An Investigation on Time and Cost Overrun in Construction Projects

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ABSTRACT

The success of construction projects is highly dependent on meeting the aim of project and objectives within the specified time and budget. Management plays a big role in construction projects. Most important problems that management faces in the projects are methods of execution, management of workers, equipment, scheduling and money.

Delay and cost overrun are two of the important defects in construction industry. These failures can lead to various types of negative affections like disputes between contractor and client, decrease quality of work and health and safety accidents. Therefore, there is a high necessity for further investigation on delay and cost overrun factors as well as quality and health & safety and suggesting right actions to minimize these kinds of defects.

Keywords: Delay, Time overrun, Cost overrun, Investigation

ÖZ

İnşaat sektöründe projelerin başarısı, projenin belirtilen süre ve bütce dahilindeki hedeflerine ulaşmasına bağlıdır. Yönetim, inşaat projelerinde büyük bir rol oynar. Proje yönetiminde karşılaşılan en önemli faktörler yürütme işleri, işçilerin yönetimi, ekipman, planlama ve paradır.

Gecikme ve maliyet taşması, inşaat sektöründe yer alan önemli kusurlarından ikisidir. Bu başarısızlıklar, çeşitli tiplerde olumsuz etkilere yol açabilir. Örneğin, müteahhit ve müşteri arasındaki anlaşmazlıklar, iş kalitesinin azalması ve iş sağlığı ve güvenliği kazalarıdır.

Bu nedenle, gecikme, maliyet taşması, ve ayrıca kalite, iş sağlığı ve güvenliği ile ilgili daha fazla araştırmaya gerek vardır.İnşaat

Anahtar Kelimeler: Gecikme, Zaman taşması, Maliyet taşması, Araştırma

To my loving parents who supported me all the way hoping that I made

them proud.

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LIST OF ABBREVIATIONS

ADB	Asian Development Bank
AFDB	African Development Bank
AVRII	Average Relative Importance Index
CBA	Cross Border Agreement
DCA	Department of civil aviation
DOTC	Department of Transportation and Communication
EA	Executing Agency
GDP	Gross Domestic Product
GOB	Government of Bangladesh
ICR	Implementation Completion Report
IRR	Internal Rate of Return
ICAO	International Civil Aviation Organization
IDA	International Development Association
ILS	Instrument Landing System
INR	Indian Rupees
JBRLP	Jamuna Bridge Railway Link Project
Km	Kilometer
LCCA	Life Cycle Cost Analysis
MPW	Ministry of public works
NPV	Net Present Value
PCR	Project Completion Report

PIU	Project Implementation Unit
PV	Present Value
RESA	Regional Environmental and Social Analysis
RII	Relative Importance Index
ROI	Return Of Investment
ROR	Rate Of Return
RSP	Rank of Studied Projects
SFD	Sinking Fund Deposit
SPCA	Single-Payment Compound Amount
SPPV	Single-Payment Present Value
SPSS	Statistical Package for Social Science
TA	Technical Assistance
TVM	Time Value of Money
UNECE	United Nations Economic Commission for Europe
USCA	Uniform Series Compound Amount
VOC	Vehicle Operating Cost
WB	World Bank

Chapter 1

INTRODUCTION

1.1 Introduction

The Construction industry has a great influence on the economy of all countries. It is one of the parts that provide vital factors for the development of any economy. According to World Bank, the share of construction industry in developing countries is approximately between 6-9% of the Gross Domestic Product (GDP). (Unit, South Asia Sustainable Development, 2007)

According to United Nations Economic Commission for Europe (UNECE) the share of construction industry in GDP was equal to 4.2% in Turkey in year 2009, and after agriculture and manufacturing industry it is in the third rank with10.1% at Turkish Republic Northern Cyprus (TRNC) in year 2003 (Europe, 2010; Örgütü, 2011).

The construction industry is an important part of the economy and has a considerable impact on the efficiency and output of other industries. It is not possible having extensive investment in manufacturing, agriculture, or service sectors without construction of infrastructure facilities in place.

It is understandable that the construction industry has special features that do not usually happen in other industries. For instance, when conditions in the construction field

changes to be more complex than what was anticipated in the planning and design phase, additional costs and time are needed. Creating large facilities takes a long time and usually absorbs a large amount of investment.

Reaching to the end of any project is not a kind of success for the project owner. For the client or owner of the project, success of a project depends on many factors; the most important factors are finishing the project within the budgeted cost and reaching to the closing date of project without delay with a good quality of work and creating no health and safety problems.

1.2 Research problem

Construction projects have troubles with construction methods and administration as well as limitation of resources, budget and time. The critical problems are failure to complete the projects on schedule and budget. In recent years, experiencing time and cost overrun is common in most of the civil engineering projects. In this study, an assessment of the records from twenty eight large infrastructure civil engineering projects showed that the projects were not often finished on time and/or within the estimated budget. These results proved the existence of problems over time and cost in the construction projects leading to delay and cost overrun. Studied projects were selected from the databases of World Bank (WB), Asian development Bank (ADB) and African development Bank (AFDB) and investigation was conducted according to their project completion reports. Most of the studied projects belong to the Project Completion Reports (PCR) that published between years 2000 to 2010. The projects were selected from the developing countries like Iran, Turkey, Pakistan, Kazakhstan, China and Republic of Korea.

It is important to apply the maximum efforts to do such a study, to discover the above factors in different countries with dissimilar conditions. It is too important to care for all the general and local failure and weak points from all points of view toward the problem. Therefore, giving detailed procedures in order to avoid time and cost overruns at civil engineering construction projects are vital.

1.2.1 Cost overrun in projects

It is common to see a construction project failing to reach its objectives within the predicted cost. Cost overrun is a very common phenomenon that almost associated with nearly most of the projects in construction industry. It is more severe in developing countries like Iran and Turkey, where these overruns sometimes go beyond 50% of the expected cost of the project. For example, in the project of "state and provincial roads project" in Turkey the cost overrun was about 56.4% of the estimated budget (The World Bank, 1998 B).

1.2.2 Time overrun in Projects

Delay is one of the most usual, significant and serious problems which impact the time factor in the civil Engineering construction projects. Even with technological advances and getting better understanding of project management by project managers, time overrun is a critical factor. There are different reasons for delay in the projects. Causes such as "postponement of material delivery to the site of the project" which experienced at "Airport Development project" in Philippines (The ADB, 2005), equipment failure which experienced at "Xieng Khouang road improvement project" in Lao people's democratic (The ADB, 2006), political issues which experienced at "Third road rehabilitation and maintenance project" in Republic of Nicaragua (The World Bank, 2007 B), and Sever weather conditions that happened in "Gujarat earthquake

rehabilitation and reconstruction project" in India (The World Bank, 2009 A) are also reasons and instanses for delays. In some cases delays make the condition even more complex. It is required for a detailed appraisal to recognize the delay factors and choose accurate and right actions to reduce the adverse impact of delays on the duration of the projects.

1.3 Research scope and objectives

The significance of time and cost in the construction projects is not extensively recognized by the contractors and project managers in some developing countries. Even with the accessibility of a range of different controlling software like MS Project and Primavera and new techniques in construction industry, most of the construction projects still have difficulties in preventing delay and cost overrun. Therefore, having good knowledge on how to control the cost and time factors and knowing their impact on the time of project, and reducing the factors leading to cost overrun is essential. In addition, awareness of owners, consultants and contractors about these factors, and trying not to create reasons that are leading to cost and time overrun is quite important.

Therefore objectives of this research are:

a) To investigate the existence of cost and time overrun factors in large construction projects;
b) To investigate the reasons for cost and time overrun in construction projects;
c) To undertake a questionnaire to investigate the existence and the reasons of time and cost overrun in Iran, Turkey and TRNC;
d) To recognize the most important factors that affect construction time and cost, quality of works and health & safety issues in the above mentioned countries;

e) To analyze and tabulate the reasons of delay and cost overrun through factor index analysis;

f) To assess the impact degrees of the time and cost overrun, Quality and health & safety;

g) To develop a satisfaction factor for the projects based on data provided in the feasibility reports and completion reports.

1.4 Methodology

This research consists of six phases; the first phase is recognizing and classifying the problems and making the objectives of the study and improvement of research plan. The second phase of the research consists of surveying about time value of money and feasibility reports. The third phase of the research includes selecting large construction projects which financed by international banks like WB, ADB and AFDB as case studies. Twenty eight projects were carefully chosen and studied. These cases were discussed on the subject of the causes of time and cost overruns. The fourth phase of the research includes the questionnaire design, throughout handing out the questionnaire to some reliable owners, consultants and contractors in Iran, Turkey and TRNC. The questionnaire's aim was to collect the required data in order to investigate and reach the research purpose. It was conducted due to investigation on impacts of 46 different factors relevant to time, cost, quality and health & Safety issues in the civil engineering projects. It was also carried out to analyze and tabulate the results based on the respondents to recognize the critical factors that are affecting the time and cost of projects. The fifth stage of the research focused on factor analysis of the results and discussions. Microsoft Excel was employed to perform the required analysis. After

analyzing data; a satisfaction factor was developed based on the estimation and actual time and cost obtained from feasibility report and completion report in studied projects. The final phase of the research includes the conclusions and recommendations.

1.5 Works done

In this research the following tasks have been undertaken:

a) An investigation on the existence of time and cost overrun in construction projects;
b) An investigation to find the reasons of time and cost overrun;
c) Categorizing the causes of time and cost overrun;
d) A questionnaire was prepared for finding the most important reasons of cost and time overrun in the construction projects in Iran, Turkey and TRNC;
e) An index analysis has been done by employing Microsoft Excel;
f) A satisfaction factor was developed for the construction projects based on the cost and duration of projects.

1.6 Achievements

Based on the analysis results of the case studies and questionnaires, the following items were achieved.

a) Proof of the existence of the time and cost overrun in the construction projects;
b) The important reasons for time and cost overrun, quality and health & safety issues were recognized and extracted;
c) The information about the severity of the impacts on the main factors,
d) A satisfaction factor was developed for projects.

1.7 Structure of the Thesis

The structure of this thesis is as follows:

Chapter 1 is the introduction of this thesis. It largely focuses on the scope and objectives, methodology, work completed and achievements of this study. Chapter 2 describes time value of money, importance of it and time value of money tips. Chapter 3 introduces feasibility reports, objectives of feasibility reports, contents and different types of them. Chapter 4 explains the questionnaire. It includes the basic data of the respondents, design and contents of the questionnaire. Chapter 5 contains the selected twenty eight case studies representing international construction projects. The objectives and reasons of time and cost overrun at the projects are described. Chapter 6 is about discussions and results of both case studies and questionnaires. Chapter 7 is conclusions and recommendations. It concludes the study with summary of the study findings and the contribution of the study, the areas of future research and recommendations.

Chapter 2

TIME VALUE OF MONEY

2.1 Introduction

It is not possible to evaluate an investment simply by estimating the total cash inflows and outflows and concluding if they are positive or negative without first considering when the cash flows occur.

One of the most essential concepts in finance is that cash has a “Time Value”. That is to say that cash in hand today is worth more than cash that is anticipated to be received in the future. The reason is uncomplicated: A dollar that you get today can be invested such that you will have more than a dollar at some upcoming time. This directs to the saying that we frequently use to summarize the theory of time value: A dollar today is worth more than a dollar of next day.

The time value of money (TVM) theory is expression on the fact that present money in hand is more worthy than a similar amount of cash expected in the future. If this statement is accepted as a fact, then profits and expenditure are worth more if they are achieved much earlier. TVM calculation is based on present worth and discounting methods. The present value technique calculates the TVM by adjusting throughout compounding and discounting cash flows to show the increased value of money when invested. For instance, if there will be an alternative to prefer between two million

dollars today or two million dollars two years after present time, most people select the first alternative. The first option is much good because if you got the cash now in your hand, you could spend it and gain an additional return over the two years.

This theory that one million cash today in any currency is worth more than the equal amount next day is called the time value of money.

2.2 Importance of Time Value of Money

There are three major reasons why a dollar to get in the future has value less than a dollar to get instantly. The first and most clear reason is the existence of positive rates of inflation which decrease the purchasing power of dollars during the time. Second reason is the concept that a dollar today has more value today than in the upcoming days for the reason that the opportunity cost of lost earnings that is, it could have been invested and earned a benefit between today and any time in the future. As the third reason it has to be in mind that, all future value of money is only promises in some good judgment and it can be full of some uncertainty about their possibility of happening.

