bath.

Kibler, B.E. (1992) Integrated Cost and Schedule Control, *Cost Engineering, Vol. 34/No. 7,* USA.

Langford, D., Hancock, M.R., Fellows, R. & Gale, A.W. (2000) *Human Resources Management in Construction* , Longman, London.

Martin, B.A., CCE. (1992) Aspect of Cost Control, *Cost Engineering, Vol. 34/No. 6,* USA.

Mawdesley, M., Askew, W. & O'Reily M. (1997) *Planning and controlling Construction projects: the Best Laid Plan*, Longman, England.

Naoum, S.G. (1998) *Dissertation Research and Writing for Construction Students*, Butterworth-Heinemann, Oxford.

Oberlender, G.D. (1993) *Project Management for Engineering and Construction*, McGraw-Hill, New York.

Oxley, R.& Poskitt, J. (1992) *Management Techniques Applied to the Construction Industry*, 4th ed, BSP Professional Books, London.

Patrascu, A. (1978) *Construction Cost Engineering, Craftsman Book Company,* California.

Pilcher, R. (1992) *Principles of Construction Management*, 3rd ed, McGraw, London.

Polit, D.F. & Hungler, B.P. (1985) Essential of Nursing Research Method and Applications, J.B. Lippincott Company, Philadelphia.

Project Management Institute (PMI) (2000), *A guide to the Management Body of knowledge (PMBOK Guide 2000 Edition).*

Raffensperger, J.F. (2002). Retrieved July 23, 2002 from
http://www.interchange.net/cgibin/odp/frames.cgi?url=http://spreadsheetstyle.com

Rehberger, J.P. (1998) *Control Phase: Manage the Investment by Monitoring for Results.* Retrieved June 2, 2002, from http://www.gao.gov/policy/itguide/homepage.htm.

Ritz, G.J. (1994) *Total Construction Project Management*, McGraw-Hill, Schnberger.

Sargent, R. (2000) *Verification, Validation, and Accreditation of Simulation Models*, Proceedings of the 2000 Winter Simulation Conference. Retrieved September 1, 2003 from http://cfpm.org/~scott/proc-rat/proc-rat3_12.html

Sha'at, K.(1993) *A stochastic Cost Engineering System for Construction Project through the Rational Bill of Quantity*, PhD thesis, University of Leads, UK.

Singh, H. (1999) *Construction Management and Accounts*, 3rd ed, McGraw-Hill, Delhi.

Walpole, R.E., Myers, R.H. & Myers, S.L. (1998) *Probability and Statistics for Engineers and Scientists*, 6th ed, Prentice Hall International, Inc., New Jersy.

Weisberg, H.F. & Bowen, B.D. (1977) An Introduction to Survey Research and Data Analysis. Retrieved from www.faculty.washington.edu

Wideman R.M. (2001). *Cost Ceiling-to-Cost Performance Measurement Baseline.* Retrieved July 3, 2002,fromwww.pmforum.org/library/glossary/PMG_C10.htm

Wideman R.M. (2002) *Construction Claims identification, communication, and record keeping.* a paper presented to a TUNS/Revay seminar in 1990. Retrieved June 9, 2002, from http://www.maxwideman.com/papers/construction/intro.htm

Wideman. R.M. (1995) *Cost Control of Capital Projects,* BiTech Publishers Ltd. Retrieved July 2, 2002, from www.maxwideman.com

Willis, C.J. & Ashworth, A. (1992) *Practice and Procedure for the Quantity Surveyor*, 9th ed, BSP Professional Books, Oxford.

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Annex 1

Field survey questionnaire (In Arabic)

الجامعة الإسلامية - غزة

قسم الهندسة المدنية

استبيان عن
ممارسة مراقبة تكاليف المشاريع بواسطة مقاولي قطاع غزة

جزء من البحث التكميلي لنيل درجة الماجستير

في إدارة التشييد

الباحث/ م. محمد عبد الله الأستاذ

المشرف/ د. كمالين شعت

فبراير/ ٢٠٠٣

استبيان عن
ممارسة مراقبة تكاليف المشاريع بواسطة مقاولي قطاع غزة

السادة المقاولون/

نشكر سيادتكم للمساهمة في أوقاتكم و مجهوداتكم في تعبئة هذا الاستبيان.

يعتبر هذا الاستبيان جزء من البحث التكميلي لنيل درجة الماجستير في إدارة المشاريع. من خلال الاستبيان يتم التعرف على واقع نظام مراقبة تكاليف المشاريع لمقاولي قطاع غزة، و من ثم محاولة حــل مــشاكل النظــام المتبع و تطويره.

يتكون الاستبيان من الأجزاء التالية:

١- السيرة الذاتية للشركة.

٢- استخدام أدوات و تقنيات نظام مراقبة تكاليف مشاريع التشييد.

٣- استخدام الحاسوب في نظام مراقبة تكاليف مشاريع التشييد.

٤- تطبيق نظام مراقبة تكاليف مشاريع التشييد.

جميع البيانات و المعلومات الواردة في الاستبيان ستستخدم فقط لتقييم و دراسة نظام مراقبة تكاليف المــشاريع المتبع، و المعلومات الشخصية و الخاصة الواردة لن تنقل إلى أي جهات أخرى.

الباحث
محمد عبد الله الأستاذ

الجزء الأول/ السيرة الذاتية للشركة

١- سنة تأسيس الشركة _____

٢- مجال عمل الشركة:

- أعمال أبنية: □ رئيسي □ فرعي □ لا يوجد
- أعمال مياه و صرف صحي: □ رئيسي □ فرعي □ لا يوجد
- أعمال طرق: □ رئيسي □ فرعي □ لا يوجد

٣- درجة تصنيف الشركة حسب تصنيف اتحاد المقاولين لمجالات العمل التالية:

- أعمال أبنية: □ درجة أولى (أ، ب) □ درجة ثانية □ درجة ثالثة
- أعمال مياه و صرف صحي: □ درجة أولى (أ، ب) □ درجة ثانية □ درجة ثالثة
- أعمال طرق: □ درجة أولى (أ، ب) □ درجة ثانية □ درجة ثالثة

٤- المركز الإداري لمن يقوم بتعبئة الاستبيان:

□ مدير/ نائب مدير □ مدير مشروع أو مشاريع □ مهندس موقع □ غير ذلك _____

٥- متوسط إجمالي عدد الموظفين خلال الخمس سنوات الماضية _____

٦- متوسط عدد الموظفين حسب الشهادات العلمية خلال الخمس سنوات الماضية:

- ماجستير فأعلى: □ لا يوجد □ يوجد عدد _____
- بكالوريوس: □ لا يوجد □ يوجد عدد _____
- معهد متوسط: □ لا يوجد □ يوجد عدد _____
- ثانوية عامة: □ لا يوجد □ يوجد عدد _____
- دون الثانوية العامة: □ لا يوجد □ يوجد عدد _____

٧- متوسط عدد الموظفين الفنيين حسب مجالات التخصص الهندسي خلال الخمس سنوات الماضية:

مهندس مدني _____ مهندس معماري _____ مهندس كهرباء _____ مهندس ميكانيك _____

مهندس متخصص بغير ما ذكر _____ فني _____

٨- عدد المشاريع المنفذة خلال الخمس سنوات الماضية:

□ ١٠ فأقل □ ٢٠-١١ □ ٣٠-٢١ □ ٤٠-٣١ □ ٥٠-٤١ □ أكثر من ٥٠

٩- إجمالي قيمة المشاريع المنفذة خلال الخمس سنوات الماضية (بالمليون دولار):

□ ١,٥ فأقل □ ٣-١,٦ □ ٤,٥-٣,١ □ ٦-٤,٦ □ ٧,٥-٦,١ □ أكبر من ٧,٥

١٠- المعدات و الآليات المستخدمة خلال الخمس سنوات الماضية في العموم هي:

□ مملوكة للشركة بالكامل

□ مستأجرة بالكامل

☐ مملوكة و مستأجرة مع تغليب الملكية.

☐ مملوكة و مستأجرة مع تغليب الاستئجار.

١١ - أنواع العقود الهندسية التي نفذتها الشركة خلال الخمس سنوات الماضية:

☐ جميعها باستخدام نظام سعر الوحدة (Unit Price)

☐ جميعها باستخدام نظام المقطوعية (Lump Sum)**.**

☐ باستخدام كلا من النظامين و لكن معظمها باستخدام نظام سعر الوحدة.

☐ باستخدام كلا من النظامين و لكن معظمها باستخدام نظام المقطوعية.

الجزء الثاني/ استخدام أدوات و تقنيات نظام مراقبة تكاليف مشاريع التشييد

١٢ - في الجدول التالي استفسارات عن استخدام أدوات و تقنيات نظام مراقبة تكاليف مشاريع التشييد، و الاستفسارات مقسمة إلى ثلاث مجموعات كالتالي:

أولا - درجة الضرورة: ضع علامةX على أحد الخيارات الثلاثة الواردة بتلك المجموعة حسب <u>قناعتكم</u>.

ثانيا - مدى الاستخدام: ضع علامة X على أحد الخيارات الثلاثة الواردة بتلك المجموعة حسب <u>استخدامكم</u> لها.

ثالثا - طريقة الاستخدام: في حالة الاستخدام، ضع علامة X على أحد الخيارات الأربعة الواردة بتلك المجموعة حسب <u>طريقتكم</u> الغالبة بالاستخدام.

ملاحظة/ يرجى إرفاق أي نماذج تستخدمونها في مراقبة تكاليف المشاريع.

طريقة الاستخدام				مدى الاستخدام			درجة الضرورة					
باستخدام نموذج محوسب	تسجيل باستخدام نموذج	تسجيل بدون استخدام نموذج	بدون تسجيل (ذهني)	يستخدم عادة	يستخدم أحيانا	لا يستخدم	ضروري	اختياري	غير ضروري	الأدوات و التقنيات		المجموعة	بند
										استخدام كود التكلفة (Cost Code) على مستوى البند.	١	المشروع/علم	أ
										استخدام كود التكلفة على مستوى الفعالية الجزئية من البند،مثلا (وجه أول للقصارة/ أعمال تسليح للأعمدة الخرسانية).	٢		
										استخدام كود التكلفة على مستوى الفعالية الجزئية من البند بحسب موقعها في الطوابق.	٣		
										استخدام كود التكلفة على مستوى مجموعة من البنود ذات القيم الهامشية التي يمكن تنفيذها معا.	٤		
										رصد توزيع الموارد من عمال، و مواد، و معدات، و مقاولي باطن على بنود الأعمال المختلفة.	٥		
										استخدام المنحنى S التراكمي للتكلفة الفعلية (Actual S-Curve)	٦		
										الاحتفاظ بملفات التكلفة (أرشفة).	٧		
										الاستفادة من المعلومات الناتجة من نظام مراقبة تكلفة المشروع (Cost Monitoring) في المرحلة التالية و هي السيطرة و التحكم في تكلفة المشروع (Cost Control)**.**	٨		

باستخدام نموذج محوسب	تسجيل باستخدام نموذج	تسجيل بدون استخدام نموذج	بدون تسجيل (ذهنيا)	يستخدم عادة	يستخدم أحيانا	لا يستخدم	اختياري	غير ضروري / ضروري	الأدوات و التقنيات	#	المجموعة	بند
									الاستفادة من المعلومات الناتجة من نظام مراقبة تكلفة المشروع فـي تحديث قاعدة بيانات التكاليف اللازمة للتسعير.	٩		
									التسجيل اليومي للبنود تحت التنفيذ، يوضـح مـثلا (رقـم الكـود- الوصف - الكمية المنفذة).	١	البنود	ب
									حساب التكلفة الفعلية للموارد (عمال - مواد - آليات -مقاولي باطن) لكل بند كل فترة معينة، مثلا (يوميا/ أسبوعيا/ شهريا).	٢		
									وجود قائمة بالعمالة المتوفرة لدى المقاول، توضح مثلا (اسم العامل - رقم العامل - الصنعة - الأجرة- أجرة الساعات الإضافية).	١	العمال	ج

طريقة الاستخدام				مدى الاستخدام			درجة الضرورة					
باستخدام نموذج محوسب	تسجيل باستخدام نموذج	تسجيل بدون استخدام نموذج	بدون تسجيل (ذهنيا)	يستخدم عادة	يستخدم أحيانا	لا يستخدم	اختياري	ضروري / غير ضروري	الأدوات و التقنيات		المجموعة	بند
									التسجيل اليومي للعمال، يوضح مثلا (أسم العامل - رقم العامـل- عـدد ساعات العمل- البند الذي عمل به).	٢	تابع العمال	
									وجود بطاقة شهرية (كارت) لكل عامل يتم به التسجيل اليومي لـساعات العمل و الساعات الإضافية، و يوقع مثلا من مراقب العمل.	٣		
									وجود قائمة بالمواد، تحتوي مثلا على (اسـم المـادة- رقـم المـادة- الوحدة- السعر).	١	المواد	د
									التسجيل اليومي للمواد المستخدمة، يوضح مثلا (اسم المادة- رقم المادة- الوحدة- الكمية المستخدمة- البند الذي استخدمت به المادة).	٢		
									وجود بطاقة (كارت) لكل مادة لاستخدام المخـزن، يـشمل (الرصـيد- المصروف- المتبقي).	٣		
									وجود نموذج طلبية مواد، يوضح مثلا (رقم الطلبية- وصـف المـادة- الكمية المطلوبة- السعر).	٤		
									تسجيل المواد المستلمة في المشروع، يوضح مثلا (رقم الإرسالية- اسم المورد- وصف المادة- كمية المادة).	٥		
									تسجيل حالة المواد في مخزن المشروع، يوضح مثلا (اسم المورد - رقم الطلبية- الكمية الداخلة- الكمية المصروفة- ميزان Balance).	٦		
									تسجيل الإشكاليات، مثلا (الفاقد- السرقة أو الضياع- نقص في التوريد عند الاستلام ...).	٧		
									متابعة الأسعار في السوق و تسجيل تغيرات الأسعار.	٨		
									وجود قائمة بالآليات، تشمل مثلا (اسم الآلية- رقم الآلية- التكلفة).	١	الآليات والمعدات	ه
									التسجيل اليومي/ الأسبوعي للآليات المستخدمة في المشروع، يوضـح مثلا (اسم الآلية- رقم الآلية- الوحدة- الكمية المستأجرة- البنـد الـذي استخدمت به الآلية).	٢		

										وجود قائمة بمقاولي الباطن، توضح مثلا (اسم مقاول الباطن - رقمـــه - صنعته).	١	و مقاولو الباطن
										التسجيل اليومي لمقاولي الباطن العاملين في المشروع، يوضح مثلا (اسم مقاول الباطن - رقمه - صنعته - البند والكمية التي نفذها).	٢	
										تلخيص الدفعات لكل مقاول باطن كل فترة معينة (مـــثلا كــل شــهر) (Progress Payment Summary Report) يوضــح مـــثلا (قيمة العقد - القيمة المنجزة حتى تاريخه - القيمة المدفوعة حتى تاريخه - المحجوز حتى تاريخه).	٣	

ملاحظة/ يرجى إرفاق أي نماذج تستخدمونها في مراقبة تكاليف المشاريع.

