Addis Ababa University

Faculty of Technology

Mechanical Engineering Department

Graduate Program in *Industrial Engineering*

MODEL DEVELOPMENT for IMPROVING the PERFORMANCE of PROJECTS

A Case Study on Ethiopian Roads Authority(ERA)

BY

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Candidate's Declaration

I hereby declare that the work which is being presented in this thesis entitled Model development for improving the performance of projects: A Case in Study in Ethiopian Roads Authority (ERA) is original work of my own, has not been presented for a degree of any other university and that all sources of material used for the thesis have been duly acknowledged.

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Abrham Talargie H/Gebriel

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Summary

Project management has been adopted by a wide range of organizations, industry, commerce and government to handle their many and varied undertakings. Generally, projects involve many people with different skills and professions, big sum of money, limited time and resources, and unique activities to be carried out. Therefore, managing a project becomes quite complex and different than managing industries, since the former has a dynamic nature.

Projects are desirable to be completed within the time frame and budgeted cost. But unfortunately, many projects take longer to complete and cost more than necessary because of lack of professional skills in the area and other various factors directly and/or indirectly related with it. In most developing countries this problem is more aggravated than those developed ones; as a result many project-sponsoring organizations are discouraged to sponsor projects in these poor countries.

In Ethiopia, the road transport accounts for over 97% of the total domestic traffic carried out by motorized transport system, most of the connecting roads are not properly maintained, which results in frequent accidents costing the life of many people and the loss of valuable resources every year. Hence, making improvement in the road sector of the country will have a significant impact on other sectors as well.

With this objective in mind this research will assess the performance of the road construction projects to investigate the undesirable causes that may hinder road construction projects from success. Therefore, the major output of this research work will be to develop a model that improves the performances of the road construction companies and the implementing capacity of the employer in Ethiopia. In order to undertake the research work, Ethiopian Roads Authority (ERA), which is in charge of the administration of the road construction projects under the federal government supervision, is selected as a case.

Therefore, senior staffs of employer organization, consulting and construction firms were contacted; through them some key project participants of each firm were identified and contacted. A list of completed road project documents were revised in detail, government and other several funding institutions' tender guidelines and records, different Standard Bidding Documents (SBD), i.e. IDA, ADB, several types of journals were also reviewed, and other relevant institutions like Central Statistics Authority (CSA) and Commercial Bank of Ethiopia (CBE) were also visited for the purpose of gathering significant information and for data crosschecking purposes.

The questionnaires as part of the data collection instrument were used during the research and were tested for their validity and reliability by first distributing a sample of 13 questionnaires, then after feedbacks were gathered and comments were considered prior of mass distribution. In total, 60 questionnaires were delivered to 10 selected organizations and 32 were returned. In this research work, in order to evaluate the performance of the road construction projects data has been also gathered from the archives at the employer head office. The data gathered has been stratified in several ways, which facilitates the detail analysis of the data from different perspectives that help the identification of the major problems causing the poor performances of the road construction projects.

In this research work a total of 3547 kilometers of road from 21 (12 projects handled by domestic and 9 handled by foreign construction firms) completed road projects were analyzed; out of the total 1073 km, 1462 km, 1012 km were Construction, Rehabilitation, and Upgrading types of works respectively. The Cause and Effect analysis was employed to identify the causes for the poor performances in both of the performance measure variables (Time and Cost overruns) considered in the study.

The performance of the local contractors was analyzed against the types of works they accomplished. Analysis from the questionnaires and the interview results revealed that the relative contributions of the employer, contractor, government, and others to the time overrun were found to be 54%, 21%, 14 %, and 11% respectively.

From the study it has been found that the performances of the projects under consideration were unsatisfactory with an average of 33.87% of cost overrun and 57.51 % of time overrun. The study revealed that finance is one of the big problems that domestic construction firms are facing today in our country. In addition to the *scarcity of finance*, they lack financial management skills that hinder their capacity to complete projects on time and within the estimated budget. It was also found that most of them lack the *experience* and the *capacity* to undertake major road projects, which requires big sum of money and high technology. Lack of *skilled manpower and professionals in the field* is another common features of the domestic construction companies, therefore, it was found difficult for local companies to meet the strict pre-qualifying conditions established for projects financed by the World Bank or African Development Bank.

The model which is the output of the study intended to improve the performance of the road construction projects is categorized under four major improvement areas: Internal to the construction company which the researcher has designated as "Project management system", those that are not within the control of the construction firms but are within the scope of the government, are designated as "Government Policies and Regulations" and "Capacity Building"; and finally those factors that are beyond the government scope coming from regional and global pressure are classified under "Environment" category.

This study also includes the software developed for crashing of networks which is intended to get accurate and optimum solutions with less time, improved productivity of the user and improving the communication between stakeholders and project team. If the project consists of hundreds and thousands of activities, manual computation not only may lose its accuracy but also become impossible to attain accurate solution of it; therefore, the advantages of using this software becomes of great value.

Finally, the study recommends the proper and systematic implementation of the model to improve the performance of the domestic construction companies and the implementing capacity of the employer (ERA), the capacity building initiatives shall be given impetus, and

address all at the top, middle and lower level of employees engaged in road construction sector; government policies directives and regulations shall be not only formulated but also properly implemented and it should consider and be updated in line with current international developments. Since the financial capacity of the contractors is extremely week, the timely payments of both advanced and progressive payments of the contractors is a crucial point to be considered by all involved parties.

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Abbreviations and/or Acronyms

AAU	Addis Ababa University
ACV	At Completion Variance
ACWP	Actual Cost for Work Accomplishment
ADB	African Development Bank
ADLI	Agricultural Development led Industrialization
APR	Annual Percentage Rate
APV	Adjusted Present Value
BAC	Budget at Completion
BADEA	Arab Bank for Economic Development in Africa
BERTA	Berhanu and Tadele
BCWS	Budgeted Cost for Work Scheduled
C/SCS	Cost /Schedule Control
CBE	Commercial Bank of Ethiopia
CMESA	Common Market for Eastern and Southern Africa
CMS	Construction Management System
CPI	Cost Performance Index
CPM	Critical Path Method
CRBC	China Road and Bridge Corporation
CSA	Central Statistics Authority
DCF	Discounted Cache Flow
EAC	Estimates at Completion
EEC	European Economic Commission
EORDF	Ethiopian people's Revolutionary Democratic Front
ERA	Ethiopian Roads Authority
ETC	Estimated Time of Completion
EU	European Union
EVC	Earned Value Concept
GDP	Gross Domestic Product
IDA	International Development Agency
IHA	Imperial Highway Authority
IRR	Internal Rate of Return
ISO	International Organization for Standardization
MARR	Minimum Attractive Rate of Return
MBE	Management by Exception
MBO	Management by Objectives
MPV	Net Present Value
NCR	Non-Conformable Reports
NDF	Netherlands Development fund
NECAT	New Era Consultancy and Trading
NGO	Non Government Organization

OBS	Organization Breakdown Structure
OPEC	Organization of Petroleum Exporting Countries
PERT	Project Evaluation and Review Technique
PM	Project Management
PMBOK	Project Management Book of Knowledge
PMI	Project Management Institute
PMIS	Project Management Information System
PMS	Procurement Management System
PSB	Parts and Supplier Branch
ROI	Return On Investment
RRD	Rural Roads Division
RSDP	Read Sector Development Program
SATCON	Samuel Teklay Construction
SBD	Standard Bidding Document
TCDE	Transport Construction and Design and Enterprise
TQM	Total Quality Management
UK	United kingdom
UNIDO	United Nations Industrial Development Organization
USD	United States Dollar
VO	Variation Orders
WB	World Bank
WBS	Work Breakdown structure

CHAPTER ONE: INTRODUCTION

1.1 Background

In almost all endeavors of achieving new products, tangible or intangible; project management has been adopted by a wide range of organizations, industry, commerce and government to handle their many and varied undertakings. Generally, projects involve many people with different skills and professions, big sum of money, limited time and resources, and unique activities to be carried out. Therefore, managing a project becomes quite complex and different than managing industries, since the former has a dynamic nature.

Projects are desirable to be completed within the time frame and budgeted cost. But unfortunately, many projects take longer to complete and cost more than necessary because of lack of professional skills in the area and other various factors directly and/or indirectly related with it. In most developing countries this problem is more aggravated than those developed ones; as a result many project-sponsoring organizations are discouraged to sponsor projects in these poor countries.

Ethiopia currently counts with an estimated population of 64 million and a territory about 1.1 million sq.km with widely dispersed population. Even though the country's economy is totally dependent on agricultural outputs with 85% of population engaged in farming sector, only 20% of the population has access to road transportation facilities, thus, 80% of the population manage the daily activities using traditional and animal based transport system. Agriculture, accounting 45% of the GDP (Gross Domestic Product), is dominated by small-farm holder farmers scattered in small rural communities, while the major markets and the collection and processing centers for crops, are concentrated in urban areas located at considerable distances from each other. In a developing country like our the growth in agricultural output which will constitute the primary basis for growth in the economy for the foreseeable future, is heavily dependent on the transport system being able to effectively integrate the rural communities with the urban centers, facilitating reliable and cost effective transportation of crops and other

agricultural outputs to the market and processing centers and to distribute the agricultural inputs and other basic needs to the geographically dispersed farming communities.

Even though, the road transport in Ethiopia accounts for over 97% of the total domestic traffic carried out by motorized transport system, most of the connecting roads are not properly maintained, which results in frequent accidents costing the life of many people and the loss of valuable resources every year.

Therefore, making improvement in the road sector of the country will have a significant impact on economic and social sectors as well. With this objective in mind this research will assess the critical factors of project time and cost overrun as well as other undesirable causes that hinder road construction projects success. Hence, the major output of this research work will be to develop a model that finds an efficient way to prevent the occurrence of time delay and cost overrun on projects and minimizes the risks of project failures. In order to undertake the research work, Ethiopian Roads Authority (ERA), which is in charge of the administration of the road construction projects under the federal government supervision, is selected as a case.

1.2 Research Objectives

In general, the objective of this research work is to analyze the major project management related problems that frequently occur in road construction projects administered by under the administration of the Ethiopian Roads Authority and to suggest solutions that may help to the elimination of unnecessary delay and cost overruns, therefore;

The general objectives of the thesis are to:

- Introduce state-of-the-art project management techniques and tools used in construction industry with special focus in road construction projects
- Contribute to the body of knowledge in the area

The specific objectives of the thesis are to:

- Identify the major causes of project delays and cost overruns on road construction projects;
- Investigate the level of implementation of the project management tools and techniques in ERA;
- Develop and recommend an effective model to minimize the problems encountered;
- Develop user-friendly computer based software for crashing of the project duration with optimum cost.

1.3 Research Methodology

In general, the following approaches were used during the progress of the research work:

- Literature review and assessment of the classical methods which are becoming state-of-the-art in the project management;
- Selection of an organization to undertake the case study;
- Identification of problems, collection of data, and analysis of the existing manuals used for project administration in the organization under investigation;
- For data collection purposes questionnaires were developed, unstructured interview with key persons together with various data collecting formats were employed;
- Developing a user friendly computer based software that can be applied for crashing of time and cost;
- Developing an integrated model that minimizes and/or eliminates the problems encountered; and
- Recommendation for implementation of the findings of the study.

1.4 Scope and Limitations

The research work will have the following deliverables: -

- Backgrounds of Ethiopian Roads Authority
- Literature review on the state-of-the-art project management tools techniques
- Solution proposal for the frequent time delay and cost overrun and other related problems
- A model developed to improve projects performance
- A user friendly computer software for crashing of time with optimum cost

Limitations

During the research of the study there have been major and minor problems faced by the author, some of them were solved easily without causing effect on the study but other were beyond the scope of the author. The major problems were the fear by workers of delivering relevant information with the study: cost and capacity related, and delivering of information associated with the name of the contractors.

CHAPTER TWO: REVIEW OF THE CONSTRUCTION INDUSTRY

2.1 Introduction

Construction industries have great influence on the state of the nation's socio-economic health. In fact, this industry is the keystone in the growth of the national economy of most countries. Times of prosperity are largely sparked by extensive private construction; in periods of recession, when construction volume suffers drastic cutbacks, government sponsored public works are used to reduce unemployment. A high level of construction activity is an indispensable element of any nation and it is also an indication of the country's healthy economy.

Narrowly defined, the industry comprises only those enterprises 'adding value' through production or assembly operations on the construction site. A broader definition would include firms and individuals involved in planning, design, the supply of building materials, plant, equipment, transport and other services.

The construction sector produces a wide range of products, from individual houses to major infrastructure such as roads, power plants and other complex deliverables. In most countries output is roughly equally divided between housing, other buildings and civil engineering projects. Although attention is mostly focused on new construction, the renovation and maintenance of existing structures accounts for almost 50% of total construction output in some of the more developed economies and an even greater share of employment.

The enterprises engaged in construction activity are equally diverse; they range from self-employed individuals providing a service to private house owners in the local community to multinational firms operating on a global scale. However, the vast majority of enterprises involved on-site constructions are small and local.

2.2 Construction Category

The field of construction is as diversified as the uses and forms of the many types of structures that it produces. However, construction can be divided into three main categories, although there is some overlap among these divisions certain projects do not fit neatly into any one of them. These are: Building construction, Engineering construction, and Industrial construction.

Building construction: Building construction covers buildings in the commonly understood sense, which are erected for habitation, institutional, educational, light industrial, commercial, social, and recreational purposes. Building construction is generally regarded as the mainstay of the industry and usually contributes about one-half of the total annual dollar volume of construction.

Engineering construction*:* Engineering construction is a very broad category covering structures that are planned and designed by professional engineers. This category includes structures that are not primarily architectural in nature, but that involves predominantly engineering field materials such as earth, steel, concrete, piping, and timbers. This broad category may be divided as -highway construction and heavy construction. Highway construction covers clearing, excavation, filling, bridge structures, and other items commonly associated with highway work. Heavy construction is usually taken to mean to include sewerage and water treatment plants, dams, waterways, pipe and pole lines, marine structures, tunnels, bridges, and railroad work. Most engineering construction projects are publicly financed.

Industrial construction: Industrial construction includes the erection of projects that are associated with the manufacturing or processing of commercial product or service. Such structures are highly technical in nature and are frequently built by specialized contracting firms that do both the design and the construction under contract with the owners. Petroleum refineries, steel mills, chemical plants electric power generating stations, and similar installations are all examples of industrial construction.

Typical of construction is the mobility of operation worksites, and are started and lasted almost several years, if not months. The number of various occupational groups is high, and numerous companies and entrepreneurs may operate on the same site.

2.3 Construction Industry in Developing Countries

The construction industry is one of the major development constraints in developing countries. This is mainly because; developing countries[1] are considerably dependent on the growth & development of their physical infrastructures. Without the development of these physical infrastructures, developing countries will remain deficit in:

- Distributing resources within and across countries;
- Providing access to economic, political and social services; and
- Attracting local and foreign investments, etc.

As a result they consume unprecedented budgetary resources towards developing these infrastructures. Unlike the developed world, most of these infrastructures remained the burden of the public sector because the private sector in developing countries is weak.

Frequently researchers mention that the physical infrastructures that countries possess are indicators for economic growth (World Bank, 1984). This fact is true because researchers had found out that the correlation between infrastructures development and the growth of the nations are considerably interlinked. In general, one thing is obvious is that physical infrastructure has influences in facilitating and enhancing economic activities.

At the same time, experiences and various sources indicate that the performances of the projects are low and cause serious problems to these countries. That is, most of these projects were not

[1] Also called Third world countries; though many do not accept this designation. The Third World displays little homogeneity; it is divided by race, religion, culture, and geography, as well as frequently opposite interests. Encarta, 2002 Microsoft Corporation.

implemented as they were expected or used to face considerable low performances. The evidence from many projects in these countries revealed that these problems are not being adequately dealt with.

These deficiencies in project management in these countries are generally originated from the three common characteristics (Figure 2.1), which are not faced by their counterparts in the developed world, Wubishet (2004); these are Scarcity of Resources, Unique Situation and Uncritical Adaptations.

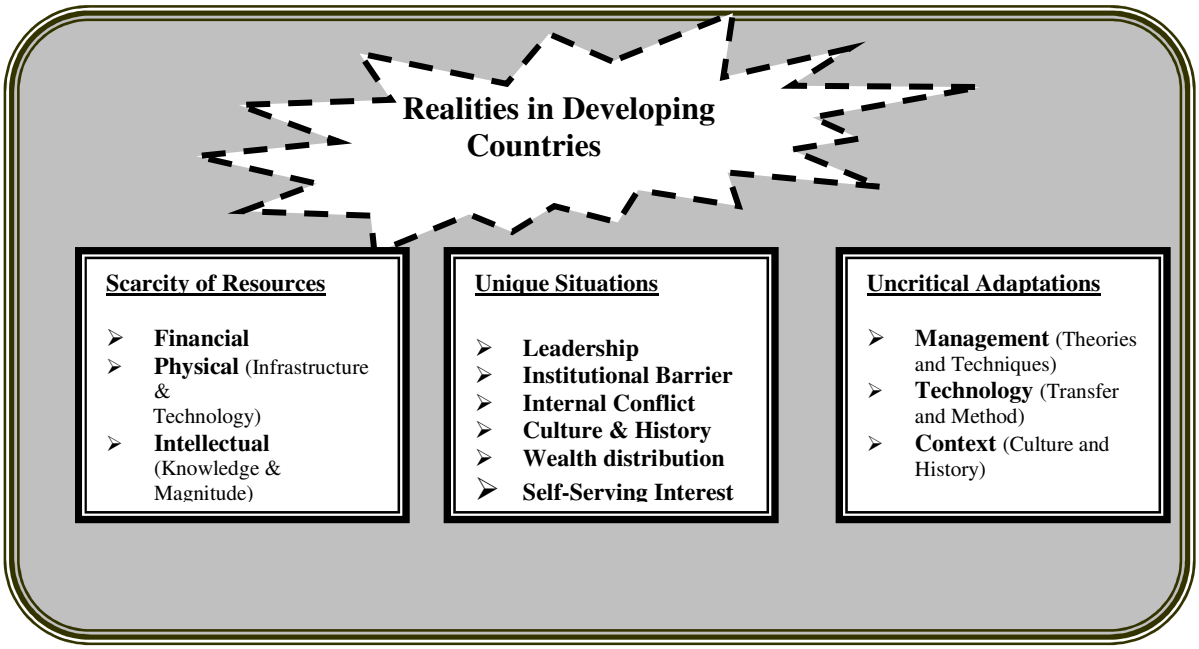


Figure 2.1 Common characteristics of the developing countries

Scarcity of resources: The developing countries are suffering from the severe scarcity of finance, human (intellectual), institutional and physical ones. In these countries the absence of these resources has caused several negative consequences in the social, political and economical aspects of their everyday life.

Unique Human and Organizational situation: This includes issues related to the state level leadership impediments; institutional barriers; internal conflict; insufficient development of financial, human and physical; capital; and cultural and historical constraints.

Uncritical Adaptations (Management & Technology): Many organizations and their projects in Developing Countries have been forced to or advised, and even feel themselves that they must strive to adopt Western thoughts and practices to achieve economic prosperity within the shortest possible time irrespective of their unique and contextual realities. This can be associated with the ambitious stand of developing countries 'Politicians' and their pressure on public institutions, for accelerated growth with little awareness over the context of capacities and capabilities of these institutions in these countries at large. Besides, many organizational practices and management training programs in the developing countries are based on 'an uncritical emulsion and extrapolation' of the experiences from the economic growth model of the developed nations neglecting their socio-cultural/socio-technical differences. Some of the common differences between developing and developed countries are shown in the table below.

Table 2.1 Table of comparisons

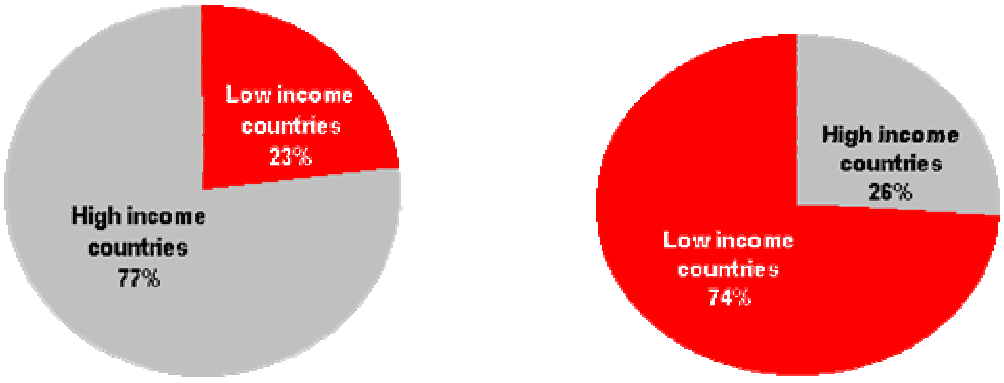
Developing countries	Developed countries
It is a weak, fragmented and compartmentalized industry working in an environment where there are no subcontracting and with very low joint venture practices.	It is large and capable industry consisting of small firms. It is a hierarchical industry where small firms serve as sub contractors.
Almost all contracts use Design-Bid-Build procurement methods largely based on control motivations.	Several options including Design-Build are in practice and trends are towards alliances & partnership approaches
it involved considerable physical works on site and more labor intensive. Hence require more characteristics of procurement of works.	It involved considerable assembly, fixing and installation works and more equipment intensive. Hence require more procurement of services.
Demand is dominated by the public sector.	Demand is dominated by the private sector.
The nature of competition in construction is substantially determined by the action of the Government.	The nature of competition in construction is substantially determined by the action of the market.
Consultants' remain faithful advisors to clients and hardly exercising their impartial responsibilities.	Consultants' roles are redefined through different procurement method, and they are in the state of strategic changes.
Information is unprepared for modern use of technologies.	Information is well geared towards modern use of technologies.
Maintenance and Refurbishment works are most neglected parts of construction works.	Maintenance and Refurbishment works are the most important parts of construction works.

Another important difference is on the amount of these countries expends on construction projects. In 1998, the expenditure varied from US$5 per head in Ethiopia to almost US$5,000 in Japan. This means that construction output, by value, is heavily concentrated in the rich, developed world. The high-income countries of Europe are responsible for 30% of global output, the United States for 21% and Japan for 20%, China, despite its huge size and rapid economic growth in recent years lags a long way behind with only 6%, India has 1.7%, and others sharing 21.3%.

The distribution of construction employment is almost the exact reverse of the distribution of output (as shown in the Figure 2.2). While three-quarters of output is in the developed countries, three-quarters of employment is in the developing world. Official data suggest there are around 111 million construction workers in the world, some 80 million of them in the low and middle-income countries. However, as many construction workers in these countries are informally employed and therefore not counted in official data, the real number is much higher.

The reason for the greater employment-generating potential of construction activity in the developing countries can be traced to differences in technology. There is a very wide choice of technology available for most types of construction and the technology adopted tends to reflect the relative cost of labor and capital. In the richest countries, where labor is expensive, machines have largely replaced workers in many of the tasks involved in new construction (although repair and maintenance is still very labor intensive).

In developing countries, where labor is relatively cheap, the majority of tasks are undertaken by manually with minimal use of machinery and equipment. From the above facts one can easily conclude that the construction industry in developing countries should be the sector that local governments must stress and support in order to maintain a sustainable economic growth and maintaining the employment to help the citizens remain productive.



Output Employment

Figure 2.2 Comparison of output and employment between developed and developing nations

The common characteristics of all construction industries in developing countries, is the inherent nature of the delay and cost overrun in every projects they undertake. The outdated technology, unskilled labor, lack of proper project management and cost control knowledge they possess are the major reasons for their low performances generated from within the construction companies and the frequent war, ethnic conflicts, political instability, inconsistency of policies and regulations are the major factors from the government's side that lead to the low performances of the construction industries.

Therefore, how to remove these undesirable causes of the low performances of these kinds have been and still remains to be the concern of all construction companies, governments, and project stakeholders in these countries.

2.4 The Construction Industry in Ethiopia

The construction industry is one of the most important sectors to be given due consideration in Ethiopia because it directly or indirectly affects all other sectors of the economy. Investment in nearly every field: Agriculture, Health, and Education etc. must eventually have a construction component.

Besides, the employment opportunity that this sector provides is of great importance for the country (Table 2.2). As a figure shows the construction industry (22%) is found in 3rd position in providing a permanent as well as a temporary employment opportunity, after Agriculture and Manufacturing with 43.9% and 24% respectively for temporary employment opportunity and 21.2% and 40.1% for permanent employment (14.4%). Even though this figure shows the status of a single quarter, the result of analysis for several years shows that construction industry provides a great number of employment opportunities for the citizens of the country. During the command economy almost all construction activities were performed by huge state owned companies (their primary objective was only create employment opportunities) where no proper implementation of project management and cost control techniques was employed, which eventually led them to inefficiencies, frequent delays and significant amount of cost overrun in every projects undertaken.

Table 2.2 Sectoral distribution of number, investment capital and expected employment creation capacity of projects.

Sector/Sub-Sectors	**Number of Projects**		**Investment Capital**		**Permanent Employment**		**Temporary Employment**	
	Number	**Share %**	**Number**	**Share %**	**Number**	**Share %**	**Number**	**Share %**
Agriculture	26	8.6	1053.70	34.3	2936	21.2	1076	43.90
Manufacturing	103	34.0	755.81	24.6	5558	40.1	588	24.0
Construction	**41**	**13.5**	**172.09**	**5.6**	**1994**	**14.4**	**540**	**22.0**
Hotel & Tourism	4	1.3	10.79	0.4	95	0.7	-	0.0
Real Estate	11	3.6	135.20	4.4	379	2.7	157	6.4
Trade	1	0.3	0.81	0.0	16	0.1	-	0.0
Education	34	11.2	212.79	6.9	811	5.9	5	0.2
Electric Supply	1	0.3	215.15	7.0	18	0.1	26	1.1
Health	5	1.7	71.00	2.3	399	2.9	-	0.0
Other Businesses	77	25.4	441.63	14.4	1646	11.9	60	2.4
Grand Total	**303**	**100**	**3068.96**	**100.0**	**13852**	**100**	**2452**	**100.0**

Source: National Bank of Ethiopia (NBE) Quarterly Bulletin; Fiscal year series, vol 18, Nov.1st, 2002-2003.

After 1991, when free market economy policy was launched in the Ethiopian economy, many construction firms had been established. The boom of these firms with less experience in the field, were in charge of handling the several types of intensive construction activities carried out throughout the country. But the little experience, the low level of skilled manpower and the outdated technology they possess limited their capacity in every aspects of their endeavor. Thus, the award of projects of complex nature requiring well established construction companies to foreign firms while local firms were restricted to handle less complex and small size projects to help grow their capacity and experience while securing the quality of the projects, was the measure taken by government for several years.

The construction industry in Ethiopia like other developing nations suffers a lot of difficulties and shortages. The main ones can be summarized as follows:

***Scarcity of finance*:** Finance is one of the big problems that domestic construction firms are facing today. Besides this scarcity of finance, they lack also financial management skills that hinder their capacity to complete projects on time and within the estimated budget.

***Big projects off-limits to domestic firms**:* Although the majority of local construction firms specialize in infrastructures, most of them lack the experience and the capacity to undertake major road projects that requires big sum of money and high technology. It is difficult for local companies to meet the strict pre-qualifying conditions established for projects financed by the World Bank[2] or African Development Bank. As a result, nearly all of the road projects financed by foreign sources go to the hands of international contractors, forcing local firms more often to handle small projects financed by the federal government.

Lack of skilled manpower and professionals: The success of any project greatly depends on the capability of its human resource. To improve the workmanship, design, and other related jobs, skilled labors and professionals are indispensable. Local construction companies suffer in this aspect; the limited capacity of the country's educational institutions in producing

[2] World Bank sponsored projects require a strong capital base (by one estimate nearly $ 3 million) and extensive international experience.

skilled labors and professionals in the area together with the low pay rate of the local construction firms instigate high-level of migration to foreign firms where the payment rate is considerably high and other benefits are relatively better.

All the above mentioned and other shortages serve as an input and take the lion share among the problems (the time and cost overrun) that domestic construction firms are suffered from. Therefore, taking into consideration the significant role that domestic construction industries play in the effort of the nation fighting against poverty through expansion of infrastructures of several types; the government, the construction firms and stakeholders involved should focus attention and integrate efforts to the minimization and/or elimination of these problems and strive for the design and implementation of policies that encourage local construction firms to strengthen their capacities of handling major projects and deliver them with the required quality.

CHAPTER THREE: INTRODUCTION TO PROJECT MANAGEMENT IN ERA

3.1 Brief History of ERA

ERA is an Ethiopian organization, working under the Ministry of Infrastructure, which is a responsible body for the overall planning of the national road network development, construction, and maintenance of trunk and major link roads of the whole country. ERA's main office located at Addis Ababa has ten districts distributed throughout the country in geographically strategic locations to facilitate the road maintenance activities. In addition to administer the federal government's road construction projects, ERA assists and supports the regional self-government road construction project offices helping them improve their capacity on road construction and administration activities.

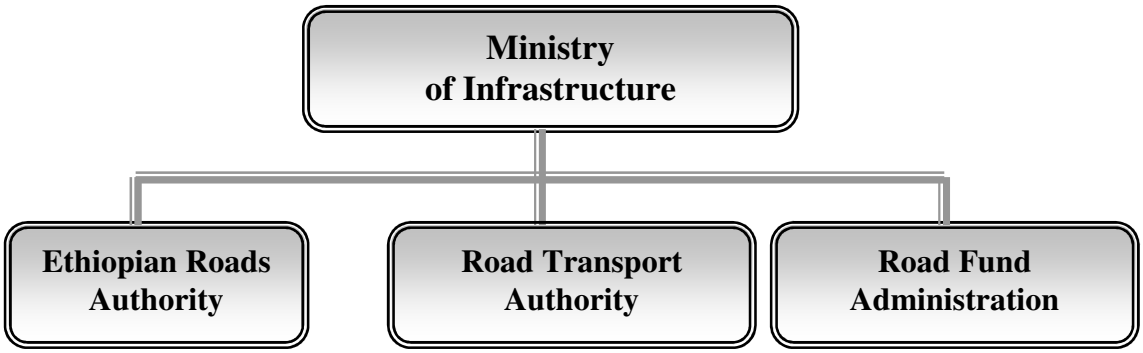


Figure 3.1 Institutional arrangement (at Federal level)

The Mission of ERA is to:

Provide safe, comfortable and adequate road infrastructure to support the socio-economic development of the nation and satisfy road users by:

- Improving the condition of roads
- Expanding the network

ERA strives to achieve its mission by working closely with other authorities under the Ministry of Infrastructure (see figure 3.1).

3.1.1 Organizational Structure of ERA

ERA has undergone through a continuous reorganizations especially during the last twenty years. Throughout these years, ERA staff and consultants undertook many studies; these continual processes of internal reorganizations created many changes in the structure and scope of tasks of the Authority.

Currently ERA's organization consists of a Board, General Manager, Chief Engineer, Press and Information Office and nine Divisions (see Appendix B). Most of the Divisions are still functioning as previous organizations while others, like Rural Roads Division (RRD) are weakened as most of their activities are being transferred to the Regional Government states road construction offices.

3.1.2 Powers and Duties of ERA

The powers and duties of ERA alluding to the proclamation N^{o} 63/1993 are:
Without prejudice to the powers vested in National/Regional self governments by law the Authority was vested with responsibility for the construction, improvement, maintenance of the country's roads and the registration, licensing and regulation of construction machineries. This responsibility is to:

- Determine standards for roads, designate highways and rural roads;
- Carryout feasibility studies of highways, prepare short and long-term plans and programs, and upon approval, cause the implementation of same;
- Provide technical assistance and advice to national/regional governments regarding the construction and maintenance of roads; prepare directive on participation by national/regional governments in the construction and maintenance of highways;
- Cause the supervision of and inspect construction works on highways to ensure their conformity with the quality standards, the time limit and the price level provided in their contracts;

- Undertake studies regarding materials to be used for the construction and maintenance of roads, and apply useful results thereof;
- Render manpower training service relating to the construction and maintenance of roads;
- Determine the extent of land required for its work in the adjacently as well as surrounding of roads, and the conditions of use of such land by others;
- Use free of charge land and such other resources as quarry substance required for the purpose of road construction, camp storage of equipment and other required services; provided, however, that is it shall pay compensation in accordance with the law for properties on the land it uses;
- Own property;
- Enter into contract;
- Sue and be sued in its name;
- Perform other acts as are required for attainment of its objectives.