2.3 Time Value guidelines

Whether saving for retirement or a down payment on a home, college funding or dependent care needs, cash will be to a great extent influenced by a small amount of uncomplicated time value tips. Some of the tips are as follows:

a) The longer time of preparing, results the fewer objectives with cost. Invest savings and earn a positive return, will earn interest, and also the interest earned will begin to earn interest. This is called compounding.

b) The higher the interest rate secured and added on the savings, the faster the money will grow. In general, the amount of risk taking on the investments will

determine the long term rate of return. The longer time of saving to reach to the goals, the more risk should take on the investments and the greater rate of return should be expected.

2.4 Basics of Time Value of Money

The value or worth of money changes owing to changing purchasing ability over time under influence of interest rates, inflation and deflation and attributed to earning potential of alternative investments over time.

The TVM theory is a reflection on the fact that present capital (cash in hand) is more valuable than a similar amount of money received in the future. If this assumption is accepted as fact, then benefits and costs are worth more if they are achieved much earlier. TVM computation is based on present value and discounting techniques. The present value method captures the TVM by adjusting through compounding and discounting cash flows to reflect the increased value of money when invested.

2.5 Present Value

The calculation of PV (Present Value) is really essential in many financial and economical calculations. Different options will have different combinations of related primary and future expenses and future savings. Consequently, in order to make possible comparison and judgment between two or more alternatives, the primary and future costs are converted to today's currency (Dollar), or PV to allow comparison.

The PV calculation employs the discount rate and the time a cost was or will be incurred to find the present value of the cost in the base year of the study period. While most initial costs occur at about the same time, initial costs are considered to occur for the

period of the base year of the study. Therefore, there is no need to determine the PV of these initial costs because their PV is equal to their actual cost.

The calculation of the PV of future costs depends on time. The time period is the difference of the time of primary costs and the time of future costs. Primary costs are incurred at the start of the study period at year zero, the base year. Future costs can be incurred anytime between year one and for instance year forty. The PV calculation is some kind of equation that allows the summation of initial and future costs.

The discount rate also states the present value of future costs along with time. Since the present discount rate is a positive rate, future costs will have a PV less than their cost at the point of time they are incurred. Future expenditures can be crashed into two categories:

a) Recurring costs;

b) One-time costs.

Recurring costs are those that occur each year over the duration of the study period. Most of the operating and maintenance costs are recurring costs**.** One-time costs are those that do not occur each year over the time span of the study period. For instance most replacement costs are one-time costs. To make simpler the LCCA (life cycle cost analysis); all recurring costs are stated as annual expenses incurred at the end or beginning of each year and one-time costs are incurred at the beginning or end of the year in which they occur as well. To determine and calculate the PV of future one-time costs the following formula is used (Equation 1):

$$PV = A_t/(1+d)^t \quad (1)$$

Where:

PV: Present Value

A_t: Amount of one-time cost at the time (t)

d: Discount Rate (Real)

t :Time (expressed as number of years)

To calculate the PV of future recurring costs the following formula is used (Equation 2):

$$PV = [A_0 (1 + d)^t - 1] / [d(1 + d)^t] \quad (2)$$

Where:

PV: Present Value

A_0 : Amount of recurring cost

d = Real Discount Rate

t = Time (expressed as number of years) (Tim Mearig, 1999)

2.6 Discounting

Discounting is a method used to compare costs and benefits that happen in different time spans. It is independent to inflation and is based on the theory that generally, people prefer to obtain goods and services at the present time rather than later. This is known as "time preference".

When comparing two or more alternatives, a general base is required to ensure fair evaluation. As the attendance time is the most suitable time reference, all future expenses must be adjusted to their PV. Discounting refers to the application of a selected discount rate such that each future cost is adjusted to present time, for instance the time when the judgment is made.

To sum up the procedure of converting streams of benefits and costs over time in the future back to a correspondent "present value" is called discounting.

2.7 Discount rate

PV uses a discount rate to discount upcoming costs to present day value. In order to be able to integrate and evaluate cash flows that are incurred at different times during the life cycle of any project, they have to be made time-equivalent. To construct time-equivalent cash flows, the LCC technique changes them to present values by discounting them to a certain point in time, generally the base date. The interest rate used for discounting is a rate that shows an investor's opportunity cost of money over time, meaning that a depositor, investor or shareholder wants to get a return at least as high as that of his/her next best investment. Therefore, the discount rate stands for the investor's minimum satisfactory rate of return.

2.8 Net present value (NPV)

The Net Present Value (NPV) of an alternative is the summing up of all the positive and negative flow of cash (primary costs, replacement costs, residual cost values, operating and maintenance costs, repayments, etc) that can happen over the time span of analysis and is changed to present time value of Dollar. The alternative or a group of alternatives with the highest NPV is the most gainful and satisfactory choice from the cost point of view.

Engineers always would like a simple and single value, criteria for a project; the answer for life cycle cost is using net present value. NPV is the current value of profits minus current value of expenditures. Projects with the highest NPV are generally the winner.

Often for incremental changes on a project, there are not enough details to arrive at a positive NPV. Therefore many improvement projects must be selected on the smallest amount of negative NPV from many alternatives.

As an example, if there is a project with the following cash flows shown in table 1 and with 9% discount rate, the NPV for this project will be negative:

Table 1: Cash flow table for project 1

Year	Cash flow
1	$2,900,000
2	$1,175,000
3	$1,886,000
4	$243,000

$$\text{NPV} = \$\text{-}2900000 + \frac{\$1175000}{(1+0.09)^1} + \frac{\$1886000}{(1+0.09)^2} + \frac{\$243000}{(1+0.09)^3} = \text{-}\$46969.62 \text{ (Negative)}$$

And for another project with the following cash flows shown in table 2, during 4 years with 12% discount rate, the NPV will be positive.

Table 2: Cash flow table for project 2

Year	Cash flow
1	$1,750,000
2	$975,000
3	$830,000
4	$333,000

$$\text{NPV} = \$\text{-}1750000 + \frac{\$975000}{(1+0.12)^1} + \frac{\$830000}{(1+0.12)^2} + \frac{\$333000}{(1+012)^3} = \$19229.45 \text{ (Positive)}$$

2.9 Category of TVM applications

The six fundamental types of TVM problems are explained in the following paragraphs. These problems can be discussed in terms of the basics that introduced before to illustrate problems as well:

a) The direction in time that cash-flows are changed to comparable values,

b) Whether there is a single cash flow type or a frequent and repetitive series,

c) The decision for unpredictable or unidentified value of the problem.

The first three categories are related to compounding, or the change of current values and series benefit or costs to future values. The rest of the categories contain discounting, or determining PV of future cash flows. The first and fourth Category affects single payment problems and varies just by whether the FV or PV is being required. Second and fifth categories are used to deal with series payments. Third and sixth categories are used where the amount of the output in a series is being required and When the full amount value of the series of payments is previously known at some point in time. Therefore, they vary from second and fifth category correspondingly only by which one is the unidentified or decision variable in the investigation. In each one of the cases, once the suitable category is recognized for the answering a problem, the related method can be rearranged to answer different alternatives of the problem. These six problem categories are expressed more detailed in the following scenarios:

2.9.1 Single-Payment Compound Amount (SPCA)

It states the problems that contain an identified single primary cost putted in at specific interest rate and compounded at a standard basis. It is employed when it is required to identify the value to which the primary investment will increase by the end of a specific period of time. For instance saving deposit account which gives interest is correspond to

a SPCA problem. It is used when it is desired to determine how much a primary invest will increase to the finishing of a particular time stage. Variables of the method employed to answer this problem can be used to decision of:

a) The time taken for an investment to twice amount of money at a specific interest rate,

b) The yield on an investment that doubled in value over a known period of time.

According to Bruce J. Sherrick et al. formulas of each type are: (Bruce J. Sherrick, 2000)

$$F = P\ (1 + i)^n \tag{3}$$

Where:

F: Future value

P: Present value

i: Constant interest rate

n: Number of years or periods

2.9.2 Uniform Series Compound Amount (USCA)

This type belongs to the problems that include identified intervallic outflows at a common interval into an “interest bearing account” or “interest paying investment” that allows interest to be reinvested into the project. It is used to solve for the FV that this method for outflows of deposits increases into at compound interest, while continued for the particular span of time.

One example for this type is finding an amount of money for a retirement account anticipated if periodic monthly deposits are made into an “interest paying investment account”. Solving alternatives of this problem are:

a) When will an account have some specific amount of value if periodic investments of known amount are paid with a constant interval and a known interest rate?

b) What rate of return (ROR) is required if specific periodic payments are paid into an account and a specific future amount is required?

$$F = A\,[((1 + i)^{n} - 1) / i] \quad (4)$$

Where

F: Future value

A: Uniform amount per period

i: Interest rate

n: Numbers of periods

2.9.3 Sinking Fund Deposit (SFD)

A third type of the compounding problem happens while the aim is to pay regular uniform payments that will produce a predefined much of money by the end of a known span of time. The compound interest rate and the number of payments to be pay are defined, but the amount of the required payments is not known. For instance, a father decides when his baby is born; invest a monthly investment toward a college education. If the objective is to have $50,000 at the end of eighteen years, based on SFD method and knowing the interest rate it can be determined the amount of the required monthly investment to reach that objective.

$$A = F\,[i / ((1 + i)^{n} - 1)] \quad (5)$$

Where:

A: Uniform amount per period

F: Future value

i: Interest rate

n: Number of periods

2.9.4 Single-Payment Present Value (SPPV)

SPPV problems contain computation to get the answer for the discounted worth of an upcoming single expense or any type of cost that result in an equal value in exchange at the present time. Getting an answer for the present worth of certain or given future payment is the opposite of the problem of finding the FV of a certain PV. The direction in time toward which money is being changed is the only dissimilarity between SPCA and SPPV problems. For example it is used for determining the present value of a guarantee that a person makes to pay another person a certain amount of money in the future at today.

$$P=F/(1+i)^n \tag{6}$$

2.9.5 Uniform-Series Present Value (USPV)

In such these kinds of problems, some outflows of the same size are to be expected at other points of time in the future, and the PV of the all series of outflows is being required. Even though this type of problems is practically like to a series of single payment PV problems, the formula employed is too much easier if the outflows can be converted as a series. For instance, computation of the PV of a group of planned retirement payments, a series of sales revenues, or another condition in which there is a series of upcoming cash inflows.

$$P = A\,[((1 + i)^n - 1) / (i\,(1+i)^n] \tag{7}$$

Where:

P: Present value

A: Amount per interest period

i: Discount rate

n: Discount periods

2.9.6 Capital Recovery (CR)

The capital recovery problem directly associated with the USPV and it is also famous as the loan paying back problem. In this type, the amount of loan which must be repaid or present value is known and the interest rate on owing left over principal is known. The amount of the same payments which covers both interest and principal is required and it must be made each time phase to accurately retire the whole remaining principal with the last payment.

$$A = P\,[(i\,(1 + i)^{n}) / ((1+ i)^{n} - 1)] \qquad (8)$$

Where:

P: Present value

A: Amount per interest period

i: Interest rate

n: Discount periods

Chapter 3

FEASIBILITY REPORTS

3.1 Introduction

A feasibility report is a study of the practicability of an idea. It focuses on helping answer the important question of “should we go on with the planned project idea?” All activities of the report are intended for helping answer this question.

Feasibility reports can be used in many ways but mainly focus on planned business projects. Engineers and anybody who has a business construction idea should perform a feasibility study to determine the practicality of their idea before going toward the development of a construction. Determining that the business idea of the project will not work, it can prevent time and cost overrun before inception.

Also a feasibility report is engineering studies based on engineering investigation, which offers enough information to decide whether or not the project should be continue to the final engineering and construction phase.

When a construction project is planned, a feasibility study will be performed to review the strength and failing points of the project objectively. The feasibility report will consist of the expected costs, potential financial benefits, effects on the surrounding area of the project including adjacent structures and environment, the viability of the

proposed design, the site conditions, and other reports to help in deciding whether the project will provide a proper return for the required time and resource investment.

In case of major large projects, there are no routine answers. At the beginning of any capital construction project, it is important to establish whether the elements of location, market conditions, financial, and design merge to produce a viable result that will meet owner's requirements.

The feasibility study characterizes how the construction objective is to be accomplished, what kind of risks is included and if there is any special safety, expertise or building considerations needed. With constructing on detail information of market conditions, it can be developed feasibility reports that evaluate everything necessary for a project to function, providing the information necessary to make vital business and investment decisions.