الجزء الثالث/ استخدام الحاسوب في نظام مراقبة تكاليف مشاريع التشييد

١٣ - استخدام شركتكم لبرامج حاسوب في دعم مراقبة تكاليف المشاريع:

□ لا تستخدم   □ تستخدم برامج جداول إلكترونية مثل الإكسل Excel   □ تستخدم برامج متخصصة

١٤ - في السؤال السابق في حالة استخدامكم لبرامج حاسوب في دعم مراقبة تكاليف المشاريع، حـــدّد مـــدى اســـتخدامكم لتلـــك البرامج في المجالات التالية بوضع علامة X في أحد الخيارات:

لا تستخدم	تستخدم أحيانا	تستخدم عادة	الاستخدام	بند
			التسجيل اليومي للبنود تحت التنفيذ مع الموارد المستخدمة لها (عمـــال، مـــواد، معـــدات، مقـــاولي الباطن).	أ
			تقرير التكلفة الفعلية لكل بند موزعة على الموارد (عمال، مواد، معدات، مقاولي باطن).	ب
			تقرير العمالة لكل بند، يشمل مثلا (البند - كميته - عدد الساعات الاعتيادية و قيمتها و عدد الساعات لإضافية و قيمتها - عدد الساعات الكلية و قيمتها).	ج
			تقرير المواد لكل بند، يشمل مثلا (البند - كميته - قيمة المواد المصروفة عليه).	د
			تقرير الآليات و المعدات لكل بند، يشمل مثلا (البند - كميته - عدد الساعات الاعتياديـــة و قيمتهـــا - عدد الساعات لإضافية و قيمتها - عدد الساعات الكلية و قيمتها).	ه
			تقرير مقاولي الباطن لكل بند، يشمل مثلا (البند - كميته - القيمة المنفذة من قبل مقاول الباطن).	و
			جدول الكميات و التكاليف الفعلية (حتى تاريخه أو عند أي تاريخ).	ز
			المنحنى - S للتكلفة الفعلية (Actual S-Curve).	ح
			في مشاريع المباني متعددة الطوابق: تقرير يوضح تكلفة البند في كل مجموعة من الطوابق.	ط

١٥ - رتب مدى استخدام شركتكم للبرامج التالية في العمل: (أعط رقم ١ للأكثر استخدام و رقم ٢ للذي يليه و هكذا.....)

Access □   Excel □   MS Project □   Word □

الجزء الرابع/ تطبيق نظام مراقبة تكاليف مشاريع التشييد

١٦ - بين رأيك في مدى تأثير المعوقات التالية في الاستخدام الكفء لنظام مراقبة تكاليف المشاريع:
(ضع علامة X في أحد الخيارات)

ضعيف جدا	ضعيف	متوسط	كبير	كبير جدا	المعوق	بند
					عدم إدراك أهمية نظام مراقبة تكاليف المشاريع للمقاول.	أ

						بند
					عدم فهم نظام مراقبة تكاليف المشاريع.	ب
					عدم القدرة على تطبيق النظام.	ج
					عدم وجود قناعة لتطبيق النظام.	د
					عدم وجود رغبة في تطبيق النظام.	ه
					عدم التزام الإدارة العليا بتطبيق النظام.	و
					عدم توفر الاستشاري الخبير الذي يمكنه المساعدة في تطبيق النظام.	ز
					الاعتقاد بأن تطبيق النظام يضيع وقت المشرفين على تنفيذ المشاريع.	ح
					الاعتقاد بأن الفائدة المرجوة منه قليلة بالنسبة لتكلفة تطبيقه.	ط

١٧ - قيّم الفوائد التالية المرجوة من تطبيق نظام مراقبة تكاليف المشاريع حسب درجة الأهمية:
(ضع علامة X في أحد الخيارات)

غير مهمة بتاتا	غير مهمة	لا يوجد فرق	مهمة	مهمة جدا	الفائدة	بند
					تقليل تكلفة المشروع.	أ
					زيادة دقة تسعير مشاريع لاحقة.	ب
					حفظ سجلات التكاليف.	ج
					حفظ حقوق المقاول و العمال و الموردين و مقاولي الباطن.	د
					دقة معرفة السيولة النقدية (Cash Flow) اللازمة لمشاريع مستقبلية.	ه
					الدقة في تحديد قيمة الفاقد في المواد.	و
					الدقة في تحديد إنتاجية العمال و المعدات.	ز
					توفير معلومات التكلفة الضرورية لنظام التحكم بتكلفة المشروع (Cost Control).	ح
					زيادة القيمة المكتسبة (Earned Value).	ط
					حفظ حقوق المقاول في الأعمال الإضافية.	ي

١٨ - حدّد درجة أهمية العوامل التالية في نجاح و فعالية تطبيق نظام مراقبة تكاليف المشاريع:
(ضع علامة X في أحد الخيارات)

غير مهم بتاتا	غير مهم	لا يوجد فرق	مهم	مهم جدا	العامل	بند
					اهتمام الإدارة العليا.	أ
					توفر الموارد المالية المناسبة.	ب

					مرونة إجراء التغيير	ج
					سهولة تطبيق النظام بالإضافة لفعاليته.	د
					حوسبة النظام	ه
					إمكانية الاستفادة من الخبرات السابقة.	و
					تشجيع المؤسسات المهتمة بقطاع التشييد مثل اتحــاد المقـــاولين، و توفيرهــا للبرامج التدريبية	ز

Annex 2

Field survey questionnaire (English version)

THE ISLAMIC UNIVERSITY- GAZA

Civil Engineering Department

Questionnaire about
Cost Monitoring Practice of Gaza Strip Contractors

In Fulfillment of MSc. Degree Requirement
in Construction Management

Student: Mohammed Al-Ostaz
Supervisor: Dr. Kamalain Sha'at
Feb, 2003

Questionnaire about

Cost Monitoring Practice of Gaza Strip Contractors

Sir/

I strongly thank you for your contribution of time and effort to complete this questionnaire.

This questionnaire is considered a part of the fulfillment of the master degree requirement in construction management. Through the questionnaire, the realist of the cost monitoring system of Gaza Strip contractors will be detected, then an attempt to solve the problems of the system and to improve it.

The questionnaire consists of the following sections:
1- Company profile.
2- Application of cost monitoring tools and techniques.
3- Computer applications in cost monitoring.
4- Implementation of cost monitoring systems.

The data that is given in the questionnaire will be used only for evaluation and exploration the cost monitoring system, also the personal and peculiar information will not be transferred to any party.

The Researcher
Mohammed Al-Ostaz

Section One
Company Profile

1- Year of company establishment _____

2- Company work field:
- Building works: ☐ Main ☐ Secondary ☐ Unspecialized
- Water and sewerage works: ☐ Main ☐ Secondary ☐ Unspecialized
- Roads works: ☐ Main ☐ Secondary ☐ Unspecialized

3- Company classification according the contracting union for the following fields:
- Building works: ☐ First class (A,B) ☐ Second class ☐ Third class
- Water and sewerage works: ☐ First class ☐ Second class ☐ Third class
- Roads works: ☐ First class (A,B) ☐ Second class ☐ Third class

4- Managerial position of the respondent:
☐ Director/Vice director ☐ Project manager ☐ Site engineer ☐ Non of the

5- Average of employees number (in the year) during the last five years _____

6- Average of employees number (in the year) during the last five years according to their scientific certificates:
- MSc. And higher: ☐ Existing ☐ Unexisting Number _____
- BSc.: ☐ Existing ☐ Unexisting Number _____
- Intermediate institute: ☐ Existing ☐ Unexisting Number _____
- Baccalaureate-Tawjihi: ☐ Existing ☐ Unexisting Number _____
- Under baccalaureate: ☐ Existing ☐ Unexisting Number _____

7- Average of technical employees number (in the year) during the last five years according to the engineering specialization:

Civil engineer _____ Architect engineer _____ Electrical engineer _____
Mechanical engineer _____ Other specialist engineer _____ Technical _____

8- Number of executed projects during the last five years:
☐ 10 and below ☐ 11-20 ☐ 21-30 ☐ 31-40 ☐ 41-50 ☐ More than 50

9- Total amount of executed projects during the last five years (in million dollars):
☐ 1.5 and lesser ☐ 1.6-3 ☐ 3.1-4.5 ☐ 4.6-6 ☐ 6.1-7.5 ☐ More than 7.5

10- Used equipment during the last five years, in general are:
☐ Completely owned by the company.
☐ Completely hired by the company.
☐ Owned and hired but most of them are owned.
☐ Owned and hired but most of them are hired.

11- Types of the engineering contracts which the company executed during the last five years are:
☐ Exclusively unit price contracts.
☐ Exclusively lump sum contracts.
☐ Both unit price and lump sum but most of them are unit price.
☐ Both unit price and lump sum but most of them are lump sum.

Section Two

Application of Cost Monitoring Tools and Techniques

12- In the following table, inquiries about the using of tools and techniques of the cost monitoring system. These inquiries are divided into three groups as follow:

Firstly- Degree of Necessity: Put X mark in one of the three choices of this group according <u>your viewpoint</u>.

Secondly- Extent of Use: Put X mark in one of the three choices of this group according <u>your using</u>.

Thirdly- Method of Use: Put X mark in one of the three choices of this group according <u>your prevailing method</u>.

Item	Group		Tools and Techniques	Degree of Necessity			Extent of Use			Method of Use			
				Unnecessary	Optional	Necessary	Not used	Sometimes used	Usually used	Without recording (in memory)	Recording without a form	Recording by using a form	By using a computerized form
A	Project/General	1	Using the cost code at the level of item.										
		2	Using the cost code at the level of sub-activity of item, for example (first face for plaster/ reinforcement work for concrete columns).										
		3	Using the cost code at the level of sub-activity of item according its location in the stories.										
		4	Using the cost code at the level of a set of minor items which can be executed together.										
		5	Monitoring the resources allocation of various working items. (resources include labor, materials, equipment and subcontractors).										
		6	Using the S-curve of actual cost.										
		7	Keeping of cost records (archiving).										
		8	Making use of resulting information from cost monitoring system in the next stage which is the cost control.										
		9	Benefiting of resulting information from cost monitoring system in updating the cost database which is required for pricing future projects.										
B	ct	1	Daily recording of in-progress items, the record declares for example (cost code- description- executed quantity).										

Item	Group		Tools and Techniques	Degree of Necessity			Extent of Use			Method of Use			
		2	Calculating the actual cost of resources (labor, materials, equipment and subcontractors) for each item periodically, for example (daily/weekly/monthly).										
				Unnecessary	Optional	Necessary	Not used	Sometimes used	Usually used	Without recording (in memory)	Recording without a form	Recording by using a form	By using a computerized form
C	Labor	1	Providing a list of the available labor which the contractor possess, the list illustrates for example (labor name- labor number- craft- regular rate- overtime rate).										
		2	Daily recording of labor, the record shows for example (labor name- labor number- number of regular hours- number of overtime hours- the item in which a labor works).										
		3	Providing a card for every labor in which the regular hours and the overtime hours are registered, also it is signed for example by the foreman.										
D	Materials	1	Providing a list of materials, it includes for example (material name- material number- unit- price).										
		2	Daily recording of used materials, the record illustrates for example (material name- material number- unit- used quantity- the item in which the material is used).										
		3	Providing a store card for each material, it contains for example (input- output- balance).										
		4	Providing materials purchase order form, it includes for example (order number- material description- required quantity- price).										
		5	Recording the received materials on site, the record shows for example (delivery number- material name- material description- quantity).										
		6	Reporting the situation of materials in the store, the report illustrates for example (supplier name- order number- quantity input- quantity output- balance).										