In 1993 regional governments rural road organizations were established and have takeover the responsibilities of regional roads. Currently ERA is responsible for the administration of the overall planning, network development, construction and maintenance of all roads both trunk and major link roads in the country.

3.2 Current Situation of Ethiopian Roads

It is well known that transportation is fundamental to the development and operation of any society. It permits that geographically distant resources become accessible with transportation, connect people, transfer of technology and also goods needed in different places. This make evident that the economic growth of any society in any part of the world is directly related to the availability of transportation. Without question, a society without an advanced transportation system remains primitive.

Transport services are divided into two major categories [Donald J. Bowers et al]: (1) the movement of materials and products (freight), and (2) the movement of people (passenger). In order to facilitate adequate transportation system the construction of adequate road infrastructure is a vital requirement.

In Ethiopia the road infrastructures had reached such a level of deterioration in the early 1990s that it became a serious hindrance to the government's efforts in reviving the economy. The road density in Ethiopia is among the lowest in Africa and other developing countries, with an estimated 21km of road per 1000 sq km and 0.43 km per 1000 population (RSDP1996). Even though the road transport in Ethiopia accounts forever 97% of the total domestic traffic carried out by motorized transport system, most of the connecting roads are not properly maintained which results in frequent accidents costing the life of many people and the loss of valuable resources every year.

In 1991, in addition to the 13,000 Kilometers of all weather roads, of which about 4,000 were asphalted and 8,900 Kilometers of all weather gravel roads; there were 4,900 Kilometers of rural roads, making a total of nearly 18,000 kilometers of all types of roads. The road network in Ethiopia, centered in Addis Ababa radiates in all directions in a spoke-like pattern. However, substantial parts of the country, notably in the West, Southwest, and Southeast, still lacked all-weather connections to this network. Only about 12 % of the population living in these parts of the country had ready access to roads. Most roads in the national network were concentrated in the central, eastern, and northern highlands.

During the 1936-1941 Italian occupation, the building of roads increased mobility of people and resource throughout the country and also helped Italy consolidate its rule over Ethiopia. By 1941 there were about 7,000 Kilometers of roads, of which about half were surfaced with asphalt. After liberation, road construction and maintenance stagnated because of lack of funds, equipment, and expertise. Until 1951, when the government established the Imperial Highway Authority (IHA) with the help of World Bank funds and the technical assistance from the United States Bureau of Public Roads, the development of Ethiopia's highway system continued.

The Imperial Highway Authority played a major role in the construction of roads until the revolution. The "derg regime" restructured the Imperial Highway Authority as the Ethiopian Road Authority and the Rural Roads Task Force. The government created the latter to develop rural roads outside the main system and to expand feeder roads within the main system. The World Bank, which had financed four previous highway programs, funded this project also. In addition, the African Development Bank (ADB) and the European Economic commission (EEC) provided assistance for road construction and maintenance activities. Despite these efforts, Ethiopia's road network remained primitive and quite limited, even by African standards. This shortcoming had tragic consequences during the 1984-85 famine when the lack of adequate roads contributed to Ethiopia's inability to distribute food and other commodities to the famine victims. As a result, many thousands of Ethiopians perished. In 1991, completion of an adequate nationwide highway system continued to be one of Ethiopia's major development challenges for the new transitional government[3]. The road sector development, which is considered as one of the crucial factors for the countries socio-economic development was given great emphasis at governmental level with continuous increase in the allocation of budget ranging on the average from 15 % to 20% and of the total yearly allocated budget.

In 1997, ERA with the support of other development partners launched the Road Sector Development Program (RSDP) to tackle the shortcomings in the road sector and complement other sectoral development programs. This program provides a comprehensive approach of integrating the implementation of key road investments with major policy and institutional reforms. Accordingly, the major goals defined by RSDP are directed to:

ii- Improve transport operating efficiency and reducing road transport costs for both freight and passengers. So as to encourage production, distribution, and export;

iii- Provide access to rural, other neglected and food deficit areas to:

- Support efficient production, exchange and distribution of goods throughout the country;

[3] This is the party that currently ruling the country, called: Ethiopian People's Revolutionary Democratic Front (EPRDF).

- Exploit the utilization of the vast natural resources of Ethiopia which are unexploited so far;

iv- Develop institutional capacity of the road sector at federal and regional levels.

The main objective of RSDP I (1997-2002) has been the improvement of the road network that has been continuously deteriorating to hamper the efficiency of the road transport system throughout the country. The first phase of the RSDP was completed in June 2002. RSDP I focused on rehabilitation and upgrading of main roads, and new construction of link and regional roads.

The focus of RSDP II (2002-2007) is to continue the momentum to achieve the road condition targets, as well as to reinforce the process begun under RSDP I and provide a sustainable level of essential road infrastructure to people in rural areas. The second phase of the RSDP, like the first phase, is consistent with the economic policy of the country. It is in line with the Agricultural Development Led Industrialization[4] (ADLI) assisting government objectives in improving and expanding the road networks so that it can enlarge social service[5] coverage in the Country.

The primary objective of RSDP II is to restore and expand Ethiopia's road network, which have become an obstacle and major impediment to sustainability of the economic development program. The classical target is to have, by 2007, 80%, 63%, and 60% of the paved, gravel and regional roads respectively in acceptable condition from the current average of 57%.

RSDP II would consist of civil work program including rehabilitation/upgrading of 3669 km of all roads, new construction of 7183 km roads, and improvement of bridges and structures. Also, road maintenances programs including periodic maintenance on 2559 km of roads and routine maintenance on all types of roads will be carried out. The program, which is expected to be financed parallel by IDA, EU, ADB, NDF, BADEA, OPEC fund, Japan, Germany, Italy, UK, Ireland, Sweden, several other NGO's, and The Ethiopian government road fund.

[4] A national strategy adopted in August1997 by the government of Ethiopia for its accelerated development.
[5] Are programs that help people with basic necessities, health, behavior, and family problems, and efforts at career development and self-improvement.(Encarta, Encyclopedia 2003. Microsoft Corporation).

3.3 Review of the Current Practices in ERA

Following, under this subtopic, the review of the different subsystems integrating ERA and practices are discussed to give the reader a better understanding of the Authority's working procedures and give the researcher (me) a deep understanding and appreciation of the system for further detail analysis of the problem.

Procurement Management System (PMS): ERA has long been committed to central procurement but random or piece meal purchasing has been the principal mode of procurement of goods for some time. Procurement in ERA is organized under the supply and equipment division with local and foreign purchases being handled by two separate sections.

Competitive tendering is used whenever advantages are found and the legal requirements met, some civil and consultancy works are directly awarded to public enterprises (generally when a project is locally financed). Award is made in all cases to the lowest responsive bidder meeting the required specifications. However, this practice overlooks the competitive bidding process and frequently results in lower performances.

Financial Management System: The financial management system in ERA is not computerized. Though the manual for computerizing of all subsystems is already prepared; still some of the subsystems are not integrated with the central financial management system, causing inaccuracies and delays in the monthly cash reports and making complex the timely acquisition of the required cost related information.

Supply Management System: Supply is the process of materials handling between procurement and the end users (i.e. projects and districts). In ERA Parts and Supplies Branch's (PSB) operations were systematized and based on the principles of modern warehousing systems. When the manual was revised, PSB was assigned immediate responsibility for the ordering unit of stock replenishment, receiving, storage, inventory control, transport pool and administration. Some of the problems observed in this subsystem are:

- The PSB is not computerized
- The delivery periods of requested items are too long.
- Warehousing facilities are in poor condition.

Equipment Management System: ERA owns an equipment fleet[6] of 3,752 units of construction, transport and other related equipment. Of these, 47% were technically available, 27% under repairs and 26% awaiting disposal. The estimated of annual equipment depreciation and investment costs are 250 million Birr with associated operating costs estimated at 200 million Birr, according to these estimates a significant part of ERA's road maintenance and construction costs are equipment related. The efficiency and effectiveness of utilization of equipment dominate the performance of ERA, and the number of construction equipments is very few as compared to the demands in the sector. These and other facts demanded ERA to share the road construction projects among the private (local and foreign) firms engaged in the construction sector; therefore, gradually ERA became the employer of the road construction, rehabilitation and maintenance projects.

Maintenance Management System: Maintenance has a considerable impact on any project; by not properly implementing routine and periodic maintenance activities; more damage and frequent breakdown of construction machineries will happen.

In ERA, there are 10 districts and each has a varying number of maintenance sections that actually perform the road maintenance. Programming and planning is performed at head office with the districts being responsible for the execution of the maintenance activities as per the plan. However, the head office may have no a proper understanding of the capability of the districts on performing maintenances by the programs provided from the top, this might cerate plan-capacity discrepancy on maintenance management system.
Some of the problems are:

- Inadequate funds for maintenance
- Improper planning and work execution
- Shortage of skilled manpower

[6] The estimation is based on the inventory held as of June 1996,(Reform Study Report, 1997)

Construction Management System: ERA has a revised Construction Management System (CMS) manual. This manual contains the objectives, guidelines and procedures, which are clear, straightforward and easy to follow. However, the manual has failed short on the following areas:

- Production rates and performance standards are not realistic and currently updated;
- There is lack of incentives to reward performances exceeding pre-set standards;
- CMS is not computerized and cannot interface with other financial systems; and
- Lack of central co-ordination is reflected in the poor quality of construction, supervision, continuity, environmental concerns, safety, and training.

Contract administration System: Contract administration department is responsible to undertake the administration of the road construction projects under ERA. This department prepares and evaluates the tender documents on a number of projects and administers the contract agreements. The main problem observed in this department is it the low quality of contract documents frequently produced often creating disputes with contractors.

*Information resource management system: E*RA is currently installing and upgrading the data processing services by integrating all systems to facilitate data access to all users. The system is being operated in batch processing mode and cannot replace the comprehensive systems needed for Supplies and Equipment Management system. Even though ERA pioneered in the introduction of computer, the systems have not been fully developed to include all areas of functions of the Authority, particularly the districts and projects. This has contributed to poor management of information, lack of dependable cost accounting and proper resource management.

Human resource development: Human resource management especially manpower planning ensures proper recruitment, development and advancements of personals of the Authority at different levels and disciplines. Skill upgrading of employees can be attain by developing and implementing a comprehensive program through "in-house-training" and working closely with training or educational institutions within[7] and outside the country.

[7] The memorandum understanding signed between AAU and ERA this year is one example.

Before a decade ERA enjoyed a very good reputation as an institution in Ethiopia because of its creative management, training program and the development and implementation of its many operational manuals. Unfortunately most of these manuals have not been updated or revised, so the policies and procedures could not meet current needs and requirements.

Despite the problems encountered within the different systems integrating ERA, the Authority has been reasonably effective in implementing its programs with respect to construction and maintenance of roads. However, the deterioration of machineries due to old age, lack of institutional capacity improvement and the expanding responsibilities have hindered the efficient performances of the authority.

This study, however, will identify the major problems faced by ERA in its endeavor to discharge its responsibilities in developing the desired level of road network in the country. Actually ERA is mostly responsible for administering the projects run by local and foreign contractors for which the study will focus.

CHAPTER FOUR: PROBLEM IDENTIFICATION

4.1 Statement of the Problem

In Ethiopia the road infrastructures required for its development are very weak in quality and quantity (chapter 3, section 3.2). In recognition of this, the government has given higher priority in the issue. But infrastructures require huge amount of money, skilled manpower, state-of-the-art technology, and above all high quality of management skills to efficiently manage construction related projects, unfortunately this is not possible by counting only the internal capacity (at least by now). Therefore, foreign construction companies relatively better in their capacities participate in this sector together with the local construction firms, which have been flourished mainly in the last decade.

The performances of these firms have been analyzed and it was observed that considerable time and cost overruns occur when the actual values were compared to their planned values. Besides, dissatisfaction of stakeholders during acceptances and uses of the completed projects and their contribution to their intended objectives (largely based on predefined goals) were low. As a result, the performances of these projects riddled the government, policy makers and regulators, international development financers, and practitioners in the field considerably.

Generally local contractors lack adequate and sufficient experience in road construction activities. They lack professionals with the required quality, number, skill and experience, and good team composition. They also lack the essential project management and cost control skills; as a consequence they often take the lowest tender prices and win projects eventually they end up in producing low quality study document that would distort the information and create difficulties in decision-making resulting in frequent disagreement during supervision between contractors and ERA.

The lack in project management skills generally lead to the following major problems that are usually observed with almost all local contractors, these are:

- Inadequate planning and control methodologies and systems implemented;
- A lack of integration of the organization, the work, the people and the management systems employed; and
- Inadequate and inappropriate project organization structures, which lead to problems of authority, responsibility, communication and coordination, etc.

All of the above project management related problems force local contracting companies to low performances -causing undesirable delays, cost overruns and stakeholders dissatisfaction. Therefore, the major problems confronted by ERA during administration of projects can be classified under the following two major categories.

i. Project delay due to:

- Inefficiency of project management by contractors
- Procurement of materials is characterized with delays
- Inadequate maintenance planning, outdated construction equipments employed and lack of spare parts
- Poor knowledge of risk management techniques by contractors
- Poor techniques of early identification and solving of disputes

ii. Cost overruns due to:

- Inaccurate estimation of project costs
- Variation in the scope of work due to poor design
- Price escalation and inflation
- Poor cost control techniques employed
- Claims by contractors to compensate their low offers to win competition

The above mentioned problems are not inherent to all construction companies; however, with adequate training on the area of project management tools and techniques, involvement of skilled professionals on the construction firms may be some of the measures to gain a solid improvement of the current situation observed on most of the local construction companies engaged in road construction and maintenance projects. Therefore, minimization of the delays and cost overruns, if not elimination may become true in most of the projects administered by ERA.

4.2 Significance of the Problem

For many decades, the time delays and cost overruns on road construction projects have been a key issue for the government, contractors and ERA in Ethiopia. This is because its significant role on the development of the economic and social sector of the country and the government allocates great deal of money every year in the road sector development. Since Ethiopia's population is largely connected through the road network (most of them are poor and not well maintained), the timely completion of any road construction project will have a vital contribution on the proper management of the farming, production, distribution and other indispensable sector activities.

From the contractor's point of view the timely completion of the project may liberate many of its equipments and other scarce resources, to accelerate the newly awarded projects on other areas. Especially important is the likely effect on costs. If the planned timescale is exceeded, the original cost estimates and budgets are almost certain to be exceeded too. This issue is more significant for construction firms possessing limited number; high valued expensive construction equipments that are not easily accessible; and that possess limited finance capacity. In addition, the timely completion of projects by a contractor will create good image and competitive advantages to win the award of future projects.

Since the availability of well expanded and maintained roads is a crucial factor for the well functioning of any country's economic and social sectors, the federal government of Ethiopia is striving to get a satisfactory level of road network throughout the country to facilitate the transportation communication to accelerate its growth to pushup the nation from the extreme level of poverty and recurrent starvation striking the country. Therefore, to achieve these objectives the federal government and other partners for development allocate and donate respectively every year a big sum of money to improve the actual condition of the roads (Table 4.1). Thus, the proper utilization of the allotted budget for the intended purpose is the primary objective of the of the project sponsors.

Table 4.1 Expenditure per year for road construction projects in Ethiopia ($000)

	Fiscal years (Ethiopian calendar)						
Source of funds	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
Loans	329098.00	564460.00	288187.00	354152.20	-	936123.10	1316071.0
Grants	250100.00	476813.00	523491.00	232857.50	-	339063.50	546186.0
Government Expenditure	418210.00	515840.00	295500.00	503109.60	-	501377.00	571456.0
Total	**997408.00**	**1557113.00**	**1107178.00**	**1090119.30**	**1445000.70**	**1776563.6**	**2433713.0**

Therefore, the application and implementation of project management tools and techniques in road construction projects will play an important role in preventing delays, cost overruns and other undesirable troubles that cause devastating results in the development of the nation's economy. More state-of-the-art tools and techniques, user friendly software are developed every year. Researches undertaken in these critical issues are plentiful; trainings and workshops are organized at institutional level, and the recent memorandum of understanding signed between ERA and AAU to share experiences and knowledge in the area justify the significance of this research work.

CHAPTER FIVE: STATE-OF-THE-ART

5.1 The Need and Difficulty of Managing Projects

In today's business environment most organizations often use projects to handle their businesses; the use of projects in many organizations became difficult due to different requirements that fall under three major categories (Wubishet, 2004), these are to:

- Cope with requirements of the markets and their accelerated rate of changes
- Integrate and align the different but competing interests of stakeholders, and
- Balance between stability, security and institutionalism, on the one hand; and flexibility, dynamism and challenges on the other hand.

Market demands: Today's market environment is dictated by many changes. With globalization and free market economy policy organizations became flattened and started to employ outsourcing, alliances and continuous adaptation to environmental situations.

These accelerated changes called upon organizations to adapt flexible approach through a predetermined goal of managing business; that is, management by project. Even if, this showed an increase in the use of project in general, construction projects have long been in practice due to its demand for a separate technical skill. But, the premises and practices have considerably changed overtime.

Demand for Integration and Alignment: Projects involve many stakeholders who possessed common but at the same time competing interests and objectives. This is intensified in the case of public construction projects in developing countries. An issue like accountability for implicit owners, the need for an accelerated development, international donor's involvement, etc., has increased the complexity of such projects.

However, a project is established to meet specific results aligned for a predetermined goal. Hence the main challenge would be to enable these contrasting demands be aligned and integrated to these common goals. These raised the issue of attending a common goal while the objectives of each stakeholder were not ignored as well.

The integration of these stakeholders and disciplines together with the need for alignment of their objectives towards the common goal, without denying the importance of individual objectives are, therefore, a necessity.

Demand for Balancing or Trade off: Projects are set in a structured and patterned scope of activities within the framework of a temporary organization. On the one hand, mutual adjustment, direct supervision, standardization of works, processes, outputs, humans skills and equipment productivity were fundamental ways of coordinating project tasks. These were meant for their internal stability, security and institutionalization of objectives.

On the other hand, the complexities, speed and uniqueness of the project scenario entailed the inevitability of highly likely uncertain and dynamic transformations, which create challenges and changes to prevail. This definitely calls for flexibility, multidisciplinary development and integration among stakeholders, which are also parts of the important conditions in project works.

In general, projects were used to balance these needs due to the inability of permanent organizations with their operational tasks, which are often meant to incline most of their internal stability and survival. This intensified the use of management by project to cope with the flexibility requirements on the one hand, and the continuity requirements on the other. Therefore, project development has become a way of combining a sense of security in an unstable environment with development challenges in everyday work.

5.2 Project Management Concept

5.2.1 Project definition

A project is a unique and time urgent effort to provide a product according to a certain specification and within fixed time and resource limit. Dr.J.M.Juran (1989), the quality expert has defined the *project as a problem scheduled for solution*, which has a considerable merit. It can also be considered as a temporary endeavor undertaken to create a unique product or service. This undertaking must have a defined scope, a specific beginning and end, and produce some type of deliverables to an internal or external customer. A project has specific goals (implicit and explicit) and defined roles and responsibilities. A project is:

- Planned, executed and controlled
- Has one clear objective
- With fixed time frame
- Performed by people

Projects are not new; monuments surviving from the earliest civilization testify to the incredible adherents of our ancestors and still evoke our wonder and admiration. Modern projects, for all their technological sophistication, are not necessarily greater in scale than some of those early colossal works. But the economic pressures of the industrialized world, competition between rival contractors, and greater regard for the value and well being (and hence the employment costs) of the people who constitute the project work force have all led to the development of new techniques for managing projects. In general, projects possess the following major identifying characteristics:

Projects are ***Unique***, involving a degree of innovative characteristics depending on the type of projects; and hence employ process orientation, management of uncertainty and changes, and flexible approach to its management; uniqueness in projects differs considerably among different types of projects depending on their complexity such as variety, size, importance, difficulty in handling, etc.

Projects are ***Temporary***, this characteristic is related to the timing of the project, which focus a transient relationship between project and parent organization covering two aspects: limited resources and the lifetime of the project organization.

Projects are ***Components of a certain Business*****,** requiring predetermined goals and courses of actions; and hence performance-oriented and constrained. That is, projects are usually established for achieving a predetermined specific goal. All processes in project management are, therefore, conducted to achieve this goal.

The principal identifying characteristic of a project is its novelty. It is a step into the unknown, burdened with risk and uncertainty. No two projects are ever exactly alike, and even a repeated project will differ in one or more of the commercial, administrative, or physical aspect from its predecessor. By their characteristics projects are classified under four main headings:

i. *Civil engineering, construction, petrochemical, mining and quarrying projects*: These projects incur special risks and problems of organization and communication. They often require massive capital investment; interdisciplinary skills and they require rigorous management of progress, finance and quality.

ii**.** *Manufacturing projects:* Manufacturing projects aim at the production of a piece of equipment or machinery (which are usually conducted in a factory); ship, aircraft, land vehicle, or some other item or specially designed hardware are example of these type of projects.

iii. *Management projects:* These types of projects prove the point that every company, whatever its size, can expect to need project management expertise at least once in its lifetime. These are the projects that arise when companies relocate their headquarters, develop and introduce a new computer system, prepare for a trade exhibition, produce a feasibility or other study report, mount a stage show, or generally engage in any operation that involves the management and coordination of activities to produce an end result that is not identifiable principally as an item of hardware or construction.

iv. *Research projects:* Projects for pure research can consume vast sums of money, last for many years, and end up with results that please, surprise or disappoint and produce nothing of value.

These projects carry the highest risk because they aim to extend the boundaries of current scientific knowledge. Unlike all other types of projects, their end objectives are usually difficult or impossible to define. Research project may, therefore, not be amenable to strictly obey project management processes. However, some form of control must be attempted.

All types of projects share one common characteristic: the projection of ideas and activities into new endeavors. The ever-present element of risk and uncertainty means that the steps and tasks leading to completion can never be described with absolute accuracy in advance; for some complex projects the achievement of a successful outcome may even be in question. Therefore, project shall be properly managed to get the desired and predefined objective.

5.2.2 Project management

Project management is a disciplined process for the coordination and direction of resources to achieve pre-established project objectives. Project management can be defined as the function of forecasting or predicting as many of the dangers and problems as possible and to plan, organize and control activities so that the project is completed successfully in spite of the risks. The aim is for the final result to satisfy the project sponsor or purchaser, within the promised timescale and without using more money and other resources than those, which were originally set aside or budgeted for.

Much of the development in project management methods have taken place in the second half of the twentieth century, spurred by impatient project purchasers (who want their projects finished quickly so that their investments can be put to profitable use as soon as possible), competition between nations for supremacy in weapons and defense systems has played a major part in the development of sophisticated project management techniques, and the process has been accelerated further by the widespread availability of powerful, reliable and relatively cheap computers.

Project management is more effective when it makes appropriate use of the basic management functions and in this sense; project management is a specialized branch of management. Planning and control must, of course, be exercised over all the activities and resources involved in a project.

The project manger therefore needs to be able to understand, at least in outline, how the various participants operate, and to appreciate their particular problems (or recognize their failings). This demands sufficient and fairly wide experience. Thus, in this practical sense, project management is akin to general management.

It is important, therefore, to understand that effective project management embodies a whole framework of logical and progressive decision-making, the use of common sense and perception, proper organization, effective commercial and financial management, meticulous attention to documentation and routine clerical tasks, and clear grasp of proven and long-established principles of management and leadership.

The major reason for the development of project management as a separate body of knowledge is that the traditional forms of organizations and management techniques couldn't handle project works effectively (Harrison; 1997). This might explain why, even today, the bulk of project management literature is more concerned about management tools and techniques than building theories for project management.

In contrast, the general management of business and industrial corporations assume a broader outlook with greater continuity of operations. Nevertheless, there are sufficient similarities as well as differences between the two so that modern management techniques developed for general management may be adapted for project management.

Table 5.1 Definitions for project management

Guide to PMBOK, 1996 & 2000	Project management is the application of knowledge, skills tools and techniques to project activities in order to meet or exceed stakeholder's needs and expectations from a project.
A K munns & BF Fjeeirmi, 1996	They defined project management on the basis of identifying differences in project and project management success. It is the purpose of controlling the achievement of the project objectives. Through utilizing the existing organizational structures and resources without disturbing operation of the company.
Hira N. Ahuja, et al 1994	Project management is the process of applying management techniques and systems to direct and control suitable resources in order to successfully deliver the intended scope of the project.
F.L Harrison, 1992	Project management can be defined as the achievement of a project's objective through people, and involves the organizing, planning and control of resources assigned to the project, together with all those involved, both in-company and with other companies involved.
Dennis lock	Project management is the art of directing and coordinating human and material resources throughout the life of a project by using modern management techniques to achieve predetermined objectives of scope, cost, time, quality and participation satisfaction.
Wideman, 1983	Project management is the art and science of directing human and material resources to achieve stated objectives within the constraints of time, budget and quality and to the satisfaction of everyone involved.

The basic ingredients for a project management framework may be represented schematically in Figure 5.1. A working knowledge of general management and familiarity with the special knowledge domain related to the project are indispensable. Supporting disciplines such as computer science and decision science may also play an important role. In fact, modern management practices and various special knowledge domains have absorbed various techniques or tools, which were once identified only with the supporting disciplines. For example, computer-based information systems and decision support systems are now commonplace tools for general management. Similarly, many operations research techniques such as linear programming and network analysis are now widely used in many knowledge or application domains. Hence, the representation in Figure 5.1 reflects only the sources from which the project management framework evolves.

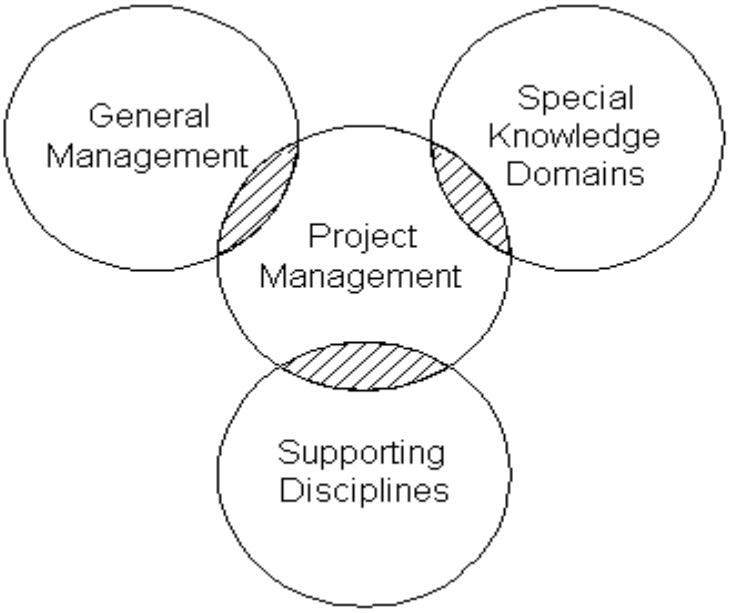


Figure 5.1 Basic ingredients in Project Management

Specifically, project management in construction sector encompasses a set of objectives, which may be accomplished by implementing a series of operations subject to resource constraints. There are potential conflicts between the stated objectives with regard to scope, cost, time and quality, and the constraints imposed on human, material and financial resources. These conflicts should be resolved at the onset of a project by making the necessary tradeoffs or creating new alternatives. Subsequently, the functions of project management for construction projects generally include the following:

1. Specification of project objectives and plans including delineation of scope, budgeting, scheduling, setting performance requirements, and selecting project participants;
2. Maximization of efficient resource utilization through procurement of labor, materials and equipment according to the prescribed schedule and plan;
3. Implementation of various operations through proper coordination and control of planning, design, estimating, contracting and construction in the entire process; and
4. Development of effective communications and mechanisms for resolving conflicts among the various participants.

5.2.3 The project management process

The management process of projects can be understood as a series of managerial and administrative actions, functions, changes or operations performed in the creation, making all treatments undertaken to create a product. This definition can be further qualified by applying system approaches to process.

Each project management process can then be described in terms of its *Inputs* –Resources, Antecedents and Objectives; *Transformation mechanisms* – Activities, Actions, Methods, Tools and Techniques; *Outputs or Outcomes* – Documents, Objectives and Products (PMBOK, 1996).

Project management process can be differentiated into *project-product* and *project-management* process. The former takes into consideration product-oriented process that covers specifying, creating, and operating including the disposal or otherwise of the product lifetime of the project with all the variations embedded in their particular application areas. When addressing the problem of traditional project-management, Davidson (1994), advocated for a project-product life cycle. His views on the traditional project-management often limit the project cycle to four phases: Conception, Planning, Execution, and Closeout. And he provocatively suggested one more phase, "Operation and Maintenance".
His addition underlines the distinction between the two types of processes described above. The project-product life cycle is mush longer than the project-management life cycle. For instance, a cost cutting measure during the project-management life cycle can increase the operation and maintenance cost many times during the project-product life cycle.

Benator & Thumann, 2003 also indicated that the lowest cost facility for the project often resulted in the highest operation costs and they recommended life cycle costing approach for an economic decision-making.

PMBOK, 1996 & 2000, approached project management processes along five linked process groups (Figure 5.2). These process groups are Initiating, Planning, Executing, Controlling, and Closing processes linked by the results they produce.

The three middle process groups possess an iterative links based on three possible choices: go/no-go/may-go decision basis. A go decision takes the process into the next process; a no-go causes to stop; and a may-go decision provokes the iterative links once again. PMI's project management processes are derived from the combination of two concepts. The first is the basic three management processes most management models serve to organize their ongoing activities with. These are the three middle process groups: Planning, Executing, and Controlling.

They identify planning as a devise of workable scheme to accomplish an objective; executing for carrying out the plan and controlling as a measuring process for tracking progress and taking corrective action whenever necessary. The second is the basic definition of a project itself. That is; projects are temporary and have a definite lifetime. Accordingly, they brought two additional management processes. These are Initiating and Closing processes. They are meant for the birth and the end of projects.

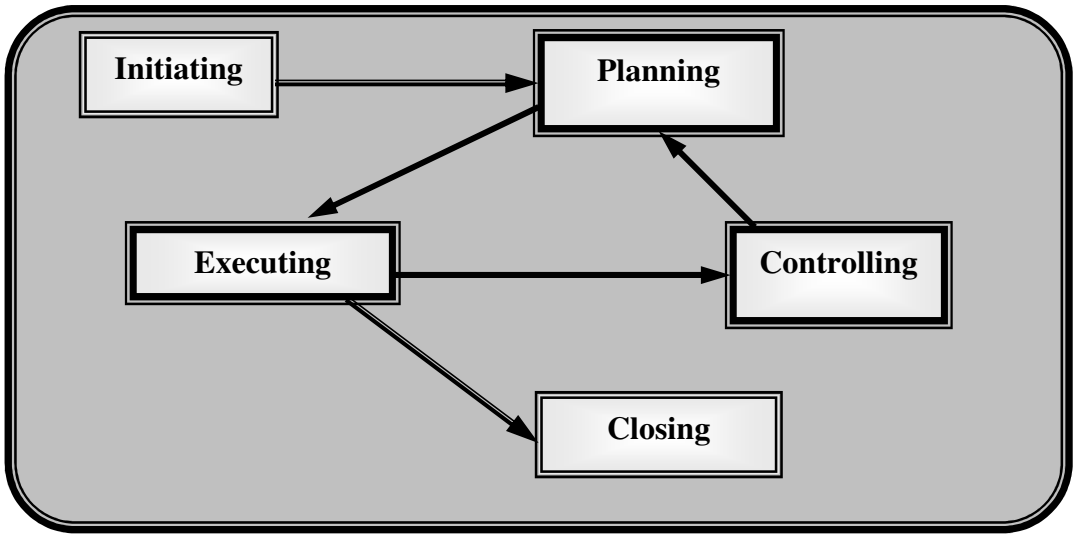


Figure 5.2 Basic Project Management Process (Source: PMBOK, 1996 & 2000)

5.3 Project Objectives

Every project is required to fulfill certain requirements specified by the owner and strictly followed by the contractor. The objectives within the project sphere may be defined in terms of the three main parameters (Figure 5.3): quality, cost and, time.

Performance and quality. The end result of the project must be fit to the purpose for which it was intended -the specifications must be satisfied. Development projects for consumer goods must produce articles that satisfy the market requirements. The design concept, engineering and quality have to result in a reliable product. Reliability objective competence in engineering and design is obviously essential. But this must be complemented by adequate quality procedures, for which ISO 9000 are accepted as the controlling standards and the starting point from which to implement a quality management system. In more recent years the concept of Total Quality Management has come to the fore, with responsibility for quality shared by all the staff and work force from top management downwards.