Generally a feasibility report includes:

a) Complete cost/benefit studies expected throughout the life of the project
b) Assessment of market trends,
c) Area-specific set of laws,
d) Impact appraisal and mitigation costs,
e) Identify and assessment of risks related to constructing on a site,
f) Residual land and construction value costs for future projects,
g) Help on determining whether to continue or reject a development opportunity.

3.2 Importance of feasibility report

A feasibility reports main purpose is to evaluate the economic viability of the projected business. The feasibility report should answer the question: "Does the proposed project make economic sense?" The report should provide a careful analysis of the business opportunity, including a look at all the potential obstructions that may stand in the way of the project's success. The result of the feasibility report will specify whether or not to proceed with the proposed project. If the results of the feasibility study are positive, then the owner can proceed to develop a business plan.

If the outcomes show that the project is not a good business idea, then the project should not be followed. Although it is not easy to accept a feasibility study that shows such results, it is much better to find it out sooner rather than later, when more time and money would have been invested and lost.

Regularly, the steering committee of any project may face resistance from some members on the need to do a feasibility study. Many people will think that they know the proposed project is a good idea, so why it is needed to perform a costly study just to prove what they already know?

The feasibility study is vital because it makes the assessment team to put their ideas on paper and to assess whether or not these ideas are reasonable. It also makes the team to begin formally assessing which steps to take next.

Also The employment of a feasibility study has often helped companies in understanding which projects to contract and which ones to discard before investing money and time in a project that shows no promise of gaining revenue.

3.3 Who will prepare feasibility report?

The clients or governmental agencies normally employ a consultant company to conduct the feasibility study. Since the consultant company is not dependent on the two sides of the project, it is in a better position to offer an objective analysis of the proposed project. The consultant should have a good understanding of the constriction industry as well as the new technologies and business models. Consultant's previous experience should be directly related to work.

3.4 Objectives of feasibility study

Feasibility reports are the first study and evaluation on the potential profits associated with undertaking a specific construction project. The key objective of the feasibility study is to think about and assess all factors linked with the project, and decide if the investment of time, cost and other resources will reach to a suitable result. While carrying out a primary study, it is not unusual for a feasibility report to be highly detailed in depth.

When a company is considering a new operation or the taking of a new project, the feasibility study is a logical tool to utilize before any resources are invested in the new project. One of the most essential aspects of the study is to make sure that all amount of monetary investment required to successfully bring the project to achievement is considered. Frequently, this will include addressing components such as labor,

construction, construction facilities, and the cost of raw materials. After determining the total cost of the project the study can progress to the next level.

In the second part, the feasibility study will also deal with costs and other issues that are indirectly related with the project. The general idea of feasibility studies is to make sure that there is a reasonable understanding of what will be vital to be done in the project and also effectively cost-effective project.

In brief the main objectives of feasibility report are to report about the following issues:

1) What are the achievements of the proposed project?
2) Who will be concerned in operating the projected project in the organization or company?
3) The benefits that project will give.
4) The estimated cost of the project.

3.5 Contents of feasibility reports

Feasibility studies assess three main scopes of any project that has to be evaluated:

1) Concept of the project,
2) Economical viability,
3) Financial viability.

The conceptual viability relates to the business plan and its functionality with respect to the use of space, departmental functions and all the things about the way to conduct the project.

The economical viability is related to the benefit and cost resulting from the subtraction of outcomes from incomes.

The financial viability studies and focuses on the investments configuration of financing and computes the ratio between equity and amounts outstanding, loan payment capacity, Internal rate of return (IRR), PV and NPV.

The content of feasibility and pre-feasibility reports differ from project to project. In common, a general introduction provides a clear picture of the project, the purpose and goals, limitations and the parties involved. The content of a feasibility study will depend on the range and size of the project. For smaller projects, the feasibility study may be a few pages, containing short answers to the governmental and legislation requirements, but for large projects it may be too much more pages. For small projects it may includes as follows:

a) Project objectives;
b) Expected benefits
c) The planned procurement technique
d) The time-frame for execution of the project

For large projects, especially those to be implemented as a lease or Build-Operate-Transfer (BOT) and/or with special considerations it should be done in more complete and inclusive format. For large projects the following should be added:

a) Technical study and evaluation,
b) Economic and financial appraisal,
c) Social and environmental analysis.

In general things to be studied and reported in the feasibility study should includes:

a) The organizational chart;

b) Shareholders, users, policies, objectives;

c) Troubles with the current system;

d) Objectives and other requirements for the new project;

e) The problems to be solved;

f) Achievements;

g) Limitations of the project;

h) Possible options;

i) Different or special project alternatives for solving the mentioned problems;

j) Advantages and disadvantages of the alternatives;

k) Is this project feasible or not?

l) Which one of the alternatives is favored?

Figure 1 shows an overview of the steps and content of a feasibility study.

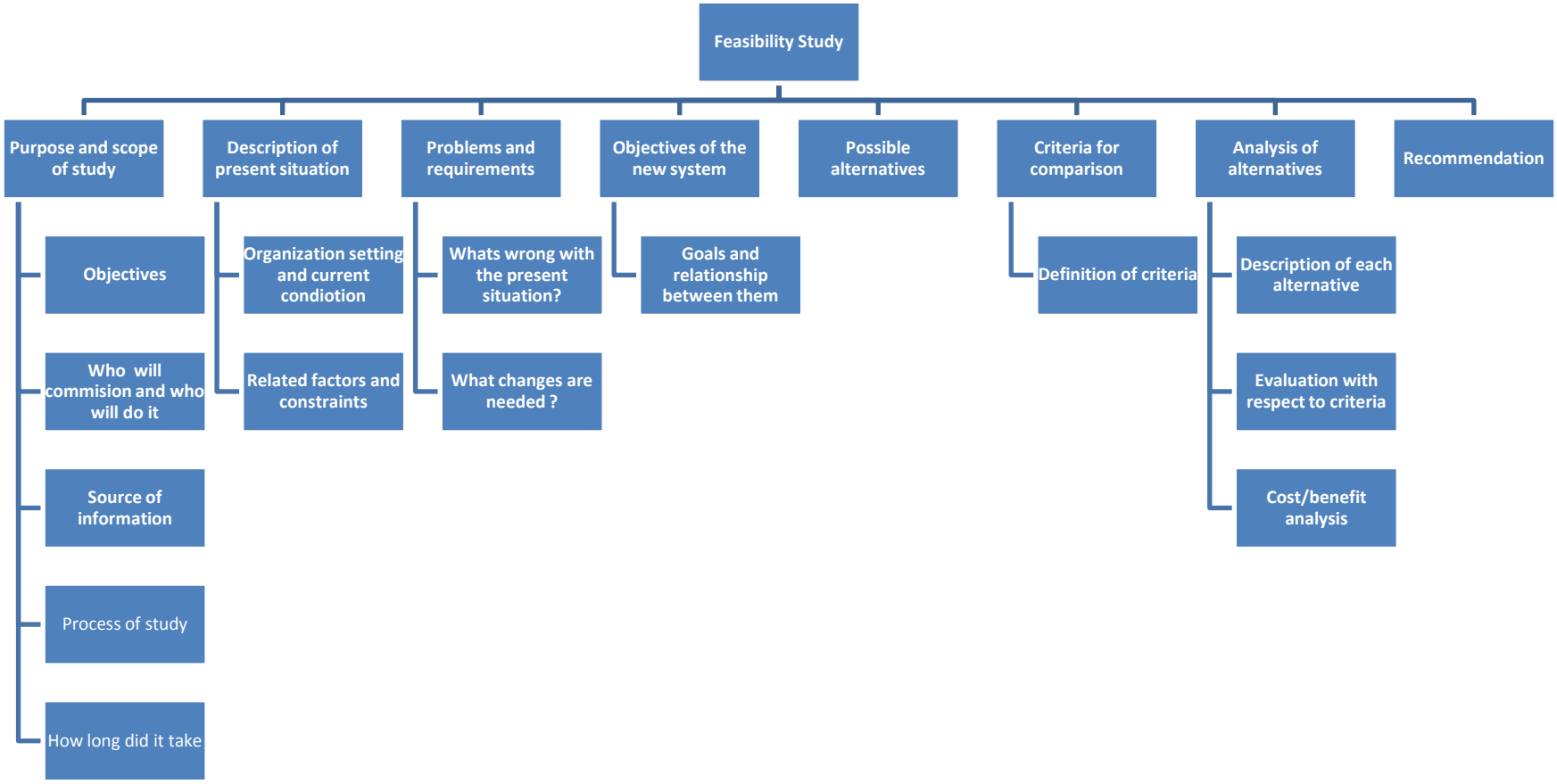


Figure 1 : Steps of a feasibility study

3.6 Types of feasibility reports

Feasibility studies can be grouped and categorized into:

a) Economic feasibility

b) Technical feasibility

c) Operational feasibility

d) Schedule feasibility

e) Legal and contractual feasibility

f) Political feasibility

3.6.1 Economic feasibility

Economic feasibility reports are necessary during the early progress of any project and form a vital part in the construction development route. Accounting and advice-giving feasibility reports facilitate companies and organizations to evaluate cost and benefits of projects before financial capitals to be paid.

According to the information presented in the economic feasibility report, a business case is used to encourage the audience that a specific project should be implemented. It is frequently a precondition for any funding approval. The business case will detail the explanations why a particular project should be undertaken and has higher priority than others. It will also summarize the strengths, weaknesses and validity of guesses as well as evaluating the financial, none financial and economical costs and benefits and essential preferred options.

An economic feasibility report can help companies, organizations and governmental agencies to:

a) Identify the business necessities that must be met by the prefered project and include the critical outcome and income success factors for the project
b) Detail different approaches that will meet business requirements, including comparative cost and benefit.

Economic feasibility report is also called cost-benefit analysis and focuses on calculating the project costs and benefits. It uses the concept of time-value of money (TVM) which compares the present cash outlays to future expected returns as well.

3.6.1.1 Answered questions in economic feasibility

a) Is the project achievable, with given resource limitations?
b) What are the benefits of doing the selected project?
c) What are the development and operational costs of the project?
d) Are the benefits worth the costs of the project?

3.6.2 Technical feasibility

Technical feasibility focuses on company or organization's capability to construct the projected project in terms of operating environments, project size, difficulty, experience of the organization in handling the comparable types of projects and the risk analysis.

3.6.2.1 Questions to be answered in technical feasibility

Technical feasibility of a project generates information and answers the following points:

a) Availability of the technology to implement the project,
b) Explanation of feasible technical options for project,

c) Identification the problems and issues that linked to the technical completion of the project,
d) Achievability of the project with existing technology or the anticipated technology,
e) Technical risks which may be happened during the project,
f) Skill requirements to take up the project,
g) Right tools and equipments to take up the project,
h) Essential trainings for different parts of the project.

3.6.3 Operational feasibility

Operational feasibility deals with assessing the degree to which a planned system solves project troubles. Operation feasibility also identifies the importance of the problem and the adequacy of any way out. It includes social issues including internal issues such as manpower problems, labor protests, manager conflicts, organizational resistance and policies; and also external issues, like government policies.

3.6.3.1 Answered questions in operational feasibility

The important questions that help in testing the operational feasibility of a project are following:

a) Does administration support the project?
b) Are the users happy with in progress project?
c) Will it reduce the operational time considerably? If yes, then it is welcome to change and implement with the new system.
d) Have the users participate in the planning and development of the project? Early involvement decreases the likelihood of resistance towards the new system.

e) Will the proposed system in reality benefit the organization?