Item	Group		Tools and Techniques	Unnecessary	optional	Necessary	Not used	Sometimes used	Usually used	Without recording (in memory)	Recording without a form	Recording by using a form	By using a computerized form
		7	Reporting the problems, for example (wastage and breakage, theft and loss, shortage in deliveries, etc).										
		8	Following up the prices in the market and recording the variation of prices.										
			Degree of Necessity — **Extent of Use** — **Method of Use**										
E	Equipment	1	Providing a list of equipment that includes for example (equipment name- equipment number- rate).										
		2	Daily/Weekly recording of used equipment in the project, the record illustrates for example (equipment name- equipment number- unit- hired quantity- the item in which it is used).										
F	Subcontractors	1	Providing a list of subcontractors, it includes for example (subcontractor name- his number- his craft).										
		2	Daily recording of the subcontractors working in the project, the record declares for example (subcontractor name- his number- his craft- the item in which he worked).										
		3	Summarizing the payments of every subcontractor periodically (for example every month), Progress Payment Summary Report, the report declares for example (contract amount- completed value to date- paid to date- retaining to date).										

Note/ Please attach any forms which you are using them for cost monitoring.

Section Three
Computer applications in cost monitoring

13- Using of your company of software for supporting the cost monitoring:
☐ Not use.
☐ Use spreadsheet such as Excel.
☐ Use special software for cost monitoring.

14- In the previous question, in the case you are using software which support the cost monitoring, determine the extent of your use of these software in the following fields by putting X mark in one of the choices:

Item	Use	Usually used	sometimes used	not used
A	Daily recording of the in progress items and the resources used for them. (resources mean labor, materials, equipment and subcontractors)			

Item	Use	Usually used	sometimes used	not used
B	Actual cost report for each item, the cost is allocated on the resources (labor, materials, equipment and subcontractors).			
C	Labor report for each item, the report includes for example (the item- its quantity- number of regular hours and their amount- number of overtime hours and their amount- number of total hours and their amount).			
D	Materials report for each item, the report includes for example (the item- its quantity- amount of materials used for it).			
E	Equipment report for each item, the report includes for example (the item- its quantity- number of regular hours and their amount- number of overtime hours and their amount- number of total hours and their amount).			
F	Subcontractors report for each item, the report includes for example (the item- its quantity- the executed amount by the subcontractor).			
G	Bill of quantities and the actual costs (up to date or at any date).			
K	S-curve of actual cost.			
H	In the multistory buildings, a report provides the cost of item at each group of stories.			

15- Rank the following software according your extent of handling them in the job:
(give number 1 for the more in use, number 2 for the coming after, and so on ….)
  ☐ Word   ☐ MS project   ☐ Excel   ☐ Access

Section Four
Implementation of cost monitoring systems
16- Give your opinion about the extent of the following obstacles on using efficient cost monitoring system: (put X mark in one of the choices)

Item	Obstacle	Very Strong	Strong	Intermediate	Weak	Very Weak
A	Non-realization of importance of cost monitoring system by the contractor.					
B	Absence of understanding of cost monitoring system.					

Item	Obstacle					
C	Inability of the system implementation.					
D	Absence of convincing of the system implementation.					
E	Absence of ability to implement the system.					
F	Absence of commitment of top management to implement the system.					

Item	Obstacle	Very Strong	Strong	Intermediate	Weak	Very Weak
G	Absence of expert consultant who can help in the system implementation.					
K	The thinking that implementing the system wastes away the time of project supervisors.					
H	The belief that desired benefit from the system is little comparing with its cost.					

17- Value, according the importance degree, the following desired benefits beyond implementing the cost motoring system: (put X mark in one of the choices)

Item	Benefit	Very important	Important	No Deference	Not Important	Never Important
A	Reducing project cost.					
B	Increasing pricing accuracy of future projects.					
C	Keeping cost records.					
D	Maintaining droits of contractors, labor, suppliers and subcontractors.					
E	Accuracy of knowing the cash flow which is needed for future projects.					
F	Accuracy of determining the materials waste amount.					
G	Accuracy of determining the productivity of labor and equipment.					
K	Providing cost information which is vital for project cost control.					
H	Increasing the earned value.					
L	Maintaining contractor droits of the additional works.					

18- Determine the importance degree of the following factors which affect the success and efficiency of cost monitoring implementation: (put X mark in one of the choices)

Item	Factor	Very important	Important	No Deference	Not Important	Never Important
A	Commitment of top management.					
B	Availability of appropriate monetary resources.					
C	Flexibility of the system.					
D	Easiness of implementing the system, in addition to its effectiveness.					
E	Computerizing the system.					

F	Possibility of benefiting from the previous experiences.					
G	Encouraging of institutions which are concerned with the construction sector, such as the Contractors Union, and organizing training programs					

Annex 3

Figures for the software reports

Figure A3.1 (Microsoft Excel - Daily Database)

	Cost Code	Item Description	Floors Range	Item Unit	Item Quantity	L Amount	M Amount	E A
1	Project Nam	(الكل)						
2	Date	(الكل)						
3								
4	Gross Amo							
5	Cost Code	Item Description	Floors Range	Item Unit	Item Quantity	L Amour	M Amou	E A
6	3100	R.Concrete B300 for Foundation	0-4	m3	8	188.1	2120	
7	مجموع 3100							
8	3200	R.Concrete B300 for Grounde Beams & Steps	0-4	m3	18	82.375	4050	
9					4	172.5	5110	
10	مجموع 3200							
11	3300	R.Concrete B300 for Necks & Columns	0-4	m3	2	156.15	5443	
12	مجموع 3300							
13	3400	R.concrete B300 For Slabs thickness 30cm	5-9	m2	15	197.25	7029	
14	مجموع 3400							
15	4100	Block work for walls thickness 20 cm	5-9	m2	80	197.75	5100	
16	مجموع 4100							
17	4200	Block work for internal walls thickness 15 cm	5-9	m2	8	32.2	475	
18					80	197.6	4560	
19					88	232.65	5054	
20	مجموع 4200							
21	4300	Block work for internal walls thickness 10 cm	0-4	m2	64	186.3	3800	
22	مجموع 4300							
23	المجموع الكلي							
24								

Figure A3.1: Up-to-date item cost report

Figure A3.2 (Microsoft Excel - Daily Database)

	Date	Cost Code	Item Description	Floors Range	Item Unit	Item Quantity	L Amour	M
1								
2	Project Nam	(الكل)						
3								
4	Gross Amou							
5	Date	Cost Code	Item Description	Floors Range	Item Unit	Item Quantity	L Amour	M
6	21/02/04	3100	R.Concrete B300 for Foundation	0-4	m3	8	188.1	
7	مجموع 21/02/04							
8	22/02/04	3200	R.Concrete B300 for Grounde Beams & Steps	0-4	m3	4	172.5	
9	مجموع 22/02/04							
10	23/02/04	3300	R.Concrete B300 for Necks & Columns	0-4	m3	2	156.15	
11	مجموع 23/02/04							
12	24/02/04	3200	R.Concrete B300 for Grounde Beams & Steps	0-4	m3	18	82.375	
13		3400	R.concrete B300 For Slabs thickness 30cm	5-9	m2	15	197.25	
14	مجموع 24/02/04							
15	25/02/04	4100	Block work for walls thickness 20 cm	5-9	m2	80	197.75	
16	مجموع 25/02/04							
17	26/02/04	4200	Block work for internal walls thickness 15 cm	5-9	m2	80	197.6	
18	مجموع 26/02/04							
19	27/02/04	4200	Block work for internal walls thickness 15 cm	5-9	m2	88	232.65	
20	مجموع 27/02/04							
21	28/02/04	4200	Block work for internal walls thickness 15 cm	5-9	m2	8	32.2	
22	مجموع 28/02/04							
23	29/02/04	4300	Block work for internal walls thickness 10 cm	0-4	m2	64	186.3	
24	مجموع 29/02/04							

Figure A3.2: Daily cost report

Figure A3.3: Item labor cost report

Cost Code	Item Description	Floors Range	Item Unit	Quantity by Labor	L Reg. Hours	L O.T. Hours	L W Hou...
3100	R.Concrete B300 for Foundation	0-4	m3	8	40	26	
مجموع 3100							
3200	R.Concrete B300 for Grounde Beams & Steps	0-4	m3	18	27	3	
				4	40	22	
مجموع 3200							
3300	R.Concrete B300 for Necks & Columns	0-4	m3	2	40	21	
مجموع 3300							
3400	R.concrete B300 For Slabs thickness 30cm	5-9	m2	15	40	33	
مجموع 3400							
4100	Block work for walls thickness 20 cm	5-9	m2	80	24	36	
مجموع 4100							
4200	Block work for internal walls thickness 15 cm	5-9	m2	8	8	4	
				80	24	36	
				88	32	43	
مجموع 4200							
4300	Block work for internal walls thickness 10 cm	0-4	m2	64	40	29	
مجموع 4300							
المجموع الكلي							

Figure A3.3: Item labor cost report

Figure A3.4: Item materials cost report

Cost Code	Item Description	Floors Range	Item Unit	Item Quantity	مجموع
3100	R.Concrete B300 for Foundation	0-4	m3	8	2120
مجموع 3100					2120
3200	R.Concrete B300 for Grounde Beams & Steps	0-4	m3	18	4050
				4	5110
مجموع 3200					9160
3300	R.Concrete B300 for Necks & Columns	0-4	m3	2	5443
مجموع 3300					5443
3400	R.concrete B300 For Slabs thickness 30cm	5-9	m2	15	7029
مجموع 3400					7029
4100	Block work for walls thickness 20 cm	5-9	m2	80	5100
مجموع 4100					5100
4200	Block work for internal walls thickness 15 cm	5-9	m2	8	475
				80	4560
				88	5054
مجموع 4200					10089
4300	Block work for internal walls thickness 10 cm	0-4	m2	64	3800
مجموع 4300					3800
المجموع الكلي					42741

Figure A3.4: Item materials cost report

تعليمات إطار بيانات أدوات تنسيق إدراج عرض تحرير ملف

C36

	A	B	C	D	E	F	G	
1	Project Nan (الكل)							
2	Date (الكل)							
3								
4	E Amount							
5	Cost Coc	Item Description	Floors Range	Item Unit	Item Quantity	E Reg. Hours	E O.T. Hours	E V Hou
6	3100	R.Concrete B300 for Foundation	0-4	m3	8	0	0	
7	3100 مجموع							
8	3200	R.Concrete B300 for Grounde Beams & Steps	0-4	m3	18	0	0	
9					4	0	0	
10	3200 مجموع							
11	3300	R.Concrete B300 for Necks & Columns	0-4	m3	2	0	0	
12	3300 مجموع							
13	3400	R.concrete B300 For Slabs thickness 30cm	5-9	m2	15	0	0	
14	3400 مجموع							
15	4100	Block work for walls thickness 20 cm	5-9	m2	80	0	0	
16	4100 مجموع							
17	4200	Block work for internal walls thickness 15 cm	5-9	m2	8	0	0	
18					80	0	0	
19					88	0	0	
20	4200 مجموع							
21	4300	Block work for internal walls thickness 10 cm	0-4	m2	64	0	0	
22	4300 مجموع							
23	المجموع الكلي							

Item vs Equipments

NUM

جاهز

Figure A3.5: Item equipment cost report

تعليمات إطار بيانات أدوات تنسيق إدراج عرض تحرير ملف

B36

	A	B	C	D	E	F	G	H	I	
1	Project Nan (الكل)									
2	Date (الكل)									
3										
4	S Amount									
5	Cost Coc	Item Description	Floors Range	Item Unit	Item Quantity	مجموع				
6	3100	R.Concrete B300 for Foundation	0-4	m3	8	0				
7	3100 مجموع					0				
8	3200	R.Concrete B300 for Grounde Beams & Steps	0-4	m3	18	0				
9					4	0				
10	3200 مجموع					0				
11	3300	R.Concrete B300 for Necks & Columns	0-4	m3	2	0				
12	3300 مجموع					0				
13	3400	R.concrete B300 For Slabs thickness 30cm	5-9	m2	15	0				
14	3400 مجموع					0				
15	4100	Block work for walls thickness 20 cm	5-9	m2	80	0				
16	4100 مجموع					0				
17	4200	Block work for internal walls thickness 15 cm	5-9	m2	8	0				
18					80	0				
19					88	0				
20	4200 مجموع					0				
21	4300	Block work for internal walls thickness 10 cm	0-4	m2	64	0				
22	4300 مجموع					0				
23	المجموع الكلي					0				
24										