Budget. The project must be completed without exceeding the authorized expenditure. For most commercial or industrial projects, failure to achieve this objective will lead to reduced profits and lower return on capital investment or actually go to bankruptcy. Many projects are undertaken where there is no direct commercial profit motive (for instance, road construction projects by federal government), but proper attention to budgets and financial management to avoid the cost overrun is always essential. In extreme cases a project may have to be abandoned if funds run out, in which case the work and funds already invested are forfeit and must be written off.

Time Completion. Actual progress must match planned progress, so that all significant stages of the project take place no later than their specified dates, leading to final completion on or before the planned date. This timescale objective is extremely important. Quite apart form the effect on the project purchaser or sponsor, late running will disrupt resource plans for following projects. Especially important is the likely effect on costs. If the planned timescale is exceeded, the original cost estimates and budgets are almost certain to be exceeded too.

Delays on a major project can easily cause additional costs amounting to thousands of dollars per day. There can also be the ignominy of cost penalties. In contracts, which provide the project customer with the sanction of penalty payment for each day or each week by which the contractor fails to meet the delivery obligation in the very worst case, the contractor could suffer severe cash flow problems -even bankruptcy through the inability to issue valid invoices.

If however, work is carefully monitored and managed so that it proceeds against a sensible, achievable plan, much of the cost control battle will already have been won. Time is money.
It may be necessary to identify one of the three objectives (i.e. performance, cost, or time) as being of particular importance, depending on the needs of he project client or customer. The allocation of resources and management attention can then be biased accordingly. But generally these three, Cost, Quality, and Time are essentially incompatible. The art is to maintain a proper balance between the three so that quality is not sacrificed for either time or cost.

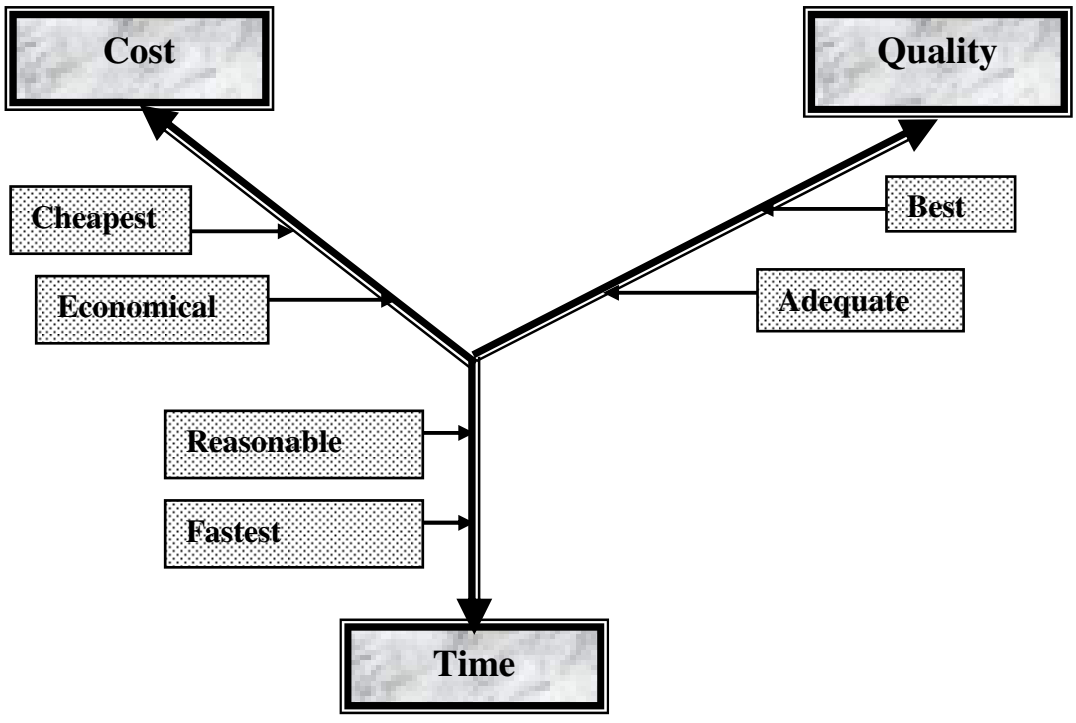


Figure 5.3 Triangle of project objectives

5.3.1 Management by Objectives

The management by objectives (MBO) technique assigns responsibility for the completion of achievable objectives; the project manager as part of the planning and control system will define these objectives. The monitoring of those objectives can be effectively controlled using management by results.

The overall objective is to complete the project within the time, cost and quality constraints set by the client (Figure 5.3). To achieve this, the project manager must subdivide the client's scope of work into a list of project activities with associated objectives.

The objectives associated with these activities can now be clearly identified and communicated to the responsible parties. The use of graphics (Gantt chart, bar charts, CPM, etc) will greatly assist the dissemination process.

5.3.2 Management by Exception

To supplement the management by objectives approach there is another management technique called Management by Exception (MBE). The MBE technique focuses the manager's attention on the activities that have gone off course and need to be controlled to ensure the activities will meet their objectives.

The MBE technique uses a filter to select the non-conforming activities. When projects have a 100 or more activities the project manager can't effectively monitor all of them. MBE addresses this problem by enabling the project manager to set the threshold limits for the exception reports. This could be, for example, the critical activities and any other activities that are running late, over budget or not meeting the required specification.

5.4 Project performance

Generally, reports and studies of many projects indicated that poor performances prevail, if not failures. These non-performances are attributable to their unforeseen (not anticipated), or foreseen (anticipated but their prediction lapsed, mistaken or cheated) events. This study considered changes caused by unforeseen events as associated with uncertainties.

The reality of domestic construction companies here in Ethiopia showed that several projects often fail to deliver the full initial scope, on time and within budget. As a result, resources and efforts are wasted, and expectations unachieved (Wubishet, 2004). Wubishet stated that performance is a controversial issue that stakeholders have their own view. On the one hand, there were instances

where a number of projects that came in on time, under budget and according to specification were found failures. On the other hand, there were also instances where projects which were considered failure due to their time and cost overruns, but have come to be viewed as major success overtime.

A report from World Bank revealed that the development initiatives for developing countries were conceived as failure in spite of approximately USD 40 billion was poured into each year. This was considered more in the case of sub-Saharan Africa where Ethiopia belongs. That is 54 % of projects sponsored by the WB (1979-'83) were considered failures by the bank itself.

In order to improve performance of projects, tracking them from its birth to its end is always a necessity. Therefore, determining project performances become one of the major tasks in the project management system. Above all these, the performance of road construction projects has an extensive effect on the economic well being of developing countries, like ours.

5.4.1 Performance definition

Projects were dated from ancient times, these project were assessed for performances in the context of different considerations. Generally, when we speak of performance, there is a consensus among researchers that it represented the accomplishment of their peoples or materials/equipments, plants or methods/techniques or organizations or products or their combinations. But, their differences lie on the issue of determining whether these accomplishments are poor or good performances.

However, attempts to address the broad scope of performance and trying for a universally accepted concept and definition for all contexts are too ambitious and disservice to the users. But generally, performance can be understood as a means to represent accomplishments through subject-object relationships and their metaphors.

5.4.2 Project performance measurement and evaluation

Every endeavor shall be measured against the original plan, which makes measurement basic for improving performances and assists in providing accountability and learning in all business administrations. A performance measurement serves a variety of functions in project management. These include the establishment of probable targets, the tracking of performances and feedback to management. Measurements can also be used for rewarding/punishing behavior, and modeling and prediction project performances. There should also be an understanding that not all measures are good.

Besides, evaluations are generally serving two major purposes: feedback as learning tool, and to make operations and results transparent aimed at improving both performances and accountability. Therefore, *performance* and *evaluation* is more important in projects due to the following two major reasons:

- Projects are often executed with borrowed resources on a need bases whose loyalties lie to the least with functional departments; and

- Project players continually changed to cause discontinuity in outlook and requirements that tend to drift according to the interpretation of the latest players.

These reasons defuse accountability leading issues to fall through cracks, under carpet and behind mirrors. Hence, inadequate level of follow-through and finger pointing when things go wrong are more or less a usual practice. Consequently, no one seems answerable for mainly bad decisions and actions. Therefore, implementing systematic, fair and rigorous performance measurement and evaluation mechanisms can enforce and strengthen accountability in projects (Davidson Frames J., 1994). Project performances have therefore developed its measurement and evaluation overtime and so far two major approaches were developed with regard to completion time and cost performances. These are variance or Deviation Analysis based on direct differences or Earned value Analysis or Earned Value Concept (EVC).

In using simple deviation analysis could not address whether the project is on or above or below cost or time performances, and indicate/predict/ the likelihood of completion cost and time. Harrison indicated that simple deviation analysis does not use sufficient information to determine performances.

For the implementation of an effective cost control mechanism on construction projects the second approach, which is the Earned Value Concept (EVC), is of great value in today's complex projects. The EVC is a development of the Cost/Schedule Control System[8] (C/SCS) towards full integration of cost and time. When this approach is combined with forecasting, the project manager has the best of both worlds; the performance measuring mechanism should periodically (weekly, monthly, etc.) assess progress and costs in comparable units against a baseline. It is essential for effective project control that performance is measured while there is still time to make corrective action.

The EVC implies the measurement of accomplished work at any time in the course of the project in terms of budgets planned for that work. Furthermore, it implies the use of these data to quantify contract cost and schedule performance.

[8] It has been used by the US Department of Defense since the 1960s.

EVC is quantifiable by means of three basic indicators. They are: the Actual Cost for Work Performed (ACWP), the Budgeted Cost for Work Performed (BCWP), and the Budgeted Cost for Work Scheduled. (BCWS). All other Performance Measurement System (PMS) indices are derived from these three:

- ACWP represents the costs actually incurred and applied or distributed in accomplishing the work performed within a given time period. It is a familiar indicator to all, they are which makes or breaks all projects. ACWP, when interacted with other PMS parameters, serves as a reference point for the earned value data elements relationships.

- BCWP is the earned value. BCWP signifies the value of completed work. As such, it reflects the progress made along the contract plan. BCWP; is derived by determining the budget for all completed works including the completed portions of in-progress work. In contrast to the traditional measurement of actual costs against the budget, the earned value is the performance indicator of both cost and schedule. The reason for this dual characteristic is that the budget plan is firmly tied to specific increments of work, called elements of the project Work Break down Structure (WBS), rather than to expenditures of funds.

- BCWS represent where the project manager planned to be by a certain date; it is the sum of the budgets for the scheduled work packages. BCWS is similar to a time phased budget plan or spend plan. However, it is directly related to the manner in which the work is to be performed rather than how the money is to be spent. BCWS is the indicator of planned progress. BCWS becomes meaning full when the budgets are relatable to the work scope WBS elements. Furthermore, the budgets for the individual work element must “add up". That is, the sum of distributed budgets, undistributed budgets, and management reserve should be equal the negotiated contract plus the estimated cost for authorized work.

Use of EVC as a management technique demands rigorous organization of the project work for the purposes of proper budgeting and scheduling A major consequence of EVC implementation is development of a family-type diagram for subdivision of the overall work effort into identifiable smaller activity packages. The work breakdown structure, establishes the framework for contract execution, cost reporting, schedule and technical performances.

The WBS is the structuring of the project work into greater detail and more manageable units of work. The WBS must be structured so that any level of detail can be rolled up to the next higher level of detail. It facilitates uniform planning, assignment of responsibilities, and measurement of project status.

The WBS defines and establishes reporting categories. These reporting categories are used for the project management control (only one WBS is developed and used for each project). However, the WBS is just one of several reporting categories that may be used to define contract objectives. The others include cost element, organization function, and contract line item. Typically a contractor requires vertical summation of costs. This means that cost information is provided along all ascending levels of the project, starting with the individual cost centers. Traditionally, cost reporting and budgeting have been produced along the organization functional division. This too can be provided at the lowest WBS level by horizontal summation of costs.

For performance measurement purposes, a unique set of earned value data elements is generated from the three basic indicators, i.e. ACWP, BCWP, and BCWS.

Table 5.2 Expressions in Earned Value Concept (EVC)

Cost Variance (CV)	**=**	**BCWP - ACWP**
Schedule Variance (SV)	**=**	**BCWP - BCWS**
Cost Performance Index (CPI)	**=**	**BCWP / ACWP**
Schedule Performance Index (SPI)	**=**	**BCWP / BCWS**
Estimate to Completion (ETC)	**=**	**(BAC- BCWP) / CPI**
Estimate at Completion (EAC)	**=**	**ACWP + ETC**

Besides, performance indices Schedule Performance Index (SPI) and Cost Performance Index (CPI) during the course of the project, the contractor makes estimates of cost at completion (EAC) for the actual cost-to date, plus the latest estimate for the remaining authorized work. The EAC is based on the knowledge of performance to date and the actual costs to date applied to the future. Because the budget at completion (BAC) can be readily obtained by summing all the budgets allocated to the contract, the difference between EAC and BAC signifies at completion variance (ACV). Again, a negative value indicates an unfavorable situation. Accordingly, the following expressions can be used for computations (Table 5.2). The expressions used for computations based on EVC are shown in Figure 5.4.

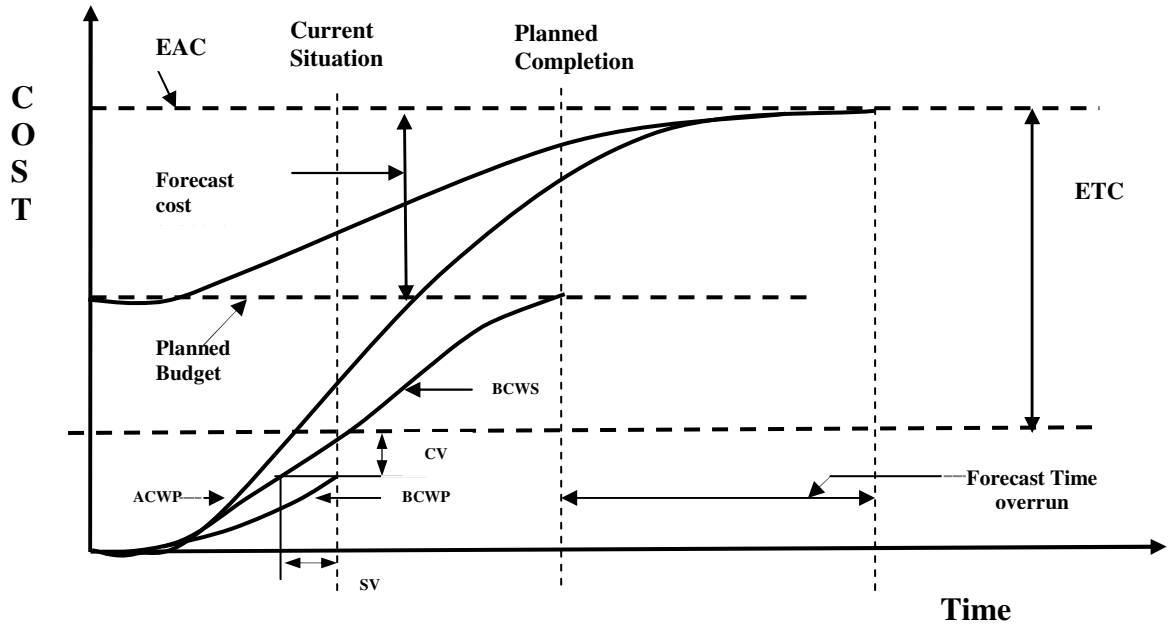


Figure 5.4 Earned Value Computations

The EVC approach has also its own limitations. These included:

- the cost and effort to make the system for earned value analysis is initially extensive,
- the inability to reveal cost information's immediately causing time gap for decision making,
- the issue of its use for project performance analysis, and
- the reliance on a single, that is; financial which is an objective system of measurement.

However, the Earned Value Concept analysis can be used as one of the objective performance measurements to evaluate projects in order to implement further improvement of the performances in the construction projects under consideration.

Generally, reports and studies of many projects indicated that poor performances prevail, if not failures. These non-performances are attributable to their unforeseen (not anticipated), or foreseen (anticipated but their prediction lapsed, mistaken or cheated) events. This study considered changes caused by unforeseen events as associated with uncertainties.

The reality of domestic construction companies here in Ethiopia showed that "several projects are withdrawn before completion, surviving projects often fail to deliver the full initial scope, on time and within budget, and project time and cost overruns frequently run over hundreds of percentages". As a result, resources and efforts are wasted, and expectations unachieved.

Performance is a controversial issue that stakeholders have their own view. On the one hand, there were instances where a number of projects that came in on time, under budget and according to specification where found failures. On the other hand, there were also instances where projects which were considered failure due to their time and cost overruns, but have come to be viewed as major success overtime.

In order to improve performance of projects, tracking them from its birth to its end is always a necessity. Therefore, determining project performances become one of the major tasks in the project management system. Above all these, the performance of road construction projects that consumes huge amounts of national budget has a widespread effect on the economic well being of developing countries, like ours.

5.5 Project Management Organization

The establishment of an effective operation organization is one of the principal functions of management. The main task of a contractor's organization is to plan, direct and control the elements associated with the construction of the projects so that the best combination of

operational economy and time efficiency is obtained (Clough page 25 & 26). In order to implement these functions, the contractor must create an organizational structure that is particularly suited to his needs. The organizational framework must be sufficiently stable to assure actions but yet be flexible and adaptive.

The mere act of making a formalized analysis of the necessary tasks, how they relate to the company as a whole, and who is responsible for each task, created a clear understanding of who, what, when, and how activities are successfully carried out to eventually complete the project. An organizational plan removes confusion; indecision, buck passing, duplicated efforts, and neglected duties.

It should be obvious that, if all the project objectives are to be achieved, the people, communications, jobs and resources must be properly organized. But the form, which this organization should take, may not be so obvious.

A good organization will ensure that clear lines of authority exist, and that every member of the project knows what he or she must do to make the project a success. This is part of the management communication framework, essential for motivating all the staff employed. A well-motivated group can be a joy to work with. A badly informed group, with vague responsibilities and ambiguous levels of status and authority, is likely to be poorly motivated, slow to achieve results, costly to run and frustrating to work with.

The complement of good management communications is the provision of adequate feedback paths through and across the organization. These allow progress to be monitored, difficulties to be reported back to executive management and expert specialist advice on technical problems to be sought by any participant. When defining an organizational structure the terms Responsibility, Authority,

Accountability and Delegation will clearly be defined Burke (1992). Following some commonly used project organization types are discussed.

Functional project organization: Most contractors are organized administratively into functional departments covering the basic engineering, procurement and construction functions.

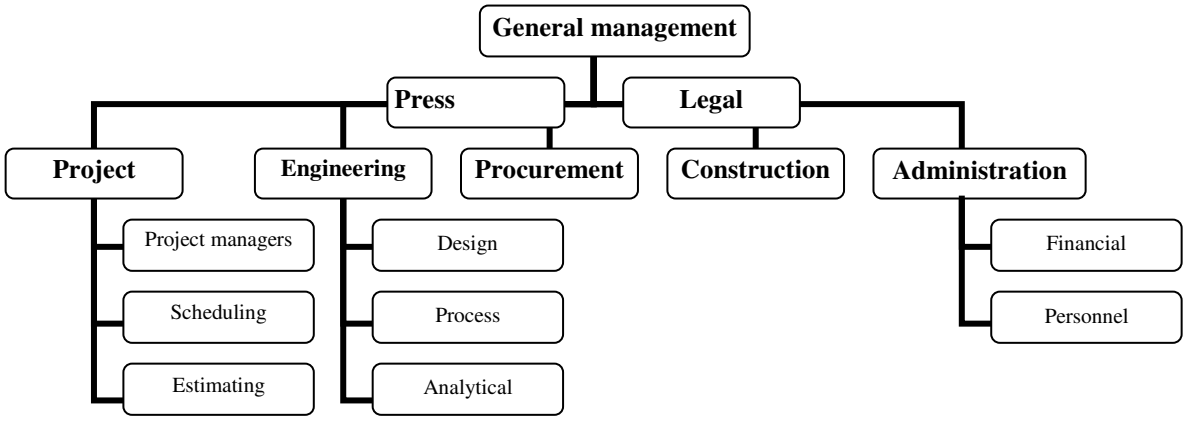


Figure 5.5 Functional organization structures

Advantages: -

- Lines of communication are well established
- Quick reaction time to problems within the department
- Simple to estimate and apply budgetary control
- Provide the normal career path for advancement and promotion

In this type of organization, people are grouped according to their similarities -in terms of activity, expertise, etc. Thus all marketing people are in one department; all design people are in another. The continuity of knowledge and experience is therefore great. Expertise in functional areas is retained and developed, and clear career paths exist in each function.

However, the functional organization structure does offer excellent facilities within its own department, but where a multi-discipline scope calls for interaction with other departments the system is found lacking.

Pure project organization: The pure project organization structure is similar in shape to the functional organizational structure except it is dedicated to one project. It has autonomy from the rest of the company, as a self-contained unit with its own technical staff and administration. Here the teams are arranged according to the type of project. Different project teams are organized for the purpose with their own resources. This may minimize the dispute for resources, but if the company has a number of projects running concurrently with pure project organizational structures this could lead to duplication of efforts and resources in many areas.

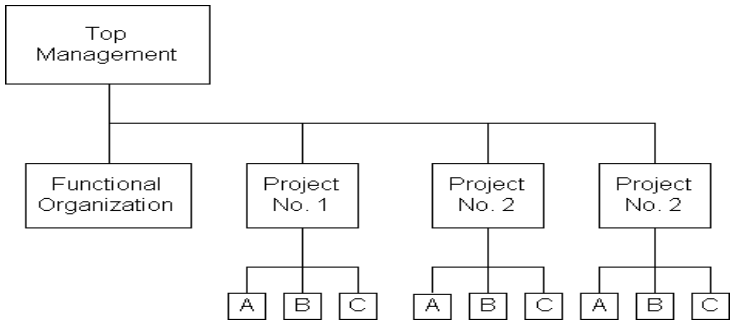


Figure 5.6 Pure project organization chart

Matrix organization: A matrix organization is a network of intersections between a project team and the functional elements of an organization. As additional project teams are arrayed across an organization's functional structure, more intersections come into existence. In Matrix organization there is no special project team. Instead, permanently established groups of people are organized according to their special skills or disciplines. Every project handled by the firm within this functional, or matrix organization has its own project manger (Figure 5.6), but all these project managers draw upon the same specialist groups for their manpower and other resources. Their inference is functional, and the people in the specialist groups remain administratively responsible to their own departmental line Managers.

The assigned project manager would be responsible for directing and coordinating the work, but would have on line authority over any member of any group. It is clear that the lines of commands are complex, and individuals working in any one of the groups find themselves responsible to their own chief, but with added responsibility to the project manager regarding

some elements of their work. Such complexity can lead to conflict, but there are compensating features such as high degree of resources utilization.

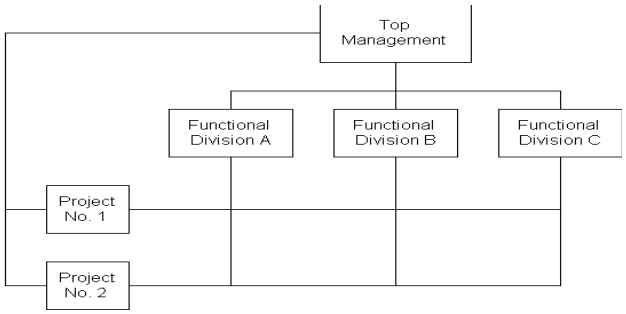


Figure 5.7 Matrix project organization chart

Which type of organization is best? Selecting the right organization structure is essentially a balancing act between addressing the scope needs, the project needs and the client needs. The choice can be further complicated when a structure appropriate for one company may be a burden for another, the project could therefore evolve into many different structures running concurrently.

Functional project organizations are indicated for companies that handle a number of small projects in which neither the amount of resources nor the timescale needed for each project is great. When the project requires input from a number of different departments the matrix structure offers a real solution to the functional division of responsibility and authority.

Pure project organization can be directed to a single purpose -the successful completion of a project. A team can be completely autonomous. It is provided with and relies on its own resources. There is no clash of priorities resulting from a clamor of different projects in competition for shared resources.

However, the establishment of a pure project organization helps the organizers to contain all the work and its information within closed, secure boundaries: especially when highly confidentiality and secretly is requited. But in general, if the project is a large capital project, which will run for a few years, setting up a pure project structure may be the most expedient and appropriate decision.

5.6 Project Success Factors

The traditional success criterion for project implementation is based on whether the project was completed: t*o specification; to budget; and, to time*. This very narrow view has been unable to assure the *success* of an individual project. In order to assure a success of any project a project manager and respective stakeholders shall review the following most significant points for the specific project before going to implementation.

1. ***Project mission*** -is there initial clarity of goals and a strong sense of direction?
2. ***Support from top management*** -are they willing and able to provide the necessary resources, authority and influence to bear?
3. ***Project Planning*** -is a detailed specification and schedule of activity steps produced for project implementation?
4. ***Client involvement*** -is there adequate communication, consultation and active listening for all elements of the 'client system' (including the user , stakeholders and the project winner?)
5. ***Personnel*** -is the necessary personnel for the project recruited, selected and appropriately trained?
6. ***Technical activities*** -is the required technology and expertise available to accomplish the specifically technical tasks?
7. ***Client acceptance*** -is the final project 'sold' effectively to the ultimate end-users?
8. ***Monitoring and feedback*** - is there timely provision of comprehensive control information at each stage of the implementation?
9. ***Communication*** -is there an appropriate network for all the necessary information to circulate amongst all the key players in the project implementation?
10. ***Trouble-shooting*** -is there the ability to handle unexpected crises and deviations from plan?

The proper analysis of the above 10 points help to prevent any project from failure, but these are not the only factors that shall be considered. There are other more complicated issues that must be considered when looking the project from a broader perspective. Especially for those foreign investment projects the success of the project will depend on factors and the circumstances prevailing in the host country and the region.

5.7 Project Phases and the Project Life Cycle

5.7.1 Project phases

All organizations performing projects will usually divide each project into several project phases to improve management control and provide for links to the ongoing operations of the performing organization. Each project phase is then marked by completion of one or more deliverables. The deliverables, and hence the phases, are part of a generally sequential logic designed to insure proper definition of the project. A typical project namely, project identification, preparation for tendering, sponsor's preparation of a bid, selection, project development, project implementation and operation are shown in the Figure 5.8.

5.7.2 Project life cycle

As the project life cycle progresses, the cost, time, and performance parameters must be "managed". This involves continuous preplanning of the as yet undone phases in the light of emerging data on what has actually been accomplished.

As the United Nations Industrial Development Organization (UNIDO) prescribes: *Each stage has its own particular characteristics and thus requires information and control procedures suited to it. On the basis of the maximum available knowledge about the entire project in a given project stage, the remaining stages must be planned and re-planned so that at the end of each stage an acceptable, realistic final plan to control the succeeding stage is available, plus a revised version of the preliminary plans for all future project stages. As the project passes through the various stages, the*

planning for the last and often most critical stage (construction/pre-operations) becomes more and more comprehensive and precise, and eventually permits improved control of the pertinent project activities. A clear identification of the project stages and pertinent objectives permit the responsible project initiator or other body to assign responsibilities systematically.

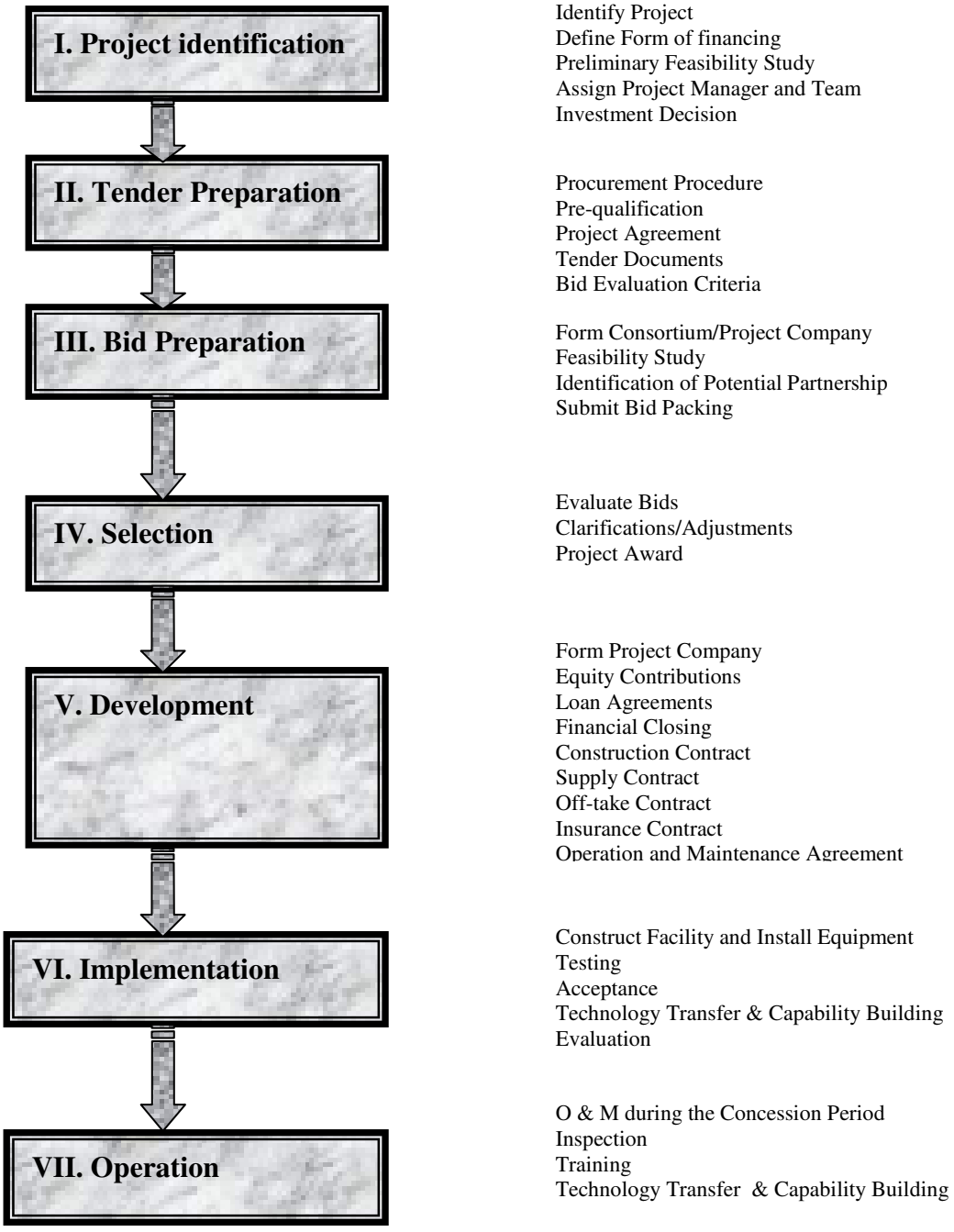


Figure 5.8 Flow diagram of project phases

Project life cycles generally define: -What technical work should be done in each phase. Who should be involved in each phase?

Most project life cycle descriptions share a number of common characteristics (Figure 5.9): -

- Cost and staffing levels are low at the start, higher toward the end, and drop rapidly as the project draws to a conclusion.;
- The probability of successfully completing the project is lowest, and hence risks and uncertainties are highest, at the start of the project. The probability of successful completion generally gets progressively higher as the project continues; and
- The ability of the stakeholders to influence the final characteristics of the project and the final cost of the project is highest at the start and gets progressively lower as the project continues.