3.6.4 Schedule feasibility

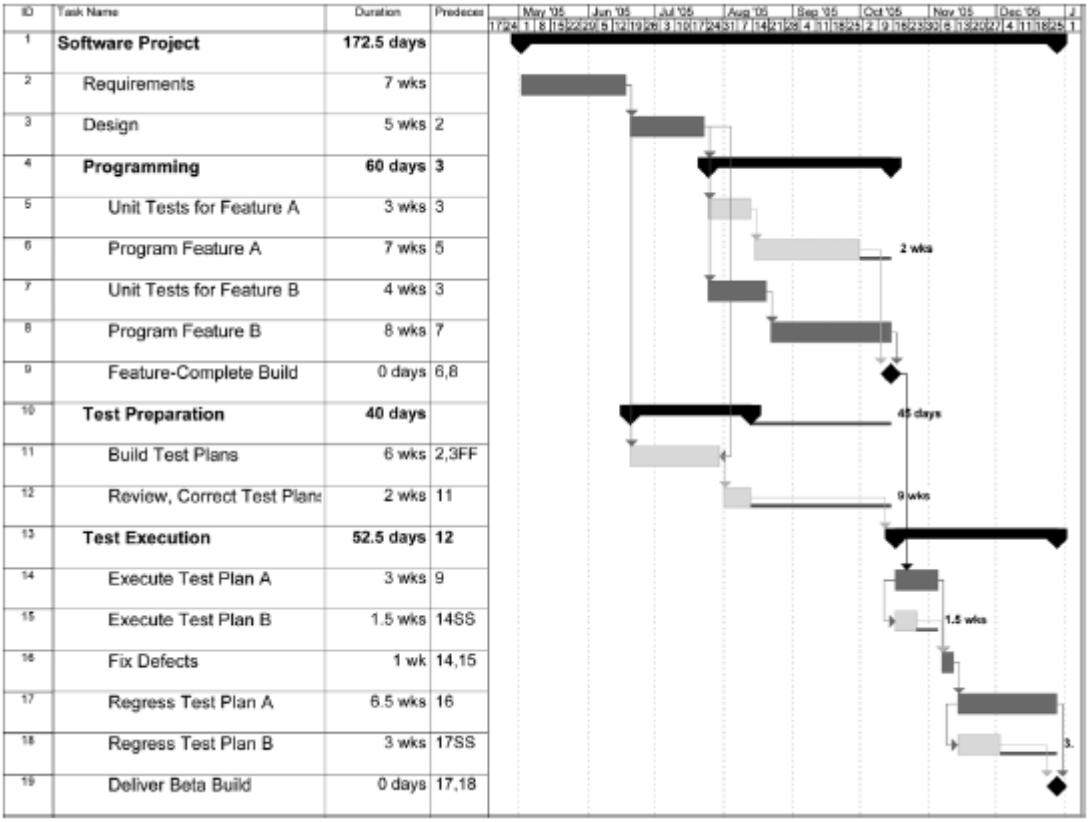
A schedule is a record of events that must happen at a specific period of time. When projects are put on a schedule, there is a time closing date or preferred completion date set. Schedules are essential to making sure the right beginning and finishing time of any project and activities during the project execution phase. The feasibility of a schedule is the likelihood of the project being accomplished by the due date or deadline of the project.

Some projects are commenced with specific closing date. It needs to determine whether the deadlines for the project are mandatory or not. The analyst can recommend different schedules if the closing dates are desirable rather than fixed. Often in projects contractors may have the knowledge and new technologies, but it does not indicate that they have the ability required to appropriately apply that technologies and finish the project on schedule.

The schedule feasibility shows the expected time to complete the project. This includes the schedules of each activity in a project and the total project time. It can change if unforeseen challenges occur.

A schedule could be arranged with a Gantt chart, which demonstrates the areas, steps forward and time distribution of the system (Figure 2).

The objective of schedule feasibility is to split the tasks and time in an accurate way, then execute the project to come to end effectively.



ID	Task Name	Duration	Predecessors
1	**Software Project**	**172.5 days**	
2	Requirements	7 wks	
3	Design	5 wks	2
4	**Programming**	**60 days**	**3**
5	Unit Tests for Feature A	3 wks	3
6	Program Feature A	7 wks	5
7	Unit Tests for Feature B	4 wks	3
8	Program Feature B	8 wks	7
9	Feature-Complete Build	0 days	6,8
10	**Test Preparation**	**40 days**	
11	Build Test Plans	6 wks	2,3FF
12	Review, Correct Test Plans	2 wks	11
13	**Test Execution**	**52.5 days**	**12**
14	Execute Test Plan A	3 wks	9
15	Execute Test Plan B	1.5 wks	14SS
16	Fix Defects	1 wk	14,15
17	Regress Test Plan A	6.5 wks	16
18	Regress Test Plan B	3 wks	17SS
19	Deliver Beta Build	0 days	17,18

Figure 2 : Gantt chart

3.6.4.1 Answered questions in schedule feasibility

Objective of Schedule feasibility is answering the major time associated questions as below:

a) Is there right prediction of time for the project?

b) How practical is the project timetable?

c) Does the project accomplished in the anticipated time?

d) Does it take into consideration the national holidays, team or individual leaves?

e) Are specified deadlines optional or not?

3.6.5 Legal and contractual feasibility

The legal and contractual feasibility is the procedure of assessing the possible legal and contractual effects and results due to the construction of a projected system.

Legal and contractual feasibility relates to issues like, copyright laws and labor laws. It also contains study relating to contracts, liability, violations, and other legal problems frequently unknown to the technical employees.

3.6.6 Political feasibility

The political feasibility is the results of evaluation that how key shareholders and beneficiaries within the organization or government view the proposed system. Political feasibility finally evaluates how the main stakeholders within the organization view the proposed system.

3.7 Advantages and disadvantages of feasibility reports

The feasibility study is the vital step in any construction industry projects. That is because it makes study of different features like cost required to put into practice and execute the project and the time required for each stage and activity of the project. If these significant factors are not studied then without doubt it would affect the organization or contractor and the development of the project would not be a success. So for managing the project and the organization effectively, this stage is a very important stage in any construction project. Feasibility study is also known as project requirement analysis. In this stage, analyst team has to contact clients and analyze their requirement and evaluate the system. By making study in this way it would be possible to make a report for the area of complexities in the project. By making a detailed evaluation and assessment in this area a detailed document or report is prepared in this phase which has

details like project plan or schedule of the project, the cost forecast for developing and performing the project, target dates for each stage of delivery of project.

There are many advantages of performing a feasibility study before any project.

3.7.1 Advantages

One of the significant advantages of any feasibility study is that it does not pay attention only to a single area or some of the particular areas of the project. Some of advantages are summarized below:

a) It facilitates recognizing the risk factors involved in executing the project.
b) It assists in planning for risk analysis.
c) It helps in performing cost and benefits analysis which assists the organization and project to run effectively.
d) It facilitates making training plans to execute the project.
e) Helps if the company can manage to pay for the project.
f) Helping if the company has enough resources to implement the project.
g) Assisting if the project has good enough return on investment (ROI).
h) Helping if the company has enough time to do the project.

3.7.2 Disadvantages

a) Predicted income and outcome that are included in projected financial reports are all depending on future prediction which is extremely uncertain.
b) For the large to small projects it requires extensive documentation.
c) For regular projects historical data may be complex or subjective.
d) Cost of preparing the feasibility report.

Chapter 4

QUESTIONNAIRE

4.1 Introduction

A questionnaire was developed to investigate and assess sensitivity of owners, consultants, and contractors to the importance of causes that affect the time, cost, quality and health & safety of the construction projects. Factors making time and cost overruns in construction projects were first identified and examined through the questionnaire.

This questionnaire survey was targeted at 70 participants using the simple sampling technique. The response rate for the questionnaire survey was 63%.

4.2 Questionnaire design

This research has implemented field survey methodology to uncover factors influencing delay, cost overruns, low quality and health and safety issues arising during construction stage. To identify the delay and cost overrun factors in construction industry, literature reviews and case analysis were carried out. After that, a questionnaire was prepared. The designed questionnaire was randomly distributed to major construction parties (owner, consultant and contractor) in different countries. For each factor, the respondents were requested to answer the severity impact of it on the time, cost, quality and health and safety. A five-point scale of 0 to 4 was considered for evaluating the

impact of each factor. These numerical impact values are assigned to the respondents' rating:

0: Not significant;

1: Slightly significant;

2: Middle;

3: Very significant;

4: Extremely significant.

In the structured part of the questionnaire, 46 causes drew which were listed in 7 respective categories (Appendix 1).

4.3 Questionnaire content

The questionnaire included seven parts that related to the factors of time, cost, quality and health and safety.

Parts of the questionnaire are:

1) Factors related to management of work
2) Economic factors
3) Factors related to owner-client
4) Factors related to consultant of the project
5) Factors related to contractor of the project
6) Factors which are related to material, manpower and equipment
7) External factors

4.4 Organization profile

Seven general questions were prepared on information about company such as the name of company, major type of work, gender of the worker, the contact person and his/her experience, age of the respondent, a question about where the respondent works in and his/her position.

4.5 Profile of Respondents

Face-to-face delivery was favored to encourage respondents and raise the response rate but another way like email also employed. A total of 70 questionnaires were sent to construction professionals involved in large projects.

4.5.1 Gender, age and location

91% of contributing persons were male while the rest 9% were female. The age average of participants was between 30 to 40 years while the dispersion of the working country of them was as 79% from Iran, 16% from Turkey and Northern Cyprus and the rest from Bosnia Herzegovina and Netherland.

6.2.2 Company type of respondents

The contributions of respondents were (Figure 3):

a) 70.5 % contractors,

b) 18.2 % consultants,

c) 11.3 % Owners

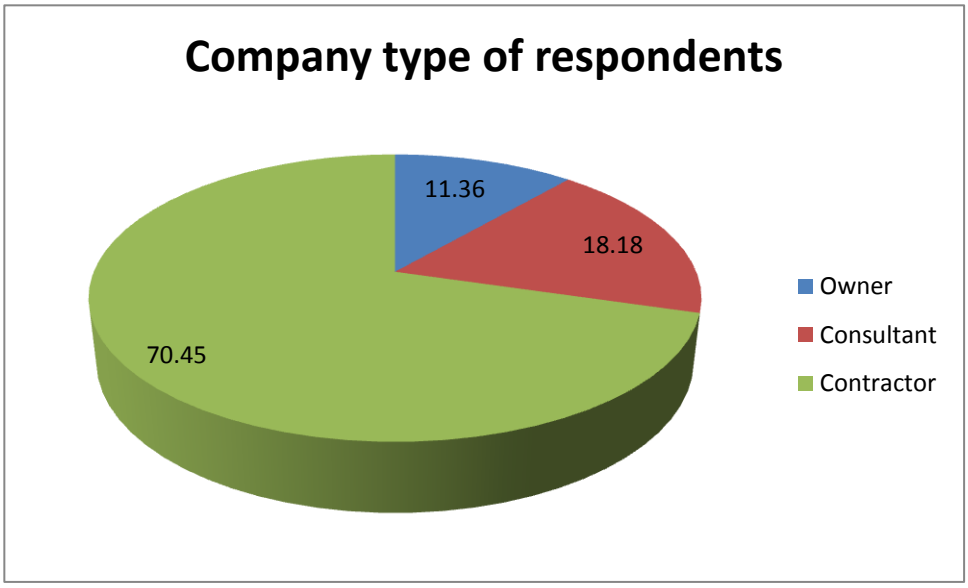


Figure 3 : Company type of respondents

4.5.2 Work experience of respondents

Figure 4 shows work experience of respondents. 29.5% of respondents have 1 to 5 years, 40.90%, 6 to 10 years, 27.30%; 11 to 20 years and the rest have more than 20 years of civil engineering related working experience. It would be better if the percentage of respondents whose experiences were 10 years or more could be increased. However it has to be mentioned that a large number of young practitioners have been graduated in recent years to meet the increasing demand in construction industry demand, and they have got high positions in their organizations. This is the most important factor which makes the results of the questionnaire reliable.