Item vs Subcontractors I

NUM

جاهز

Figure A3.6: Item subcontractors cost report

١٢١
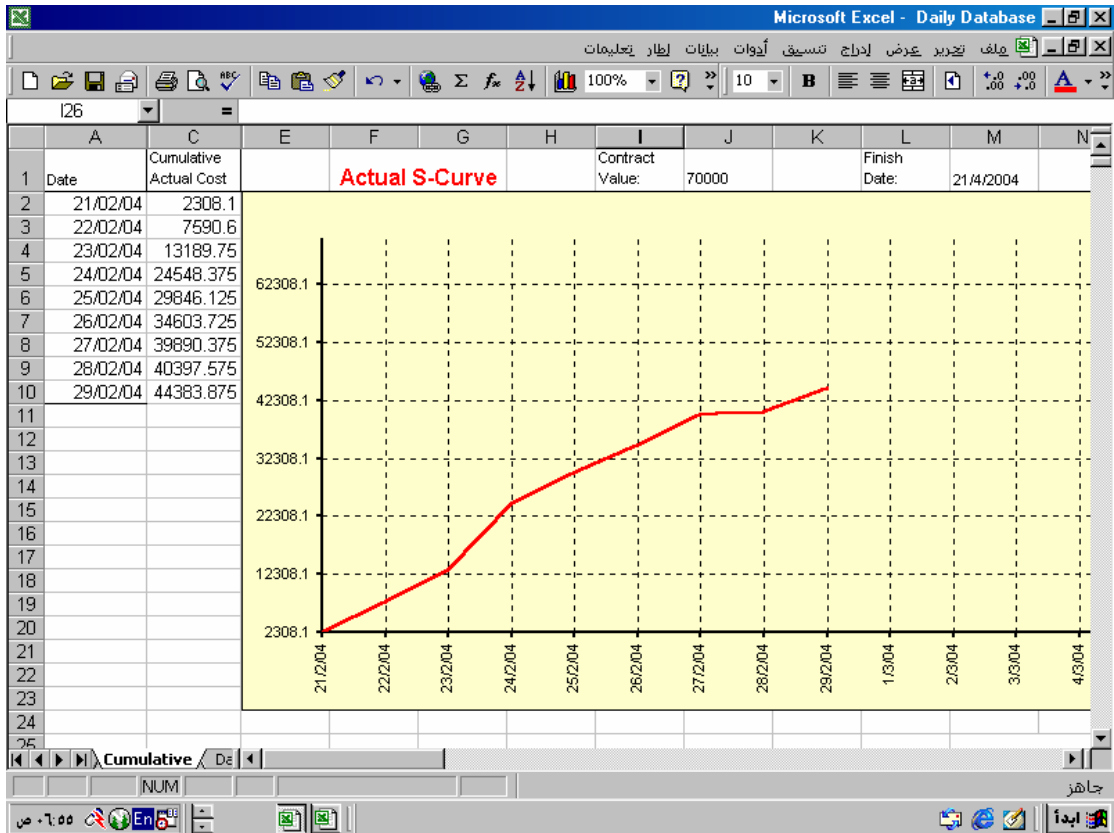
Figure A3.7: Actual S-curve

Figure A3.8: Cost per floor group floor report

١٢٢

Annex 4

Software evaluation questionnaire (In Arabic)

استبيان تقييم برنامج الحاسوب (CMS) "Cost Monitoring Software"

السادة شركة/

نشكر سيادتكم للمساهمة في أوقاتكم و مجهوداتكم في تطبيق برنامج الحاسوب CMS الخاص بمراقبة تكلفـــة مشاريع التشييد و المقدم لسيادتكم لتجربته في مشروع حقيقي.

يرجى من سيادتكم تعبئة هذا الاستبيان، و ذلك من أجل التحقق من البرنامج المذكور. إن رأيكم و ملاحظـــاتكم على البرنامج مهمة جدا لتقييمه.

الباحث

محمد الأستاذ

أولا/ التقنيات التي يوفرها البرنامج

بين مدى موافقتك على أداء التقنيات التالية التي يوفرها البرنامج و الخاصة بمراقبة تكاليف المشاريع و ذلــك بوضع علامة x في أحد الخيارات:

موافق بدرجة ضعيفة جدا	موافق بدرجة ضعيفة	موافق بدرجة متوسطة	موافق	موافق جدا	التقنيات	الرقم
					قوائم بالموارد المتوفرة لدى المقاول من عمال و مواد وآليات و مقاولي باطن مع معلومات عن تلك الموارد.	١
					رصد الفعالية الجزئية من البند،مثلا (وجه أول للقصارة/ أعمال تسليح للأعمدة الخرسانية) و من ثم تحويل كميتها إلى كمية من البند نفسه.	٢
					تقرير التكلفة الفعلية لكل بند موزعة على الموارد (عمال، مواد، معدات، مقاولي باطن).	٣
					جدول الكميات و التكاليف الفعلية عند أي تاريخ.	٤
					تقرير العمالة لكل بند، يشمل مثلا (البند - كميته - عدد الساعات الاعتيادية و قيمتها - عدد الساعات لإضافية و قيمتها - عدد الساعات الكلية و قيمتها).	٥
					تقرير المواد لكل بند، يشمل مثلا (البند - كميته - قيمة المواد المصروفة عليه).	٦
					تقرير الآليات و المعدات لكل بند، يشمل مثلا (البند - كميته - عدد الساعات الاعتيادية و قيمتها - عدد الساعات لإضافية و قيمتها - عدد الساعات الكلية و قيمتها).	٧
					تقرير مقاولي الباطن لكل بند، يشمل مثلا (البند - كميته - القيمة المنفذة من قبل مقاول الباطن).	٨

				المنحنى S للتكلفة الفعلية (Actual S-Curve).	٩
				في مشاريع المباني متعددة الطوابق: تقرير يوضح تكلفة البند في كل مجموعة من الطوابق.	١٠
				الاحتفاظ بقاعدة بيانات و يمكنه التزويد بسجلات التكلفة.	١١

ثانيا/ التصميم و التركيب:

بين مدى موافقتك على الخصائص و الميزات التالية و الخاصة بتصميم و تركيبة البرنامج و ذلـــك بوضـــع علامة X في أحد الخيارات:

موافق بدرجة ضعيفة جدا	موافق بدرجة ضعيفة	موافق بدرجة متوسطة	موافق	موافق جدا	الخصائص/ الميزات	الرقم
					البرنامج مرن، و يمكن تحديث البيانات فيه بسهولة.	١
					استخدامه بصورة عامة سهل.	٢
					يوفر الوقت و الجهد.	٣
					طريقة إدخال البيانات سهلة و واضحة.	٤
					التقارير و المخرجات واضحة و سهلة القراءة و الفهم.	٥
					طريقة فرز البيانات سهلة.	٦
					الجمل و الأرقام الواردة فيه مختصرة و مفيدة و حجمها مناسب و مقروءة.	٧
					يمكن إيجاد المعلومات فيه بسهولة.	٨
					الوصف و طريقة الاستخدام المرفقة (Manual) مفهومة.	٩
					يوفر سهولة و ارتياح في التعامل معه لأنه عمل ضمن بيئة برنامج Excel	١٠

					التدريب عليه سهل و لا يحتاج لوقت كبير، كما أنه لا يحتاج لموظف محتــرف Professional للتعامل معه.	١١
					يمكن تطبيقه في معظم المشاريع بأنواعها في قطاع غــزة. (البرنــامج ملائــم لمقاولي غزة).	١٢
					يساهم في تطوير مراقبة تكاليف المشاريع في قطاع غزة.	١٣

ثالثا/ أذكر الصعوبات التي واجهتك في استخدام البرنامج.

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

خامسا/ في رأيك، ما هي مميزات البرنامج.

Annex 5

Software evaluation questionnaire (English version)

Questionnaire about
Evaluation of "Cost Monitoring Software" (CMS)

Sir/

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

Please fill this questionnaire which aims to verify the CMS software.

<div align="right">

The Researcher

Mohammed Al-Ostaz

</div>

First/ The CMS cost monitoring tools and techniques

Clarify your extent of agreeing with the performance of following cost monitoring tools and techniques which are provided by the CMS software: (put x mark in one of the choices)

No.	Tool/ Technique	Strongly Agree	Agree	Intermediately Agree	weakly Agree	Very Weakly Agree
1	Lists of available resources (labor, materials, equipment, subcontractors) which the contractor possesses. The lists includes data about these resources.					
2	Monitoring the sub-activity of item, for example (first face for plaster/ reinforcement work for concrete columns). Also, converting the sub-activity quantity to the item quantity.					
3	Up-to-date actual cost report for each item, the cost is allocated on the resources (labor, materials, equipment and subcontractors).					
4	Actual cost report for each item at any date.					
5	Up-to-date labor cost report for each item, the report includes for example (the item- its quantity- number of regular hours and their amount- number of overtime hours and their amount- number of total hours and their amount).					
6	Up-to-date materials cost report for each item, the report includes for example (the item- its quantity- amount of materials used for it).					
7	Up-to-date equipment cost report for each item, the report includes for example (the item- its quantity- number of regular hours and their amount- number of overtime hours and their amount- number of total hours and their amount).					
8	Up-to-date subcontractors cost report for each item, the report includes for example (the item- its quantity- the executed amount by the subcontractor).					
9	S-curve for actual cost.					
10	In the multistory buildings, a report provides the cost of item at each group of stories.					
11	Keeping a database and providing a cost records.					

Second/ The design and structure

Clarify your extent of agreeing with the following features of CMS design and structure: (put x mark in one of the choices)

No.	Feature	Strongly Agree	Agree	Intermediately Agree	weakly Agree	Very weakly Agree
1	The software is flexible, and the data can be updated easily.					
2	In general, its use is easy.					
3	Save time and effort.					
4	Method of entering the data is easy and clear.					
5	The reports and outputs are clear, and easy to read and understand.					
6	Method of sorting the data is easy.					
7	The sentences and numbers of its context are concise, and their sizes are suitable and readable.					
8	The information can be inquired easily.					
9	The method of use is understandable.					
10	Because CMS is built under Excel environment, it provide an ease and comfort dealing.					
11	Training to use the CMS is easy and does not need for a great time. Also, it does not need for a professional user to deal with it.					
12	It can be applied for the most of Gaza Strip projects. It is suitable for Gaza Strip contractors.					
13	It Contributes in improving the cost monitoring practice in Gaza Strip.					

Third/ Declare the difficulties that you faced during the use of CMS.

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

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Fifth/ According to your opinion, what are the CMS advantages.

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Annex 6

Overview for relevant cost monitoring computer packages

1. Costrack [*]

Costrack is a construction accounting software.

System Overview

- **System Manager Module:** Total cost-to-date reporting. All labor, equipment, material, and Miscellaneous costs are reported against cost account codes.
- **Labor Tracking Module:** Employee time-keeping and cost tracking system. Daily hours reported for payroll are verified against the time clock. Labor hours entered by cost account code provide accurate labor cost information.
- **Equipment Tracking Module:** Accrual of all equipment rental charges. Hourly, daily, weekly, and monthly time periods are continuously evaluated to calculate the best price for each piece of equipment.
- **Material Tracking Module:** Purchases of all materials and supplies, along with any markup, delivery, or configuration charges, are entered and accrued against cost account codes.
- **Miscellaneous Cost Tracking Module:** Special costs, which are not clearly delineated between labor, equipment, or materials, are entered and accounted for to provide a complete picture of dollars spent.
- **Purchase Order Tracking Module:** Company purchase order information is entered to track the costs committed to-date for the project. Actual cost-to-date is compared against the purchase order to identify contractors, or suppliers, that are nearing or exceeding the purchase order amount.
- **Vehicle Tracking Module:** Each vehicle that is approved to enter the facility is issued a bar-coded identification card. Vehicles on-site, traffic patterns, and vehicle usage can be reported and analyzed for any time period.
- **Scheduling System Interface:** Man-hours and dollars can be exported to Primaviera's P3 for comparison of budget to actual and a projection of cost-to-completion. The actual quantity and actual cost fields in P3 are updated based on cost account code, company, and resource. Allowing for reports and projections by piece and type of equipment, unit, company, resource, or any combination.
- **System Flow Chart:** Information flow chart

Details of Labor and Equipment Tracking Modules

Labor Tracking Module

The labor-tracking module has two significant functions:1) Tracking the times that employees enter and leave the site. 2)Tracking all costs associated with labor. Tracking employees is done through a bar-coded, tamper-proof, photo identification card, which is electronically scanned each time the employee enters or leaves the site. Labor costs are tracked using daily foreman timesheets. Each labor hour is entered by cost account code.

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[*] Retrieved September, 2002, from www.costrack.com

Computer Solutions, Inc. Casper, WY 82604, Phone: 307-237-5910, Fax: 307-237-0955**,** E-Mail:csi@trib.com

1) <u>Labor Tracking:</u> A digital photograph of each worker is taken when they are hired. This photo is used with DataCards'® Quick Works Express software and photo id printer to create a rugged, tamper proof identification badge containing the following information:

- company Logo
- The name of the project
- The worker's first and last name
- The contractor they work for
- The worker's picture
- The worker's employee number
- Any other required information

As each worker enters or leaves the facility security personnel scan their photo id. The procedure of having a person scanning each individual badge, rather than unsupervised time clocks, eliminates the possibility of one person clocking in two badges; reduces the anonymity of the workers, provides a cordial atmosphere, controls the flow of workers in and out; and maintains strict gate control.

During the project, cordless hand-held laser scanners are used to scan both individuals and vehicles. These fast, accurate readers allow for rapid scanning which minimizes men waiting to leave. This prevents workers from quitting work and lining up early in order to scan out.

As each worker's badge is scanned the punch is permanently logged into the time database. As it is recorded the punch is identified as an in or out punch. This helps eliminate the problem of missing or reversed punches. All past punches are retained, allowing a punch report to be printed for any time period, showing each worker's exact in and out times.

2)<u>Cost Tracking:</u> Prior to the start of each shift time sheets are printed for each foreman. These sheets list each man that is assigned to the foreman's crew. At the end of each shift the foreman time sheets are entered into the system and a variance report is printed showing any workers who reported time is greater than their time on-site.

The Variance report drags information from the punch database and compares it with the times entered from the foreman time sheets. Any differences between the reported time and the actual time on-site are immediately identified. These differences are investigated and resolved within two shifts. After the all the correct hours have been entered a detailed labor report is printed. This report pulls information from multiple databases and produces a report which lists each employee's name, classification, rate, hours worked, and total cost for the shift.