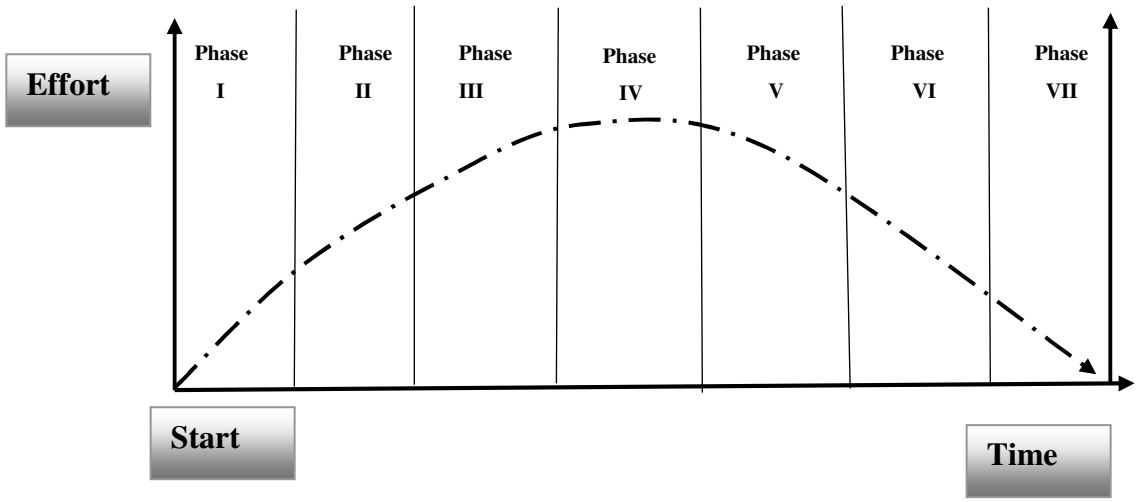


Figure 5.9 Project life cycle

5.7.3 Project stakeholders

Project stakeholders are individuals and organizations that are actively involved in the project, or whose interests may positively or negatively be affected as a result of project execution or project completion; they may also exert influence over the project and its results. The project management team must identify the stakeholders, determine their requirements, and then manage and influence those requirements to ensure a successful project.

Key stakeholders on every project include:

Project manager - the individual responsible for managing the project.

Performing organization - the enterprise whose employees are most directly involved in doing the work of the project.

Project team members - the group that is performing the work of the project.

Sponsor - the individual or group internal or external to the performing organization that provides the financial resources, in cash or in kind, for the project.

Customer - the individual or organization that will use the project's product. There may be multiple layers of customers.

Project stakeholders can be categorized also - internal and external, owners and financers, sellers and contractors, team members and their families, government agencies, individual citizens, temporary or permanent lobbying organizations, and society at large.

Managing stakeholder expectations may be difficult because stakeholders often have very different objectives that may come into conflict.

In general, differences between or among stakeholders should be resolved in favor of the customer. This does not, however, mean that the needs and expectations of other stakeholders can or should be disregarded. Finding appropriate resolutions to such differences can be one of the major challenges of project management.

5.8 Project Selection

The selection of the right project for future investment is crucial for the long-term survival of the company. The selection of the wrong project may well precipitate project failure and is waste of resources.

Project selection is ultimately the responsibility of senior management, who's decision should be based on informative data, it is obviously influenced by the state of the economy, during a down turn it may be argued that most companies will take on any work that keeps going in the short term.

Models of selection

There are two basic types of project selection models used to represent a project's structure, namely *numeric* and *non-numeric*. A numeric model is usually financial based and quantifies the project in terms of either percentage return on investment or time to repay the investment. While non-numeric models on the other hand look at a much wider picture of the project considering items from market share to environmental issues. An urgency criterion is one of these types.

Numeric models. The numeric selection models may be sub-divided into financial and scoring types. The financial types are: Payback period, Return on investment, Net present value (NPV), and Internal Rate of Return (IRR).

Payback period. Is the time taken to gain a financial return equal to the original investment. The time period is usually expressed in years and months.

The advantages of the payback method are:

- It is simple and easy to use
- The uncertainty of future cash flows is reduced
- It reduces the project's exposure to risk and uncertainty by selecting the project that has the shortest payback period.

The disadvantages are:

- It does not consider the time value of money
- It is not suitable to evaluate long term projects
- The figures are based on project cash flow only. All other financial data are ignored.

Return On Investment. This technique looks at the whole project investment. This method first calculates the average annual profit, which is simply the project outlay deducted from the total gains, divided by the number of years the investment will run. The profit is then converted into a percentage of the total outlay using the following equations.

$$Average\ Annual\ \text{Pr}ofit = \frac{(Total\ \ gains) - (Outlay)}{Number\ of\ Years}$$

$$\text{Re}turn\ on\ investment = \frac{(Average\ \ Annual\ \text{Pr}ofit)}{Original\ \ investment} \times 100$$

The ROI is simple to use like payback period, but further it considers the cash flow over the whole project. The outcome of the investment is expressed as a profit and percentage return on investment, both parameters readily understood by management.

Discounted Cash Flow. The Discounted Cash Flow (DCF) technique takes into consideration the time value of money, for example, a $ 100 today will not have the same worth or buying power as a $100 this time next year. These discounting techniques enable the project manager to compare two projects with different investment and cash flow profiles. There are two basic DCF techniques, which can model this effect, Net Present Value (NPV) and internal rate of return (IRR).

5.9 Project Financing

A private company which plans to undertake large capital projects may use its retained earnings, seek equity partners in the project, issue bonds, offer new stocks in the financial markets, or seek borrowed funds in another fashion etc.

In Ethiopia road construction projects demanding huge capital investment are undertaken by funds borrowed from international financial institutions like World Bank, African Development Bank (ADB), grants and loans from bilateral and multilateral agreements, international organizations like European Union (EU), and savings of the federal government, etc. (see Table 4.2).

Nowadays, private sector investment and management of public sector assets is being openly encouraged by governments and multilateral agencies that recognize that private sector companies are better equipped and more efficient than governments in developing and managing major public services.

Generally the project implementation demands for the establishment of a separate project company by the project sponsors. Such type of arrangement has several advantages for the sponsors:

- It allows the sponsors to borrow funds to finance a project without increasing their liabilities beyond their investment in the project; and
- Lenders assume a part of the project risks, since they are lending without full recourse and primarily on the basis of project assets.

The sponsors have to consider how to allocate risks to other participants in their consortium. They also need to carefully analyze the financial feasibility of projects, in the light of the risks involved and their proposed distribution before submitting bids of proposals for the schemes. For instance, if the initial project sponsors have limited or no previous experience in the operation and management of such projects, they will want to find co-sponsors with the appropriate operating experience or to subcontract the work to specialized private operators.

Project financing involves the funding of project on the merits of the projects themselves and to a much greater degree than conventional financing for manufacturing projects, lenders will seek loan repayment security from a project's cash flow and the contractual agreements making up the project's security package, rather than from the physical assets of the project. The common features of financing are as follows:

- The financing is more often defined by its revenue stream than by its products or markets;
- Interrelated contracts with third parties, such as suppliers, purchasers/consumers and government agencies, are crucial to the credit support for the project;
- Loan repayments are secured by project cash flows, as in contractual agreements or as indicated by demand forecasts, rather than by projects assets; and

- To minimize their exposure to project risks and uncertainty, project sponsors will rely primarily on contract enforceability (or guarantees).

5.9.1 Types of capital

There are, in principle, three types of capital available to all projects: equity, debt and mezzanine capital. Each plays a specific role in project financing and has its own risk characteristics. The return on each type of capital is determined largely by its risk characteristics.

Equity Capital: It represents the funds provided by the owners and is the lowest-ranking capital in terms of its claims on the assets of a project. Normally, any distributions that can be made to equity investors is done after all other project obligations are satisfied. If a project fails, there fore, all other claims must be met before equity investors can make any claims. Equity investors therefore bear a higher degree of risk than any other providers of capital. Moreover, if after all other obligations are met, the value of the remaining assets is less than the initial equity capital of the project; the investors will bear the loss. For this reason, equity capital is also referred to as risk capital, while equity investors bear the highest risk; they also stand to make the biggest gains if a project is successful. In highly successful project, the residual value of assets, after all obligations are met, will certainly exceed the initial equity capital of the project. This surplus will be at the disposal of the providers of equity capital in the form of capital gains.

Debt Capital: Senior debt has first claim over all the assets of a project and must be repaid first, according to a predetermined schedule. In contrast to equity capital, a project's senior debt has the highest ranking of all capital. The claims of others can be considered only after the claims of senior debt are satisfied. It bears the lowest risk of all capital and correspondingly, the returns are usually limited to just the interest payments on the loans, irrespective of how successful the project may be.

Mezzanine Capital: The key characteristic of mezzanine capital is that it has both debt and equity features and, correspondingly, it has a risk profile that is somewhere between debt and equity capital. Examples of mezzanine financing are subordinated loans and preference shares. Both have the characteristics of debt, in that regular payments of interest and/or capital are involved. However, payments are subordinated to senior debt and need only.

5.9.2 Types of project contracts

While construction contracts serve as a means of pricing construction, they also structure the allocation of risk to the various parties involved. The owner of the project has the sole power to decide what type of contract should be used for a specific facility to be constructed and to set forth the terms in a contractual agreement. It is important to understand the risks of the contractors associated with different types of construction contracts.

***Lump Sum Contract*.** In a lump sum contract, the owner has essentially assigned all the risk to the contractor, who in turn can be expected to ask for a higher markup in order to take care of unforeseen contingencies. Beside the fixed lump sum price, other commitments are often made by the contractor in the form of submittals such as a specific schedule, the management reporting system or a quality control program.

***Unit Price Contract*.** In a unit price contract, the risk of inaccurate estimation of uncertain quantities for some key tasks has been removed from the contractor. However, some contractors may submit an "unbalanced bid" when it discovers large discrepancies between its estimates and the owner's estimates of these quantities. Depending on the confidence of the contractor on its own estimates and its propensity on risk, a contractor can slightly raise the unit prices on the underestimated tasks while lowering the unit prices on other tasks. If the contractor is correct in its assessment, it can increase its profit substantially since the payments is made on the actual quantities of tasks; and if the reverse is true, it can lose on this basis.

Cost Plus Fixed Percentage Contract. For certain types of construction involving new technology or extremely pressing needs, the owner is sometimes forced to assume all risks of cost overruns. The contractor will receive the actual direct job cost plus a fixed percentage,

and have little incentive to reduce job cost. Furthermore, if there are pressing needs to complete the project, overtime payments to workers are common and will further increase the job cost. Unless there are compelling reasons, such as the urgency in the construction of military installations, the owner should not use this type of contract.

Cost Plus Fixed Fee Contract. Under this type of contract, the contractor will receive the actual direct job cost plus a fixed fee, and will have some incentive to complete the job quickly since its fee is fixed regardless of the duration of the project. However, the owner still assumes the risks of direct job cost overrun while the contractor may risk the erosion of its profits if the project is dragged on beyond the expected time.

Cost Plus variable Percentage Contract. For this type of contract, the contractor agrees to a penalty if the actual cost exceeds the estimated job cost, or a reward if the actual cost is below the estimated job cost. In return for taking the risk on its own estimate, the contractor is allowed a variable percentage of the direct job-cost for its fee. Furthermore, the project duration is usually specified and the contractor must abide by the deadline for completion. This type of contract allocates considerable risk for cost overruns to the owner, but also provides incentives to contractors to reduce costs as much as possible.

Target Estimate Contract. This is another form of contract, which specifies a penalty or reward to a contractor, depending on whether the actual cost is greater than or less than the contractor's estimated direct job cost. Usually, the percentages of savings or overruns to be shared by the owner and the contractor are predetermined and the project duration is specified in the contract. Bonuses or penalties may be stipulated for different project completion dates.

Guaranteed Maximum Cost Contract. When the project scope is well defined, an owner may choose to ask the contractor to take all the risks, both in terms of actual project cost and project time. Any work change orders from the owner must be extremely minor if at all, since performance specifications are provided to the owner at the outset of construction. The owner and the contractor agree to a project cost guaranteed by the contractor as maximum. There may be or may not be additional provisions to share any savings if any in the contract. This type of contract is particularly suitable for turnkey operation.

5.9.3 Evaluation of alternative financing plan

Since there are numerous different sources and arrangements for obtaining the funds necessary for facility construction, owners and other project participants require some mechanism for evaluating the different potential sources. The relative costs of different financing plans are certainly important in this regard. In addition, the flexibility of the plan and availability of reserves may be critical. As a project manager, it is important to assure adequate financing to complete a project. Alternative financing plans can be evaluated using the same techniques that are employed for the evaluation of investment alternatives.

A general approach for obtaining the combined effects of operating and financing cash flows of a project is to determine the adjusted net present value (APV) which is the sum of the net present value of the operating cash flow (NPV) and the net present value of the financial cash flow (FPV), discounted at their respective minimum attractive rates of return (MARR), i.e.,

(1) $$APV = [NPV]\, r + [FPV]\, rf$$

Where r is the MARR reflecting the risk of the operating cash flow and r_f is the MARR representing the cost of borrowing for the financial cash flow. Thus,

(2) $$APV = \sum_{t=0}^{n} \frac{A_t}{(1+r)^t} + \sum_{t=0}^{n} \frac{\bar{A}_t}{(1+rf)^t}$$

Where A_t and $\bar{A}_t$ are respectively the operating and financial cash flows in period t.

Typically, the interest rate for borrowing is stated in terms of *annual percentage rate* (A.P.R.), but the interest is accrued according to the rate for the interest period specified in the borrowing agreement. Let i_p be the nominal annual percentage rate, and i be the interest rate for each of the p interest periods per year. By definition

(3) $$i = \frac{i_p}{p}$$

If interest is accrued semi-annually, i.e., p = 2, the interest rate per period is $i_p/2$; similarly if the interest is accrued monthly, i.e., p = 12, the interest rate per period is $i_p/12$. On the other hand, the effective annual interest rate i_e is given by:

$$(4) \quad i_e = (1+i)^p - 1 = \left(1 + \frac{i_p}{p}\right)^p - 1$$

Note that the effective annual interest rate, i_e, takes into account compounding within the year. As a result, i_e is greater than i_p for the typical case of more than one compounding period per year.

For a coupon bond, the face value of the bond denotes the amount borrowed (called *principal*) which must be repaid in full at a maturity or due date, while each coupon designates the interest to be paid periodically for the total number of coupons covering all periods until maturity. Let Q be the amount borrowed, and i_p be the interest payment per period, which is often six months for coupon bonds. If the coupon bond is prescribed to reach maturity in n years from the date of issue, the total number of interest periods will be pn = 2n. The semi-annual interest payment is given by:

$$(5) \quad i_p = iQ = i_p \frac{Q}{2}$$

In purchasing a coupon bond, a discount from or a premium above the face value may be paid.

An alternative loan arrangement is to make a series of uniform payments including both interest and part of the principal for a pre-defined number of repayment periods. In the case of uniform payments at an interest rate i for n repayment periods, the uniform repayment amount U is given by:

$$(6) \quad U = Q\frac{i(1+i)^n}{(1+i)^n - 1} = Q\left(U/P, i, n\right)$$

Where (U/P, i, n) is a capital recovery factor which reads: "to find U, given P=1, for an

interest rate i over n periods." The number of repayment period n will clearly influence the amounts of payments in this uniform payment case. Uniform payment bonds or mortgages are based on this form of repayment.

Usually, there is an origination fee associated with borrowing for legal and other professional services which is payable upon the receipt of the loan. This fee may appear in the form of issuance charges for revenue bonds or percentage point charges for mortgages. The borrower must allow for such fees in addition to the construction cost in determining the required original amount of borrowing. Suppose that a sum of P_o must be reserved at t=0 for the construction cost, and K is the origination fee. Then the original loan needed to cover both is:

$$(7) \qquad Q_0 = P_0 + K$$

If the origination fee is expressed as k percent of the original loan, i.e., $K = kQ_0$, then:

$$(8) \qquad Q_0 = \frac{P_0}{1 - K}$$

Since interest and sometimes parts of the principal must be repaid periodically in most financing arrangements, an amount Q considerably larger than Q_0 is usually borrowed in the beginning to provide adequate reserve funds to cover interest payments, construction cost increases and other unanticipated shortfalls. The net amount received from borrowing is deposited in a separate interest bearing account from which funds will be withdrawn periodically for necessary payments. Let the borrowing rate per period be denoted by i and the interest for the running balance accrued to the project reserve account be denoted by h. Let A_t be the net operating cash flow for - period t (negative for construction cost in period t) and $\overline{A}_t$ be the net financial cash flow in period t (negative for payment of interest or principal or a combination of both). Then, the running balance N_t of the project reserve account can be determined by noting that at t = 0,

$$(9) \qquad N_0 = Q - K + A_0 \qquad \text{and at } t = 1, 2,...,n:$$

(10) $$N_t = (1+h)N_{t-1} + A_t + \bar{A}_t$$

Where the value of A_t or $_t$ may be zero for some period(s). Equations (9) and (10) are approximate in that interest might be earned on intermediate balances based on the pattern of payments during a period instead of at the end of a period.

Because the borrowing rate i will generally exceed the investment rate h for the running balance in the project account and since the origination fee increases with the amount borrowed, the financial planner should minimize the amount of money borrowed under this finance strategy. Thus, there is an optimal value for Q such that all estimated shortfalls are covered, interest payments and expenses are minimized, and adequate reserve funds are available to cover unanticipated factors such as construction cost increases. This optimal value of Q can either be identified analytically or by trial and error.

5.10 Project Cost Estimate and Control

5.10.1 Introduction

For the project manager to effectively plan and control a project accurate estimating is essential. Accurate estimates of project costs provide an essential part of the proper basis for management decisions and control. The most obvious reason for producing cost estimates is to assist in pricing decisions, but that is by no means the whole history. Cost estimates are usually needed for all types of projects, including in-house projects without fixed prices. Timescale planning, pre-allocation of project resources, the establishment of budgets for funding, manpower and cost control, and the measurement of achievement against expected performance all demand the provision of sound estimates.

The quality of the estimate should be seen as the best approximation based on the time available, the information available, the techniques employed, and the expertise and experience of the estimating personnel. Generally the quality of the estimate can be improved

as the project is executed when more detailed and accurate information becomes available. Although estimating usually focuses on the financial aspects of the project, it is important to remember that the costs cannot be accurately established until the other factors of time, resources, material and equipment have been quantified.

The accuracy of the estimate will depend on the level of detail it is based on, this information will come from: The

- Scope of work
- Contract
- Specification
- Extent of risk and uncertainty in the project.

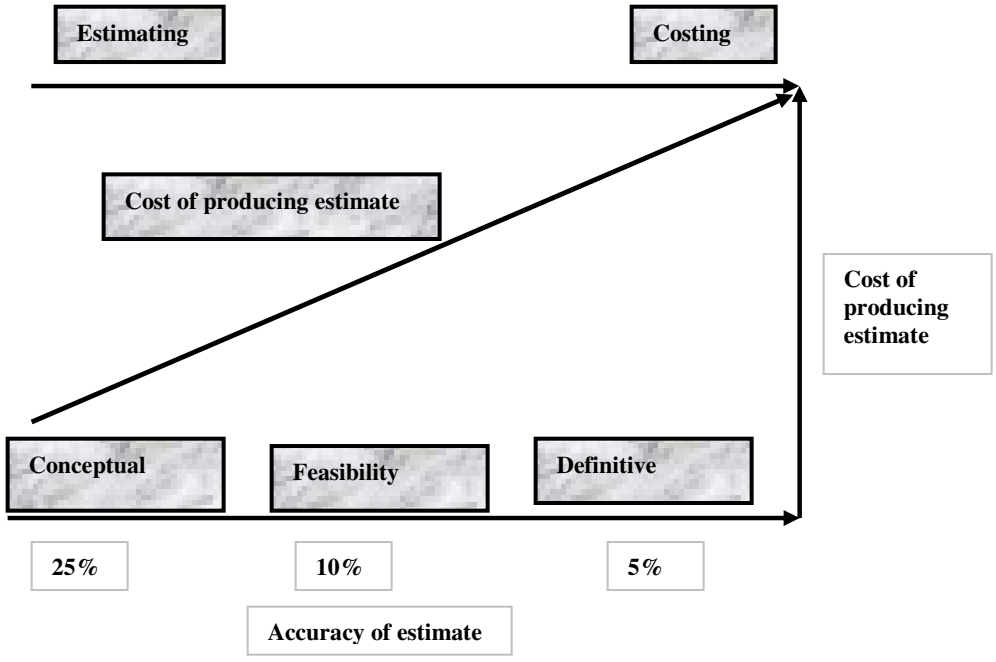


Figure 5.10 Estimate accuracy

For the economic analysis projects should incorporate elements to ensure that:

- The economic analysis of projects include an assessment of the sustainability of project effects to ensure that the project provides sufficient incentives for producers;
- Sufficient funds are available to maintain project operations;

- Environmental effects are included in the analysis;
- Least cost means of providing the project benefits is used; and
- The distribution of project benefits and costs is consistent with project objectives.

5.10.2 Costs associated with construction

The costs of a constructed facility to the owner or contractor include both the initial capital cost and the subsequent operation and maintenance costs. Each of these major cost categories consists of a number of cost components, which include the following:

- Wages and benefits of the direct hire construction labor;
- Salaries, benefits, and expenses of construction supervisors;
- Rental, purchase and maintenance of construction tools and equipment; and
- Provision of temporary construction facilities, building, utilities, construction supplies, and protection materials.

Of the above, the major cost is the wages of the construction labor, which can be controlled if the labor hours can effectively be controlled. Arthur E.Keridge (1968) outlines a series of guidelines of great value to achieve control of costs of this nature through labor productivity improvement. In general, costs associated with projects can be categorized as Direct costs, Indirect costs, Labor costs, Material and Equipment costs, Transport costs, Preliminary and General (P&G) costs. The magnitude of each of these cost categories depends on the nature, size and location of the project as well as the management organization among many other considerations. The owner or contractor interested in achieving the lowest possible overall project cost consistent with its objectives must know and understand the nature of each cost before starting the exercise of cost control.

***Contingencies*.** Estimating assumes that normal working conditions and practices will prevail during the project life cycle. Unfortunately the real world does not work that way and allowances should be made for the risks and uncertainties. Therefore, in most construction budgets, there is an allowance for contingencies or unexpected costs occurring during construction. This contingency amount may be included within each cost item or be included

as a single category of construction cost. The amount of contingency is based on historical experience and the expected difficulty of a particular construction project. For example, a construction firm may make estimates (allowance) of the expected cost in five different areas:

- Design development changes;
- Schedule adjustments;
- General administration changes (such as wage rates);
- Differing site conditions for those expected; and
- Third party requirements imposed during construction, such as new permits.

The contingency allowance is usually added as a percentage to the estimated cost of the project. The size of the contingency will depend on many factors such as the type of project, general efficiency and competence of the company and the degree of vulnerability of the project to risk and uncertainty. Contingent amounts not spent for construction can be released near the end of construction to the owner or to add additional project elements.

5.10.3 Cost estimate types

Construction estimating is the compilation and analysis of the many items that influence and contribute to the cost of a project. Estimating, which is done before the physical realization of the work, requires detailed study of the contract documents. It also involves a careful analysis of the results of the study to arrive at the most accurate estimate of the probable cost consistent with the bidding time available and the accuracy and completeness of the information submitted.

Clough (1969) states that much of the credit for the success or failure of a contracting enterprise must be ascribed to the skill and astuteness of its estimating staff. On the one hand, a contractor must be the low bidder on a sufficient number of the projects he bids in order to stay in business. On the other hand, the jobs that he obtains must not be priced so low that it is impossible to realize a fair profit from them. In an atmosphere of intense competition, the preparation of realistic and balanced bids requires the utmost in good judgment and estimating skill.

Since, the estimation of construction costs is a necessary and decisive part of any construction operation contractors and stakeholders must give due consideration on the estimation part prior to bid.

Construction cost constitutes only a fraction, though a substantial fraction of the total project cost. However, it is the part of the cost under the control of the construction project manager. The required levels of accuracy of construction cost estimates vary at different stages of project development, ranging from ballpark figures in the early stage to fairly reliable figures for budget control prior to construction. Since design decisions made at the beginning stage of a project life cycle are more tentative than those made at a later stage, the cost estimates made at the earlier stage are expected to be less accurate. Generally, the accuracy of a cost estimate will reflect the information available at the time of estimation.

Construction cost estimates may be viewed from different perspectives because of different institutional requirements. In spite of the many types of cost estimates used at different stages of a project, cost estimates can best be classified into three major categories according to their functions. A construction cost estimate serves one of the three basic functions: design, bid and control. For establishing the financing of a project, either a design estimate or a bid estimate is used.

1. Design Estimates. For the owner or its designated design professionals, the types of cost estimates encountered run parallel with the planning and design as follows:

- Screening estimates (or order of magnitude estimates)
- Preliminary estimates (or conceptual estimates)
- Detailed estimates (or definitive estimates)
- Engineer's estimates based on plans and specifications

For each of these different estimates, the amount of design information available typically increases. In the planning and design stages of a project, various design estimates reflect the progress of the design. At the very early stage, the *screening estimate* or *order of magnitude* estimate is usually made before the facility is designed, and must therefore rely on

the cost data of similar facilities built in the past. A *preliminary estimate* or *conceptual estimate* is based on the conceptual design of the facility at the state when the basic technologies for the design are known. The *detailed estimate* or *definitive estimate* is made when the scope of work is clearly defined and the detailed design is in progress so that the essential features of the facility are identifiable. The *engineer's estimate* is based on the completed plans and specifications when they are ready for the owner to solicit bids from construction contractors. In preparing these estimates, the design professional will include expected amounts for contractors' overhead and profits.

2. Bid Estimates. For the contractor, a bid estimate submitted to the owner either for competitive bidding or negotiation consists of direct construction cost including field supervision, plus a markup to cover general overhead and profits. The direct cost of construction for bid estimates is usually derived from a combination of the following approaches.

- Subcontractor quotations
- Quantity takeoffs
- Construction procedures.

The contractor's bid estimates often reflect the desire of the contractor to secure the job as well as the estimating tools at its disposal. Some contractors have well-established cost estimating procedures while others do not. Since only the lowest bidder will be the winner of the contract in most bidding contests, any effort devoted to cost estimating is a loss to the contractor who is not a successful bidder. Consequently, the contractor may put in the least amount of possible effort for making a cost estimate if it believes that its chance of success is not high.

3. Control Estimates. For monitoring the project during construction, a control estimate is derived from available information to establish:

- Budget estimate for financing
- Budgeted cost after contracting but prior to construction
- Estimated cost to completion during the progress of construction.

Both the owner and the contractor must adopt some base line for cost control during the construction. For the owner, a *budget estimate* must be adopted early enough for planning long term financing of the facility. Consequently, the detailed estimate is often used as the budget estimate since it is sufficient definitive to reflect the project scope and is available long before the engineer's estimate. As the work progresses, the budgeted cost must be revised periodically to reflect the estimated cost to completion. A revised estimated cost is necessary either because of change orders initiated by the owner or due to unexpected cost overruns or savings.

Cost estimating must obviously start from some form of project specification. It is clear that the better the project can be defined at the outset, the less chance there should be of making estimating errors. However, the possibility of error can never be reduced to zero, and no sensible person could ever declare the initial cost estimates for a total project to be entirely free from error and completely accurate. Estimating always involves an element of personal judgments. Because any project is a new venture, it always must contain some uncertainty. In many cases it may not even possible to declare with confidence what the total costs are of till the end of a project, owing to the complexities of cost collection, cost appointment and accounting methods.

However, steps can of course, be taken to remove some possible sources of estimating errors and to ensure that effective systems are in place for subsequent cost measurement. The cost estimator should be aware of the problems, but must not allow these to deflect him from the primary task, which must always be to use all the data and time available in producing the most accurate estimate possible, in other words a calculated judgment of what the project should cost if all goes according to expectations. Estimates made with a high degree of confidence will greatly assist those responsible for any competitive pricing decision, and accurate estimates improve the effectiveness of cost budgets and resource schedules.

Some companies in the construction, petrochemical, civil engineering and other industries find it convenient to classify project cost estimates according to the *degree of confidence* that the estimators con express in their accuracy. These classifications obviously depend on the quality of information available to the estimators and the time allowed for preparing the estimates. Here is one useful set of estimate categories.

Ballpark estimates: are those made before a project starts, when only very hazy information exists and when particularly all details of the work need to be formulated. Ballpark estimates are also made in emergencies. They are particularly valuable for arriving out preliminary checks on possible resource requirements, for screening enquiries for tenders and for other early planning decisions. They should never for example, be used as a basis for fixed price tendering. A well-reasoned ballpark estimate might achieve an accuracy of ±25%, given a generous amount of luck and good judgment.

Comparative estimates: as their name implies, are made by comparing work to be done on the new project with work done on similar projects in the past. They can be attempted before detailed design work takes place, when there are no accurate materials lists or work schedules. Comparative estimates are commonly used as the basis for tenders but they may not provide accuracy more than ± 15%.

Feasibility estimates: can only be derived after a significant amount of preliminary project design has been carried out. In construction projects, for example, the building specification, site data, provisional layouts and drawing for services are all necessary. The accuracy should be better than ± 10%.

Definite estimates: Cannot be made until most design work has been finished, all the major purchase orders have been placed at known prices, and actual work on the project construction or assembly is well advanced. Estimates can be labeled 'definite' when the point in time is reached where their declared accuracy is ±5% or better.

Whenever a cost estimate is made, whether it is for a major construction project or for engineering or a manufacturing project, it is important that the figures given are qualified by a declaration of their expected accuracy.

5.10.4 Allocation of construction costs over time

Since construction costs are incurred over the entire construction phase of a project, it is often necessary to determine the amounts to be spent in various periods to derive the cash flow

profile, especially for large projects with long durations. Consequently, it is important to examine the percentage of work expected to be complete at various time periods to which the costs would be charged.

In general, the work on a construction project progresses gradually from the time of mobilization until it reaches a plateau; then the work slows down gradually and finally stops at the time of completion. The rate of work done during various time periods (expressed in the percentage of project cost per unit time) is shown schematically in Figure 5.7 in which ten time periods have been assumed. The solid line **A** represents the case in which the rate of work is zero at time t = 0 and increases linearly to 12.5% of project cost at t = 2, while the rate begins to decrease from 12.5% at t = 8 to 0% at t = 10. The dotted line **B** represents the case of rapid mobilization by reaching 12.5% of project cost at t = 1 while beginning to decrease from 12.5% at t = 7 to 0% at t = 10. The dash line **C** represents the case of slow mobilization by reaching 12.5% of project cost at t = 3 while beginning to decrease from 12.5% at t = 9 to 0% at t = 10.

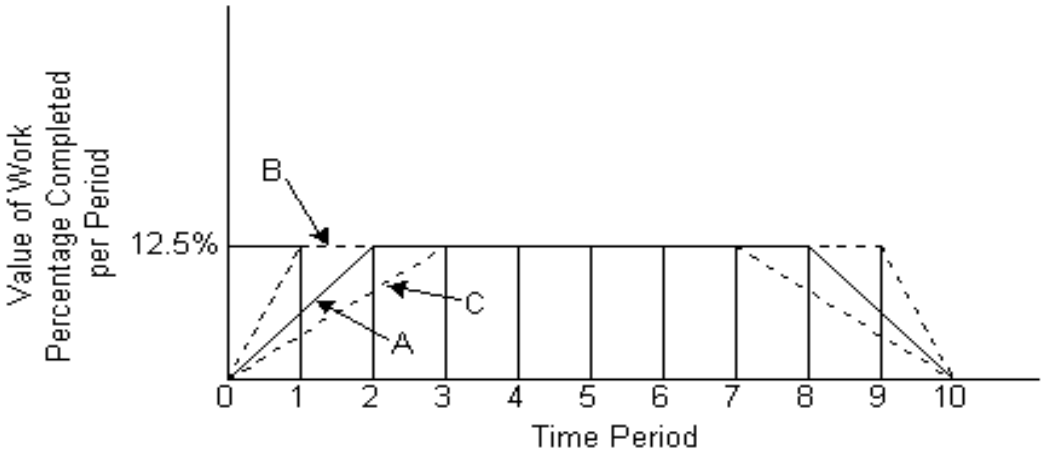


Figure 5.11 Rate of work progress over project time

The value of work completed at a given time (expressed as a cumulative percentage of project cost) is shown schematically in Figure 5.11. In each case (A, B or C), the value of work completed can be represented by a "S-shaped" curve. The effects of rapid mobilization and slow mobilization are indicated by the positions of curves B and C relative to curve A, respectively.