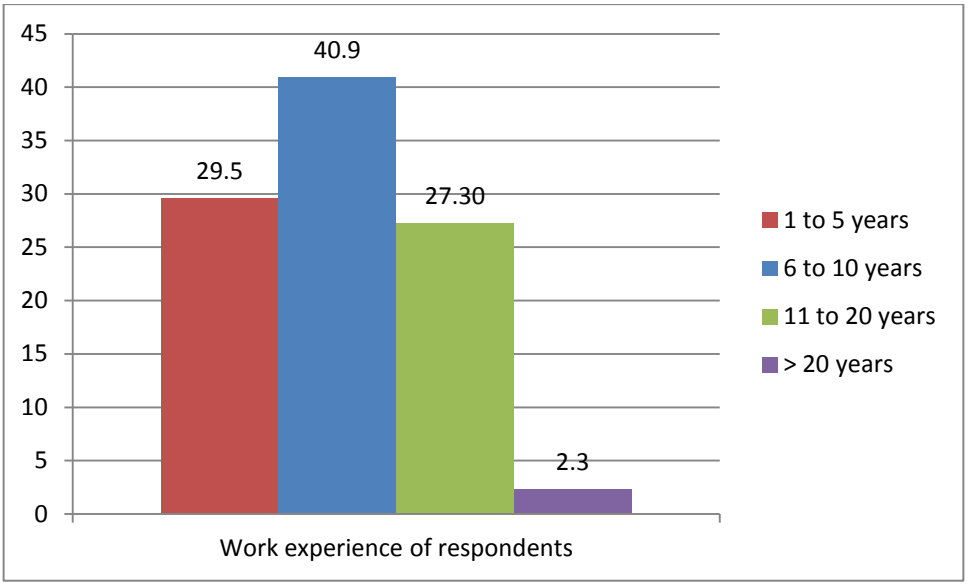


Figure 4 : Work experience of respondents

4.5.3 Position of respondents

Figure 5 shows the respondent's contribution in questionnaire based on their position at organization or companies they are working are as below:

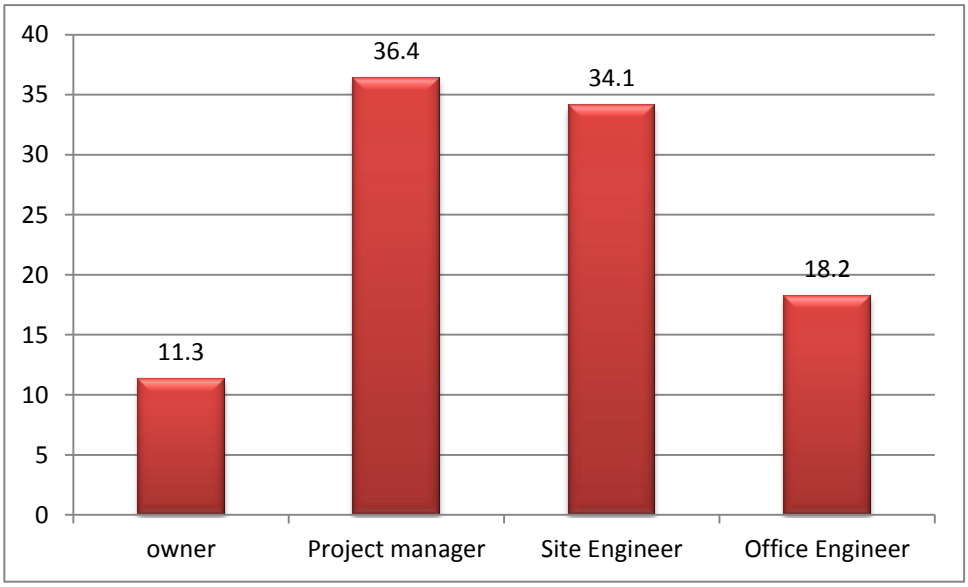


Figure 5 : Position of respondents

4.5.4 Participants major type of work

Regarding type of projects, Figure 6 shows dispersion of the respondent's major type of the work as 79.5% building, 6.9% roads and airport band, while 13.6% of participants are working in water and sewerage related projects.

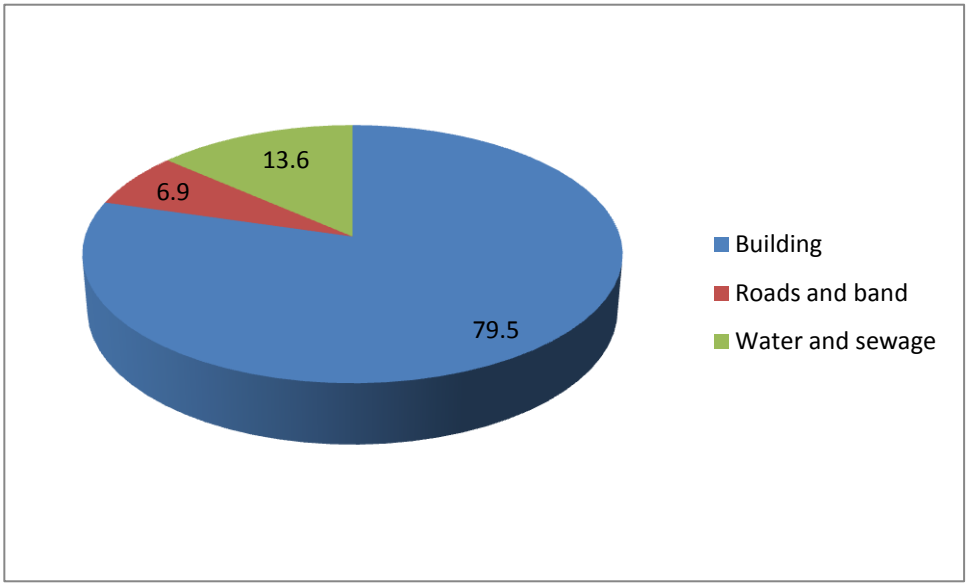


Figure 6 : Type of work

4.5.5 Educational level

Participant's level of academic studies is another factor which makes the results more reliable. 22.7% of respondents have bachelor degree, 63.6% have Master of Science degree and 13.7% have PhD degree.

4.5.6 Experience versus type of work

Table 3 shows that 29.54% of the respondents have experience between 1 to 5 years in civil construction works and 40.92% of respondents have experience between 6 to 10 years, 27.3% of respondents have experience from 11 to 20 years, and 2.3% have experience more than twenty years. This table also indicates that most participants are

contractors with (70.45%) where 34.10% of them are engineers with experience between 6 to 10 years.

Table 3 : Experience versus type of work

	1-5	**6-10**	**11-20**	**>20**	**Total**
Owner-Client	2.27 %	4.55	4.55	0	11.37 %
Consultant	11.36 %	2.27 %	4.55 %	0	18.18 %
Contractor	15.90 %	34.10 %	18.18 %	2.27 %	70.45 %
Total	29.54 %	40.92 %	27.28	2.27 %	100

Chapter 5

CASE STUDIES

5.1 Introduction

Duration and cost at project closing date are the two criteria of successful project and project management. Most civil engineering, regularly, large construction projects have met delays and cost overruns. In this chapter cause of delays and cost overruns in 28 large civil Engineering projects with WB, AFDB and ADB has been derived. Causes of delay and cost overruns in these projects were analyzed and ranked with respect to frequency and importance indices.

Factor analysis technique was applied to the causes, which categorized in seven categories: factors related to management of work, economic factors, factors related to owner of the project, factors related to consultant of the project, factors related to contractor, factors related to material, man power and equipment and the seventh category is external factors. These findings might encourage practitioners to focus more on delay, cost overruns, quality and health and safety problems that might have existed in their projects.

5.2 Project completion

A project is considered as finished when its services and components are significantly completed and are ready to operate.

5.3 Time overrun

When an operation faces a delay owing to a late start or late finish of previous activity, the proceeding activities will also experience a late start and cause extra time to the project. Late start of execution of the project or late finish of construction phase of the project and commissioning of it may lead to delay. Time overrun occurs when a project is finished later than the original estimated time.

5.4 Cost overrun

Cost overrun occurs when the actual cost for the project is more than the estimated cost.

5.5 Projects

In this part, twenty eight large scaled construction projects were selected as case study. The projects were selected based on the types of the projects and availability of feasibility stages predicted data and actual time and cost. All projects have been financed by WB, AFDB and ADB. Selected project types are new construction, reconstruction and improvement of the existence facilities. In this chapter, the objectives of each project and causes of time overrun and cost overrun will be discussed.

5.5.1 Road reconstruction and improvement project

This project has been implemented in Republic of Honduras. According to WB's Implementation completion results and report (The World Bank, 2007 A):

5.5.1.1 Objectives

The objectives of the project were:

a) To repair roads damaged by Hurricane Mitch, happened in Honduras at year 1998.

b) To improve trade corridors

5.5.1.2 Time overrun

There are some reasons for delays in this project. The process for selecting and signing contract with the consulting companies in charge of project management and external inspection took longer time than estimated and delayed the start up of the project. In both processes, Government of Honduras was slow to approve the contracts, resulting in delays of approximately one year.

5.5.1.3 Cost overrun

Most of the civil works performed under the project faced cost increases in compare with estimations. These increases were attributable to a variety of causes such as:

a) Additional activities identified for the period of work which were not considered in stage of road engineering designs,
b) Changes required because of problems in engineering designs,
c) Considerable lags between the dates of design and works execution,
d) Price changes.

Total actual cost of this project was $118.2million.

5.5.2 Shaanxi roads development project

This project has been implemented in Republic of China. According to the ADB completion report (The ADB, 2010):

5.5.2.1 Objectives

The key objective of the project is to speed up the economic development in the region and thereby decrease poverty in Shaanxi Province. Also this project was planned to:

a) Get better access of farming and manufacturing products to markets;
b) Improve entrance of the rural population to economic opportunities, employment, and public services;

c) catch the attention of investors by lowering transport costs in the project region;

d) Reduce road traffic and accidents on existing roads.

5.5.2.2 Time over run

At appraisal stage, the highway was designed as a 176-km four-lane, access-controlled toll highway. Highway civil works started in December 2002, about 12 months after the original schedule due to delayed loan effectiveness. The highway was completed in September 2005 as indicated by the appraisal schedule. The construction stage was shortened by about 12 months by successful and efficient project management, administration and utilizing advanced construction methods and new materials.

5.5.2.3 Cost overrun

The actual project cost was $965.50 million, which was $208.50 million above the appraisal estimation. Apart of highway, local road development was increased from 627 km at appraisal to 1,605 km at the end of the project. A few highway civil works activities caused some major deviation due to geotechnical difficulties and design changes.

5.5.3 Third road rehabilitation and maintenance project

This project has been implemented in Republic of Nicaragua. Based on the World Bank report (The World Bank, 2007 B):

5.5.3.1 Objectives

The key objectives of the Project were to:

a) Get better transportation roads network along selected international roads;

b) Get better access to productive farming regions and to rural parts.

5.5.3.2 Time overrun

The project's closing date was initially scheduled for December 31, 2005 but was extended three times, for a total amount of 18 months. The initial extension was granted until June 8, 2006 on the basis of the previous delays that happened due to extreme and untimely rainfalls, the complicated political and economic climate, and the periodic shortages of corresponding monetary resources. The second addition of time for completing the project granted until December 30, 2006 to permit the completion of civil works affected by the continued untimely rainfalls. Finally, the project completion date was changed to June 30, 2007 to permit the conclusion of studies and consulting services related to the Regional Environmental and Social Analysis (RESA) needed for the proposed Naciones Unidas- Bluefields road improvement.

5.5.3.3 Cost overrun

The major civil works contracts for the rehabilitation of the Managua-Izapa and the Muhan-El Rama road sections were fully completed and put into operation within the project implementation period, with no significant cost overruns. Total actual cost of this project was $88.7million.

5.5.4 Road maintenance and development project

This project has been implemented in Government of Nepal. As reported by WB in the ICR (The World Bank, 2007 C):

5.5.4.1 Objectives

The original project development objectives as outlined in the appraisal and completion report were to:

a) Reach to sustainable maintenance, reconstruction and construction of cost effective roads in road network;

b) Get better access to region head offices, decrease motor vehicles transportation costs and delays in project region;

c) Make rural employment throughout using labor-based industries; and

5.5.4.2Time overrun

The Project closing date was extended twice and approved by the Regional Vice President. During the second restructuring, it was extended by 24 months from December 31, 2004 to December 31, 2006 to complete the increased scope of work which had been added in the first restructuring. The project closing date was extended for the second time by six months from December 31, 2006 to June 30, 2007 to complete the remaining works which had been disrupted during the intensified conflict and ensuing political disturbances in 2005 and early 2006.

5.5.4.3 Cost overrun

The most significant changes in cost made in the restructurings were:

a) Changes in the scale and scope of works in different components,

b) Increase in International Development Association's share of funding (during the first restructuring),

c) Reallocation of unspent funds from the cancelled activities to components which could be implemented successfully but had been under-funded due to public sector budget crisis.

Total actual cost of this project was $59.14million.

5.5.5 Airport Development Project

This project has been implemented in Government of Philippines. As stated in the completion report (The ADB, 2005):

5.5.5.1 Objectives

The objectives of this project were to improve and construct bigger airport to make trusted and safe all-weather operations including landing and departure of planes that obey the standards of the International Civil Aviation Organization (ICAO) and to eliminate existing airport's problems, which were limiting the expansion of domestic and international air services. This project contained airside and landside civil engineering operations, supply of equipment, training of equipments and consulting services.