The detailed labor report is sent back to the contractor for verification of rates and hours. This step is crucial, because it allows discrepancies in the time sheets to be corrected by the contractor early in the process. After verification of hours and rates, the contractor signs the sheet as actual billable hours. The report is then sent on to the plant representative for approval. At this stage problems such as hours being charged against the wrong cost code, and unauthorized work being done, can be resolved. When correct the plant representative approves the charges for the shift. Copies are

made and the contractor is approved to invoice for the dollar amount. This procedure has been proven to speed up the invoicing process, the contractors invoices match the approved dollars thus allowing the invoices to be sent throughout without delay.

Equipment Tracking Module

The equipment-tracking module provides shift-by-shift information and billing amounts for each piece of equipment a contractor has on-site. When a piece of equipment is brought on-site its information, along with an associated cost, is entered into the system. When the equipment is removed from site, or made inactive, charges stop accruing.

For auditing purposes, a report by contractor, or by piece of equipment can be printed at any time allowing the project auditor to verify the equipment that is being charged.

Equipment Module
There are two methods for entering equipment into the system
1) Entering Equipment Daily

- Equipment rates are initially entered into the system for each contractor.
- The system then generates a Foreman Equipment Sheet that lists each piece of equipment that contractor has.
- The Foreman then enters in the hours used and the correct work order number.
- Then the Foreman's sheets is taken and entered into the computer after each shift

2) Entering Equipment Using The General-Site Module

- Equipment that is used on a daily basis throughout the turn-around can be classified as General-Site.
- After initially entering the contractors equipment rates the system is given a start and end date that the equipment will be used.
- Now, all it have to be done is print out that contractors equipment for that day and the system automatically charges the equipment and computes using the correct rates and time periods.

The system has eliminated the need to constantly enter equipment that is used on a daily basis and figures the rates at either a daily, weekly, or monthly basis.
This not only saves time by doing away with unneeded data entry but also allows the Foreman to stay in the field where they are needed. The Equipment Module allows the contractor to have access to up to the minute cost-to-date.

Tracks Rental Equipment Daily
The Rentals Module tracks equipment that is rented by the contractors from third parties. Examples are office trailers, air compressors, and moveable facilities. Similar to the equipment tracking module, each piece of equipment and its associated vendor is entered into the program when it is brought on-site. Reports of the equipment that is being rented, by which contractor, and how much it is costing is available each shift.

2. ComputerEase Software for Contractors[*]

"Ease-of-Use" Features

- Quick, accurate help is on-line at all times.
- Learning curve is days, not weeks.
- Easy-to-follow step-by-step plan to get your system up and running quickly.
- No need to go to another screen to enter information, just point, click and add.
- Each user can establish a unique menu.

ComputerEase™ Modules

- Job Costing
- Equipment Costing
- Accounts Payable
- Accounts Receivable
- General Ledger
- Inventory/Purchase Order
- Payroll
- Service Management
- Estimating/Partners
- FieldEase

3. The American Contractor[**]

System Overview

The American Contractor products are fully-integrated, flexible computer programs designed to meet the Accounting and Job Cost Tracking needs of today's contractors. Major program modules include Accounting, Payroll, Job Cost Tracking, Work Orders, Purchase Orders, Inventory, Equipment Costing, and Estimating. All program modules integrate with each other. Other features include Subcontract Control, Lien Release Tracking, and Quantity Tracking. User defined data fields and electronic notes of unlimited length can be attached to most records. User-defined lists and custom reports are easily produced with a built-in Report Writer.

Job Cost Tracking

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[*] Retrieved September, 2002, from www.construction-software.com

ComputerEase, 3016 Harrison Avenue•Cincinnati, OH 45211•Phone: 888-661-8887•Fax: (513) 481-6324

**Retrieved August, 2002, from www.cbs-software.com

CBS Software, Inc., ٣٤٦٠Ocean View Blvd., Suite C, Glendale, CA 91208-1538, Phone: (818) 236-2600   Fax:(818) 236-2603

- **Flexible Tracking.** Track as much or as little detail as you want. Budget and track by overall job, by subjobs (tract work), or by tracking codes within jobs. Use your own tracking codes or choose from standards such as CSI.
- **Job Budgets.** Create from estimates, previous budgets, manually, or import from other programs.
- **Change Orders.** Track and invoice separately. Handles pending and contract change orders. Allows multiple tracking codes per change order.
- **Job Status Report.** Compares costs and billings against budget and contract amounts. Shows cash spent and received. Can include labor even before posting payroll.
- **Burdened Labor Costs.** Labor includes exact calculated burden and/or user-defined percentages.
- **Work in Progress.** Job Profitability report allows entry of percent complete or cost to complete Computes over/under billings.
- **Quantity Tracking and Billing.** Optionally budget unit quantities and enter quantities completed. Bill by units at a contract unit price.
- **Additional Reports.** Projected Cost & Variance report allows user input of percent complete. Committed Cost report.

4. Basic Builder[*]

Basic Builder® is a construction software package that is easy to learn, simple to use and powerful enough to manage the entire business. It fits small and medium contractors who seek control without information overload. Its clear and eye pleasing reports say it much better than any ad or brochure. Basic Builder® was developed with industry standard tools (Microsoft Visual Basic) and data bases (Microsoft Access).

Full integration From invoice entry to job budgeting to financial statements to customer time and material billing, a single entry does it all.

Easily expandable Basic Builder® lets you start with the core modules of Job Cost, Accounts Payable and General Ledger.

Easy to Learn, Simple to Use Point and click and you're in. It's that easy. The graphic interface in Basic Builder® is as beautiful as it is practical. The icons and the hot spots are similar to those used on the most advanced web site. The point and click interface and the drag and drop capability makes this so easy to begin and such a snap to master, that even less experienced computer users will become confirmed "Basic Builder builders" in no time.

Learning Companion Documentation Straightforward, step-by-step instructional manuals lead you through setup and normal operation. The manuals are rich in example and screen captures to clearly illustrate daily and monthly procedures. You can learn at your own pace without the requirement to know accounting conventions. If you don't know a debit from a credit, you will be at home with this system. Once setup, the general ledger account numbers auto-fill in most entries. You charge the invoices and payroll to jobs and the general ledger account numbers auto-fill. It is the

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simple things that make life easier: an automatic backup prior to posting, fast restore when required, a calculator button on entry menus to check math.

Export to Common Formats Every report can be sent to a word processing or spreadsheet file (Excel, Word, Lotus, etc). You can then modify the report or data to suit you.

Internet Reporting The Internet is an integral part of the growth path for Basic Builder$^®$. Part of the project management collaborative solution, WIPNet allows you to access your Basic Builder$^®$ data (with proper security clearance) via reports on the Internet. You can see checks written, costs posted, and profit/loss statements from any internet connection. In addition to the reporting, you can have virtual jobsites where you can assemble all contracts, pictures and correspondence about the job.

Job Costing

Cloning for rapid creation of new jobs High speed creation of new jobs is a must for the busy operator. Several existing jobs can be merged into one and the old budgets can be copied as well as the cost code structure. It is simple and it is fast.

Drill down from budget to cost, to payments The Job Cost budget screen layout is simplicity itself. Designed for easy reading and manipulation, you can enter and change any information you see. As you double click on 1000 Building Permit, you see that an invoice for $419.34 has been charged and another double click on the invoice drills to the payment information. Check 1001 has been written for the full amount. No other system can show you payments within Job Cost so simply.

Retain important information in archives A system that can keep important Job Cost information for later review will yield benefits in the future. To take full advantage of a computer system, the software must provide simple archival and retrieval of critical information. In Basic Builder, this is an easy two step process.

Rich reporting satisfies the most demanding Reports are the heart of any system; they are the measure of a program's usefulness.

Track both costs and payments Too often we fail to realize the value of payment information on a job cost report.

You decide what information to enter With Basic Builder$^®$, you can add items you want to record in every major module. The screens are easy to customize and the data appears on reports.

5. The CONTRACTOR[*]

The CONTRACTOR is a construction accounting software.

The components include Job Cost, General Ledger, Payroll, Accounts Payable and Accounts Receivable. Other completely integrated modules and options available may include Equipment Costing, Purchase Orders or Inventory.

Two Feature:
- Reporting has never been easier. You can create new reports and modify existing reports within a matter of minutes.
- ODBC (Open Database Connectivity) enables you to access your data in other ODBC-compliant applications, such as Microsoft Excel, Microsoft Access, Lotus Smartsuite, ACT, FoxPro, Paradox, Corel WordPerfect, Btrieve, Seagate Crystal Reports, and dBase.

Job Cost module

Job cost stores all estimated, committed, and actual dollar units and hours for in-depth analysis of each construction project. As is consistent with a "single source entry" system, information processed through Accounts Payable, Payroll, Purchase Orders, Subcontract Control, Accounts Receivable, Inventory Control, and Equipment Costing, update Job Cost without additional entries. Principals, controllers, project managers, and accounting departments benefit from job cost information and the knowledge and confidence that come from having accurate job cost information.

Management Tools of Job Cost module

- Quickly review labor reports and compare estimated versus actual hours, dollars, and units.
- Review costs in summary or detail arrangements to better focus on profitability.
- Track pending and approved change orders.
- Access financial and contract reports for easy compliance with the most stringent bonding requirements.
- Allows field personnel to report units or percent complete for accurate analysis of job costs from the field.
- Compare estimated, actual, and committed costs for both lump sum and unit cost bid items.
- Historical access by project, project manager, customer, and job class.
- Easily create customized inquiries and reports using the Report Formatter.
- User-defined fields enable the addition of company-specific information.
- Job Cost with Dimension provides multi-level interactive inquiries, filters, and sorting capabilities to delve into the details controlling a job's profitability.

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[*] Retrieved September, 2002, from www.cbs-software.com

CBS Software, Inc ٣٤٦٠, Ocean View Blvd., Suite C, Glendale, CA 91208-1538, Phone: (818) 236-2600   Fax: (818) 236-2603
The CONTRACTOR is a registered trademark of Maxwell Systems, Inc.

6. Pivot[*]

Conac Pivot is a complete job cost and financial management tool, and it designed to meet the demands of the medium to large-size contractor.

The key functions are general ledger, accounts payable and receivable (including invoicing and quotations), payroll, job cost, purchase order, inventory management, time and material billing, change order control, work orders and equipment costing - are seamlessly integrated. In addition, Conac Pivot is easy to use, following MS Office interface standards to reduce the learning curve and increase productivity.

Job Cost

- Track actual vs. budgeted costs.
- Summarize a project's gross margin.
- Make detail inquiries by supplier, invoice or labor.
- All information flows through accounts payable and payroll modules.
- Set up jobs automatically using data from Conac Trackpoint.

Job Cost Reports

- Job Inquiry Report
- Job Summary Report
- Job Trial Balance
- Committed Cost
- Productivity Report
- Contracts In Progress Report
- Job Budget Report
- Year-to-Date quantity complete report
- Forecast S to Complete Report
- Job Analysis Report

7. The Construction Manager[**]

The Construction Manager is a complete job cost and financial control system designed for the construction industry. It provides all the information you need about your contracts, labor and material costs, subcontractor's performance and cash position. Plus it offer you great flexibility in how you use that information. There are

more than 150 reports available throughout the system that can be viewed on-screen or printed. Executive inquiries let you examine your jobs and company costs in summary or detail and it keeps a complete history of every transaction for every job, for the life of your job.

Components
Accounts payable, accounts receivable, progress billing, time & materials billings, general ledger, payroll, job cost, purchase order, and inventory.

Job Cost
The Construction Manager lets you keep a close eye on costs and alerts you to possible problems while there is still time to take action. The Job Cost application is a centralized storehouse for all job information processed which is updated from all applications and is available to help you manage every aspect of each job.

Job Cost Features
Flexible cost coding by job, phase, cost code and cost type
- Track labor productivity, analyze unit costs and manage subcontract relationships
- Control job cash flow

Improve Your Estimating: The Construction Manager allows you to track actual job costs and performance against estimates at a detailed level. Not only is the information you track useful for managing the job, but it can be used to modify future estimates. Automatically copy the estimates from Geac's integrated estimating application or manually enter them to setup the job. Subcontract performance, unit production and labor productivity calculations let you manage your job from many different aspects and can also be used to improve the accuracy of future bid proposals.

Accurately Measure Job Progress: Based upon information you enter, the system automatically calculates percentage complete, cost to complete and projected cost at completion for each cost breakdown. These forecasts can be based upon quantities, hours or dollars you entered in the other applications. To increase accuracy based upon actual job conditions, field reported percentage complete and quantity installed can be used to project cost at completion and ultimately, job profitability. A complete history is available for each job. Use the job inquiry to view on screen job summary information or "step down" to increasing levels of detail all the way to individual historical transactions. This information, in summary or detail, is also available using a wide variety of reports that allow you to analyze and manage each job easily.

Control Job Cash Flow: Customer billings and cash receipts automatically update the job from Accounts Receivable, as well as vendor invoices and cash payments from Accounts Payable. This information is centralized to provide easy cash flow status on the job.

8. INTERAC Construction Accounting System[*]

The INTERAC Construction Accounting System is an integrated system designed specially for the construction industry.