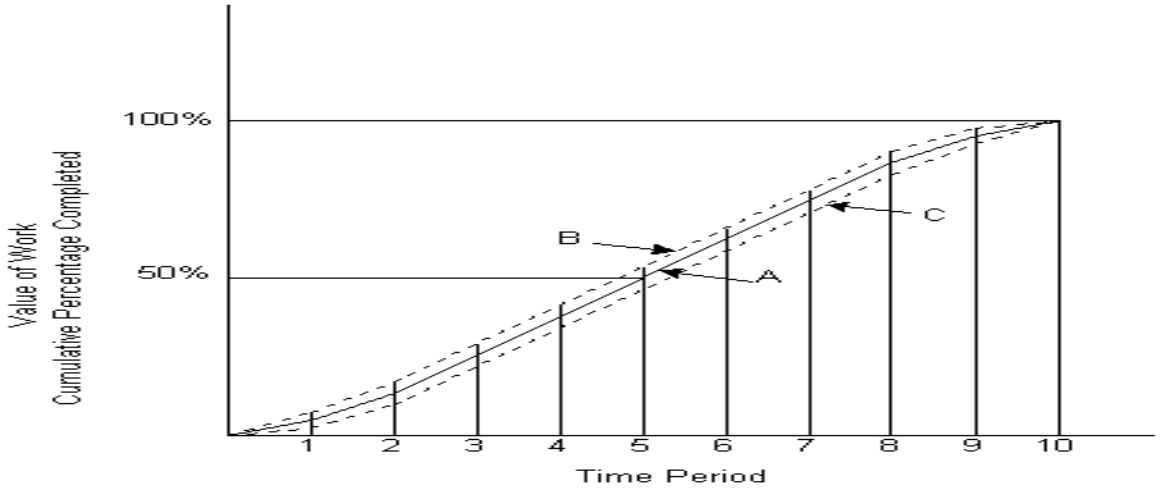


Figure 5.12 Value of work completed over project time

While the curves shown in Figures 5.11 and 5.12 represent highly idealized cases, they do suggest the latitude for adjusting the schedules for various activities in a project. While the rate of work progress may be changed quite drastically within a single period, such as the change from rapid mobilization to a slow mobilization in periods 1, 2 and 3 in Figure 5.11, the effect on the value of work completed over time will diminish in significance as indicated by the cumulative percentages for later periods in Figure 5.12. Thus, adjustment of the scheduling of some activities may improve the utilization of labor, material and equipment, and any delay caused by such adjustments for individual activities is not likely to cause problems for the eventual progress toward the completion of a project.

In addition to the speed of resource mobilization, another important consideration is the overall duration of a project and the amount of resources applied. Various strategies may be applied to shorten the overall duration of a project such as overlapping design and construction activities or increasing the peak amounts of labor and equipment working on a site. However, spatial, managerial and technical factors will typically place a minimum limit on the project duration or cause costs to escalate with shorter durations.

5.10.5 Cost control and achievement analysis

During the execution of a project, procedures for project control and record keeping become indispensable tools to managers and other participants in the construction process. These tools serve the dual purpose of recording the financial transactions that occur as well as giving managers an indication of the progress and problems associated with a project.

Project control procedures are primarily intended to identify deviations from the project plan rather than to suggest possible areas for cost savings. This characteristic reflects the advanced stage at which project control becomes important. The times at which major cost savings can be achieved are during planning and design stages of the project. During the actual construction, changes are likely to delay the project and lead to increase costs. As a result, the focus of project control is on fulfilling the original design plans or indicating deviations from these plans, rather than on searching for significant improvements and cost savings. It is only when a rescue operation is required that major changes will normally occurring in the construction plan.

For cost control of a project, the construction plan and the associated cash flow estimates can provide the baseline reference for subsequent project monitoring and control. For schedules, progress on individual activities and the achievement of milestone completions can be compared with the project schedule to monitor the progress of activities. Contract and job specifications provide the criteria by which to assess and assure the required quality of construction. The final or detailed cost estimate provides a baseline for the assessment of financial performance during the project. To the extent that costs are within the detailed cost estimate, then the project is thought to be under *financial control*. Overruns in particular cost categories signal the possibility of problems and give an indication of exactly what problems are being encountered. Expense oriented construction planning and control focuses upon the categories included in the final cost estimation. This focus is particular relevant for projects with few activities and considerable repetition such as grading and paving roadways.

For control and monitoring purposes, the original detailed cost estimate is typically converted to a *project budget*, and the project budget is used subsequently as a guide for management. Specific items in the detailed cost estimate become job cost elements. Expenses incurred during the course of a project are recorded in specific job cost accounts to be compared with the original cost estimates in each category. Thus, individual job cost accounts generally represent the basic unit for cost control.

In addition to cost amounts, information on material quantities and labor inputs within each job account is also typically retained in the project budget. With this information, actual materials usage and labor employed can be compared to the expected requirements. As a result, cost overruns or savings on particular items can be identified as due to changes in unit prices, labor productivity or in the amount of material consumed.

Since the objective of cost control is to keep the project within budget, to do this one needs early warning of impeding deviations, and the information to take corrective action before costs are out of control. Effective cost control depends on several basic principles:

- The owner's project team representatives must provide the lead to keep the job on cost target, without overemphasis on operational factors;
- The project schedule must be realistic and achievable with the personnel available to it, and the deliveries currently attainable. The schedule should be correlated to the over-all cost objective;
- All cost items should be compared to a budget prior to commitment, and as incurred;
- The effect on cost, of changes to project scope and design criteria, must be estimated and evaluated before final commitment;
- Cost data should be given to the various groups on the project team to stimulate on attitude of cost consciousness;
- There must be procedures for periodic reporting and evaluation of costs committed as well as incurred, and of estimation costs yet to be committed or incurred;
- Control is required both for quantities and unit costs;
- Project management should frequently review costs and commitments versus job

progress. It should take corrective action wherever deviations occur from plans and budgets.

The first step in cost control is to prepare a good estimate. Cost cannot be controlled if there is and inadequate, incomplete, or unrealistic estimate. The figure below illustrates the increasing probability of improved accuracy as estimates are made at progressive stages of project execution.

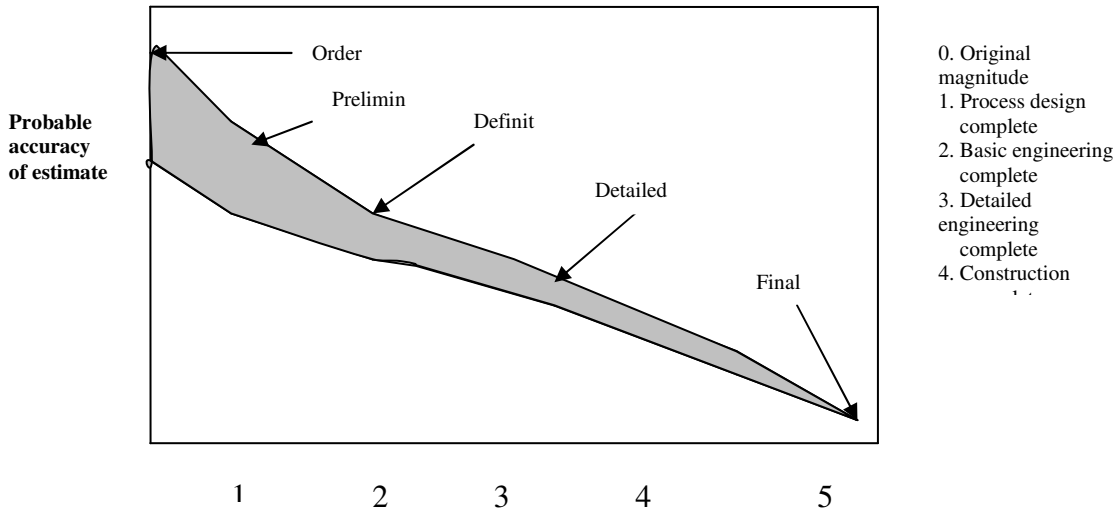


Figure 5.13 Probable accuracy of cost estimation

Cost control can only be applied at a level corresponding to the quality and detail of the estimate available. Project cost control starts on the wrong base if there is a poor estimate. Estimates may be arbitrarily reduced or an estimating accuracy may be claimed which is not supported by the project scope definition available. Poor project execution may be blamed for cost overrun when an unrealistic or over optimistic project estimate is the problem.

For the implementation of an effective cost control mechanism the Earned Value Concept (EVC) (discussed in section 5.4 of this chapter) is of great value in today's complex projects. The EVC is a development of the cost/schedule control system towards full integration of cost

and time. When this approach is combined with forecasting, the project manager has the best of both worlds; the performance measuring mechanism should periodically (weekly, monthly, etc.) assess progress and costs in comparable units against a baseline. It is essential for effective project control that performance is measured while there is still time to make corrective action.

Use of EVC as a management technique demands rigorous organization of the project work for the purposes of proper budgeting and scheduling.

A major consequence of EVC implementation is development of a family-type diagram for subdivision of the overall work effort into identifiable smaller activity packages. The work breakdown structure, establishes the framework for contract execution, cost reporting, schedule and technical performances.

The WBS is the structuring of the project work into greater detail and more manageable units of work. Then the process of developing the WBS becomes establishing a project schema for dividing the project into major groups then divides the major groups into tasks, subdivide the tasks into subtasks, and so forth, each package or unit of task has its identification code that differentiates from the other tasks.

The WBS must be structured so that any level of detail can be rolled up to the next higher level of detail. It facilitates uniform planning, assignment of responsibilities, and measurement of project status.

The WBS defines and establishes reporting categories. These reporting categories are used for the project management control (only one WBS is developed and used for each project). However, the WBS is just one of several reporting categories that may be used to define contract objectives. The others include cost element, organization function, and contract line item. Typically a contractor requires vertical summation of costs. This means that cost information is provided along all ascending levels of the project, starting with the individual cost centers. Traditionally, cost reporting and budgeting have been produced along the

organization functional division. This too can be provided at the lowest WBS level by horizontal summation of costs.

The WBS divides the overall project into elements that represent assignable work units; these work units then become the common denominator around which the project management system is built. Each project must be subdivided into tasks that are capable of being assigned and accomplished by some organizational unit or individual. These tasks are then performed by specialized functional organizational components. The overall "map" of the project represented as the collection of these units gives the project manager many organizational and subsystem interfaces to manage.

The underlying philosophy of the work is assignable and for which accountability can be expected. Each work package is a performance-control element; it is negotiated and assigned to a specific organizational manager who is responsible for a specific objective (which should be measurable), detailed task descriptions, specifications, scheduled task milestones, and time-phased budget in dollars and manpower. Each work package manager is held responsible for the completion of the work package in terms of objectives, schedules, and costs by the project and the functional managers.

5.11 Project Planning, Scheduling and Controlling Techniques

5.11.1 Introduction

Construction projects are complex, and a large job will literally involve thousands of separate operations. If a project is to be completed within the time called for in the contract, the work must be very carefully planned and scheduled in advance. Thus, a typical project involves many tasks that are dependent upon one another as well as many other tasks that are totally independent of each other, and when interrelated in a project, they create a complicated web of individual time and sequence relationships. When all these tasks are superimposed, it becomes obvious that construction project *planning* and *scheduling* is a very complicated and difficult management function.

Project planning. Is a fundamental and challenging activity in the management and execution of construction projects. It involves the choice of technology, the definition of work tasks, the estimation of the required resources and duration for individual tasks, and the identification of any interactions among the different work tasks.

A good project plan is the basis for developing the budget and the schedule for work. Developing the project plan is a critical task in the management of construction, even if the plan is not written or otherwise formally recorded. In addition to these technical aspects of project planning, it may also be necessary to make organizational decisions about the relationships between project participants and even which organizations to include in a project.

In developing a project plan, it is common to adopt a primary emphasis on either cost control or on schedule control as illustrated in Figure 5.14. Traditional scheduling procedures emphasize the maintenance of task precedence (resulting in *critical path scheduling* procedures) or efficient use of resources over time (resulting in *job shop scheduling* procedures). Finally, most complex projects require consideration of both cost and scheduling over time so that planning; monitoring, and record keeping must consider both dimensions. In these cases, the integration of schedule and budget information is a major concern.

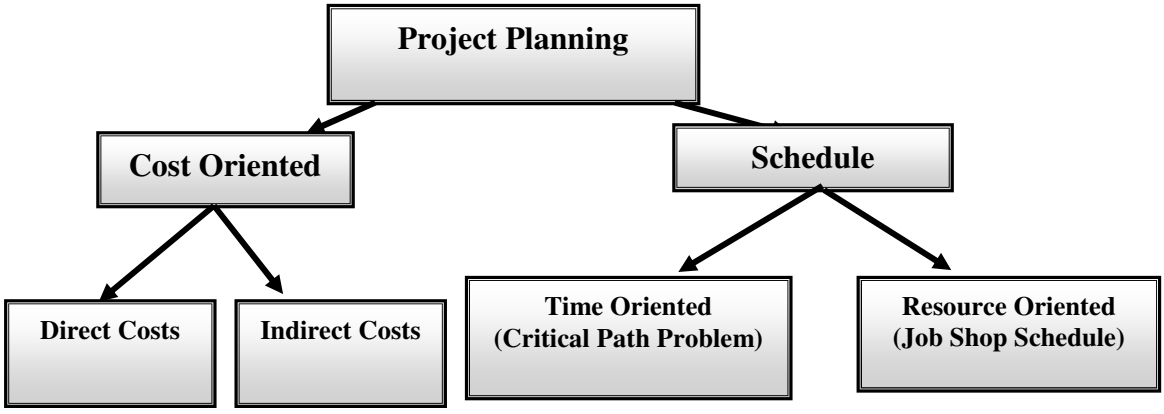


Figure 5.14 Alternative Emphases in Construction Planning

Scheduling. In addition to assigning dates to project activities, project scheduling is intended to match the resources of equipment, materials and labor with project work tasks over time.

Good scheduling can eliminate problems related with bottlenecks, facilitate the timely procurement of the necessary materials, and ensure the completion of a project as soon as possible. In contrast, poor scheduling can result in considerable waste of labors and equipments waiting for the availability of needed resources or the completion of preceding tasks; causing delays tasks and delaying the completion of the entire project.

Traditionally, contractors have scheduled their construction projects largely on the basis of experience and intuition. Bar graphs (Gantt charts) have been used for many years in conjunction with project scheduling. These graphical representations of work versus time are easily read and undoubtly will continue to serve as a simple and understandable way of scheduling construction and recording its progress. However, the bar chart is very limited in its usefulness because it does not show the interrelationships and interdependencies between operations that effectively control project progress. In addition, it is difficult to modify the usual bar chart to include recursions made as the project proceeds.

Modern conditions of intense competitions, soaring costs, tight time schedules, and increasing complexity of construction procedures have lent great impetus to the development of more efficacious ways of planning and scheduling construction projects.

Project Planning Steps

The CPM network diagram and scheduled bar chart provide a highly structured and methodical approach to project planning; Burke (1992). The following steps may be used as a guideline, or checklist to develop the baseline plan. Within these steps are a number of iterative loops, which should be performed until an optimum solution is derived.

1. Define the scope of work. Outline the method statement or build method, sequence of work and quality control plan;
2. Define the project objectives with respect to time, cost and resources;
3. Generate a responsibility matrix linked to the Work Breakdown Structure's work package or activity. Develop the Organization Breakdown Structure (OBS) to identify the project's lines of communication through which instructions and information will flow;

4. Develop the Work Breakdown Structure (WBS) to structure the scope of work and produce a complete list of activities;
5. Estimate activity time duration, cost expenditure, resource requirements and procurement lead times;
6. Determine the relationships between activities and draw the network diagram;
7. Develop the project calendar or work pattern;
8. Perform the CPM time analysis (forward pass, backward pass) to establish an activity table consisting to Early Start, Early Finish, Late Start, Late Finish, Activity float and the Critical Path;
9. Draw the scheduled bar chart;
10. Analyze resources with respect to resource requirements, resource availability, resource loadings and resource smoothing. If necessary re-analyze project time to produce a manpower histogram and "S" curve to plan and control productivity;
11. Generate project accounts and financial reports. Budgets per activity or WBS work package. Integrate cost and time to produce the cost "S" curve or BCWS.

It is advisable to substantially complete the planning before the execution of the project. This will allow the project manager the opportunity to plan and control the project before things go out of control. The execution phase will be controlled through the following steps:

12. Control the scope of work through the following documents:
    Site communications, Impact Statements, Non-conformance reports (NCR), Change requests and concessions, Drawing revisions, Modifications and variation orders (VO), Extracts to contract, Specification and configuration revisions.
13. Project expediting involves the follow up function to confirm that; orders have been received, materials have been procured, work has started and planned delivery dates will be achieved;
14. Project tracking and data capture, to quantify and measure project performance;

15. Analyze performance data to generate status reports and earned value analysis to clearly outline the project's actual progress against the baseline plan. Extrapolate forward to forecast and predict project trends;
16. Decide on corrective action where necessary to keep the project on track;
17. Issue instructions;

The control functions are shown diagrammatically on the figure below:

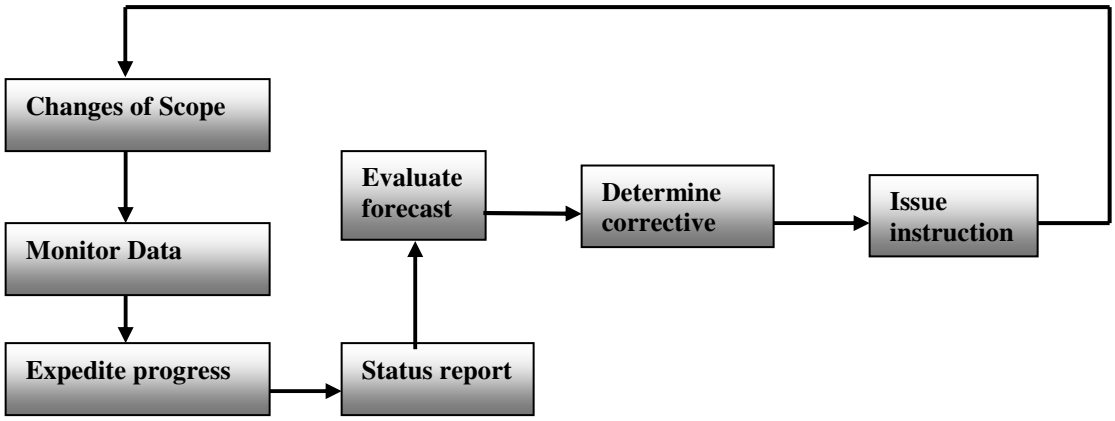


Figure 5.15 Project control functions

5.11.2 CPM and PERT

Since about the late of 1950, a new concept in planning and scheduling has been developed and utilized. The new system allows the analysis of sequences and time characteristics by the use of network diagrams. CPM (Critical Path Method) and PERT (Program Evaluation and Review Technique) were introduced in 1958, Lewis (1993); these techniques are widely used as a management system on military and other more complex projects.

Although CPM and PERT are similar to one another in several important respects, the two methods differ somewhat in their applications and objectives. PERT is particularly useful when applied to research and development tasks in which the work is entirely or largely new in concept and is being attempted for the first time. In such cases time requirements can seldom be predicted accurately and probabilistic principles are used in conjunction with the estimation of time requirements. The PERT procedure is time concerned.

CPM on the other hand, leads itself well to projects on which costs and time can be predicted with a higher degree of certainty. It is a method for achieving schedule and cost control over projects such as constructions of jobs whose many elements are susceptible to reasonably accurate estimates of cost and time. In many cases, there are systems in use that are essentially a combination of some of the features of both the PERT and the CPM methods. Generally, however, it has been found that the original CPM methods are best suited to construction projects.

The Critical Path Method (CPM)

The initial phase of CPM is that of planning. The project must first be broken up into its elemental, time-consuming "activities." An activity is a simple identifiable work step in the total projects. The extent to which the project is subdivided into activities depends upon a number of practical considerations, but the following factors should be taken into account.

1. Different areas of responsibility, such as subcontracted work, which are distinct and separate from that being done by the prime contractor directly;
2. Deferent categories of work as distinguished by craft of crew requirements;
3. Deferent categories of work as distinguished by equipment requirements;
4. Different categories of work as distinguished by materials such as concrete, beams and columns;
5. Distinct and identifiable subdivisions of structural work such as walls, slabs, beams, and columns;
6. Location of the work which necessitates different times of different crews to perform;
7. Owner's work breakdown for bidding of payment purpose; and
8. Contractor's work breakdown for estimation of cost accounting purposes.

The activities chosen may represent relationally are segments of the project or may be limited to small steps. If the activity breakdown is too gross, the job plan developed will not yield information in sufficient detail to be optimally useful. However, if the subdivision of the work is carried to the other extreme, the excessive detail tends to obscure the really significant planning factor. Thus, after the separate activities have been identified and sequential

relationships between them are determined, that is sometimes referred to as "job logic" and is an enumeration of the necessary time order of construction operations. When the time sequence of activities is being determined, the practical limitations such as the approval of shop drawing, delivery of materials, special labor needs, equipment requirements, or availability of completed contract drawings must be recognized and take into consideration.

5.11.3 Project scheduling

The essential information for project scheduling is the network diagram and a time duration estimate for each activity. These estimated durations are very important and the measure of usefulness of CPM depends in large measure on their accuracy.

Project scheduling is accomplished by carrying out a series of simple computations that yield valuable project control information. An overall project completion time is first established. Assuming for the moment that the resulting project completion date is acceptable, we then determine times or dates within which each activity must start and finish if the established project completion date is to be met.

Estimation of activity duration: The first step in the scheduling processes is to estimate the time necessary to carry out each activity. Much of the value of the CPM process depends on the accuracy of the estimated activity durations (i.e. hours, calendar days, or shifts). The following rules constitute the basis for this important step:

i. The duration of each activity is based on “normal” level of manpower and equipment that the estimator usually assumes when he prices the job. This normal level is about optimum in the sense that it represents the activity duration for minimum direct cost, and does not include indirect costs.
ii. It is important that each activity be evaluated independently of all the others, for example, if an activity might take longer than usual because of unanticipated delay in material delivery, delivery should be made a separate activity with a realistic duration of its own.

iii. A normal workday or week is assumed. Overtime or multiple shifts are not considered unless this is a standard practice or part of a normal period.

iv. Activity durations must be estimated without regard to predetermined contract completion dates. Otherwise unconscious adjustments may be made to fit the activities into the time available. Quite obviously this defeats the entire scheduling process.

v. Consistent time units must be used throughout the project scheduling process.

It is not desirable to add a contingency factor to any individual activity duration to allow for unpredictable project delays. Such a contingency is better included in the time required for overall project completion.

5.11.4 Project control

Project control is the proactive process of monitoring project performance and taking corrective action to eliminate or reduce negative impacts on project objective.

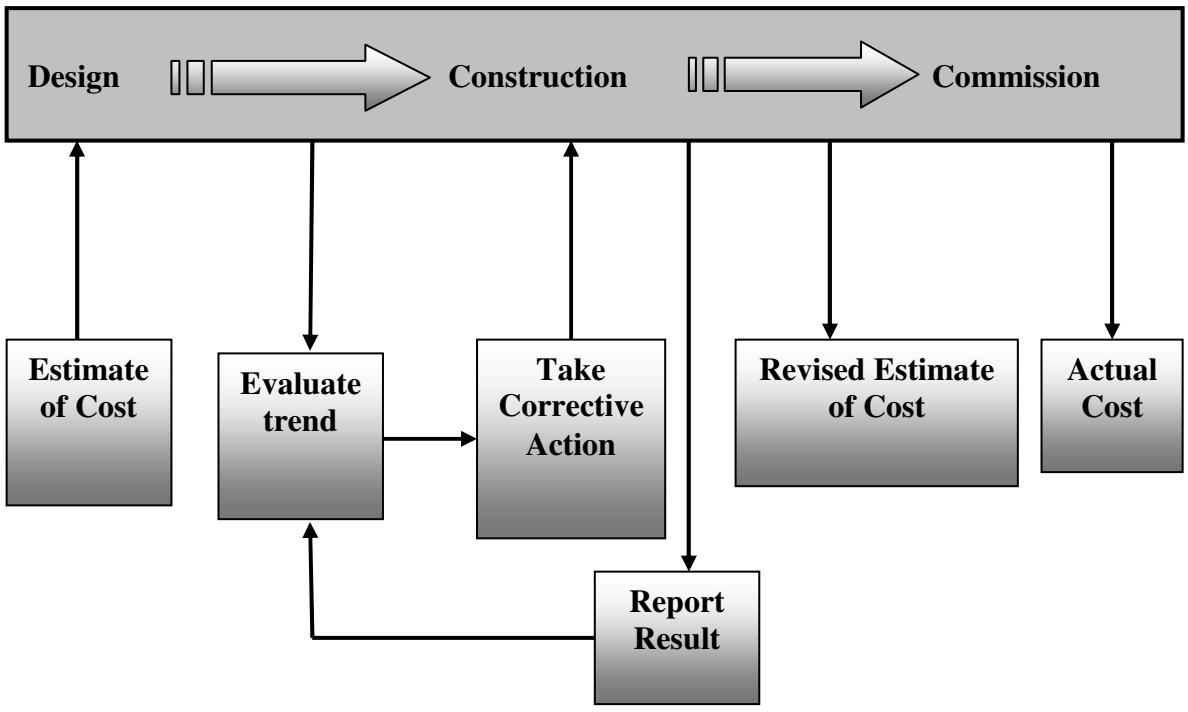


Figure 5.16 Project cost control model

Elements of project control

1. Prepare periodic status report
2. Identify the variances[9] from the integrated project plan
3. Analyze the variances to determine possible impacts and causes
4. Take corrective action and follow up.

5.11.5 Benefits of the project planning and control system

One of the main responsibilities of the project manager is to plan, track and control the project to meet preset objectives. To do this effectively the project manager requires accurate and timely information. This information should be supplied by the project's planning and control system, which outlines the scope of work and measures of performance against the original plan.

Companies sometimes resist using project planning and control techniques because of the additional management cost. However, it should be appreciated that lack of information could be even more expensive if it leads to poor management decisions. Listed below are some of the main advantages associated with a fully integrated project planning and control system:

Estimating: The performance of the current project will form the estimating database for future projects. If this data is not collected by the planning and control system it may be lost forever.

CPM: Critical Path Method (CPM) forces the managers to think about planning in a structured manner, the critical activities give a guide to the level of detail. The CPM presentation offers a tool for discussion with the other managers.

Project-Corporate system integration: The planning and control system can provide the link between the project and corporate reporting systems. Without this link double processing may be necessary to satisfy the information needs of both systems.

[9] In this case also the Earned Value Concept is of great use to identify the cost and schedule variances.

Response time: Timely response on project performance is essential for effective project control. The planning and control system can adjust the feedback to address the needs of the project.

Reporting Interfaces: The planning and control system's database can be structured around the WBS for project reporting and around the Organization Breakdown Structure (OBS) for corporate reporting. Without this integrated system the two reporting requirements would have to be processed separately.

Trends: Projects are best controlled by monitoring the progress trends of time and cost performances. This information may not be timely available to the project manager if the trend parameters are derived from a number of functional sources.

Data Capture: If the project progress reporting is based on information supplied by the functional departments, the project manager cannot control the accuracy of this information.

Cost of Mistakes: To implement a fully integrated project management system will certainly increase the project office budget. However, without an effective planning and control system the cost of mistakes due to lack of adequate control, may be even higher.

Procedures: The planning and control system enables the project manager to develop procedures and work instructions tailored to the specific needs of the project.

Client: The project manager is the project's single point of responsibility and the company's representative to the client. When holding meetings with the client the planning and control system will provide detailed information about every aspect of the project.

The above points outline the benefits of an independent project management planning and control system to give the project manager the best opportunity to effectively plan, monitor and control the project. Unfortunately it is not always possible to substantiate these benefits financially as many of them like good customer service are intangible.

5.12 Project Management Information System (PMIS)

An information system is as essential to the effective control of projects as it is to meeting external reporting requirements, to reporting project progress to top management, and to performing effective project planning David and William (1983).

The development of a project management information system involves the gathering and coalescing of data from the functional units supporting the project. An information system should be designed to serve two purposes: first, visibility for the functional manager, in terms of his input to the PMIS, and second, visibility for the project manager, in terms of cost, time, and performance.

Many project managers rely on historical information, which depicts the past and present rather clearly but which does not allow them to focus the future in a manner, which would permit control actions to be taken before minor project problems become major ones. In any case, whether the various information systems developed by individual project managers are good or bad, the various systems are often not well integrated. Thus, while each information system may provide the individual project manager with the information desired, the output of the various system may not provide information adequate for decision making and planning at the overall organizational level.

A project management information system may be developed within an organization to serve as a model information system for all projects. The term "model" is used here in the sense of a basic information system structure, which will provide essential information to the project manager and to top management, and, at the same time, will be:

1. Sufficiently flexible so that it can be modified to suit the unique needs of the individual project manager;
2. Adaptable to many different projects; and
3. Adaptable to differing customer information requirements.

Such a model PMIS will provide a basic information source to meet the requirements of functional manager, project manager, top management, and customer information. It can serve as a point of departure for project managers who desire to implement their own systems.

By virtue of this flexibility, it should provide all levels of management with "personalized" information; and, at the same time, it should provide standardized information, which is integrated into an overall planning and control system Lewis (1983).

5.13 Quality and Safety of Road Projects

In every project the primary responsibility of a project manager is to assure the quality of the workmanship and the safety of its workers because the success depends on these two major issues; therefore, organizations introducing the Quality and Safety systems in their projects are more likely to succeed. There may be different organization type for quality and safety control during construction phase of the projects. One common model is to have a group responsible for quality assurance and another group primarily responsible for safety within an organization. In large organizations, departments dedicated to quality assurance and to safety might assign specific individuals to assume responsibility for these functions on particular project. For small projects, the project manager himself or an assistant might assume these and other responsibilities.

5.13.1 Quality control

Quality control in projects typically involves ensuring compliance with minimum standards of material and workmanship in order to ensure the performance of the facility according to the design. For the purpose of ensuring compliance, random samples and statistical methods are commonly used as the basis for accepting or rejecting work completed. Rejection of work completed is based on non-conformance or violation of the relevant design specifications.

Another more effective way of assuring quality is through the implementation of Total Quality Control throughout the project organization. In this system, no defective items are allowed

anywhere in the project management process. While the zero defects goal can never be permanently obtained, it provides a goal so that an organization is never satisfied with its quality control program even if defects are reduced by substantial amounts year after year. This concept and approach to quality control was first developed in manufacturing firms in Japan and Europe, but has since spread to many construction companies. The best-known formal certification for quality improvement is the International Organization for Standardization's ISO 9000 standard. ISO 9000 emphasizes good documentation, quality goals and a series of cycles of planning, implementation and review.

Total quality control is a commitment to quality expressed in all parts of an organization and typically involves many elements. Design reviews to ensure safe and effective construction procedures are a major element. Other elements include extensive training for personnel, shifting the responsibility for detecting defects from quality control inspectors to workers, and continually maintaining equipment. Worker involvement in improved quality control is often formalized in quality circles in which groups of workers meet regularly to make suggestions for quality improvement. Material suppliers are also required to ensure zero defects in delivered goods.

Of course, Total Quality Control or Management is difficult to apply, particularly in construction projects. Assessment made to identify the implementation of the TQM or ISO 9000 in Ethiopian construction firms, the response was surprising (the survey shows that non of the companies are implementing any of the quality systems as a means of quality improvement); they had no idea whether these quality systems could be applied in construction activities. The unique nature of each facility, the variability in the workforce, the multitude of subcontractors and the cost of making necessary investments in education and procedures make programs of total quality control in construction difficult. Nevertheless, a commitment to improved quality even without endorsing the goal of zero defects can pay real dividends to organizations.

5.13.2 Safety in construction projects

Typical of road construction project is the mobility of operations: worksites are started and terminated almost annually, if not monthly; the numbers of various occupational groups is high; and numerous companies and entrepreneurs may operate on the same site. Safety and health in road construction work has always been more difficult to organize than in fixed-site industries. Many occupational hazards are simultaneously present at construction sites, and they occur in numerous different combinations: Accident risks, dusts, noise and vibration, chemicals and other hazardous materials, heavy physical work, ergonomic problems and, not the least important psychological stress due to the hectic pace of working to tight schedules are among the occupational hazards of construction work.

Against such a background, it is no wonder that, in most countries, the construction sector has tenfold risk of occupational accidents than national averages. Even in highly industrialized countries, the trends of occupational hazards in construction projects may show increasing rates while, e.g. manufacturing makes steady improvement in health and safety. But the situation does not necessarily need to be so. The reduction can be accomplished, but there is no simple answer, because several simultaneous factors should prevail in order to obtain an impact that improves safety. Some of the essential contributors are:

- Provision of up-to-date information in the form of easy-to-use data base
- Raising of awareness among construction workers (using different medias)
- Encouraging inspectors to become agents of positive change at construction sites
- Implementing systematic Safety and health auditing

Despite the non-availability of exact statistics and substantial underreporting, informal means of information revealed that the number of deaths, injuries and material damage in the road construction projects in Ethiopia is estimated to be high.