5.5.5.2 Time overrun

At assessment stage, the grant of the agreement between client and contractor for civil engineering and operation in airside was planned for February 1996 and the initiation of operations for May 1996. However, beginning of construction was postponed by 28 months until September 1998. The key cause for this postponement was the slow movement of the land purchase. At assessment phase, the apparatus setting up had been scheduled from July 1996 forward. It actually began only in the first 4 months of 2001 with a postponement of above 42 months owing to slow procurement. All of the works was finished in December 2003 against the June 1999 completion date as predicted at appraisal stage, with a delay of 3 years and 6 months.

Additional delays that occurred earlier than the beginning of the construction which were less important than the delay of land acquisition were attributed to:

a) The slowness in employment of consultants for more in depth design work and construction management;

b) The time taken to review prequalification and official tendering documents by the Department of Transportation and Communication (DOTC) and the Project Implementation Unit (PIU);
c) The slowness of the approval process of the prequalification stage;
d) Poor communications between DOTC and PIU with ADB and the project consultants;
e) Bad weather conditions with unusual high raining in 1999;
f) Low speed of procurement progress for the airside and landside civil engineering activities;
g) Low speed process of works on the passenger terminal structure when Structural damages were recognized;
h) The consultant of the project discharged unilaterally by DOTC for six months attributed to disagreement on tasks and duties for the structural problems.

5.5.5.3 Cost overrun

The Project has been finished at amount of $121.41million while it was $16 million more than the appraisal phase estimation. The extra cost was attributed to plan and design changes that had been prepared after the project had initiated. $6 million out of the M$16 extra cost was the result of additional land acquisition; the other part of it was attributable to the repositioning of the terminal complex.

Some of the other extra expenditures were:

a) Near to $2million for the drainage construction;
b) About $1million for communications tower apparatus with advanced conditions than initially intended to buy;

c) About $1m more than estimated for buying Instrument Landing System (ILS) instrument due to procurement of a better one with advanced performance and specifications;

d) Increasing the time period of consultancy for consultants caused extra costs about $1 million attributed to long delays during and before project execution.

5.5.6 Gujarat emergency earthquake reconstruction

This project has been implemented in Republic of India. As reported by World Bank in the completion report of this project (The World Bank, 2009 A):

5.5.6.1 Objectives

The key objectives of the Project were to help Gujarat in implementation of the second phase of a program of repair and reconstruction in the region affected by the huge seismic activity on the first month of 2001including:

a) Repair of accommodation and public structures;

b) Reinstallation of basic road networks in the region.

5.5.6.2 Time overrun

The large quantity of reasons for delay affected each component of project differently. The main reasons were:

a) The scale of the housing reconstruction program drove a tight operational plan. Consequently, late starters - mainly in urban housing (or beneficiaries who experienced problems ‘out of the ordinary’) - were severely handicapped in completing their homes within the required period and budget. Furthermore, there was an extensive delay in the completion of urban plans for 4 towns, which concomitantly delayed the reconstruction of housing in the affected towns

b) The scope of the technical requirements in constructing dams (which included required retroactive engineering designs, approvals and lengthy approval processes) worked against the completion of works in three years. This was compounded by weak contractor capacity.
c) The innovativeness of the Disaster Management Program (i.e. its design in the absence of any experience both in the state and in India) also militated against timely completion of the component.
d) The original unrealistic 3-year implementation period was a contributory factor to the required extension.
e) Severe floods happened in 2005 and 2006.

5.5.6.3 Cost overrun

The total project cost at appraisal was $503.70 million and the actual amount of the completed project was $480.50 million, which is 4.5 percent less than the appraisal prediction. The lower cost and under-estimation for this project was mainly attributable to the cancellation of loan occurred in two installments, first in June 2005 to reallocate funds to the Emergency Tsunami Reconstruction project, and the second in January 2007 because of the potential savings arising out of reduced financing required for housing component of the project and favorable USD - INR (Indian Rupees) exchange rates.

5.5.7 Xieng Khouang road improvement project

This project has been implemented in Lao People's Democratic Republic. In reference with the implementation completion report by ADB (The ADB, 2006):

5.5.7.1 Objectives

The key objectives of the project were to:

a) Decrease transportation costs;
b) Make cost effective and maintainable all-weather access roads to the other parts of the country, mainly to most important marketplaces;
c) Enhance about 136 km of national road between Phou Khoun and Phonsavan;
d) Enhance about 131 km of road between Phonsavan and the Vietnam border;
e) Improve about 31 km of road between Phonsavan and Muang Khoun;
f) Enhancing about 100 km of selected feeder roads.

5.5.7.2 Time overrun

The finish date of the project was estimated to be on the end of June 2002, which was changed in the first extension to the end of December 2005. In the appraisal stage, the project was estimated to be executed over 5 years, containing preconstruction activities that had previously initiated under advance procurement phase in early 1997 and with construction being finished by the end of December 2001. Actual implementation took over 9 years, including preconstruction phase in 1997, until 31 December 2005. A significant reason of the delays in beginning of the civil engineering works was attributed to the selection of contractors through the prequalification procedure. A contractor was selected and contracted two contracts and tried to execute both of them with the same management, equipment, and human resources, resulting in major delays to construction. Another part of delay in this project was attributed to an addition of the project scope. There were other delay factors such as:

a) Delay in the contractors' equipment coming to the site of the project;
b) Slow getting ready works to begin the project;
c) Poor quality organization, scheduling and communication of contractor;
d) Bad weather circumstances.

5.5.7.3 Cost overrun

The total project cost at appraisal was $64.50 million and the real cost of the completed project was $60.74 million, which is 5.8% less than the appraisal prediction. The main reason for cost under-run was due to no physical and price contingencies in the project.

5.5.8 Tehran sewerage project-Phase 1

This project has been implemented in Islamic Republic of Iran. According to the WB's ICR of the project (The World Bank, 2009 B):

5.5.8.1 Objectives

The important objective is to improve the surrounding conditions for the Tehran population as a metropolis. The detailed objectives were:

a) Provide a suitable and acceptable wastewater gathering and treatment facilities for about more than two million population of Tehran;
b) Enhancement in public health and lessening pollution of the surface and underground water;
c) To provide treated wastewater for irrigation in the region of the project.

5.5.8.2 Time overrun

Delays were related to:

a) Shortage of materials (mainly cement);
b) Overall slowdown in construction by the contractor for about 12 months, while claims related to the delays incurred at the initial stages of the contract were being discussed and agreed upon;
c) Added level of complexity due to the high water table in these areas;
d) Difficulty in obtaining permits from the Tehran municipality in a timely manner.

5.5.8.3 Cost overrun

The higher than estimated costs of the project were mainly a result of delays, high inflation in the face of a relatively constant exchange rate, and the devaluation of the US Dollar against the Euro. Total actual cost of this project was $359.22million.

5.5.9 Pusan and Taejon sewerage project

This project has been implemented in Republic of Korea. As stated in the ICR of the WB (The World Bank, 1996):

5.5.9.1 Objective

The key objectives of the project were to:

a) Get better environment conditions in two large cities;

b) Decrease pollution of the Korea's rivers and coastal waters;

c) Reduce health hazards associated with unhealthy water.

5.5.9.2 Time overrun

The only delay in implementation was in Pusan where the project was located close to a residential area. Neighboring resident representatives held lengthy discussions with the city to ensure that the appearance and operation of the completed plant would not adversely affect their living conditions. This matter was resolved by a partial redesign of the component which was satisfactory to the residents. Due to the delay in implementation in Pusan, the closing date was extended.

5.5.9.3 Cost overrun

Due to extension of implementation of the project in Pusan, there was cost overrun in this project. The actual project cost was US$ 278.6 million which was only fractionally higher than the appraisal estimate.

5.5.10 Karachi port modernization project

This project has been implemented in Pakistan. Based on the ICR of the WB (The World Bank, 1998):

5.5.10.1 Objectives

The major project objectives were to:

a) Improve land-side access to the port,
b) Construction of a liquid products marine terminal,
c) The Jinnah Bridge Phase II,
d) Quay-side pavements,
e) Keamari - Groyne access Road.

5.5.10.2 Time overrun

The Project was originally appraised in June 1988, but the appraisal was not finalized (post- appraisal) until December 1990. Negotiations took place in April 1991 and board presentation was in May 1991. The main reason for the delay was due to a disagreement over the procurement of mobile container cranes. The planning commission who withheld government project approval argued that mobile cranes were relatively inefficient and were not a worthy investment. The project was also delayed when the WB decided that the bids for the major civil works components should be available. Decisions concerning private sector participation are being delayed and the interest of the private sector to participate is also reduced.

Political instability and labor unrest was another reasons for delay in the beginning of the project. Particularly towards the end of the project in 1996/97, political conditions ad affected the decision-making process of the country.

The government's attention was focused mainly on holding elections and transferring power to an elected government. As a result, virtually all economic development activities were suspended and various procurement items being processed or under award were put on hold.

The delay between the original appraisal and post appraisal of 18 months allowed project preparation to advance and helped to reduce implementation delays. Nevertheless, delays did develop during the implementation of the project and most components were delayed one-to- two years.

5.5.10.3 Cost overrun

The components were executed within the Staff appraisal report (SAR) estimated costs. They were built in accordance with the required high standards, are being properly maintained and are operating correctly. Total actual cost of this project was $155.1m.

5.5.11 Second national highway project

This project has been implemented in Government of India. As stated in the WB's ICR (The World Bank, 2002 A) :

5.5.11.1 Objectives

The intentions of the project were to:

a) Modernize key sections of the National Highway network.

b) Promote improvements in road engineering and construction.

c) Assist the State of Orissa in the reconstruction of flood damaged bridges.

5.5.11.2 Time overrun

The initial implementation delays were due to:

a) The long time taken to finalize the prequalification of contractors, including reaching an agreement between the ministry of surface transport and the WB on it;

b) The slow finalization of bid documents;

c) The long time taken to evaluate and finalize the civil works contracts.

The construction sites in Haryana, Orissa and Punjab were not cleared of obstructions prior to contract award, and removal of trees, utility relocation, etc., caused major hindrances and delayed the implementation considerably, especially in Orissa and Punjab. In addition, major changes in designs and drawings had to be made for the works in Haryana and Punjab during implementation which caused major delays in Haryana. Works in Punjab also got substantially delayed due to the long time taken to review and ensure structural stability of a major bridge following excessive settlement of its two foundations.

Civil works implementation got affected by delayed payments to the contractors in Orissa and Punjab due to non-availability of funds with the State governments. Due to delays in completing the railway over bridges or under bridges by Indian railways, opening of the completed highway sections got delayed.

The poor quality of engineering designs was also a major factor that negatively affected project implementation. Inadequate designs required major revisions, and this led to

delays. The worst case was in Orissa where the engineering designs did not even show the main water supply pipe for Bhubaneswar. This caused an 18 to 24 months' delay in execution of the works until the main water supply was shifted.

5.5.11.3 Cost overrun

The latest estimate of the total project cost was $417.99 million, which is about 1.08 times higher than the appraisal estimate of $385.3 million. The much higher price escalation in local costs for civil work contracts due to delayed implementation, contributed to substantial cost increase in local currency terms. Other increases in cost of the civil works component can be attributed to the increase in the scope of works in two of the States, low cost estimates, and the generally delayed implementation which caused substantial increase in local currency costs. Several minor items were added during the implementation of the project which also led to increase in final cost of the project.

5.5.12 The Eighth highways project

This project has been implemented in Republic of Paraguay. According to the WB's ICR (The World Bank, 2002 B):

5.5.12.1 Objectives

a) Improvement of key national road links,

b) Pilot soil stabilization program,

c) Road rehabilitations.

5.5.12.2 Time overrun

Heavy rains due to El Nino partially delayed the execution of civil works in 1997-1998, especially on the construction of the ring road and adjacent drainage canals. The process of contracting civil works and consulting services was permanently delayed, because of

time consuming and out of the average bank standards in terms of execution time. Various changes in government caused implementation delays. The extreme complexity of the project, the lack of local experience with such complex works, the first time use in Paraguay of standard World Bank documents and safeguard policies, all contributed to delays in implementation. Shortages in or untimely release of counterpart funds and contractors' lack of capacity to undertake the works within the agreed timeframe was the other reasons for delays.

5.5.12.3 Cost overrun

As per October 31, 2001, the total cost of the project amounted to $136.29 million equivalent, which was 51 percent higher than the appraisal estimate of $90 million equivalent.