Each module can use suite of productivity tools including:

- Custom Report Writer for tailoring reports for each application to your needs
- InterLink for importing/exporting data from or to non-Interac programs such as Excel
- Visual Link for providing ODBC access to the INTERAC accounting database
- Job Streamer for automating repetitive tasks saving time and money

The Construction core system includes:

Job Cost	Payroll (U.S. and Canadian)
Accounts Payable	General Ledger

Expansion modules include but are not limited to:

Accounts Receivable	Bank Reconciliation	Equipment Cost
Fixed Asset Management	Human Resources	Inventory
Job Billing	Order Processing	Purchase Order
Service Billing	Subcontractor Control	

Job Cost

Features included in Job Cost are as follows:
- Breakdown of information by Job, Phase, and Category
- Up to eight user-defined categories store and track information for items such as labor, material, sub-contracts, equipment rentals, etc.
- Phases can be grouped using heading and sub-phases
- Tracks costs by Job-to-Date and up to three user-defined additional periods based on days or months
- Easy job set-up using a Model Job Format, a Phase Table, or a combination of both
- Percent complete can be generated based on various criteria, manually entered, or both
- Optional information fields for categories based on user preference
- Up-to-Date job information can be viewed on the screen
- Billings and income can be stored by job, or by phases within a job
- User-defined history files with on-screen inquiry capability
- Flexible custom report design for virtually any report using Job Cost data or information from any interfacing module
- Specialized Job Report Design program provides for sophisticated reporting of job information, including variances and multi-field calculations
- Allows reports to be displayed on screen for immediate inquiry or stored in a file for later use
- Accesses all features through suitable menus, but allows the expert user to quickly move from any package/application directly to another, bypassing menus

- Interfaces to INTERAC Payroll, Accounts Payable, Accounts Receivable, Equipment Cost, Purchase Order, Inventory, Subcontractor Control, and General Ledger.

9. Bluegrass for Windows©[*]

Bluegrass for Windows© is a complete software solution for a wide range of contractors looking for help in the areas of Service Management/Dispatching, Job Costing, Vehicle Maintenance and Costing, Accounting and Executive Analysis.

Features

- Multiple companies are supported.
- Multiple divisions.
- Remote Location.
- Security is provided by main menu, housekeeping, and master function by application.
- System/wide parameters allow for changes to reporting formats and selection. criteria without the need for a programmer.
- Reporting is date sensitive.
- Network fax capabilities to send documents from within application.
- Forms such as statements, invoices, etc. allow for user format changes without the need for a programmer.
- The above forms are formatted on laser printers eliminating the need for custom forms.
- All master files support entry of comments.
- There are user-defined fields within most master files. Data entry is date sensitive. For example, posting of accounts payable invoices allows user input of any open period within the same batch.

Job Cost Management Reports

The Bluegrass Job Cost Management module contains over 40 reports. They provide comprehensive reporting of normal contract jobs, time and material jobs and service contracts. Information includes cash flow, unit costing, percent complete and projection of cost to complete. All reports provide the option of printing to screen or printer or any report may be saved to disk. Reports saved to disk are available to fax or e-mail or may be imported into Excel™ to add additional calculations or produce charts and graphs. Selected pages of any report saved to the screen can be printed. If by chance the report is not available, all information in your database can be directly linked to Access, ™ Crystal Reports, ™ Excel, ™ or any other windows product to produce a custom report made to your specifications.

Extensive inquiry screens allows, you to view information immediately without having to print reports.

The Bluegrass philosophy is to give management concise summary reports from which to make decisions, but with the ability to print detailed information when needed.

All reports provide a flexible selection menu that allows you to filter the data that is included on the report. A global preference table allows you to choose which type of costs (referred to as class) should be grouped together and which should be kept separate. For example, some contractors prefer to see labor and burden separately, other want labor and burden combined on reports but with the ability to see separately if requested. We let you choose. You can label column headings on reports and direct which type of cost is to appear under each heading.

Below are just some examples of the included reports and the selections allow:

Job Cost Summary report gives you a one-line summary of all jobs showing contract amount, actual cost, billed amount and amount paid. Select job range, Project Manager Range, Open or Complete Jobs, department or division and one or all customers. A detail option is included which gives one line per cost code.

Cost Analysis by Cost Code report gives you a complete picture of your job. Variations of this report include option for sub totals by phase.

Cost Analysis by Phase summarizes by phase and gives budget actual and remaining for each phase. **Cost Analysis by Class** prints summary by type of cost.

Cost Analysis by cost-code/class prints each class of expense with budget, expanding the report to tow lines per cost code.

Cost Analysis with Committed cost includes both purchase order and sub contract committed cost. These reports may be selected by job range, open or complete jobs, department, or division and one or all customers.

- Bonding Report
- Job in Process
- Detail Cost report
- Billing Report and by class
- Gross profit report project manager type of service salesman
- Excess Billing
- Completed jobs summary
- Job Cost Summary by Class is a profit and loss picture of each job
- Job summary with committed cost
- Unit Cost Analysis
- Job in Process
- Detail cost report
- Billing Report and by class
- Excess billing
- WIP Report-produces report for Excel™
- Dept/Division report for Excel™
- Labor reports

Job Cost Management Features

- Phase code may be tied to a profit center, so that tracking revenue and cost to multiple departments and divisions is automatic once the job is set up.
- Modern "drill down" and filtering functions make it easy for managers to review job information.
- Maintains sub-contractor-committed cost.
- Upon approval of a bid, the estimating system will interface to job cost to create the Job and budget records.
- Cost codes are user defined. They may be customized to your needs and preferences. You may set up a different code structure for each job, or create a set of master cost codes for each type of job. This master set of cost codes will be automatically copied each time a job of this type is created.
- Balancing your jobs to general ledger is easy because nothing hits job cost without hitting general ledger.
- Payroll and job cost interface to allow for workman's comp to be task specific where required.
- If you determine workman's comp by task, the actual workman's comp is applied to the job as burden.
- As an option, Workman's comp may be tied to the man and a percent applied to the labor for taxes and insurance burden.
- Reporting of labor burden cost allows you to have a more accurate job cost by allowing you to see not only what you pay an employee, but also what he/she is costing you in invisible cost. These costs cannot always be applied directly to the job. The system allows for actual, percent or actual plus a percent labor burden, which can change from job to job.
- The job determines the union area, which determines the rate and benefits. Any union burden is applied to the job.

10. HeavyJob[*]

HeavyJob is complete Job Tracking software that transforms job site information into valuable management information on a daily basis.

HeavyJob is designed specifically for foremen to enter and analyze the data that measures their progress as well as the status of the entire job. The data is accumulated over time so that foremen and management can track progress each day against the job's budget.

HeavyJob provides fast, easy entry of:

- Labor Hours

- Equipment Hours
- Progress Quantity
- Notes
- Major Material Receipt & Use

All of these items are entered against cost codes with starting budgets that can be imported from HeavyBid.

From this data, we can analyze our costs and print reports to send to other parts of the company such as management and accounting.

Designed for the Job Site

HeavyJob™/Field uses a unique crew concept as a shortcut to quickly fill out timecards. Crews are set up with labor, equipment and cost codes used the first day. Thereafter, the crew is modified each day for any changes in personnel, equipment or cost codes, and used to create a new timecard. On many days, this whole process will take less than two minutes.

The HeavyJob™/Field timecard has been designed by studying timecards from many of customers. While maintaining the appearance of a simple classic timecard, there are actually many sophisticated capabilities allowing us to cover a variety of conditions for small to very large companies.

With the addition of material information, the timecard report provides a detailed daily log for each foreman in a professional, easy-to-read format. But even better is the instant job analysis showing estimated costs and productivity vs. actual job performance.

In addition to all the features of HeavyJob/Field, HeavyJob™/Manager consolidates data from all the jobs providing a company-wide rundown on productivity, profitability, equipment utilization and more. HeavyJob/Manager also exports to accounting and produces company-wide executive level reports for all of projects.

HeavyJob™/Pocket is an economical and convenient way to collect and transmit daily jobsite data. Time card information, equipment usage, major material receipt and usage, and daily notes about the job can be recorded using and Palm III, V, or VII series device and then, with the tap of a button, be exported to either HeavyJob/Manager or HeavyJob/Field for analysis and reporting.

11. REFMAN[*]

Cost Control Overview

In the analysis and monitoring of repair costs, REFMAN has been designed to allow a non-accountant to quickly and easily forecast the cost of a refit, to compare competing tenders and to monitor costs during the repair period itself.

REFMAN simply uses the 'best' cost information which is available at any particular time. If a job is complete, the 'actual cost' is used, if a job is in progress, the 'bid' is used, and if a job has been included as an 'extra' and the only information which is available is an estimate, then that will be used.

By combining these together, at all times before, during and after the repair period, the Superintendent or Port Engineer gets the clearest possible indication of 'how much has to be saved' or 'how much is available to spend'.

REFMAN's Specification Generator and Cost Control software is fully integrated so that the framework for recording costs is created and updated automatically each time a job is added, deleted or cancelled from a specification.

REFMAN's Cost Control module is easy to use by Superintendents, Port Engineers and secretaries, even if they have little or no previous accounting or computer experience.

REFMAN's Cost Control program avoids the need to manipulate large and often cumbersome spreadsheets with their complex formulas.

Provides the Superintendent or Port Engineer with facilities for recording and comparing competing ship yard tenders on a job by job basis, in a mix of currencies.

It also provides facilities for recording estimates of the cost of yard work (optional) and sub-contract labor, owner's supply materials and general expense elements of the jobs which have been included in a specification.

Once a yard has been selected and the repair period is underway, REFMAN is used by the Superintendent in the yard (normally on a notebook computer) to monitor the cost of jobs which arise as 'extras' as well as the cost of variations in the scope of the originally contracted work.

Finally, when it is time to settle the ship yard's invoice, REFMAN provides facilities to record the actual cost of each job and produce reports in 'bid' currency for agreeing or negotiating the final cost.

Features

- Complete management of costs with the ability to record estimated yard & owner's costs, yard bid, yard exclusions/contingencies, additionals/adjustments and actual costs for each job.
- Full control over allocation of account codes to each job and the amount (or proportion) of the cost of each job to allocate against each budget.
- Automatic allocation of costs against budgets for repair, capital (investment) expenditure, insurance (casualty or damage claims) and guarantee work (for new ships).
- Yard bid evaluation which takes account of the cost of yard items, negotiated discounts, number of repair days and number of deviation days.
- Facilities to record 'supplementary' jobs which arise after the original yard tender is accepted but before the dry-docking begins.
- Facilities to record 'extra' jobs into any section or into a separate 'extras' section. Either way, 'extra' jobs are totaled separately from originally contracted work.
- On screen and printed reports to facilitate cost analysis including a one page Repair Status Sheet which shows a complete cost summary/forecast, with the ability to save and recall forecasts.
- Full reporting of the cost of projects and insurance/ casualty and guarantee claims.
- Automatic apportioning and allocation of service costs to the cost of projects and claims.
- Full reporting of the cost of owner's supply items with facilities to record up to seven categories for each job and to report by purchase/work order numbers.
- 'Tag' codes to produce cost reports and summaries for jobs of a particular type or category.
- Pre-defined reports which are easy to produce and which are error and tamper free ensures that management always receives accurate information, and in a consistent format.

12. TimeScope[*]

TimeScope

TimeScope seamlessly combines the functionality of timesheet, project tracking, activity tracking, expense reporting, cost tracking, chargeback, billing, and budget monitoring software. TimeScope is the perfect enterprise time tracking solution because it supports even the most demanding of tracking requirements while keeping time entry as straightforward as possible. Web users appreciate a fast, an easy, and a secure technology - a quantum leap over static HTML solutions. TimeScope also runs on Windows LAN or WAN desktop environments without requiring client software installation.

Functionality

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[*] Retrieved September, 2002, from www.timescope.com

Functionality is divided between the Time Sheet Toolkit, the Manager's Toolkit, and the Administrator's Toolkit. This division of functionality lets managers and administrators lever the power of TimeScope without encumbering timekeepers with excess options. It also considerably reduces licensing cost for companies interested primarily in time or expense tracking, as timekeeper licensing is relatively inexpensive.

Team members use the Time Sheet Toolkit to report time, overtime, and expenses. Managers use the Manager's Toolkit to approve time and expenses, maintain and monitor projects and budgets, explore utilization, progress, and profitability, and print reports. Administrator's use the Administrator's Toolkit to setup time and expense sheet layout and policy, customize the system as needed, define teams and employees, maintain costing and/or billing rates, and define user roles and security.

13. Kildrummy® CostMANAGER[*]

Kildrummy® CostMANAGER is an enterprise wide, project cost control solution. It bridges the gap between corporate accounting and project planning. It can be fully integrated with existing corporate systems, to provide a seamless exchange of data and is a truly multi-currency solution. It can be used on single projects or in a portfolio management (multi-project) scenario, to report across projects. It is fully scalable to large organizations and can be used in multiple locations over a WAN or the internet.

Kildrummy® CostMANAGER is extremely flexible and can be used in any organization with a multi-million dollar projects budget. It is easy to set up allowing users to configure the system to suit their own requirements. Designed to be used by all members of the project team who require to manage, analyze and report on project cost performance. This can include directors, project and program managers, project services managers and engineers, cost accountants and cost engineers.