CHAPTER SIX: DATA COLLECTION

6.1 Data Collection Methodology

For the purpose of developing a model for improving the performance of road construction projects in Ethiopia, the employer (ERA) and other involved construction and consulting firms were the main target of respondents. Government and non-government organizations related with the objectives of the study were also visited and important persons interviewed.

Senior staffs of the employer organization, consulting and construction firms were contacted; through them some key project participants of each firm were identified and contacted. A list of completed road project documents were revised in detail, government and other several funding institutions' tender guidelines and records, different Standard Bidding Documents[10] (SBD), i.e. IDA, ADB, several types of journals were also reviewed, and other relevant institutions like Central Statistics Authority (CSA) and Commercial Bank of Ethiopia (CBE) were also visited for the purpose of gathering significant information and for data crosschecking purposes. A summary of the organizations included in the study is shown in Table 6.1.

Table 6.1 The study population as a stratified category

Study population	Represented organizations	Purpose for stratified categorization
Project employer	ERA	The case study was conducted in this organization
Project sponsors & Regulators	Road Funds Authority, local and foreign financers, public regulatory bodies	Their involvement of sponsorship entailed regulatory purposes largely for accountability
Project Doers or Suppliers	Consultants or contractors	These are involved during the design and implementation phase of the project.
Other Interest Groups	Business and professional Associations.	To consider views from professionals, the community or stakeholders.

[10] Each funding institution has its own Standard Bidding Documents that shall be followed by the employer and the winner contractor.

The questionnaires as part of the data collection instrument were used during the research; significant questions were developed by the author and some were adapted from those questionnaires previously developed by ERA for similar tasks; the questionnaires were adapted to serve the purpose of the study and were tested for their validity and reliability by first distributing a sample of 13 questionnaires, after then feedbacks were gathered and comments accepted prior of mass distribution.

In total 60 questionnaires were delivered to 10 selected organizations (see Table 6.2) and each respondent was given 15 working days to complete the questionnaire. Since this season[11] was a peak time for construction works almost all the professionals in all construction and consulting firms were sent to their respective project sites, which made difficult to locate them for the interview and questionnaire filling purposes, however, the author used several ways to send the questionnaires to the sites where these professionals were found. Reminders were sent to those who did not respond within the agreed time, and an additional 10 days was given to them to return the completed questionnaires. Finally, it took as an average a month and half waiting for the responses of those respondents from far places.

Table 6.2 Distribution and responses of questionnaires

S/No.	Name of the company	Status of firms	No. of questionnaires		In %	
			Distributed	Returned	Distributed	Returned
1	ERA	Employer	24	16	40.0	50.0
2	SUR	Construction firm	5	1	8.33	3.12
3	BERTA	Construction firm	5	3	8.33	9.38
4	TCDE	Consultant	4	2	6.67	6.25
5	SATCON	Construction	4	2	6.67	6.25
6	SUNSHINE	Construction	4	2	6.67	6.25
7	CRBC	Construction *	4	2	6.67	6.25
8	Dragados	Construction *	4	3	6.67	9.38
9	China Wanbao	Construction *	3	1	5.0	3.12
10	Keang Nam	Construction*	3	0	5.0	0
	Total		60	32	100	100

*Foreign firms

[11] From January to May the rainfall is generally lower, therefore all the firms were busy expediting the road construction on the sites before the rainy season approaches.

Note: The criteria for the selection of these firms included in the study was; selecting those construction firms who had worked for the past 10 years with ERA and were involved in more than a total of 200 Km of roads within the specified time.

Of the 60 surveys sent to individuals, 32 responded. Besides, some of the questionnaires were not answered according to the instructions given for each section. This response rate 32(53.33 %), which is significant but the number could have been a little bit high if the distribution of the questionnaires was limited only within the periphery of the capital city. But for the comprehensiveness of the study an effort was made to involve those professionals currently engaged on supervision in remote site areas but the effort was not futile.

Table 6.3 Research instruments employed during the study

Instrument	Purpose	Strength	Limitations
Questionnaires	Include samples over wide sites at remote areas and get access to many participants	Cheap and appropriate to include large samples	Its response rate and weak for detail information
Interviews	Getting comprehensive information with regard to the perceptions, experiences, attitudes and values of stakeholders	Targeted and insightful	Bias from instrument, respondents, and incompleteness
Key informants	Assess patterns of stakeholders relationships including informal practices	Real, targeted and contextual coverage	Changes in behavior, observer bias and incompleteness
Documentations	Assess existing regulations and practices,	Broad coverage, unobtrusive, and stable.	Selectivity, Access, and Report bias

6.2 Measures

The participants were requested to respond all of the questions provided according the detailed instructions given for each section; furthermore, they were given a brief direction on how to proceed -at least for those participants in Addis[12]. For the purpose of modular analysis, the questionnaire was divided into four main sections: section I is concerned about the general

[12] The capital city of Ethiopia, which is formally known as Addis Ababa, meaning "new flower".

information of the organization's practices, containing 32 questions; section II covers the survey of road construction project poor performances (2 questions with a matrix table containing nine poor performance factors against three variables); section III covers the survey of causes and possible solutions to the project delay and cost overrun problems, containing 12 questions; and finally section IV covers dispute recognition, avoidance and resolution techniques containing 12 question, adding up 58 questions.

For those respondents not familiar with the questions or have no any idea about the situation, they were given a chance to answer "I don't know", such an answer was treated as a missing value; and those questions that were not responded at all were also considered as a missing value. The respondent's answers were regarded as invalid if two answers were indicated. Finally, those returned questionnaires considered as valid were analyzed in detail.

CHAPTER SEVEN: ANALYSIS AND DISCUSSION

7.1 Analysis of the Data

Based on the result of the questionnaire survey, Table 7.1 summarizes the profile of the companies and the professionals involved in the study. Among the companies who participated in the study 93.75 % of them have more than 10 years of experience, which implies that companies involved in the study have a vast of experience in the area , which implies that the information forwarded could be important as required in the study. With regard to the working experience of the professionals involved in the questionnaire survey 46.88% of them have more than 10 years of experience, among which 50% of them have participated in more than 10 road construction works. This combination of figures regarding the participants is of great value for the reliability of the information obtained from the questionnaire survey.

Table 7.1 Working experience of companies and professionals involved in the questionnaire survey

	Experience of professionals' (years)	**In %**	**Number of the road projects participated**	**In %**	**Company's experience**	**In %**
< 2	**3**	**9.37**	**1**	**3.13**	**-**	**-**
2 - 5	**5**	**15.63**	**3**	**9.37**	**-**	**-**
6 -10	**9**	**28.13**	**11**	**34.37**	**-**	**-**
> 10	**15**	**46.87**	**16**	**50.00**	**30**	**93.75**
Not specified	**-**	**-**	**1**	**3.13**	**2**	**6.25**
Total	**32**	**100**	**32**	**100**	**32**	**100**

Furthermore, the position of the respondents within the company was also analyzed (see Table 7.2). Among the respondents, 53.12 %, 25 %, 15.63%, of them were found to be experts, middle managers, and top managers respectively in their respective companies, which implies that they were more or less involved in the planning, monitoring and decision making

activities, that makes the information significant to the study. It was revealed also that two (6.25%) of the respondents didn't specify their position.

Table 7.2 Position of respondents within the company

Position	Number of professionals	In %
Top management	**5**	**15.63**
Middle management	**8**	**25**
Expert	**17**	**53.12**
Not specified	**2**	**6.25**
Total	**32**	**100**

Table 7.3 Performance of completed projects. (Cost is in millions of Ethiopian Birr)

S/N	Type of work	Firm's Origin	Planned Km	Planned scheduled time(Months)	Estimated cost	Actual elapsed time	Actual expended cost	Schedule difference	% of Time overrun	Cost difference	% of Cost Overrun	Financer(s)
1	Construction	Local	167	36	193	48	263.000	12	33.33	70.000	36.27	GoE+ WB
2	Construction	Local	141	36	68.4	65	68.400	29	80.56	-	-	GoE
3	Construction	Local	91	30	198	48	265.670	18	60.00	67.670	34.18	GoE + WB
4	Construction	Local	216	36	69.3	72	69.300	36	100.00	-	-	GoE
5	Construction	Local	212	36	78.4	88	78.400	52	144.44	-	-	GoE
6	Construction	Local	188	36	64.6	88	64.600	52	144.44	-	-	GoE
7	Construction	Local	58	36	105	56	216.800	20	55.56	111.800	106.48	GoE + WB
8	Rehabilitation	Foreign	186	60	274.5	82	512.580	22	36.67	238.080	86.73	GoE + WB
9	Rehabilitation	Local	41	36	88.2	54	156.000	18	50.00	67.800	76.87	GoE + WB
10	Rehabilitation	Foreign	146	30	260.8	39	356.500	9	30.00	95.700	36.69	GoE +WB
11	Rehabilitation	Foreign	136	30	196.5	39	278.000	9	30.00	81.500	41.48	GoE + Japan
12	Rehabilitation	Foreign	161	36	240.4	57	298.500	21	58.33	58.100	24.17	GoE + Japan
13	Rehabilitation	Local	187	36	274.4	45	412.800	9	25.00	138.400	50.44	GoE + Japan
14	Rehabilitation	Foreign	342	36	426.9	53	589.530	17	47.22	162.630	38.10	EU
15	Rehabilitation	Foreign	263	36	310	48	386.000	12	33.33	76.000	24.52	GoE + WB
16	Upgrading	Foreign	220	36	337.4	46	433.400	10	27.78	96.000	28.45	GoE + WB
17	Upgrading	Foreign	208	36	409.7	59	489.000	23	63.89	79.300	19.36	GoE + WB
18	Upgrading	Local	127	30	449.9	47	559.700	17	56.67	109.800	24.41	GoE + WB
19	Upgrading	Local	117	36	215.9	58	274.600	22	61.11	58.700	27.19	GoE + WB
20	Upgrading	Local	120	30	223	40	243.000	10	33.33	20.000	8.97	GoE + WB
21	Upgrading	Foreign	220	36	348.9	49	512.700	13	36.11	163.800	46.95	GoE + WB
		Total	**3547**	**750**	**4833.2**	**1181**	**6,528.480**	**431**	**1,207.78**	**1,695.280**	**711.23**	
		Average							**57.51**		**33.87**	

7.2 Performance Analysis of the Case Study

In this research work, in order to evaluate the performance of the road construction projects data has been gathered from the archives at the employer head office. The data gathered (Table 7.3) has been stratified in several ways which facilitates the detail analysis of the data from different perspectives, that help the identification of the major problems causing the poor performances observed on the road construction projects. The proportion of the project works analyzed in this study assist analyzing whether there was some kind of association between the performance measure variables and the type work done, a total of 3547 kilometers of work were included in the analysis, distributed among different types of work as shown in Figure 7.1.

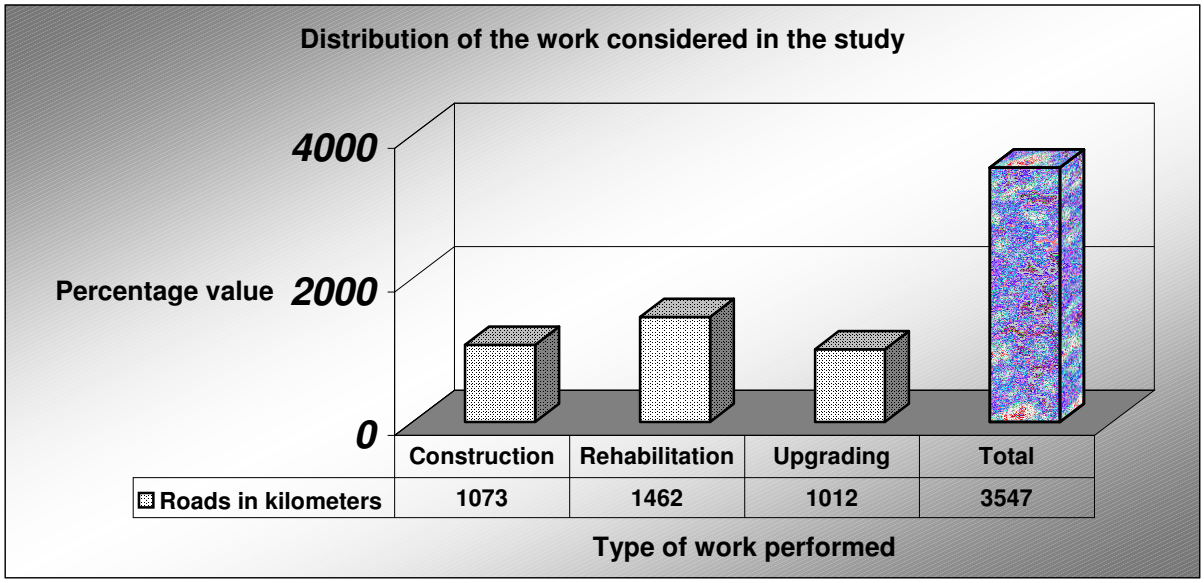


Figure 7.1 Types of works considered in the study

From the study it has been found that performances of the majority of the projects under consideration were unsatisfactory with an average of 33.87% of cost overrun and 57.51 % of time overrun observed in 21 projects considered in this study. This may sound simple, but for the Ethiopian construction industry, it is a serious and at the same time complex. This is compounded when one considers the alarming drop of the coffee[1] in the international market,

[1] Coffee accounts for about two-thirds of all exports and is the most valuable foreign-exchange earner. (Encarta Microsoft, Encyclopedia 2003).

which has resulted in a drastic decline in revenue generation and, consequently, a lower level of government spending and economic growth. The questionnaire survey section I question 25 reveled that 84.34 % of the respondents believe the lack of managerial experience caused managements to not complete the projects within the estimated time and budget. The time and cost performances observed in the different work types (Figure 7.2) shows that the Construction work showed the highest percentage of the time overrun with 88.33 %; this is because all the road Construction[2] works considered in the study are undertaken by domestic construction companies where the resource and capacity related problems are natural (it is also demonstrated in Figure 7.3). However, the time overrun was observed in all types of works regardless of the type of work performed. With respect to cost analysis, the Rehabilitation type of works show the highest percentage of cost overrun with 47.37 %, while the Upgrading and Construction works performance was 46.48 % and 25.27 % respectively.

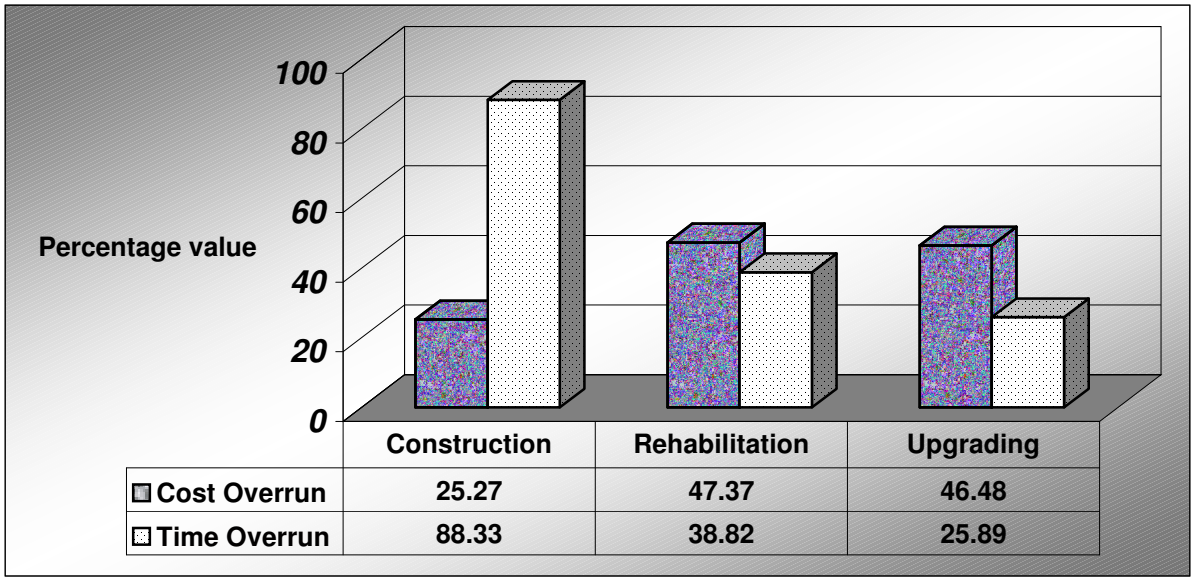


Figure 7.2 Performance of Time and Cost overruns by type of work

When making a comparison between domestic and foreign construction firms, those projects handled by foreign firms showed relatively better performances in both cost and time variables (Figure 7.3). The time overrun observed in local firms is 70.37 % while foreign firms' overrun

[2] In this analysis the term "construction" refers to the construction of new roads. Which is different from Upgrading and Rehabilitation works.

was 40.37%. With regards to the cost overrun the foreign firms show the highest with 34.49% while the local firms performance was 30.4%. The fact that the cost overrun of the local contractors was below the foreign firms doesn't mean that they have performed better than their counterparts; it was because the four projects handled by local contractors were turnkey (which does not indicate whether there is a cost overrun or underrun) type of contracts; had these contract types not been included in the analysis the cost overrun for the local firms could have been raised to 45.60%, higher than foreign firms.

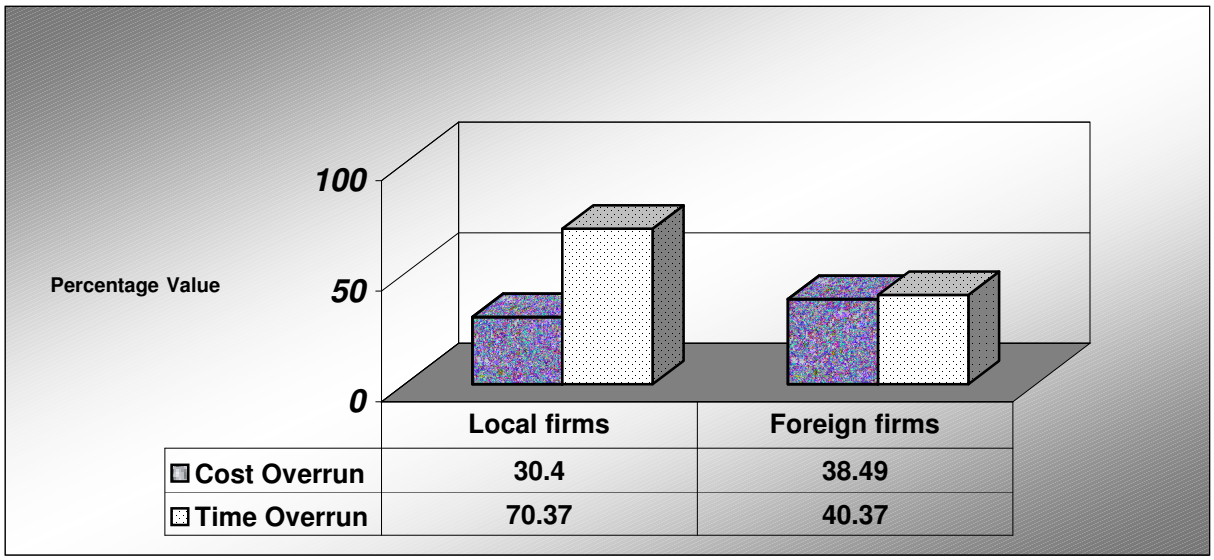


Figure 7.3 Performance measure of the local and foreign construction firms

Finally, the performance of the local contractors was analyzed against the types of works they had accomplished. This analysis shows that the local construction firms have mainly participated on Construction type of projects (58.33%); while their involvement in Upgrading and Rehabilitation works was low; 25% and 16.67% respectively. The reason that most of the Upgrading and Rehabilitation works were handled by foreign construction firms was that the strict specification and requirements demanded by the foreign financers and assistance donors which limits the locals firms' ability of competing for these types of works.

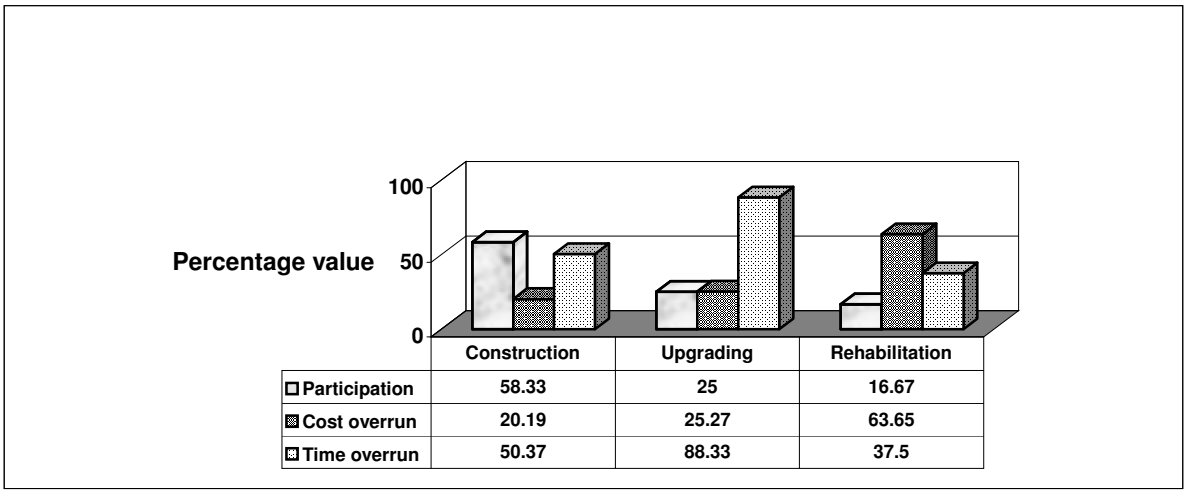


Figure 7.4 Analysis of the local contractors performances

Quality, which is another important performance parameter that is commonly used to evaluate the performance of construction activities, was not analyzed in depth here because of the complexity of gaining relevant and adequate information from the stakeholders involved, and its nature of being subjective doesn't allow itself to be analyzed it with only quantitative figures gathered from archives. But internally the process assumes that there is a certain quality level the project shall satisfy[3]; therefore when certain kilometer of road is completed the then employer accepts the portion of the road if and only if the pre-agreed standards were met. Therefore, this study assumes that those projects classified as completed, have met the required specification and/or the project is waiting for final handover.

Of the 21 road projects considered the participation of the local construction companies was 58.33 %, 25 %, and 16.67% in Construction, Upgrading, and Rehabilitation of works respectively. It was also found that they showed their lowest performance of Cost Overruns in Rehabilitation type of work with 63.75 % and the lowest performance of Time Overrun in Upgrading type of work with 88.33 % overrun. It is observed that the cost and time overruns are present in all types of works considered. In the following section the study will focus to find out the major contributors of the cost and time overrun problems that most frequently cause the low project performances. Therefore, analysis of the causes will also be carried out and finally a package of solutions to overcome these problems will be devised.

[3] This refers to the conformance to the specification that is clearly stated in the contract agreement.

7.3 Cost Overrun Analysis

Though there can be several ways of measuring the performance of the projects using the cost variable, the cost overrun is the one selected in this study that is relevant with the objective of the study. During the research work I have learned that cost related information were difficult to get; getting information from the employer's head office as well as at the contractor's office, one needs to follow a tedious procedures and routing from one functional unit to another, sometimes ending up without getting it that hinders the analyst arrive the right conclusion. Thus, implementation of the Project Management Information System (PMIS) discussed in chapter 5 section 5.13, would give a better advantage of all in need of integrated and organized information for further usage.

The cost overrun was present to all types of projects regardless of whether they were handled by local or foreign construction firms. It was observed also that the size (km of road) of the projects was not a factor for cost overrun. Therefore, a conclusion can be made that the cost overrun occurs regardless of the size of the project, the type of work performed, and whether the contractor was local or foreign, with the only distinction, that the local firms' average cost overrun was 45.60%, ranging from 8.97% to 106.48 %.

Questionnaire survey, section II question 1 revealed that the respondents ranked the Cost overrun as a 2nd after the Delay, as the most frequently occurring factor in road building projects; it was also observed that the cause that of Cost overrun on projects; the Design Changes and Disputes were ranked as 1st and 2nd respectively. Furthermore, discussing on the issue with the key informants at the employer office it was observed that the claims and dispute resolution techniques employed by the employer were not given due attention, the delay in approval of design changes were also proven to be occurring frequently causing significant loss of money, causing the valuable resources remain idle. Section II; question 9 of the questionnaire survey also revealed that 71.87% of the respondents agree that there is a strong and proportional relationship between the cost and cost overrun.

Furthermore, from the questionnaire survey section III, question 12 the respondents identified the following major factors of the cost overruns ranking them in their order of priority; these factors are summarized in Table 7.4.

Table 7.4 Result of the factor analysis from questionnaire survey

Factor	Rank
Poor const estimation	1
Frequent disputes	2
Poor design	3
Price escalation	4
Price escalation	5
Late arrival of goods	6
Adverse climate conditions	7
Change in legislation	8

7.4 Time Overrun Analysis

The study demonstrated that the time overrun observed in the local construction firms was much higher than those observed by foreign firms. From the key informants and interviews it was concluded that the Time overrun generally occurs at the project implementation stage (actual construction phase), thus, it can be attributed to the inadequate level of managerial experience they possess and the low level of implementation of the project management tools, techniques and principles before and during the project implementation phases.

In this study the Time overrun is defined as the lapse between the agreed completion date and the actual date of completion of the project. It is also important to note that time overrun is more prevalent in government-sponsored projects where direct award contract is exercised with the intention of saving time lost by “long tendering process”, but in reality they end up with highest percentage of time overrun. It was also observed that with government-sponsored projects the level of control was not similar as those of the projects financed by foreign organizations, the former was too loose creating a fertile ground for cost overrun and other related poor performances. On the other hand pointed out that the involvement of the project

sponsors in the case of assistance-financed projects, were indicated to be beyond necessary and dictating project employers too much. Both of these extreme cases of practices involvement were not productive in the healthy execution and control of project management activities. Therefore, adequate control mechanism shall be clearly discussed ahead of any contractual agreement with each type of stakeholder.

Analysis from the gathered data shows that average time overrun was 57.51 %; the interview result also revealed that the relative contributions of the employer, contractor, government regulations, and others to the time overrun are 54%, 21%, 14 %, and 11% respectively (Figure 7.5). This shows that the employer's charge arises from i. Lack of prompt approval of design changes and decision-making, ii. Not honoring payment certificates for completed works and when due, iii. Timely resolution of claims and disputes iv. Not willing to pay for material fluctuations.

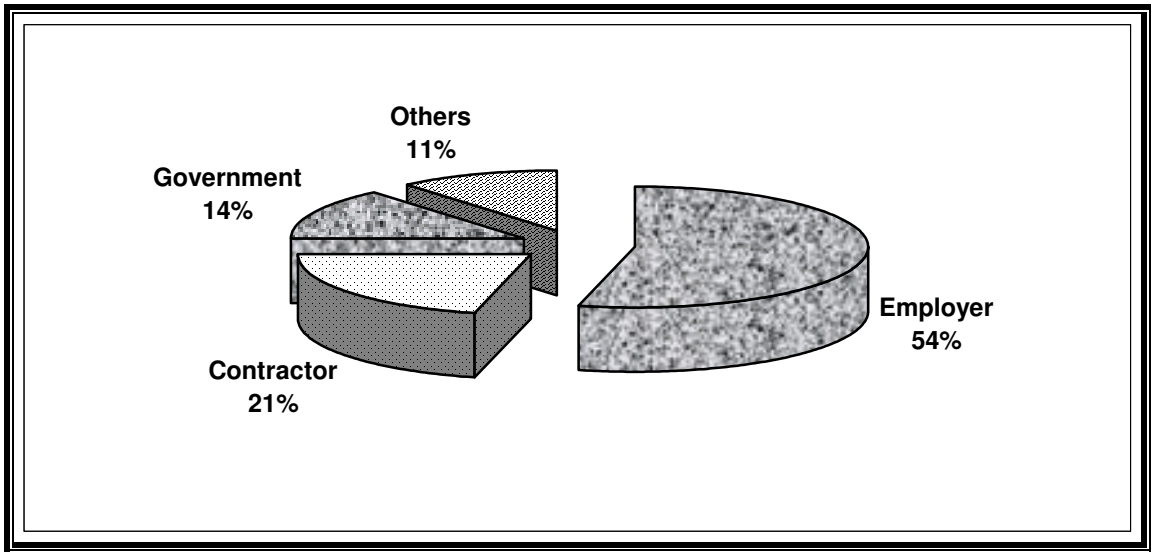


Figure 7.5 Distribution of the responsibility for time overtime

Contractors on the other side, show some difficulty in honoring the pre-agreed contract deadlines and use shortages of resources among others as an excuse, they share 21% of the blame as confirmed from the questionnaires and interviews results was arising from i. Incompetence, ii. Delays in project execution, iii. Low performance of work because of lack of the required skills, iii. Poor project management tools and techniques employed, low level of relationship between the management and labor, iv. Inadequate teamwork, v. Lack of spare

parts for unique and indispensable machineries and equipments on sites, vi. Inappropriate adaptation of technology and method; are the major factors leading to time overrun in the road construction.

Inclement weather condition, stability within and between the regional governmental states, border conflict with neighboring countries, wrong attitude, frequent change of government policies, are factors identified also as the causes for the time overrun.

7.5 Cause and Effect Analysis

The Cause and Effect analysis in the study was employed here to identify the causes for the poor performances observed in both of the performance measure variables (Time and Cost overruns) considered in the study.

Thus making a clear demarcation of the causes of the time overrun and cost overrun is almost not an easy task, because some factors that are the causes for the time overrun can be at the same time the causes for the cost overrun of the project. But in this study two different diagrams are used to make a detail analysis of the causes for further development of the performance improvement model. It shall be mentioned that some overlapping causes may be the factors for both of the performance measures; it was mainly because of the direct association of the time and cost factors on a given road project situation. The cause and effect diagram for Time Overrun and Cost Overrun is shown in Figure 7.6 and Figure 7.7 respectively. From the analysis of the cause and effect diagram, a model is developed to improve the low performances observed in the road construction projects in Ethiopia.