The initial engineering designs and technical specification studies prepared by the consultants with World Bank's Project Preparation Facility funds were not suited to site conditions, resulting in the need for major variations during construction which generated cost overruns. The most significant source of increase was the high cost of the road improvement component which jumped to about $122.48 million from about $70 million. This increase was primarily caused by cost overruns of Asuncion's ringroad and Ita-Cuatro Mojones road subprojects.

5.5.13 Jamuna Bridge project

This project has been implemented in Bangladesh. In reference with the WB’s ICR (The World Bank, 2000 A):

5.5.13.1 Objectives

The key purpose of the project was to connect the eastern and western halves of the country, separated by the Jamuna river, and therefore help stimulate economic development by making easy transportation of passengers and freight and the transmission of electrical energy, natural gas, and telecommunications facilities across the Jamuna river more cost effective and in effective way. In addition, the project was to establish a railway connection between the east and the west in a cost-effective manner.

5.5.13.2 Time overrun

There was only one late award of contract, namely for river training works, which, however, caused a chain reaction of delays in the completion of the other contracts. The resulting was six- month delay in completing all of the civil works contracts.

Other delays were mainly caused by the reasons below:

a) Cracks on the bridge deck and its precast units,
b) Underwater subsoil problems that led to slope failures in the river training works,
c) A need to redesign the east guide bund,
d) Delayed handover of the east bridge end area,
e) Slow progress in embankment construction,
f) Delay in holding decision by the donors.

5.5.13.3 Cost overrun

The total project cost was $753.7 million. This is about $57.7 million (+ 8.3%) more than the $696 million estimated in the staff appraisal report (SAR).

Because of the delay in taking decision by International Development Association (IDA), the original approved cost of the Project Performa (PP), increased from $700.00

million to $ 860.00 million at the time of commencing the project. The cost of delay in holding decision by the donors, particularly IDA was extremely high.

Serious concerns were raised especially within IDA about the economic viability and overall cost of the project. As a result of these concerns, the project was subjected to appraise more thorough economic analysis which prolonged project preparation. (According to Government of Bangladesh (GOB) these delays in project preparation led to a 20% increase in total project costs).

5.5.14 Jamuna Bridge railway link project

This project has been implemented in Bangladesh. As stated by ADB in the ICR of this project (The ADB, 2005 B):

5.5.14.1 Objectives

The aim of the Jamuna Bridge Railway Link (JBRLP) was to create well-organized and reliable infrastructure across the Jamuna River to connect Bangladesh's undeveloped part at northwest of the country with developed area in the east part of the country. At first it was not a part of the plan to include the construction of the railway lines required to link Jamuna Bridge with already existing railway network. The JBRLP was later put together with the ongoing Jamuna multipurpose bridge project which was discussed in 5.5.13. GOB and ADB as two of the financial providers of the project identified that the payback of Jamuna bridge could be increased from the inception if both road and rail connections were finished at the same time with the official opening of the bridge. Also the project's objectives were to:

a) Take away the serious rail difficulties at the Jamuna river ferry crossing system;
b) Making use of Jamuna bridge more cost effective;

c) Integrate and develop the railway system by connecting two sides of the river's railroad networks;
d) Physical and economic combination of the less urbanized part of the Bangladesh with the more developed region.

5.5.14.2 Time overrun

Major delays in contract were caused by:

a) Bangladesh Railway's delay in awarding the contract;
b) Contractor's inability to make use of the construction season effectively during the first year of implementation;
c) Poor planning of site activities;
d) Cancellation of rail procurement from the selected Canadian manufacturer;
e) Delay in effectiveness of the Spanish loan for the telecommunications subcomponent;
f) Slow performance of the French contractor in installing the signaling equipment.

5.5.14.3 Cost overrun

At assessment stage, the cost of the project was projected at $269 million. The project faced cost overrun, and the closing cost at the end was $365 million. The total raise in the costs of the project was $96 million which is 35.7% more than the estimation at appraisal stage.

The increase in projected cost was due to:

a) Project awarded with a price which was more than predicted prices;
b) Underestimation at some part of the feasibility study about the amount of works needed to be done to change the western zone tracks to double;

c) Extra consulting costs due to addition of the implementation period;

d) Changes in contract necessitated by using pre-stressed concrete sleepers instead of wooden sleepers;

e) Delays in the inception of the project.

5.5.15 First multi-state water supply project

This project has been implemented in Nigeria. According to the ICR of the AFDB (AFDB, 2007 A):

5.5.15.1 Objectives

The key objective of this project was to making water supply available to four towns in Cross River State and eight towns in another state and providing quality of water management labs in two national and 4 regional labs.

5.5.15.2 Time overrun

At assessment phase, it was intended that the project should start on the first month of 1993 with organization and administration support, management, consultancy and engineering services. The predicted closing period was about forty eight months. The project closing date was extended (delayed) 5 times from end of December 1998 to the end of the year 2006, for the implementation of all works.

Project commencement was postponed significantly due to:

a) Delay in signing the financial agreements by the Government of Nigeria and AFDB,

b) Delays in payments,

c) Re-bidding which was done for the consultancy services.

5.5.15.3 Cost overrun

The total project expenditure at appraisal stage was about $217.7million. Actual cost of the project at its closing date was about $287.33million which faced with 32% cost overrun. This much of cost overrun was due to extra works including access roads, water supply and electrical energy facilities. Also it was attributed to variation orders, price escalations in labor wages, materials, fuel and financial requests due idle time resulted from strikes.

5.5.16 Road rehabilitation project

This project has been implemented in Kazakhstan. As reported by ADB in the project's PCR (The ADB, 2004 A):

5.5.16.1 Objectives

The key objective of the project was the rehabilitation of the 192 km road section between Gulshad and Akchetau (km 596 to km 788) of the Almaty-Astana road, routine maintenance of other sections of the road, procurement of road maintenance equipment, and development of a new routine road maintenance system.

5.5.16.2 Time overrun

Due to the Contractor's internal problems coupled with the high staff turnover of the executing agency (EA) and its weakness in construction management even with the help of international consultants, the civil works suffered delays and were completed 22.5 months behind the original schedule. In addition, the cracking of the asphalt concrete pavement during the first winter season caused further delays in the works. Also due to the delayed tendering and the contractor's internal problems, the first full construction season was almost completely lost.

The civil works was delayed by 22.5 months from the original schedule. The delayed completion of civil works occurred due to:

a) Long preconstruction activities of 14.5 months (from prequalification on 23 August 1996 to contract signing on 5 November 1997) due to the EA's lack of experience in international bidding processes and unfamiliarity with Fédération Internationale des Ingénieurs Conseils (FIDIC)-type contracts, compared with the appraisal schedule of 6 months;
b) Prolonged mobilization period of about 6 months due to winter conditions and due to the difficulties of transporting road construction equipment to Central Asia (from contract signing in November 1997 to commencement of work in May 1998) compared with the appraisal schedule of 2 months (February–March 1997)
c) Delayed counterpart funds in 1999 when the contractor stopped working for a few weeks until the debts were paid;
d) Additional civil works needed in several sections of the project road where the designed rehabilitation strategy was found inappropriate.

5.5.16.3 Cost overrun

The actual project cost amounted to $78 million, compared with the assessment prediction of $77 million shows $1 million of cost overrun.

The expenditure estimate of the rehabilitation civil works at appraisal was $36.2 million. The actual cost of the civil works contract was $41.2 million which means there is 13% cost overrun. The EA was not satisfied with the engineer's performance in checking and revising design, which the EA thought caused cost overruns and contributed to pavement defects.

5.5.17 Pemba-Montepuez road rehabilitation project

This project has been implemented in Republic of Mozambique. Based on the AFDB's PCR (The AFDB, 2005 A):

5.5.17.1 Objectives

The major objective of this project was to develop road transportation services in the region of the project and decrease in road maintenance and means of transportation operating costs.

The main civil works of the project was repairing of 210 km of the Pemba-Montepuez road.

5.5.17.2 Time overrun

In the assessment estimation phase it was predicted that the project would reach to closing date in forty two months beginning from end of 1998 and come to end at June 2002. Construction phase projected to be thirty months. The project was completed in 39 months with beginning at April 2000 and ending at July 2003. The contract duration was about 60 months but there was an addition of the contract duration of 3 months because of extra work and unusual rain. Completion of the project was faced 13 months of delay compared to the assessment estimate. The reasons for delay in the closing date of the project were:

a) Slippage in loan effectiveness,
b) Delay in procuring the supervision consultant,
c) Pre-contract services including design review,
d) Finalization of contract documents and the actual procurement process,

e) The delay in the start of construction works was due to the design review carried out by the new consultant appointed for supervising the execution of the civil works.

5.5.17.3 Cost overrun

The total project cost at appraisal was $43.82 million and the actual cost of the completed project was $38.27 million, which is 12.7% less than the first assessment estimate. The lower cost for this project was largely attributable to the competitive prices in procurement phase.

5.5.18 Jamuna Bridge access roads project

This project has been implemented in Bangladesh. According to the PCR of ADB (The ADB, 2004 A):

5.5.18.1 Objective

The project's major purposes were to:

a) Making better use of the bridge through growth of the eastern main access roads;
b) Help sustainable economic growth throughout the improvement of transportation connections between farming centers and manufacturing regions;
c) Improve road safety measures.

Also this project provided reconstruction of about 143 kilometers of national roads between Jamuna Bridge and 20 kilometers south of Feni, on the Dhaka-Chittagong highway via Dhaka, and low-cost accident-preventing improvements on selected national and regional roads.

5.5.18.2 Time overrun

Civil works implementation was delayed by about 14 months, despite taking advance action on consultant recruitment and civil works procurement. However, the delay was

justified considering that project site access and works progress were seriously disrupted during the countrywide flood in 1998 which flooded about 68% of the country's land for about 11 weeks. After the flood, the embankment design level had to be raised above the highest flood level, to ensure the works' sustainability against future disasters. Additional works necessitated extended time for implementation and delayed civil works completion by 14 months.

5.5.18.3 Cost overrun

The estimated total project cost at appraisal was $196.30 million, while the actual cost of the completed project was $170.01 million. The lower cost primarily resulted from bid prices being lower than initial estimates for civil works. It's also attributed to deleting three permanent weighbridges and 18 portable weighbridges from the scope of works, and reducing the road safety component's scope of civil works. There was increase in civil works due to delay in the progress after the flood in 1998.

5.5.19 Khamane- Oxbow road project

This project has been implemented in Lesotho. In reference with AFDB's PCR (K.S.H.Rao, 1998):

5.5.19.1 Objectives

The main objective of the Khamane-Oxbow road project was to upgrade the existing gravel road to bitumen standard with a view to providing a safer, faster and all-weather road.

5.5.19.2 Time overrun

The project start up was six months behind the schedule as envisaged at appraisal. This delay could not be made up during the procurement of supervision consultant and civil works contractor. However, the major delay in the project implementation was during

the construction phase that spanned over 35 months compared to 24 months estimated at appraisal. The one-year defect liability period was from July 1990 to July 1991. Major factors that contributed to the delay during construction were:

a) Prolonged consultations with the selected contractor and consultant before the award of the contracts,
b) Disorganized and slow mobilization of the contractor,
c) Adverse weather conditions (abnormal rainfall),
d) Adoption of modified pavement design.

5.5.19.3 Cost overrun

At assessment stage, the total expenditure of the project was anticipated at $ 4.25 million and the actual expenditure of the project at completion including estimated payments for contractor's unresolved claims was $5 million which exceeded the appraisal estimate by about 20%.

The main items that contributed to the cost increase were use of crushed stone blanket, claims for delays with costs and failure to get suitable natural construction material within a reasonable free haul distance.

5.5.20 Transport sector project

This project has been implemented in Kingdom of Swaziland. As stated in the AFDB's PCR (The AFDB, 2004):

5.5.20.1 Objectives:

The project objective was to:

a) To improve government's management of road maintenance and road safety programs,

b) Upgrade Mbabane-Matsapha road to reduce road transport cost by reducing Vehicle Operating Cost (VOC), travel time and accidents.