Product Benefits

- Enterprise wide
- Improved visibility via highly flexible coding, report structures & configurable report writing
- Increased efficiency through integration with other project and corporate systems
- Standardization on an application that is widely recognized as industry best practice
- Better control and techniques to manage cost and assist in predicting the forecast cost

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[*] Retrieved August, 2002, from http://www.kildrummy.co.uk/product/manager.asp
Kildrummy Technologies Limited, sales@kildrummy.co.uk

Visibility

- Multi-level reporting analysis across the various report structures
- Graph and analyze cash flow and trends
- Export data and report formats to MS Office, Adobe PDF & Web (HTML)
- Design reports to suit your project

Flexibility

- Configure terminologies/methodologies
- Create your own reports
- Save standard reports
- Unlimited project report structures and budget coding
- User defined security privileges

Control

- Costs and manhours, revenue, budgets, forecasts
- 'What if' scenarios and variance analysis
- Full change control module, including internal transfers and trend identification
- Commitments, expenditures and project income
- Earned Value analysis and project performance indicators
- Multiple currencies

14. SCAW. Construction Management System[*]

Systems Overview

SCAW Construction Management System is a system designed to manage the total construction process from contract to completion, assuming that it is integrated with a financial management system.Based on a contract, you can perform actions such as Plan (budgeting, billing, completion), Do (collecting information about production output), Check (various kinds of management reports), and Action (budget review). additional functions such as sales management, supplier management, and order management functions help to manage many types of contracts and progress status.

Features

Management of the entire construction process from contract to completion

SCAW Construction Management System supports the entire construction process including contract administration, construction scheduling based

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on the contract, suitable construction cost control that includes shared expenses, reassignment of the completion cost, and sales processing.

Real-time system
You can capture construction cost in real time. Moreover, while you are viewing up the progress status, you can update the operating budget. Consequently, you can produce comparison reports (between actual and planned).

Supports EUC environment
SCAW Construction Management System has the ability to extract all data into Microsoft Excel form. Therefore, you can easily process the necessary data in the way users want and turn them into tables and charts.

System Flexibility
To deal with various types of industries and business styles, SCAW Construction Management system can manage many types of construction contracts and conditions. Also, it allows customers to configure the construction code for each work management unit.

15. Job Accounting Plus[*]

Job Accounting Plus is the ideal management tool for small to mid-size construction firms. Job Accounting Plus provides everything you need to effectively manage your business from estimating to controlling job costs and monitoring subs, to tracking change orders.

Job Cost, Accounts Payable and General Ledger make up Job Cost Accounting's essential core accounting tools. Job Cost features let you set up each job, create budgets, enter change orders and track all costs associated with the job. Accounts Payable features make it simple to enter and track expenses, both paid and unpaid, pay bills and print checks. The General Ledger provides full accounting capabilities including Balance Sheet, Profit and Loss, Trial Balance and Journal Entries.

Other modules availabe are: Payroll, Accounts Receivable which includes Draw Request and Time & Material Billing, Purchase Order/Subcontracts, Inventory

Job Cost tracks job data including job code, name, address, contract amount, purchaser information and lender-information costs. In addition, job costs are tracked on multiple levels including Project, Job Category and Class.

Job Costing also provides complete category information - category code, name, budget, actual costs, start and finish dates, vendor and percent complete - as well as tracking cost details and payment data by category.

Job Accounting Plus monitors change-order budgets, expenses and revenue, and integrates seamlessly with Estimating, including job budgets. It offers a full range of job-cost reports - detailed and summary reports - as well as reports by job or category, and variance reports.

Job Accounting Plus can also update Percent Complete based on your field inspection. It tracks costs and budgets by square foot, committed vs. uncommitted budgets, and actual costs. You'll also gain control over change orders be able to monitor change order budgets and revenue - and produce a user-defined change-order document for the customer to sign.

16. AccountPro 2002 Job Costing[*]

The Job Costing module provides for orderly job cost accounting and detailed tracking of billings, material and labor costs as well as units and labor hours.The AccountPro 2002 Job Costing software module may be used as a standalone Job or Project Costing module and optionally interfaced with the Accounts Payable, Accounts Receivable, Invoicing, Inventory Control, Purchase Orders, Payroll and Estimating modules. Interfacing with other AccountPro modules is automatic if installed and requires no additional setup.

Overview

- The number of Jobs you may establish is unlimited as are the number of transactions you may place into each job.
- Distribution breakdown by division (job phase) and sub-division (job sub-phase) of transactions within any job is unlimited and are all user definable.
- In addition to costs expended for a Job, the Job Costing module also tracks, in detail, billings associated with each Job.
- Payroll details may be entered directly into the Job Costing module from time sheets if the AccountPro 2002 Payroll module is not installed, or updated automatically from the AccountPro 2002 Payroll module if installed. Job Costing tracks both dollar costs and hours from the U.S. Payroll or Canadian Payroll modules.
- For companies doing both U.S. and Canadian Payroll, both may be installed on one system and update Job Costs.
- Year-end closing of the General Ledger does not affect job cost details in the Job Costing module.
- In addition to numerous reports, a totals pop-up window quickly displays a summary of contract amount, billings, costs, units including labor hours, accumulated to-date for a particular job, change or work order.

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* Retrieved September, 2002, from www.accountpro.com/mod160.htm

- Serial numbers may be tracked by postings from the Job Costing or Inventory Control module
- If the optional AccountPro 2002 Estimating module is installed, an estimate may be imported into Job Costing.

Reports

- Several comprehensive job cost reports are available and indicate, amount billed to-date, costs, hours, units, each with the option to provide information in detailed or summary format.
- Project reports may be printed for complete up-to-date costs and units for a job or jobs.
- Variance reports provide management with a quick and effective analysis of Actual, Committed and Estimated (budget) costs, hours and units.

17. Proacc[*]

ProAcc, a flexible accounting and cost control system specially designed for the construction company. It helps to manage projects in a more accurate, efficient, and profitable manner   .

Why Proacc

- Multi-site & multi-projects located in different region.
- On-line data update between main office and sites.
- Multi-user system, with password and access level setting to ensure user log-on control.
- Multi-currency system, able to handle projects with different currency.
- Provides complete set of up-to-date and meaningful reports :
  - Project Forecast
  - Project Budget
  - Sub-contractor Management
  - Sub-contractor Retention Balance List
  - Project Report
  - Construction Cost Transfer Journal
  - Payment Request Listing and Summary
  - Cost Balance Sheet
  - Trial Balance Sheet
  - Account Code Ledger
  - Cost Ledger
  - Cash Voucher
  - General Voucher
  - Account Payable List
  - Account Payable Balance Sheet
  - Paid Transaction List
- Used by multi-national companies located in 9 countries in Asia.

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[*] Retrieved October, 2002, from www.infortech.com   Infortech Software

- Suitable for varies range of users, from small construction companies to multi national construction groups.
- Report contents and layout are designed according to consultants who had solid and hand-on industrial experience.
- Relevant, efficient, and user friendly, no computer experience required.
- Further Customization available. Fully developed and support by a MSC-Status company with 7 years of industry experience.

18. FOUNDATION for Windows[*]

Whether you're an electrical contractor or an excavator, FOUNDATION for Windows is a labor-intensive contractor's best friend. This easy-to-use, Windows-based, construction accounting system features the following specialized functions:

- Microsoft® SQL server database
- Extensive payroll system
- Strong job costing and profitability
- A robust accounting environment
- True 32-bit Windows system
- Several security levels
- DataGenie© (patent pending) report designer
- InvoiceGenie© designer
- TimecardGenie© designer
- Job Cost BudgetGenie© designer
- Certified payroll
- AIA billing with rollback
- Work in progress
- Multiple state and local payrolls
- Job overhead allocation
- Handles all retainage issues
- Government taxing reports
- Powerful union reporting system
- Bonding reports - Over/under billing
- CrashProtector - Ensures data integrity
- Date-sensitive database

Job Costing

- Track actual vs. estimated costs
- Track actual vs. estimated quantities
- User-defined cost codes

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[*] Retrieved October, 2002, from www.foundationsoft.com

Foundation Software, Inc., 150 Pearl Road, Brunswick, OH 44212, Toll Free: 800.246.0800, Main: 330.220.8383, Fax: 330.220.1443, General Information: info@foundationsoft.com, Webmaster: webmaster@foundationsoft.com

- Complete audit trail
- Overhead allocation access
- Unlimited historical data
- Controls to guarantee JC/GL balances
- Bonding over abd under billings reports
- Track unit costs
- Production reporting
- User-defined labor-burden tracking

19. JIBPOWER[*]

JOBPOWER provides contractors with two premium construction software packages that combine power and ease of use - a construction accounting program and an estimating program. The accounting program also includes job management and payroll. The estimating program allows contractors to prepare quick, accurate bids and estimates. The programs are complete and comprehensive for the unique requirements of contractors   .

JOBPOWER works for general contractors, subcontractors, commercial, residential, industrial, concrete, electrical, fire protection, HVAC, mechanical, metal buildings, painting, plumbing, roofing, site work, structural steel, plus many more.

JOBPOWER includes:

Accounts Payable	Job Cost	Accounts Receivable
Payroll	Change Orders	Time & Material Billing
General Ledger	AIA Billing	Subcontract Status
Custom Job Reports	Certified Payroll	Over/Under Billings
Purchase Orders	Detailed Job Budgets	

20. MacNail Accounting[**]

MacNail Accounting is designed for small and medium-sized businesses that are run from one or more checkbooks. It does basic cash accounting, detailed job costing, and payroll. You'll find MacNail Accounting flexible and easy to use, and you don't have to learn a lot of accounting terminology in order to get started.

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[*] Retrieved September, 2002 from www.jobpow.com/index.shtml

JOBPOWER® is a product of Applied Computer Systems, Inc. 6200 Baum Drive · Suite 9 · Knoxville, Tennessee 37919Phone: (800)776-6556, Fax: (865)588-5379, E-Mail: sales@jobpow.com

[**] Retrieved September, 2002, from www.turtlesoft.com/macacc.htm

Handles your Checkbook Transactions

MacNail handles all of your financial transactions in the Checkbook Ledger. The Ledger numbers new checks sequentially, lets you insert miscellaneous transactions, and always shows you a current running account balance. Use the Reconcile command to match your Ledger against monthly bank statements.

Handles your Labor, Materials and Subcontractor Costs

Labor, Materials and Subcontractor costs go directly into special Logbooks, designed for detailed tracking of costs. The Labor Log can also be used to create your weekly payroll, and Material and Subcontractor costs can be "posted" directly to the Ledger to make month-end bill paying easier. Because you can "post" costs from the different Logbooks to the Ledgers, you can use MacNail as an Accounts Payable system as well. There is even built-in Profit and Loss tracking that lets you see your income and expenses for each project, and for each month.

Reports

With MacNail Accounting you can create several different kinds of Reports for different items and different time periods. A Financial Report lets you see your cash flow for any time period, broken down by projects. Make a Labor Report for the most recent pay period, and you'll have detailed labor information for MacNail payroll. Make a Material Report for last month, and you'll see just what you owe for accounts payable.

MacNail Accounting also includes a Query Box that lets you find specific pieces of information very quickly. It will tell you just about anything you need to know – for example, how much you've spent on materials for the Smith job, how much you've paid your plumber this year, or how much you spent on labor last month. You can even get an itemized list of all items of the desired type, if you need to look at something in more detail. You can also organize any MacNail Accounting worksheet in any kind of order with the Sort Special command. Make a Financial Report from all of last year's Ledgers, and click Tax Sort, and in just seconds you will have the information you need for your Schedule C or corporate tax returns.

Cost Control

MacNail's Job Cost Control system lets you track your costs in a very detailed way. For each project, you'll create a Job Cost Control worksheet that lists "estimated versus actual" costs for each construction category – broken down into labor, materials and subcontractors.

If you used MacNail Estimating for the project, you can create a Job Cost Control sheet directly from any estimate, using a simple menu command. For other projects, use one of the blank sheets that we provide, and type in your own numbers. The Cost Control worksheet can be used as a "progress report" sheet that will help you see how well you are doing, even when the project is only partly completed. After you type in an estimate of the completion percentage for each item, you'll be shown a predicted

total project cost, as compared to the original estimate. You can also use the same information when you bill for progress payments. When the project is finished, you'll have very detailed job cost information that can be "fed back" to your unit prices, increasing the accuracy of your future estimates.

21. capestone[*]

Capstone version 3.0 is a fully integrated construction management and accounting software package that is designed for companies involved in the construction industry. It contains integrated modules including Estimating, Job Costing and Billing, Multi-State and Certified Payroll, Accounts Payable, Accounts Receivable, General Ledger, Work Orders, Purchase Orders, Equipment, Inventory and Invoicing.

- Integration: Single entry input flows to all other modules, providing effortless input.
- Construction-Specific: Capstone is written specifically for the construction industry, with industry requirements like AIA forms, Certified Payroll, Change Orders, and Subcontractor Control.
- Up-to-Date Costs: The master file allows easy updating, by whole section, or one item at a time, making sure that you keep your cost file up-to-date.
- For All Levels of Users: Capstone is used by beginners and CPAs, hard core estimating departments and single handed operations, tracking all the information in infinite or simplified detail for any level of distribution.
- Error-Free Processing: Errors become virtually non-existent. The software prohibits unbalanced accounting entries. It advises if a sub's contract is being overpaid or if their insurance has expired.
- Time Savings: Organization, one time entry, faster production of estimates and instant, real-time reports smoothly synchronize activity within the office.