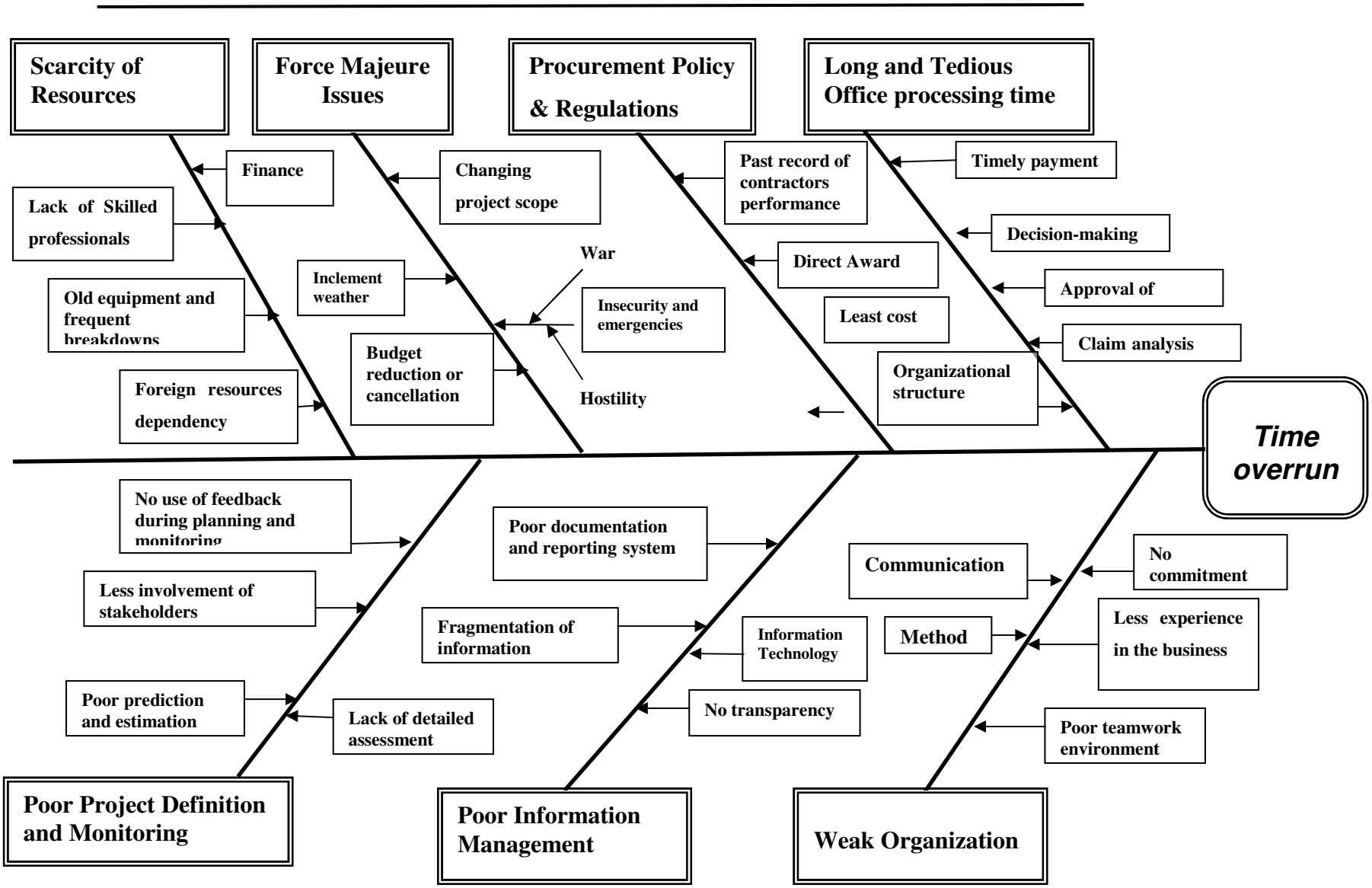


Figure7.6 Causes and Effect diagram for Time Overrun

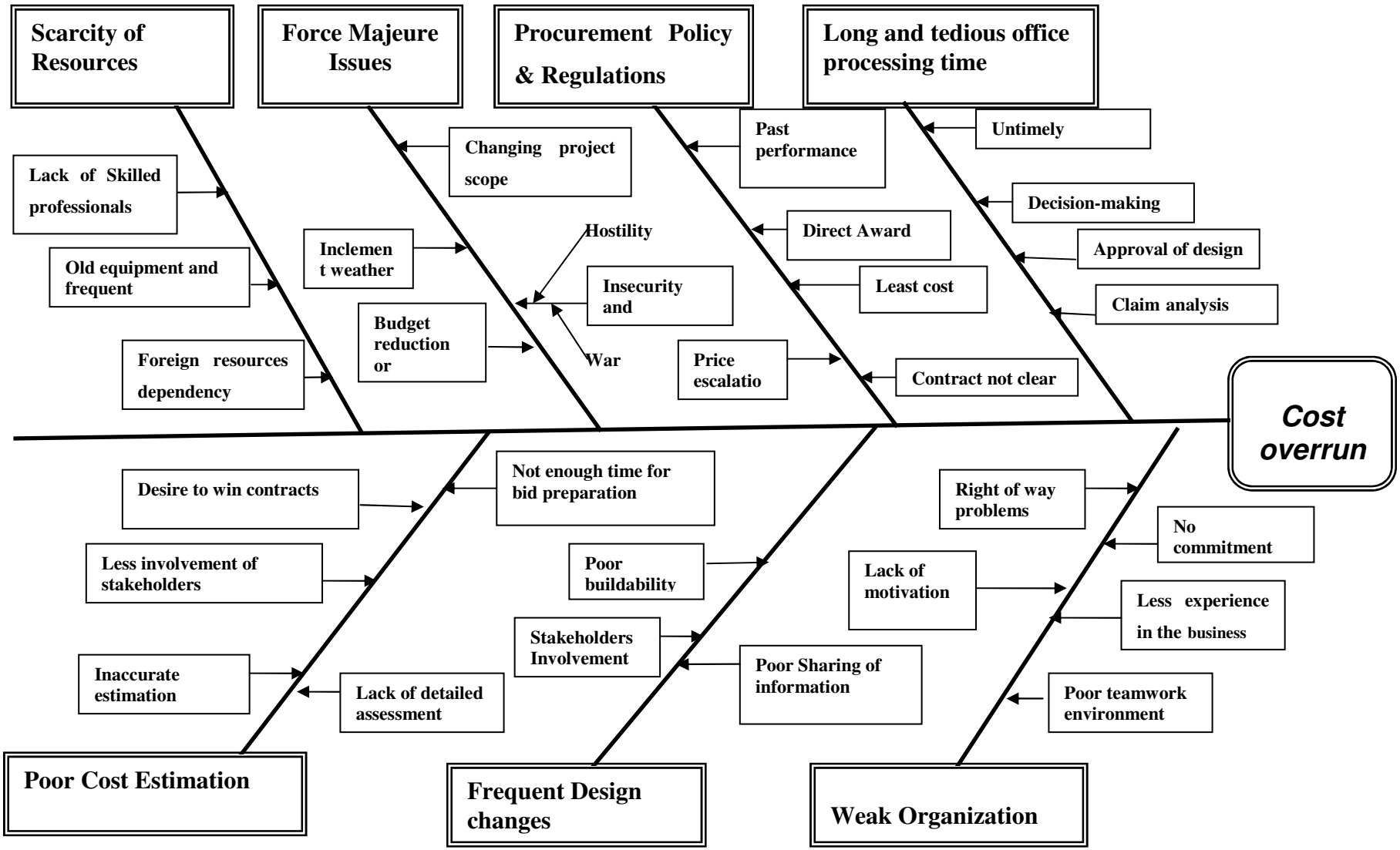


Figure 7.7 Cause and Effect diagram for Cost Overrun

CHAPTER EIGHT: PROPOSED SOLUTIONS AND MODEL DEVELOPMENT

8.1 Proposed Solutions

From the collected data, the result of the interviews, the questionnaires and other relevant sources of information used in the study, it was discovered that the performances of the road construction projects were found low on both of the performance measures (Time and Cost overrun) considered in the study. The causes for the poor performances were also identified through the use of a Cause and Effect diagram that was the basis for the development of the model for performance improvement.

The solution proposed in the study is organized in such a manner that the following assumptions were taken into consideration:

- By devising a solution for the core problems identified in the Cause and Effect diagram, the effects (Time and Cost overruns can be minimized /eliminated);
- Since the time and cost have direct association (as confirmed by the questionnaire results), the causes for time overrun have in most of the cases impact on the overrun of costs at the same time,

Procurement regulations. In most of the cases the road construction projects in Ethiopia are governed by the financer's policies and regulations. For instance if the project is sponsored by some foreign financer then the entire project management process is abided by the policies, regulations and procedures of that particular financer. On the other hand if the project is fully financed by the federal government, then the project is fully governed by the federal government's policy, regulation and procedures.

Absence of clear statements about the types of construction materials often leads to disagreements. Contractors stated[1] that many materials in the country did not have standards and this was a big problem.

In both cases the policies and regulations will have effect on the performance of the construction firms. Therefore, the strict policies by different foreign financers that limit the participation and competitiveness of the local companies shall be negotiated with the financers to be more flexible so that local companies can be involved and grow.

With regard to locally financed projects, the government can reconsider the policies to promote the complete competitive environment as the current market policy demands. The direct award policy, which deems the competitive environment, will harm the growth of the local private companies capabilities in this important sector. Another important factor is the price escalation of the materials used in the road construction. As the information obtained from discussions and the key informants in ERA and other construction companies revealed, the price escalation was not reconsidered in the contract agreements. The contract document lacks its clarity, causing more disputes that damage the relationship between contractors and the employer. In the relationship between contractor and owner the contract plays a great role, Kenneth G.Wolf; it is a key to a successful owner-contractor interface. What factors contribute to a good contract and, correspondingly, to a high project-success ratio? Shall be the focus of those project participants.

Today the market is more dynamic than ever before, with the globalization and Common Market for Eastern and Southern Africa (COMESA) are entering into effect, the market becomes more challenging for all types of businesses. The construction materials accounts to about 40-70 % of the contract price in Ethiopia, causing serious damage for contractors if price escalation is not properly considered. The other thing is that international contractors were allowed to enjoy such provisions; meaning that the cost/price escalation affects local contracts only. This partial enforcement of the regulation makes local contractors still remain

[1] This claim of contractors was raise in the meeting held with the Ministry of Capacity Building, (Reporter, a local newsletter, English version, on Wednesday, June9, 2004)

weak. If the project undertaken is of long duration, the effect would be more severe. Therefore, the procurement policies shall be reviewed so that considerations with regard price escalation are reviewed and included in the contract for better advantages of the contractor and the employer as well.

Long and tedious office processing time. As observed from the questionnaire survey and from the data gathered, the office processing time in the employer's office was longer than necessary. It was mainly associated with the low number of professionals in office as compared to the projects handled by the employer, the inadequate level of information technology system they possess which slows the reporting of project activities and performances, obstructing fast decision making, the low level of communication between different divisions integrating the employer organization, etc. It was also discovered that the office processing time has great impact in the time overrun of projects, causing the cost overrun as well, since the labor and machineries were paid without production, while waiting for some decision from the employer office. The payment for completed works is more often delayed –since the domestic contractors are financially short this may seriously affects their performances.

Another most unfavorable cause for the prolonged office processing time was the claim analysis. The claim arises when one party to the contract has suffered a detriment for which the other party should compensate that party (in our case the employer). Therefore, a construction claim is an assertion of any demand for compensation from two major categories internal and external of the project organization. If that claim is not solved on time, then it turns out to be a dispute. Disputes are the unwanted and unnecessary aspect of any project which leads to a series of problems that hinder the project from success; the bad thing of dispute is that they are inherent in most of the projects. The sources of major disputes in the road construction projects considered in this study (questionnaire survey, section IV, question 1) are identified and ranked as: (1) ambiguous and unclear contract documents; (2) poor project estimation at the beginning; (3) frequent change of design and (4) self-serving posture of disputing parties.

Questionnaire survey, section III, question 12 revealed that the delayed claim analysis was found to be the main reason for time and cost overrun in road construction projects in Ethiopia. Based on the findings, the claim analysis by the owner was investigated, and the following was observed. The contractors' written claim application is submitted to the employer within the specified time on the contract, including the reason for the claim and the amount requested, and then the employer was expected to process the claims on time and make some decision. But the process of claim analysis was observed to be slow and not well structured; and no formal procedure[2] were established at the employer's office. Causing the contractors to wait for some decision from the employer's office to proceed on the project.

Scarcity of resources. The scarcity of resources is not only a problem of the road construction companies, but also the employer faces greatly in its endeavors. The road construction projects by its nature are capital intensive, requiring large number and heavy equipments and machineries, highly skilled professionals to manipulate them, and professionals in project management aspects.

On the other hand, the employer (ERA) being the responsible body of administering of all the trunk and link road projects in the country lacks enough professionals to properly discharge its responsibilities; especially professional activities demanding high skill such as international contract administration, project planning, monitoring, negotiating, and other key positions are weak. With this respect trainings were arranged by Ministry of Capacity Building in several occasions but the trainings did not addressed the needs of the contractors (Reporter, Wednesday June, 2004).

The researcher personally tried to assess the impact of the brain drain in ERA and other companies considered in the study. The result was very frustrating, either through the scholarship, or other means exodus the number of professionals migrated in recent years was very high and is increasing year by year.

[2] No formal responsible committee or procedure was established in ERA to review claims of the contractors.

Another limiting factor of the performance of the local road construction firms is the scarcity of equipments and machineries. The equipments and machineries employed by most of the domestic road construction companies were old without adequate maintenance. Besides, the spare parts availability on sites leads them to frequent breakdowns; forcing to stoppage of the work execution, finally causing the delay of project. This is strongly linked with the financial capacity of these companies that will be discussed on the improvement model.

8.2 Model development

This section mainly deals on the issues related on how to improve the low performances observed on road construction projects, in general, solutions proposed to improve the performances of the construction companies is not a certain entity's task; rather it involves the efforts of all stakeholders. The government as a policy maker and regulatory body; the construction and consulting firms as executors and suppliers of the projects; the project employers as the responsible bodies of undertaking of projects; the project financers as the sponsors; the educational institutions as provider of the necessary required skilled and professional manpower; the professional and business associations of different types for their involvement in the study and investigation of the improvement actions in the road sector; the road users, and the community at large have their own share in the improvement process.

This model intended to improve the performance of the road construction projects, has been categorized under four major improvement areas: Internal to the construction company which the researcher has designated as "Project management system", those that are not within the control of the construction firms but are within the scope of the government, are designated as "Government Policies and Regulations" and "Capacity Building"; and finally those that are beyond the government scope, are classified under "Environment" category.

The improvement action taken in each of the categories will improve the performance of the domestic construction companies. At the same time the improved performance of the construction companies will have effect on each categories and each categories have their own influence upon another category at the same time as described in Figure 8.1.

Capacity building. As demonstrated in the study the capacity of the domestic construction companies is weak, therefore, a major task of improvement should be accomplished. The improvements can be done in the following areas:

Training: Institutions to support the road construction project industries to secure skilled and professionals shall be established at national level. Upgrading the Alemgena training center to higher-level educational institution so that other road construction companies also may have a chance to train their workers will in part improve the capacity of the workers required at medium level.

Access to financial institutions for loan: Since, financial shortage was the main one in these firms the major improvement deserves to be accomplished to strengthen them financially.

Working jointly with international firms: Those international road construction companies working in the country are highly capable of managing the road projects; they possess long years of working experience, strong financial capability and possess high technology that the sector requires. Above all they possess high level of project management skills. By creating a chance to local construction companies the transfer of technology and method of construction and the project management skills as well.

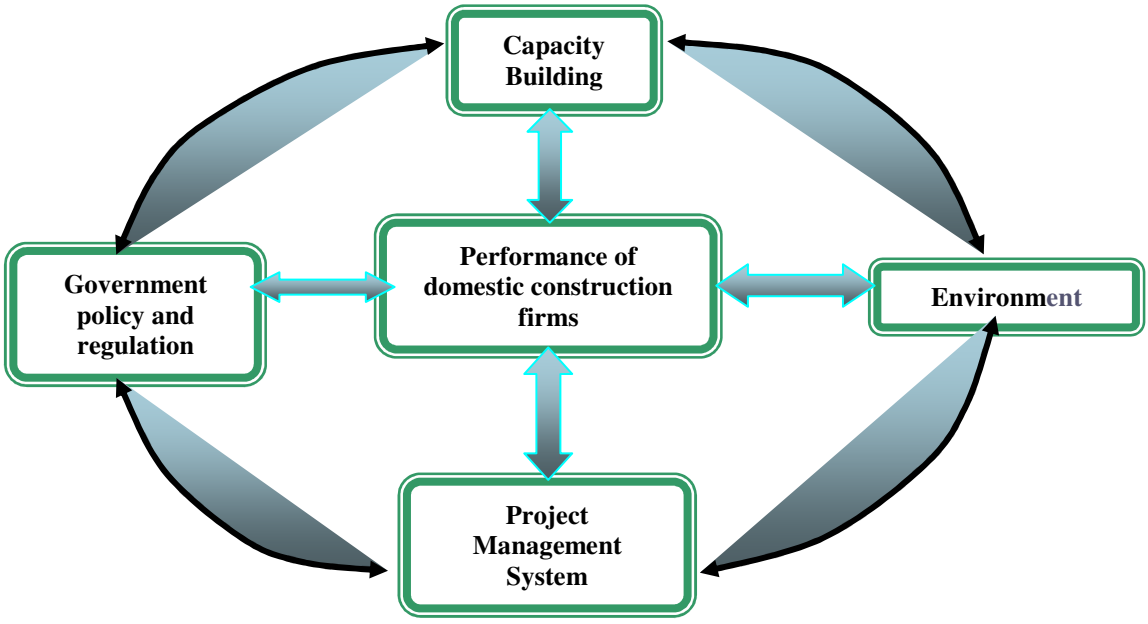


Figure 8.1 Model for performance improvement of road construction projects.

Fragmented works: The local construction firms have no enough capacity to undertake large projects requiring high resources. But the trend of breaking the large project into considerably small projects so that the local companies have a chance to participate in projects financed by foreign institutions may help to build their capacity.

Project management system. The project management system implemented in the individual company includes all the processes, related with the planning, scheduling, executing and monitoring project activities. These project management aspects that are crucial to the firm that if properly considered, improve the performances.

Training: continuous training for workers and professionals engaged in project management functions is vital. Trainings shall be continuous and tailored to address the needs of the individual companies and working areas. The training program given to carpenters, painters and masons are also important aspect of training area that improves productivity.

Project management tools and techniques: Today there are more project management tools and techniques if properly implemented are of high value. But construction companies cannot pick up any tool and try to implement it to their company, results in negative effects. With proper selection and adaptation of these valuable tools and techniques, companies may be benefited considerably.

Motivation: The motivation of workers shall be given emphasis to encourage peoples to improve their skills and increase their capacity of performing jobs. In this case, motivation refers in providing the construction workers the high calories that demands the work nature. Since the workers' wage and salary is minimal it becomes difficult even to by adequate food for survival, this eventually decreases the productivity

Cost control: The state-of-the-art cost controlling mechanism in the project management organization shall be implemented to secure the proper control of costs. The cost control activity starts at the estimation stage, therefore, proper cost estimation system is of grate value for further controlling.

Uses of software: Software are important in facilitating works on projects. Project planning, scheduling, controlling and reporting activities are easily handled with lower effort and high accuracy. Therefore, the company must invest in the recent and advanced software available (critical adaptation of the software to the companies need is also vital).

Government policy and regulation. Every effort done by individual company without the support of the government may result in failure of that specific project. Therefore, government policies and regulations are of high value for the success of any improvement efforts. When government designs construction sector related policies the following points ought be considered:

Consistency and rationality: With regard the policies and regulations, the study revealed that the changes in the policies were frequent and with no previous need assessment and investigation. This indicates that policies regarding the construction are made from the immediate needs that arises from the problems appeared instantaneously (reactive management). Therefore, by in depth investigation of the problems with stakeholders and professional associations involved, sound and long last policies benefiting all involved parties can be designed.

Direct award system: Today the market demands a highly competitive environment. Private companies need to have a complete chance of access to compete for projects. The government supported construction firms must have equal bases to compete for projects, so that the culture of competition may be progress.

Strengthening financial capability: the policies and regulations shall be aimed to solve the financial problem faced by all construction companies. Assessing all the means of providing financial access to the construction companies so that capacity, technology, and manpower related problems are minimized.

Environmental challenges. Many pressures and challenges (technological, economical, political, and social) come from the environment. Then on how to adapt to a challenging situation becomes the task of the individual companies creativity and the capability to manage the road construction project managers. Their style of management and the tools and techniques used shall also be critically examined before implementation -they shall be adapted to the country and company's situation. Therefore, the company must remain dynamic to cope up the changes dictated by global situations, and the government also shall adapt its position in line with the current situations so that all the stakeholders become not affected by the changes from external forces.

8.3 Development of Project Crashing Software

The use of project management (PM) software as a tool for managing and organizing of works has grown and continues to grow at a rapid rate in all industries. The construction industry is one in which PM software usage of particular importance. As heavy users of PM software, professionals in the construction industry have a strong interest in improving the tools and techniques available for better planning and control of projects.

From the interviews conducted over 6 construction firms (the majority were local firms), confirmed that they were using some sort of computer application software, but responded that they were not provided training on how to use the project management software. But, they believe that the PM software facilitates the efficient run of the construction activities including the project-management process. Among the PM software frequently used (by few group of respondents) are project management 98, and further upgraded to 2000, Primavera, and currently introduced software called ProMis (Project Management Information System) are mentioned, which they don't contain a crashing of projects.

The manual computation of the CPM and PERT, the finding of the critical path and crashing of the project duration with optimum cost yields accurate solution, but it involves a considerable amount of arithmetic and data recording effort. If the project consists of hundreds and thousands of activities, manual computation not only may lose its accuracy but also

become impossible to attain accurate solution of it; therefore, the advantages of using software for crashing of networks can be of great value, which some of them are mentioned below:

- Accurate and optimum solution is possible;
- Less time consumed for computation;
- Improved productivity of user;
- Improved communication between stakeholders and project teams; and
- Documentation and report compilation is made easier and fast.

The crashing algorithm

The cost slope indicating the increase in cost per unit reduction in time is defined as

$$Cost\ \ Slope = \frac{Crash\cos t - Nrmal\cos t}{Normal\,time - Crash\,time} = \frac{Cc - Nc}{Nt - Ct}$$

The cost slope represents the rate of increase in the cost of performing the activity per unit reduction in time and is called Cost/time trade off. It varies from activity to activity. The total project cost is the sum total of the project direct and indirect cost.

The following are the cost for the different activities by using the formula.

Step 1. Find the normal critical path and identify the critical activities

Step 2. Calculate the cost slope for each activity by using the formula

$$Cost\ \ Slope = \frac{Crash\cos t - Nrmal\cos t}{Normal\,time - Crash\,time}$$

Step 3. Rank the activities. The activity whose costs slope in minimum is to be ranked 1, and the next minimum as rank 2, and so on. i.e. the ranking is followed in ascending order of cost slope.

Step 4. By crashing the activities on the critical path, other paths also become critical called parallel path.

Step 5. Find the total cost of the project at each step.

Step 6. Continue the process until all the critical activities are fully crashed or no further crashing is possible.

Taking into consideration the advantages, the software used to crash the network is developed, and will have the following features (see Appendix C):

- Interface with other application programs i.e. word, access, excel
- Once activities, duration, costs are recorded it can be used several times without modification
- The graph of the project is done for better understanding of the time-cost tradeoffs.
- Easy tracking of activities and paths
- Requires less experience, therefore since it is user-friendly anyone without in depth knowledge of the software can follow the *Quick Preview* topic available in the program can run the software.

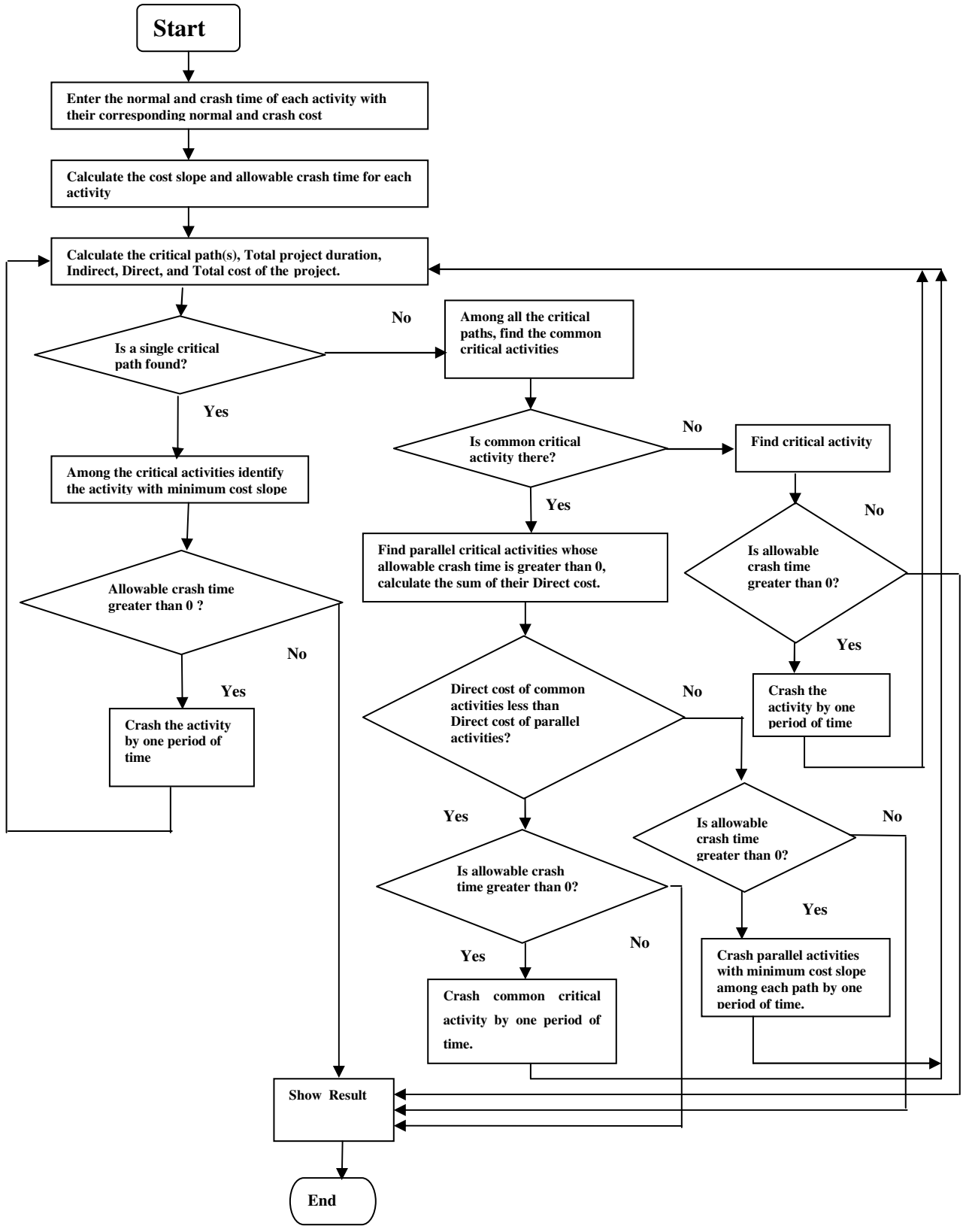


Figure 8.2 Flow chart for crashing program

CHAPTER NINE: CONCLUSION AND RECOMMENDATION

9.1 Conclusion

The findings of the study reveals that project management principles, tools and techniques are important factors for the road construction projects. Besides it was found that most of the causes for the poor performances are the result of the low level implementation of project management tools and techniques by both parties i.e. the contractors and the employer (ERA).

The performance of the road construction projects considered in the study was found to be low; with an average of cost overrun of 33.87 % and time overrun of 57.51 %. The performance of projects was low regardless of the type of work, the size of the project, and whether domestic or foreign contractors handle the project.

The time overruns were more noticeable with domestic contractors; the study also revealed that the delay occurred mainly at the implementation/execution phase of the projects. This in part was associated with the weak capacity of management project the local companies posses and the outdated equipments and machineries they employ in the project.

The cost overruns were found strongly associated with foreign contractors, this was because, the foreign companies were “claim oriented”, and they are good in claim identification, notification, and negotiation, where local firms are less experienced.

Analysis from the gathered data shows that of the 57.51 %; average time overrun the relative contributions of the employer, contractor, government regulations, and others to the time overrun are 54%, 21%, 14 %, and 11% respectively.

Even though the government has committed itself towards the development of road sector development, its policies remained to be not supporting their commitments. Policies related

issues like the direct project award, price escalation and compensation issues are among the reasons for the low performance of road construction projects. The time consuming processes on Customs and Duties Authority that cause the withholding on ports of most urgently needed and easily spoiling materials and spare parts for projects have the highest share for the delay of projects and the cost overruns.

The employer is found to be less proactive in its management of projects, longer office processing time, contract not clear, lack of prompt response to contractors, slow decision making, not timely payment for completed works contributed to get worse the relationship and creating adversarial relationship between the employer and contractors. In addition this causes unnecessary delays and cost overruns of projects.

The capacity of the domestic firms with respect to their human resource, finance, equipments and methods are found to be very weak. These factors limited their capacity to compete in ICBs sponsored by foreign financers through imposition of strict requirements that are difficult to be met by domestic construction companies.

Project information management system implemented in the employer's office was inadequate to provide transparent and timely response to the stakeholders; on time report and data access to practitioners and to contractors. These limit the access of data to contractors before bidding, that promotes the frequent change of design. Since the employer implements functional organizational arrangement of the office with poor communication system, clients often get lost in tracking their issues.

Instability (war, unrest, hostility etc.) within the country is found to be another contributor to the low performance of projects. Among these factors, unrest was the most frequently occurring phenomena, affecting more often foreign companies.

Finally, the study has found that the domestic construction companies are in their infant stage, needing the support of the government with clear and transparent policies and regulations for the benefit and growth of the whole community.

9.2 Recommendations

Since the role of the project management for the improvement of the road construction projects is crucial, involved parties –the contractor, the employer, stakeholders and professional associations should strive for its adaptation and implementation.

The capacity building initiatives shall be given impetus, and address all at the top, middle and lower level of employees. The training also shall be tailored to solve the most recurrent problems observed and at the same time introduce the recent developments in the field (their critical adaptations is important). In this regard, the establishment of joint venture with foreign reputable road construction project companies will enhance the transfer of technology and know how of project management principles tool and techniques.

Implementation of ISO 9000 by contractors and employers for projects help attain a standard project management process throughout the whole organization that assures the quality of process and work.

Government policies directives and regulations shall not only be formulated but also properly implemented and it should be updated from time to time in line with current international developments. The processes in Custom and Duties Authority shall consider in reducing the unnecessary time those sensitive and easily damaged road construction materials spend on ports.

Since the financial capacity of the contractors is extremely weak, the timely payments of both advanced and regular costs of the contractors are crucial points to be considered by both parties (contractor and employer).

The economic evaluation of the financial plan is an important factor to be analyzed for proper selection of project financers.

The contract documents and the drawings also create disputes and disagreement between contractors, consultants and the employer. However, early checking of contractors before the drawings have to be used can prevent this problem.

Finally, the improvement model developed in this study has an integrative approach in which its success depends on the involvement and active participation of all the stakeholders involved in the road sector projects. It requires the elimination of a self-serving attitude; hence, stakeholders shall gear their objectives and interests towards the common objectives, which is the development of the sustainable road infrastructure throughout the country and building the capacity of the domestic construction companies as well.

Recommendation for further study

- Study the applicability of the project management principles, techniques and tools in the Ethiopian context.
- Implementation of the Business Process Reengineering concept in ERA (road projects implementing office) to reduce the Office Processing Time.
- Detail observation of the causes for poor performances of projects with respect the types of works (Construction, Rehabilitation, and Upgrading) and study their association.

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Appendix A : Questionnaire survey

Questionnaire

The questions below are intended to identify the major causes of time delay and cost overrun on road construction projects administered by Ethiopian Roads Authority (ERA).

Your/agency profile (optional)

Name of the organization:_____

(Please indicate with "√" when appropriate)

Type of agency: _____ Contractor ____Consultant ____ Employer

_____ Financer

Other (*please specify*)_____

Year of establishment: ___ < 5 years ___ 6-10 years ___ 10-15 years ___ >15years

Mailing address: _____

Telephone: _____Fax_____E-mail_____

1. How long has your agency been involved in construction sector in general?
   ---- Less than 5 years ---- 6-10 years ---- More than 10 years
2. If you are professional in your agency, which position in the organizational level you are?
   ---- Top management ---- Middle management ---- Expert ---- Others
3. How long have you been involved in the road sector projects?
   ---- Less than 2 years ---- 2-5 years ---- 6-10 years ---- More than 10 years
4. How many road projects have you been involved in?
   ---- Less than 5 projects ---- 6-10 projects ---- More than 10 projects

Section I-General information

1. What are the major criteria ERA uses to identify potential projects among the available?

---- Regional quota ----Suggestion from government bodies

---- Benefit cost analysis ---- Food deficit area

Other (*Please specify*) _____

_____

2. Do contractors have the necessary professional and managerial skills to properly run their businesses?

----Absolutely ---- 90% of them ---- 70-89% of them ---- Below 70 %

Additional comment_____

_____

3. What are the bidding systems ERA uses to identify among potential contractors for a project?

---- Competitive bidding

---- Limited tender

---- Direct owner-contractor negotiation

Others (*Please specify*) _____

_____

4. Does ERA provide training for contractors before and during bidding?

---- Yes ---- Sometimes ---- Not at all

5. If your answer is "Yes" what type of training is provided?

_____

_____

6. How do you rate the relationship (interface) between ERA and Local contractors?

---- Good ---- Fair ---- More or less ---- Deteriorated

7. How do you rate the relationship (interface) between ERA and Foreign contractors?

---- Good ---- Fair ---- More or less ---- Deteriorated

8. If your answer is “More or less” or “Deteriorated” on the previous question, what do you think would be the major reasons?

_____

9. Do these deteriorated working relations between ERA and Contractor affect negatively the performance of the constructions in either of its project performance measures (time, quality of work, or cost)?

---- Greatly ---- Sometimes ---- Not at all

10. If your answer is “Greatly” on the previous question, what actions should be taken by ERA to resolve or mitigate the problems?

_____

_____

11. Do the local contractors hire enough professionals to handle projects?

---- Yes ---- More or less ---- No

12. Do the majority of contractors follow project management principles before and during project implementation phases?

---- Yes ---- Some of them ---- None of them follow these principles

13. How does (question No.12’s answer) affect the performance of the projects?

---- Greatly ---- Sometimes ---- Not at all

14. Dose ERA have the required Number of professionals to administer the road construction projects of the whole country ?

---- Yes ---- Not enough ---- Below the required number

15. If your answer is “below the required number” in question 14, what measures the authority takes to overcome the problem ?

---- Rely on other organizations ---- Hire contract staff per project

---- Subcontract the supervision activities

---- Multi-project supervision by a team ---- No measure has taken so far

16. Does ERA have transparent biding procedures?

---- Yes ---- Sometimes ---- No ---- I don't know

17. What is the key consideration(s) that ERA considers to evaluate the performance of contractors involved in road construction projects?

---- Time ---- Cost ---- Quality ---- All of them

18. Does ERA have a plan to implement Total Quality Management (TQM) to improve its activities?

---- Yes ---- No ---- I Don't Know ---- Question not clear

19. Do contractors motivate employees on site?

---- Yes ---- The majority do ---- No

20. Does employee motivation (on projects) have impact on good performances of projects?

---- Yes ---- Most of the time ---- No ---- On the opposite

21. Do investment and other related policies of the country (Ethiopia) encourage and support contractors?

---- Yes ---- Regularly ---- Not at all ---- Very discouraging

Other comments _____

_____

22. Does ERA consider the reputation and experience of contractors for bidding purpose?

---- Yes ---- No ---- Some times

23. Have conflicts adverse contribution in the performance of projects?

----Yes ---- No ---- Sometimes

24. If your answer is "Yes" on question No. 23, what types of conflicts are frequent?

---- Ethnical ---- Political ---- Border with neighboring countries

If other, please specify:_____

_____

25. Why contractors fail to complete projects within estimated time and budget?

---- Lack of managerial experience ---- Incompetence

Other reasons_____

_____

26. How do you rate the local consultant's competency?

---- High ---- More or less ---- Poor

27. How do you rate the foreign consultant's competency?

---- High ---- More or less ---- Poor

28. Is there any contribution of consultants for the successful performance of the contractors?

----Yes ---- More or less ---- Directly ---- Indirectly

---- It has no any contribution at all

Additional comments _____

_____

29. Do you think ERA's current organizational structure help better discharge of its duties?

---- Yes ---- No ----Poorly

30. If your answer is "No" or "Poorly", then what do you recommend?

_____

_____

31. Is the community living in the area of the project cooperative to leave the area within the required time frame?

----Yes ---- No ---- Sometimes

Additional comments_____

_____

32. Are governmental and funding organizations (or other stakeholders) working closely to the success of the projects?

----Yes ---- No ---- Sometimes

Additional comments _____

_____

Section II- Survey of the causes of road construction project poor performances

(*Please*, *if you have not been involved in any road projects, do not attempt the following questions*)

1. Rank the following poor project performances listed on the 2nd column, in terms of the importance with regards to the attributes listed on the very top row.(*Please rank the performances 1 to 9 , being 1 the attribute with high weight and 9 the attribute with less weight. E.g. if "Delays" occurs more frequently than other poor performances, you may rank it as "1" under frequency of occurrences*.)

Attributes →

S/N	Poor project performance ↓	Frequency of occurrence	Cost incurred	Difficult to manage
i	Accident			
ii	Poor buildability			
iii	Cost overrun			
vi	Defects			
v	Delays			
vi	Disputes			
vii	Design changes			
viii	Involuntary resettlements			
ix	Right of Way			

2. Indicate the extent of impact of ***inadequate design*** on the following "Poor performances."(*Please check (⟦) as appropriate*). *Hint*: *if you check "High" in the "Disputes" row, it indicates that inadequate design has high impact on the number of disputes)*

S/N	Poor project performance	High	Medium	Neutral	Low	None
i	Accident					
ii	Poor buildability					
iii	Cost overrun					
vi	Defects					
v	Delays					
vi	Disputes					
vii	Design changes					
viii	Involuntary resettlements					

Section III- Survey of the causes and possible solutions to the project delay and cost overrun problems.

The following section of questionnaire helps identify the causes of the project delays in roads construction contracts. In answering the questions below, please think in terms of your experience and /or your knowledge about the problem and check (∥) the appropriate number. If your choice is 3, 4, or 5, then indicate your reason(s) from the list given following each question in a priority order of 1 to 3. If your reason is different from the three, please provide your reason(s) on the space provided (*you may use additional sheet when necessary*)

1. *Availability of contractors*: Sufficient contractors (local) meeting the requirements of ERA are available in the market.

1 ----Strongly agree 2 ---- Agree 3 ---- Neutral 4 ---- Disagree 5 ----Strongly disagree

- Only few firms have experience in road construction
- The experience of contractors in roads construction is limited
- The road construction business is not attractive (profitable)
- Others (*Please specify*)_____
  _____
  __

2. *Selection procedure*: Contractor selection procedure by ERA invites qualified firms

1 ----Strongly agree 2 ---- Agree 3 ---- Neutral 4 ---- Disagree 5 ---- Strongly disagree

- Cost being one of the selection factors discourages qualified firms.
- Open invitation discourages qualified firms from participation.
- Selection procedure is not transparent.
- Others (*please specify*_____
  _____

3. *Request for proposals (RFP)*: The RFP is comprehensive and detailed enough that consultants might not be able to interpret it well to prepare responsive proposals.

1 ---- Strongly agree 2 ---- Agree 3 ---- Neutral 4 ---- Disagree 5 ----Strongly disagree

- The RFP is usually adopted from standards and lacks specificity
- The RFP does not reflect the actual site situation
- Others (*please specify*_____

_____

5. *Evaluation technique*: Evaluation techniques currently practiced by ERA guarantee the selection of a qualified firm.

1 ---- Strongly agree 2 ---- Agree 3 ---- Neutral 4 ---- Disagree 5 ----Strongly disagree

- Poor past performance of contractors are not considered.
- During evaluation there is no mechanism to ascertain the veracity of proposals
- No feedback of the evaluation to learn from past mistakes.
- Others (*please specify*)_____

_____

6. *Briefings*: Briefing by ERA is generally satisfactory.

1 ---- Strongly agree 2 ---- Agree 3 ---- Neutral 4 ---- Disagree 5 ----Strongly disagree

- No formal briefing session is held at all.
- Professionals are often unclear about the projects.
- The briefing rather addresses more of administrative issues than dealing with important project issues.
- Others (please *specify*)_____

_____

7. *Mobilization*: Do contractors mobilize all of the necessary resources to the site as proposed.

1 ---- Strongly agree 2 ---- Agree 3 ---- Neutral 4 ---- Disagree 5 ----Strongly disagree

- Right of way is generally delayed by third parties
- Concerned authorities are not cooperative enough
- Resettlements by land occupiers take more time than necessary
- Others(please specify)_____
  _____

8. *Selection method*: The present quality and cost based selection of contractors selects the best firm with a reasonable fee and should be maintained.

1 ---- Strongly agree 2 ---- Agree 3 ---- Neutral 4 ---- Disagree 5 ----Strongly disagree

- The weight given to quality should be raised
- Cost should not be a factor as it limits the contractor's initiative to quality work.
- Quality is subjective to evaluate based on proposals, and the present weight given is excessive.
- Others (please specify)_____

_____

9. *Delay- cost overrun association*: As a result of delay on the project, the cost overrun is also increased.

1 ---- Strongly agree 2 ---- Agree 3 ---- Neutral 4 ---- Disagree 5 ----Strongly disagree

- With good cost control techniques cost overrun can be prevented even if project is

delayed.

- Cost overrun is generally related with price escalation and frequency of accidents.
- The cost overrun has no any relation with the project delay
- Others (*please specify*)_____

_____

10. *Duration of projects*: Time estimated for projects in the proposals is generally short to complete projects on time.

1 ---- Strongly agree 2 ---- Agree 3 ---- Neutral 4 ---- Disagree 5 ---- Strongly disagree

- Time estimation by the contractor is fair but timely execution of plans is what causes delay.
- Since design changes are frequent and disputes are not solved on time, projects are obliged to remain
  paralyzed until disputes are settled to restart work.
- Time estimate is fair but project progress is affected mainly by delayed payments from ERA.
- Others (*please specify*)_____

_____

11. Does ERA track the cost growth/reduction of contractors from point of award to final closeout of any project?

---- Yes ---- No ---- No information

If yes, what are the major techniques used(*Please specify*)_____

_____

12. What do you think would be the major cause of cost overruns in projects (more than one answer is possible)

---- Poor cost estimation ---- Poor design ---- Price escalation
---- Poor risk assessment ---- Poor cost control techniques ---- Right of way problems
---- Late arrival of goods ---- Frequent disputes ---- Change in legislation
---- Adverse climate conditions

Other reasons _____

_____

Section IV- Dispute recognition, avoidance and resolution technique

The questions below are related to the recognition, avoidance and resolution of disputes, please indicate by filling the blank and using "⟧" mark in the appropriate place.

1. What are the major claim reasons in road construction projects? (*Please prioritize*)

---- Inadequate investigation before bidding

---- Contract not clear and understandable

---- Bidding below cost

---- Inadequate time for bid preparation

---- Lack of experience in bid preparation

---- Political and security problems

---- Design defects

---- Third party actions/inactions

---- Others (*Please specify*) _____

2. Has ERA used any of the following techniques or procedures in an attempt to anticipate or identify disputes on an early stages?

i. Proactive management of problems at project meetings? ---- Yes ---- No

if yes, how regularly are they scheduled?

---- Weekly ---- Monthly ---- Not regularly ---- It depends

others (*specify*)_____

ii. Pre-construction meetings? ---- Yes ---- No

iii. Bid evaluation and comparisons? ---- Yes ---- No

iv. Project cost and payment forecast? ---- Yes ---- No

v. Regular review of project report to identify pending disputes? ---- Yes ---- No

3. Does your agency have a design, engineering, or contract administration support group that can be involved on an immediate, intensive basis to resolve critical dispute issues? (*Problem intervention group*) ---- Yes ---- No

If "yes", what level of authority delegation is required to mobilize the group to assist on a problem-ridden project?

---- Advisor to the contractor ---- Advisor to central office bureau chief

---- Advisor to the project manager ---- Other (*Please specify*) _____

4. Is pre-bid meeting generally a mandatory procedure in your agency? ---- Yes ---- No

Is mandatory attendance by all bidders? ---- Yes ---- No

Are minutes distributed to all bidders? ---- Yes ---- No

5. Pre-construction meetings (after award but prior to notice to proceed)

---- Generally required ---- Always required

Topics addressed generally include:-

---- Payment processing ---- Utility conflict ---- Safety

---- Procurement items ---- Claims procedures ---- Scheduling

---- Design clarification/revision ---- Right way/site access ---- Mobilization

---- Change order procedures

Others (*Please specify*)_____

6. Does ERA allow bidders to access the project data prior to bid? ---- Yes ---- No

If "yes", to which?(more than one answer is possible)

---- Utility location maps/reports ---- As built drawings

---- Right of way information ---- Site investigation reports

---- Site surveys ---- Complete design and engineering report

---- Soil studies

Others (mention)_____

7. Are the above mention(No.6) information vital to the contractor's performance on the projects?

---- Yes ---- No ---- More or less

8. Is construction-scheduling (resources loaded and critical path indicated) mandatory on all

projects? ---- Yes ---- No

i. The schedule is performed by: ---- Program manager ---- Contractor

---- Agency in-house staff ---- Independent scheduling ---- Consultant

---- Others (mention)

ii. Is this schedule contractually binding? ---- Yes ---- No

iii. Are any of the following scheduling submissions mandatory?

---- 30-days updated schedule ---- 90-days updated schedule

---- Weekly schedules ---- Periodic but not monthly updates

---- Monthly updates ---- Complete construction schedule

---- Schedule revision to support time extensions

9. Please indicate the value of the use of the following techniques in reducing or resolving disputes/claims?

1-Very valuable 2- Valuable 3- Not valuable 4- Counterproductive

---- Pre-design/pre-construction investigation

---- Problem intervention group

---- Value engineering

---- Construction/program management consultants

---- Design Quality Assurance /Quality Control

---- Pre-bid meeting

---- Pre-construction meeting

---- Increased access of information for contractors

---- Mandatory construction scheduling (resources loaded CPM)

---- Periodic construction meetings (progress meeting)

---- Others (*Please specify*): _____

10. In the last five to ten years, has ERA used any of the following procedures and/or techniques in an attempt to resolve disputes before they are formalized into claims ? Is your agency's use of this technique increasing or decreasing?

i. By issuing change orders to settle a contract dispute matter (rather than extra work items)

---- Yes ---- No ----- Increasing use ---- Decreasing use

ii. By trying to settle the disputes in the job meetings/site meeting?

---- Yes ---- No ----- Increasing use ---- Decreasing use

iii. By dealing with disputes through formal negotiations? ---- Yes ---- No

if yes, at what administrative level were the formal negotiations held?

---- Field level ---- Central office ---- Legal department

iv. By decision of administrative agency at different levels of review with increasing authority?

---- Yes ---- No ----- Increasing use ---- Decreasing use

11. Which three of the following dispute resolution techniques in your opinion have been most effective in resolving disputes? (Please prioritize them)

---- Administrative Process

---- Collaborative Problem Solving

---- Mediation ---- Disputes Review Board ---- Partnering Implementation

---- Unilateral Change order

Other (*Please specify*)_____-

12. Which items are the main obstacles to the early resolution of disputes? (Please prioritize)

---- Defensive perspective by the contractors

---- Lack of support from the project Manager in the disputes resolution

---- Lack of know how in the analysis and resolution of dispute

---- Not enough involvement by contractor's legal department

---- Lack of prompt approval by ERA

---- Informal or formal contracting agency policy to make decision on disputes

---- Belligerent manner of disputing party

---- No convincing reason to reject claims of the contractors

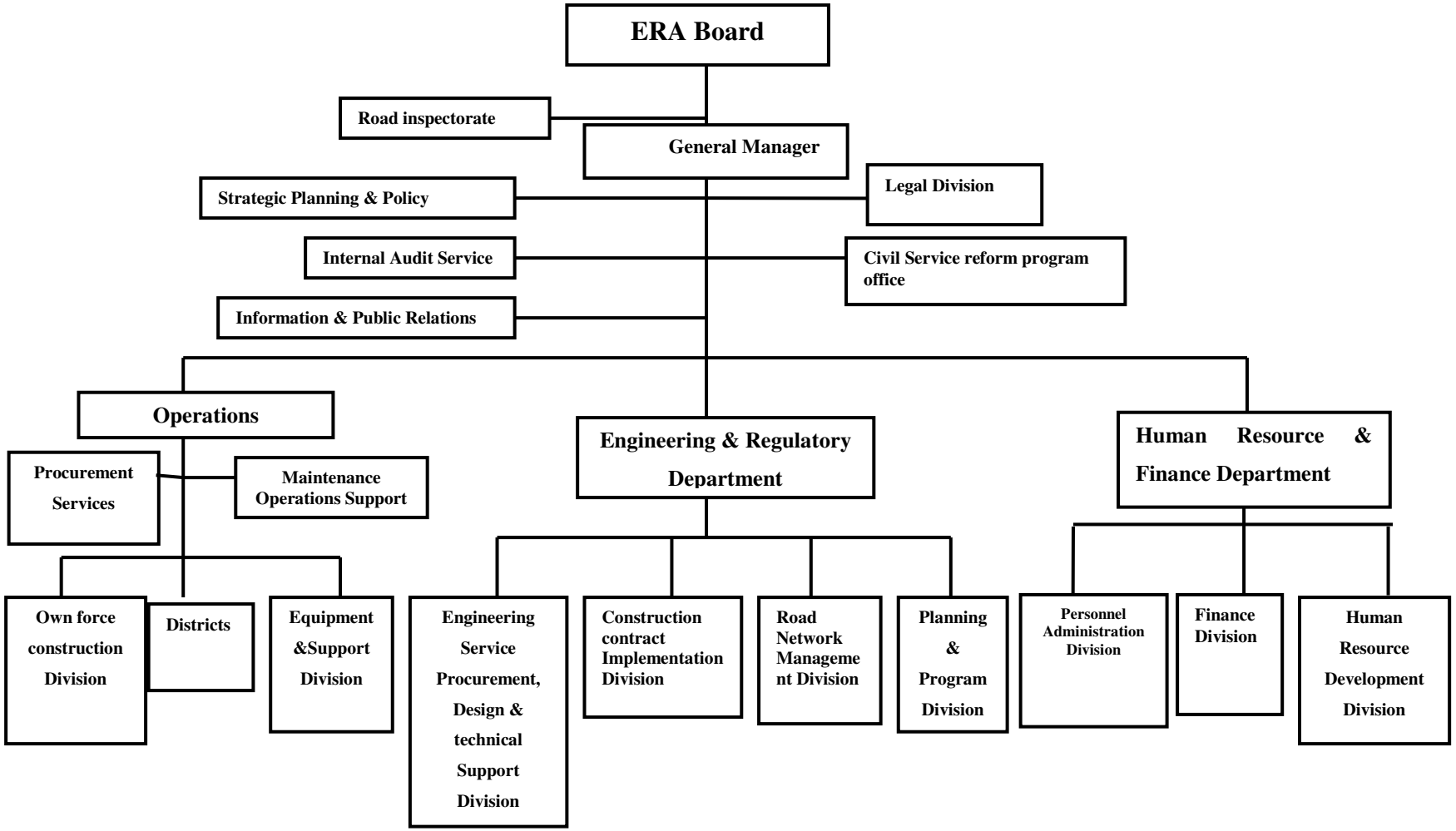
---- Either party not allowing administrative process to work

---- Self-serving posturing by parties during dispute resolution

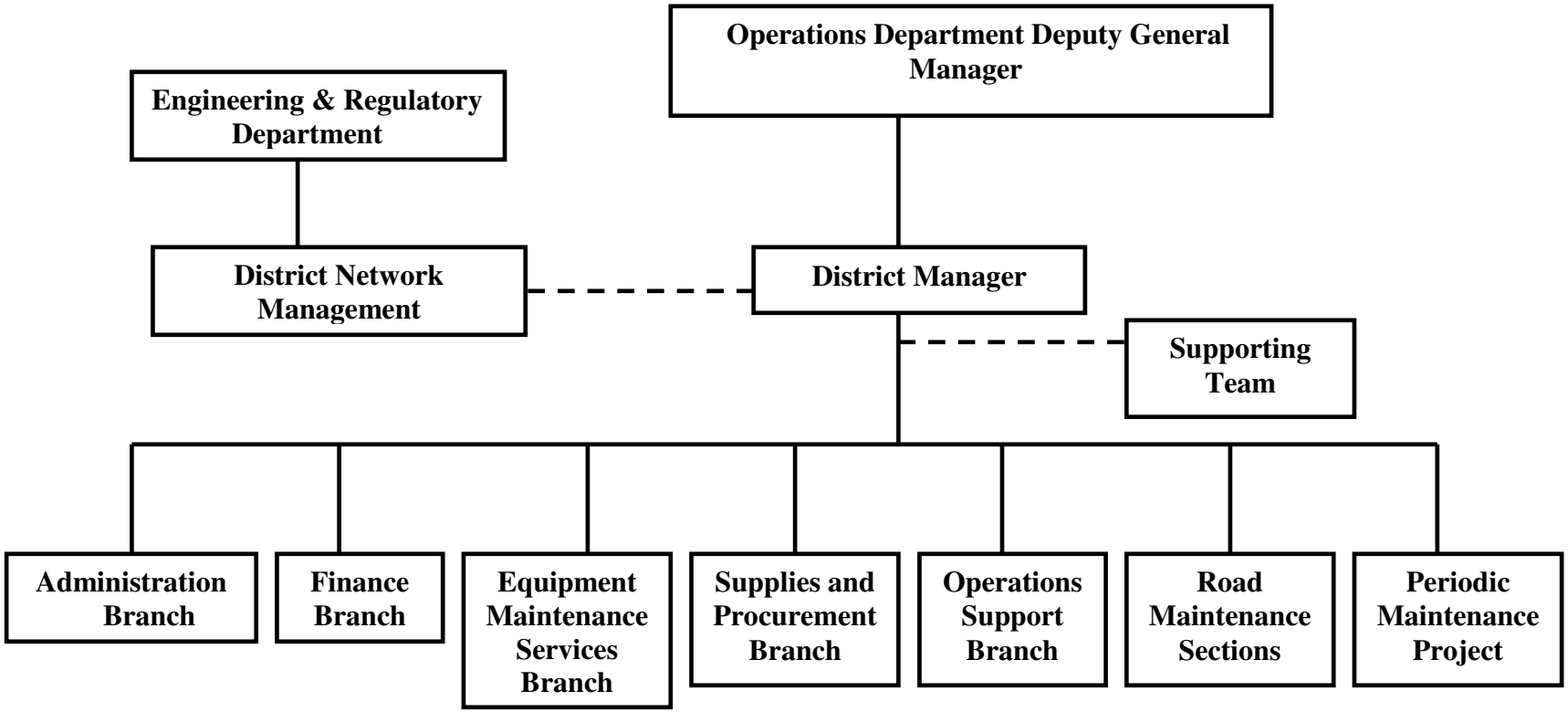
I sincerely appreciate your timely response and cooperation. Please make sure that you haven't skipped any question and return the questionnaire.

Thank you!

Appendix B: Organizational structure of ERA

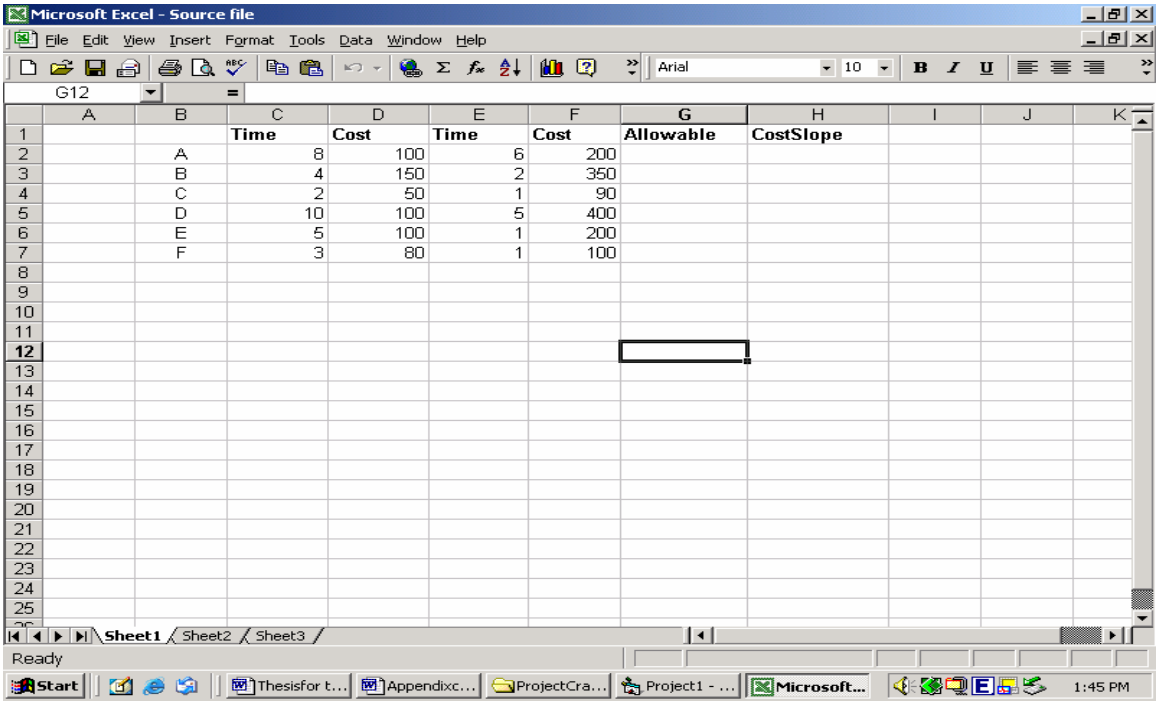


B1: Organizational structure of the head office



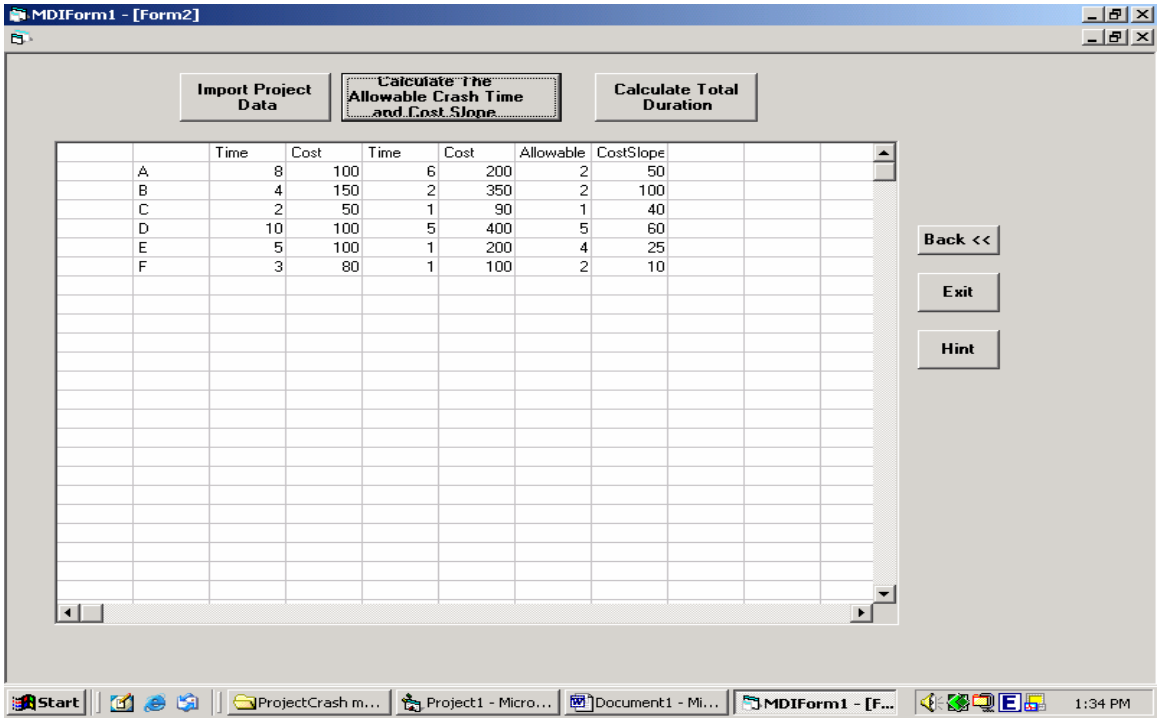
B2: Typical District level organizational chart.

Appendix C: Some important the crashing software related figures



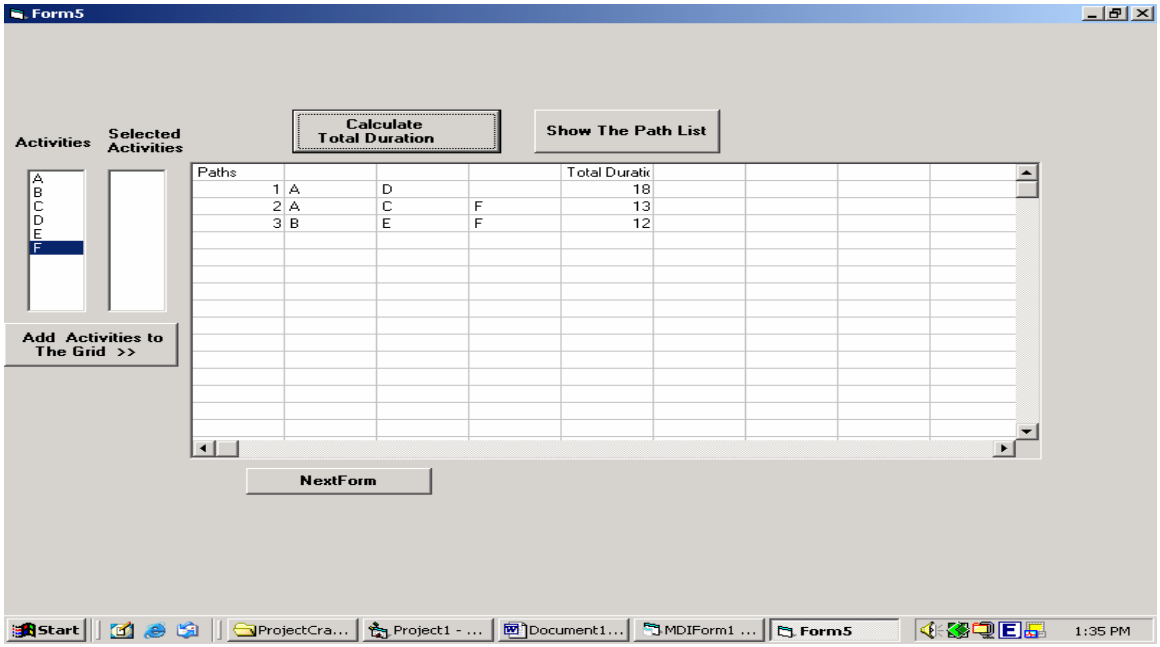
	A	B	C	D	E	F	G	H
1			Time	Cost	Time	Cost	Allowable	CostSlope
2		A	8	100	6	200		
3		B	4	150	2	350		
4		C	2	50	1	90		
5		D	10	100	5	400		
6		E	5	100	1	200		
7		F	3	80	1	100		

C1: The Excel application where the project data are easily fed.

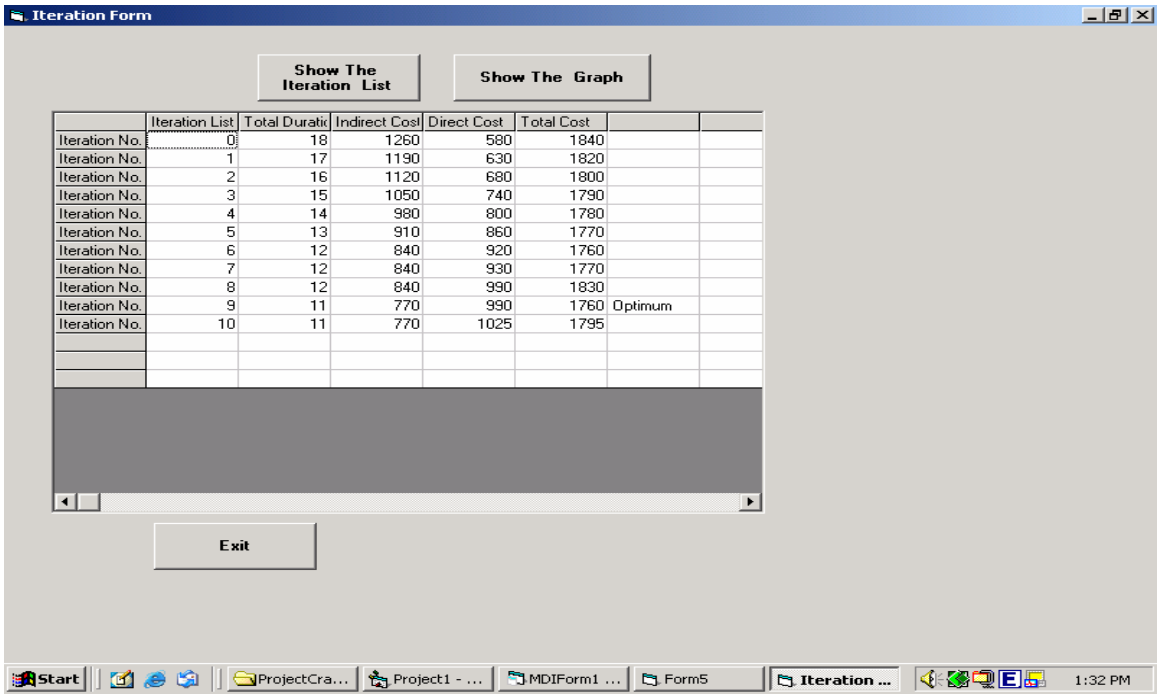


		Time	Cost	Time	Cost	Allowable	CostSlope
	A	8	100	6	200	2	50
	B	4	150	2	350	2	100
	C	2	50	1	90	1	40
	D	10	100	5	400	5	60
	E	5	100	1	200	4	25
	F	3	80	1	100	2	10

C2: The imported project data from the Excel application.



C3: The different paths of the project at the initial iteration.



C4: The iteration with the optimum short project duration and least (optimum) cost.