Base Product: Consists of the following:

- Accounting - which consists of general ledger, accounts receivable, accounts payable, financial reports, direct check writing, statements, lien releases, purchase orders, check registers, account reconciliation, period comparisons, transaction history, and invoicing.
- Estimating - The project file includes CSI or user defined cost categories. Adds profit, overhead, line-item markups, and sales tax. Contains templates, change orders, and specification tracking. Estimates include material quantities, costs, labor, subcontract requirements/costs.
- Master File - The master cost book reference has it's own cost database. Either entered manually, copied from a file, or imported from one of several third party pricing services. Automatically updates when preparing estimates. User can select a range of costs to be revised.

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[*] Retrieved October, 2002, from www.capstone-software.com

Pena Systems, Inc.

Other modules available include:

- **Payroll :** Contains flexible payroll computations, various pay rates, deductions, and fringe benefits associated with the construction industry. Includes both certified and multi-state payroll reports. Allows multiple unions / workers' compensation pay rates for employees in the same pay period.
- **Job Control Plus :** Features a CPM job option that allows critical path method scheduling for jobs. Even if you don't need the scheduling features, the CPM format offers expanded capabilities in job estimating and maintenance:
- **Subcontracts**: Tracks subcontract lien releases, charges and overpayments. Warns against overbilling and insurance expirations. Maintains subcontract and bidding histories. Allows subcontract revisions. Issues multiple party checks.
- **Job Billing:** Job costs automatically flows from accounting activity to budgets. Sets job billing for AIA, fixed bid, percent complete, time and materials, unit billings and draw billings for submission to owners / banks. Interfaces back to accounts receivable.
- **Equipment:** This full featured module contains job cost features, maintenance tracking by hours, miles or days, complete warranty tracking, license data, insurance and inspection, cost and billing tracking, full detail of asset purchase.
- **Inventory:** Features multiple locations and pricing. Tracks purchases, sales, backorders. Allows allocation to jobs.

22. Work in Progress[*]

Work In Progress is a complete construction management software that seamlessly integrates estimating, scheduling, purchase orders, job costing, customer billing, change orders, payroll, checkwriting, checkbook reconciliation and general ledger into a very affordable system.

This complete construction management system was designed by builders for builders. It provides you with the tools to easily estimate and schedule your projects, then track your budgets while quickly paying your bills and generating the necessary job cost and financial accounting controls to ensure your profitability.

Features

Work In Progress features all the tools you would expect from a top notch builders construction management software. The system is centered around nine 'views' which provide access to all the applications and information you need - Accounts Payable Invoices, Checkbook, Draws and Deposits, Budgeting, Change Orders, Customer Billing, Payroll, QuickEst estimating and Taskmaster assembly estimating.

- Fully Integrated System

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[*] Retrieved October, 2002, from www.dedicatedsoftware.com
Dedicated Software Solutions, Inc.

- Complete Construction Management & Accounting
- True thirty bit software - Written for Windows
- Easiest to use software available
- Very affordable yet comprehensive and complete
- Integrated Estimating and Scheduling system
- Estimating automatically generates Purchase Orders
- Change Order Invoicing with PO & budget tracking
- Customer Billing and Accounts Receivable
- Compare budgets for each job against actual costs
- Compare purchase orders against actual costs
- Job cost your payroll to any job or cost code
- Know if you're over budget before you cut a check
- Multiple checking accounts with bank reconciliation
- Custom lien waiver printing from check writing
- Keep your general ledger open indefinitely
- Complete financial accounting - automatically
- Audit trail for all financial transactions
- Special reports for your accountant
- Complete user support including company setup
- Expert one-on-one training available

23. PENTA[*]

Integrated Penta Modules

PENTA, the enterprise engine for e-commerce, is the only financial and project management solution on the market specifically designed from the ground up for the construction industry. A total enterprise software solution, PENTA offers seamless integration of project management, financial management, equipment cost control and labor management. From Financial Systems, Project Management, Accounts Payable and Accounts Receivable, to Inventory, Labor, and Fixed Asset/Equipment Cost, PENTA offers unparalleled flexibility and customization.

- Project Management, including: Job costing; time and billing; subcontractor control; and change order/variance control
- Materials Management
- Purchasing and Item Tracking
- Accounts Payable
- General Ledger and Financial Reporting, including: Inter-company transaction processing; inter-company consolidations; and multi-currency accounting
- Payroll, including: Time recording; labor distribution; and employee and department utilization
- Accounts Receivable
- Client Billing

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[*] Retrieved December, 2002, from sales@teampenta.com

Penta Technologies, Inc. 250 South Executive Drive Suite Two Hundred One Brookfield, Wisconsin 53005, Phone:262.782.7700 - Fax:262.780.2444

- Fixed Asset Management
- Equipment Costing, including: Preventative maintenance scheduling; usage analysis; and cost analysis

24. @Quote Plus[*]

@Quote Plus is designed for the express purpose of tracking jobs that require materials costing by the square foot. It is well-suited to industries such as construction, insulation, drywall, and roofing, and can handle both residential and commercial jobs.

@Quote Plus will generate a detailed proposal for the client, detailed work orders for the installers, and a thorough analysis of the costs involved in a job, from the materials and sales tax to the labor and miscellaneous overheads.

For labor, @Quote Plus will allow you to specify different labor rates to be paid for each material by the piece or square foot, then allow you to specify which installers get what percentage of the labor for that item or phase of the job.

25. National Job Cost CD[**]

Every Construction Company Needs to Compare Estimated and Actual Costs. But job cost tracking programs have been expensive, awkward, and hard to learn. No More! National Job Cost CD makes job cost tracking a task any contractor can handle, and for a price any construction company can afford.

Job cost tracking for construction contractors. This new program turns your estimates into invoices and exports both to QuickBooks Pro. Every check you write to suppliers, subcontractors or tradesmen is charged to a cost category in your estimate. In QuickBooks, compare estimated costs with actual costs, either item by item or category by category. When the job is complete, you know exactly where you made or lost money.

26. BuilderCentral 2000[***]

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[*] Retrieved October, 2002 from www.herodata.com/quote.htm
HERO data Services, 2 Sunshine Drive, Amherst, NY, 14228, Phone: 716.447.1858

[**] Retrieved September, 2002, from www.nwbuildnet.com/stores/ss/njc.html
NorthWest Builders Network, Inc.

[***] Retrieved September, 2002, from BC2000@wickes.com
Wickes Inc., Phone:1-800-558-1232

As a professional contractor, if your company is looking for a way to manage labor and material waste, track job costs during the construction process, estimate entire projects in as little as ten minutes to within 3% of the total project cost and receive pricing, material quotes and invoices electronically to save time, this will be of great interest to your construction company.

The complete software package contains three integrated modules: BuilderCentral Construction, BuilderCentral Financial and BuilderCentral QuickEstimator. All three modules are integrated and enables you to:

- Manage the entire construction process including: change orders, contracts, construction timelines, profitability reviews, lien waivers, purchase orders, sworn construction statements, warranty work and much more;
- Download pricing, invoices and material quotes from Wickes Lumber
- Qualify potential clients and estimate entire builder projects up to one million dollars in as little as ten minutes accurately within 3% of total project cost
- Manage entire financials including: accounts payable, accounts receivable, general ledger, check writing, payroll, job tracking and chart of accounts

27. EZTrak[*]

EZTrak is a powerful tool that calculates both cost and schedule variances. Schedule variances are determined by comparing actual to planned progress. Typically when variances exceed fifteen percent, triggers are in place for project managers to provide detailed explanations for the cause of the variance, identify and implement corrective action, and determine potential impacts on cost and schedule. EZTrak is fully compliant with cost and schedule reporting requirements, including incurred cost reporting for various governmental clients..

The cost scheduler tracks labor, equipment, purchases, subcontracts, and other expenditures daily through field data entered into EZTrak. This field data includes purchase orders, time cards, invoices, crew sheets, lodging and per diem reports. These become the actual-cost-of-work performed (ACWP). The project manager then compares the BCWS to the ACWP to determine what changes need to be made to the budget and work schedule.

28. ArchiAdmin[**]

ArchiAdmin tracks your work and costs and shows the status of your project at all times.
ArchiAdmin manages inventories, ordering, staff time costing, and sub-contracting.

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[*] Retrieved September, 2002, from www.ecc.net/project_management/management_tools

[**] Retrieved September, 2002, from www.archiadmin.com

ArchiAdmin, Unit 31, Coronation Place 10 Benson Street , TOOWONG Q 4066, Phone: 0500 555 405 Fax: 07 38707750 Mob: 0404040708

ArchiAdmin is flexible - set your own accounting period.
ArchiAdmin integrates with MYOB Attache and Pastell.
ArchiAdmin provides a timesheet system which runs in the background for instant updates on entire projects.

This vital software provides:
- A large library of template files for Word, Excel and Project.
- Macros linking with database tables and menus.
- Automated correspondence, documentation support and transmittal advices.
- Sensitivity to context of report or form being used.
- Easy installation not requiring detailed programming skills.
- Configuration by on-screen form-filling.

29. TimeScan[*]

TimeScanis a barcode-based replacement for the traditional timesheet.

TimeScan collects information on labor and equipment usage as well as installed quantities of material and sub-contracts. Timescan can also maintain a budget and control production units.

TimeScan is a full featured cost control system for a job site or an entire company.

TimeScan replaces the tedious task of preparing timesheets, keying it into a computer system, checking the results for errors, and finally, correcting any typing or information mistakes. The traditional timesheet preparation may take from a few days to a whole week.

TimeScan is a complete hardware and software solution, and it allows labor, equipment, material and sub-contract usage information as well as production information to flow directly from the foreman or superintendent to your payroll or cost control system.

TimeScan will make the information available a few minutes after the end of each shift, thus allowing for a timely managerial decision process.

30. Custom Homebuilder's Solutions[**]

Software Feature

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[*] Retrieved August, 2002, from www.time-scan.com/pages/product.html

[**] Retrieved September, 2002, from www.chsbuildersoftware.com
Telephone: 512-693-4103, FAX: 512-693-4105, Postal address: 1221 S. Congress Avenue, #124 Austin, TX 78704, Electronic mail: CHSSoftware@Prodigy.net

Designed by a degreed accountant with 20 years of back office management. Can Send data and reports to Microsoft Word, Excel, or Outlook Express!

Cost Codes and Pricing

- Use preloaded or set up your own
- Job budget templates with auto pricing updates to templates
- Job budgets, purchase orders, change orders, and costs all related with cost codes

Chart of Accounts

- Use preloaded or setup your own
- Set up one time; jobs and cost codes are not attached to chart of account G/L number

Job Costing Control

- Professional job budgets/ main line estimating
- Immediate alerts if over budget, purchase orders, and change orders
- Cost variance and detail reporting
- Estimated costs at completion that instantly reacts to all changes
- Percentage of completion reports
- Cost comparisons between jobs

31. IMP2ACT[*]

IMP[2]ACT Project Cost Control software was developed by VECO Construction, Inc., and was first used in 1992. It has been continually refined and improved upon since then. The reports that are generated by this program allow the project manager to know his project costs, productivity, and progress at all times. This allows him a proactive approach in managing his projects.

Progressing

This system used to keep track of project progress is the superintendent's Progress Input Sheets (generated by IMP2ACT). These are filled in by hand and returned to the Cost Engineer once a week for input into IMP2ACT.

The Progress Input Sheets contain the detail line item take-off quantities and man-hours referenced to cost account, activity number of the schedule, work item number, drawing number, and are identical to the G2 ESTIMATOR™ worksheets (work packages). As quantities are installed in the field, IMP2ACT is updated. This data along with the actual costs from the Field Payroll/Equipment Program is used to

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[*] Retrieved September, 2002, from www.commonwealth.ca/Management

Commonwealth Construction

generate progress information for the schedule, productivity, cost reports, and invoice reports.

Monitoring and Reporting

Monitoring actual progress against planned progress is essential to both Commonwealth and the client. This is supported by actual and accurate reporting and becomes the basis for decision making; whether it be for corrective action or forward planning. Commonwealth's integrated Project Control System allows the project manager to readily access this information in a timely manner.

Weekly Status Report

The project controls group, with participation of project management, develops a Weekly Status Report. This report highlights the major activities completed during the current week, major activities or milestones that are currently in progress, and major activities or milestones that will commence in the next week. In addition, problem areas and recovery plans are shown on this report.

Cost Report

The cost report includes the following: Current Budget, Period Costs, Cost to Date, Physical % Complete, Productivity, and Total Forecast Cost.

Construction Schedule

An updated client-defined schedule (usually a four-week schedule) is included. It shows percent complete by activity. It also shows planned completion dates by activity.

All line items are identified by a cost and systems code. Additionally, those line items that have associated physical activities or milestones will appear on the project schedules identified by their assigned cost and systems codes.

Material is coded similarly, as is all cost data including man-hours and dollars. Thus, information and data can move between elements consistently and accurately.

Manpower Curve

Provides status for both the current period and cumulative actual as compared to the planned manpower figures. A forecast line is added should a significant deviation occur.

Progress Curve

This curve is represented in the same manner as the manpower curve.

Field Payroll/Equipment System

The field payroll/equipment system is a microcomputer system that seamlessly downloads all project labour and equipment costs by Work Package on a weekly basis to IMP2ACT for the weekly cost reports.

32. CAFM Explorer[*]

Benefits

- Create Budgets from a budget spreadsheet
- Purchasing with line items
- Multiple Contracts
- Multiple Projects
- Cost Control on all expenditure
- Create Budgets from a budget spreadsheet
- Spans multiple fiscal years
- Recycles costs into next years budget
- Flexible and powerful reporting

[*] Retrieved October, 2002, from www.cafmexplorer.com/costcontrol.htm
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