5.5.20.2 Time overrun

A delay of about 24 months occurred in completing the technical assistance (TA) to the Roads Department. The delay was due to increase in the scope of services of the TA's program. The TA to road transportation commenced about five months after the appraisal forecast date and was completed about two years after the appraisal forecast completion date. The TA program to the Department of Civil Aviation (DCA) was delayed about 46 months because of start up delay of about 12 months and additional services of an individual consultant to assist the DCA in improving its day-to-day operations. Completion of the road up-grading project was delayed by 29 months in comparison with the assessment phase. The delay was due to increase in the scope of the civil works and a 9 months delay due to problem in awarding a contract to the selected contractor.

5.5.20.3 Cost overrun

The main reason of increasing the cost of the project was the increase in the scope of the works which caused a cost overrun. The total project cost at appraisal was $99.69 million and the actual cost of the completed project was $110.38 million, following revisions to the scope of services of the technical assistants and of the civil works. The cost overrun of about $10 million in the institutional support cost and road upgrading project cost, which was due to major modifications in design and changes in the scope of work is about 10.7%.

5.5.21 Road sector improvement project

This project has been implemented in Timor-Leste. As reported by ADB in PCR of this project (The ADB, 2010 B):

5.5.21.1 Objectives

The project civil works objectives were to:

a) Rehabilitation and improvement of about 123 km of core network roads,

b) Labor-intensive routine road maintenance for 45 km,

c) Sound and sustainable road maintenance policies.

5.5.21.2 Time overrun

The project was scheduled to be completed in 2 years, with implementation from January 2006 to December 2007. The project was physically completed on 30 September 2009 after 15 months extension. The project was delayed by civil unrest, intermittent law and order problems, and bad weather. The pre-construction activities including detailed design, preparation of bidding documents, tendering, and awarding of civil works contracts were planned to start after grant effectiveness. The unrest, from April to June 2006, and subsequent periods of disorder delayed the consultant's preparation of detailed designs which in turn pushed back tendering and implementation. The project came back on track in late 2007. Maximum progress was achieved from 2008 to 2009 but repeated spells of intense rainfall during this period also delayed the civil works.

5.5.21.3 Cost overrun

The actual cost of civil works was $9.58 million, 3.1% higher than the appraisal estimate of $9.29 million (excluding contingencies). The increase resulted mainly from the cost of repairing rainfall-caused damages during the civil works delay. Another cost overrun

reason was additional inputs necessary to make up for the implementation delay at the start of the project.

5.5.22 Primary Roads Restoration Project

This project has been implemented in Cambodia. As stated by ADB in PCR of this project (The ADB, 2006 B):

5.5.22.1 Objectives

The key purposes of the project were to:

a) Restoring and improving damaged sections of the primary road network, thereby enhancing the prospects for accelerated economic growth;
b) Improve accessibility, especially to rural areas, to promote economic and human development;
c) Reduce road transport costs to facilitate more efficient movement of goods and passengers.

5.5.22.2 Time overrun

The project became effective on 30 June 2000. The original finishing date of the project was 31 January 2004; however this was extended twice at the request of the contractors to end of December 2005. The extension enabled additional works to be undertaken. As envisaged at appraisal, the project was to be implemented over 40 months, from April 2000 to July 2003, with construction completed by March 2003.

The longer-than-expected implementation period was attributed to delays in the execution of civil works and procurement of equipment, as well as the additional works undertaken.

5.5.22.3 Cost overrun

At appraisal, the project was estimated to cost $88.1 million while the actual project cost was at the $86.96 million. The actual cost for the civil works for the roads and bridges component was $75.39 million (excluding physical and price contingencies), exceeding the appraisal estimate of $63.5 million. This was largely due to the high price adjustment payments in accordance with the International Federation of Consulting Engineers (FIDIC) conditions of contracts, and given that required quantities of civil works exceeded the original estimates. Another factor causing a cost overrun was the exchange rate rise and falls between the special drawing rights (SDR) and the US dollar.

To avoid further delay and due to the possibility of a more cost overrun in case of any delay on the civil works components, the weighbridges and vehicle monitoring equipment were canceled.

5.5.23 Andkhoy – Qaisar road project

This project has been implemented in Afghanistan. Based on the PCR of ADB (ADB, 2010 C)

5.5.23.1 Objectives

This project's major objective was to reduce poverty and support economic and social development. The project comprised two components:

a) Reconstruct and improve the Andkhoy–Qaisar road (210 kilometers)
b) Install road tolling facilities, which include toll plazas, computers and communications equipment

5.5.23.2 Time overrun

The project was of an emergency nature and originally envisaged to be implemented over 36 months with an estimated completion date of 31 December 2007. The consulting services contract was expected to be awarded by March 2005, and civil works contracts by 6 September 2005. All civil engineering works were to be completed by September 2007. The envisaged completion dates for major milestones in the project implementation plan were over optimistic, and actual physical completion occurred on 30 October 2010.

The project experienced over 6 months of start-up delays; Contract award for consultancy services was almost 18 months behind schedule. Commencement of construction was postponed to coincide with mobilization of the supervision consultant. All civil works packages were completed behind schedule: one of the packages was 33 months behind the initial estimate of September 2007, second package was 32 months behind and the next package was 20 months behind.

The sizable implementation delays are attributable to:

a) Delays in appointing the supervision consultant due to the withdrawal of the first-rank firm on security concerns,
b) Slow mobilization of equipment and resources by the contractors,
c) Design change of vertical alignment in mountainous areas,
d) Abnormal rains and flash flooding from March to May 2009,
e) The Afghan presidential election in 2009,
f) Numerous security incidents,

g) Ministry of public works' (MPW) weak management capacity and supervision consultant's slow actions that led to lengthy negotiations with the contractors and prolonged processing and approval of extra work variation claims.

5.5.23.3 Cost overrun

At appraisal in 2004, the total project expenditure was estimated at $80million equivalent, including $50.4 million for civil works and $12.5 million for contingencies. After the bidding in 2005, the civil works contract packages totaled $76.6 million. Additionally, a vertical alignment grade change in mountainous areas was required for packages 1 and 2 after civil works commenced, which incurred an extra cost of $16.5 million. As this design change related to safety improvements, it also increased the cost. The supervision consultant contract underwent contract variations for four times amounting to $1.5 million to accommodate the time extensions of respective civil works contracts.

5.5.24 State and provincial roads project

This project has been implemented in Turkey. According to the WB's PCR (The World Bank, 1998 B)

5.5.24.1 Objectives

The project objectives were to:

a) Keep transport costs low in Turkey by ensuring adequate renewal and maintenance of the road network;
b) Reduce the buildup of road strengthening;
c) Develop the management and safety standards of the road system by reforms, modernization and training.

In the Overall, the project successfully achieved its objectives. More than the originally planned 950 km of road improvements were implemented, equipment needed to upgrade General Directorate of Highways (KGM)'s maintenance equipment and to improve research, design and training facilities were procured and put into service, and some road safety improvements were made.

5.5.24.2 Time overrun

At appraisal, the planned date of start of project was 28 September 1991 and the actual start of work was 8 November 1991. Beginning of construction execution was postponed by 6 months until 31 December 1997 while estimated date was 30 June 1997.

One of major problems related to delays was the availability of government counterpart funding during the later years of the project which delayed the work of some contractors, and can be explained by overall macroeconomic problems. Also the amount of road improvements added to the project led to delays in completing the civil works contracts.

5.5.24.3 Cost overrun

The overall cost to bring all 31 contracts to completion was estimated by KGM in February 1998 to be $480million, which increased to $750.90 million. The increases in the original contracts were the result of extensions of the length of the roads being improved, the addition of by-passes, connecting roads and other works, and the upgrading of some roads from two to four lanes.

5.5.25 Third road rehabilitation project

This project has been implemented in Kyrgyz Republic. As stated in PCR of ADB (The ADB, 2008):

5.5.25.1 Objectives

The project consisted of:

a) Rehabilitating 120 kilometers of the Bishkek–Osh highway;
b) Improving 125 km of secondary roads in Jalal-Abad providing for the Bishkek–Osh road;
c) Providing consulting services for construction management, checking and assessment, and implementing rehabilitated road maintenance practices;
d) Procuring routine maintenance equipment.

5.5.25.2 Time overrun

Project appraisal estimated date of award of the project to contractors has to be on May 2002 which has been awarded at November 2003. The project estimated to be completed at 10 December 2005 but its actual completion date was 30 July 2007.

Project implementation met substantial delays from start-up delays and the poor performance of two contractors. Overall, project implementation took 6 years, or doubled estimated 3 years.

The pre-qualification of contractors was completed on 28 March 2003, or 11 months later than envisaged at appraisal. The bidding for civil works was completed in November 2003, or 18 months behind the appraisal schedule. Pre-qualification took 11 months, and bidding 8 months, compared with 3 months envisaged at appraisal for each of these actions. These initial delays resulted mainly from difficulties in evaluating the multiple combinations of civil works contract packages and in receiving additional verification of the credentials of the lowest bidders, who submitted bids 30% lower than

the engineer's estimate. The accumulated 18months delay in implementation was exacerbated by poor work progress under contracts.

One of the main delay reasons was the lack of sufficient financial and technical capacity of contractors which led to failing in following the construction schedule.

5.5.25.3 Cost overrun

The total appraised cost of the project was $50.0 million while the actual project cost was $57.1 million. This increase of 14.2% resulted mostly from:

a) Higher price escalation under civil works contracts,
b) Additional bridge constructed under one of the contracts,
c) Equipment cost increases,
d) Additional consulting services during the extended implementation period.

5.5.26 Roads development project

This project has been implemented in Mongolia. As reported by ADB in PCR (The ADB, 2007).

5.5.26.1 Objectives

The objectives of the project were to an improvement of 312 km of paved roads along the Ulaanbaatar–Altanbulag road with an asphalt thickness of 50 millimeters and average pavement width of 6 meters. It also was to a periodic maintenance of about 300 kilometers of the Ulaanbaatar–Altanbulag road and reconstruction of two bridges on the Darhan– Erdenet road.

5.5.26.2 Time overrun

The entire civil works package was awarded to one international contractor who had limited knowledge about Mongolia. This caused delays in equipment mobilization in the

first construction season. Besides this, delays were attributed to an increase in the quantities of works, delays in releasing counterpart payments, and unfavorable weather conditions. Although the contractor made efforts to reduce further delays, completion was delayed by 9 months after the original contract completion date.

5.5.26.3 Cost overrun

The final cost of civil works was $23.74 million, an increase of about 18.7% over the appraisal estimate. Instead of carrying out just periodic maintenance on 300 km of the road, the government had to reconstruct and rehabilitate almost 55% of that road, causing higher-than-expected civil works costs. The average cost per km was about $76,090 compared with the appraisal estimate of $66,667, resulting in an increase of 14.1%. This increase in the unit cost was attributed to unfamiliarity with the terrain and a general rise in prices associated with the Asian financial crisis in 1997–1998. Consulting costs experienced a 22% cost overrun owing to delays in completion of the civil works.

5.5.27 Second highway sector project

This project has been implemented in Republic of Cote D'Ivoire. According to the WB's PCR (The World Bank, 1992):

5.5.27.1 Objectives

The major civil works objectives of the Project were to:

a) An indicative program of investments for construction and improvement of about 875 km of new bitumen roads. 200 km of new gravel roads and a key bridge crossing;
b) The maintenance of the entire road network consisting of three classes (bitumen, gravel surfaced and rural);

5.5.27.2 Time overrun

The project was originally scheduled to be completed by June 30, 1989. The last components were finally completed one year later in mid-1990. In 1988/89, budget constraints slowed progress slightly. Start of the remaining components was slower than scheduled.

5.5.27.3 Cost overrun

The estimated project cost at appraisal was $230.7 million, while the final cost at completion was $313.2 million. This 36% increase in total costs as expressed in US dollars was attributable to the drop in the value of the dollar relative to the local currency.

5.5.28 Almaty–Bishkek regional road rehabilitation project

This project has been implemented in Kazakhstan and Kyrgyz Republic. In reference with ADB's PCR (The ADB, 2007 B):

5.5.28.1 Objectives

The key objective of the project's civil work was to repairing about 245 km of the Almaty–Bishkek road which 41 km of it was in the Kyrgyz Republic.

5.5.28.2 Time overrun

Overall, the project was implemented in nearly 7 years as compared to the estimated 4 years. The delays were caused by:

a) Delayed loan effectiveness;

b) Delayed procurement;

c) Poor performance of contractors;

d) Inexperience of the executing agency;

e) Frequent changes in project management arrangements;

f) The timing of the awarding of contracts, which coincided with the start of winter;

g) Increased quantities of works;

h) Delays in procurement of civil works due to changes in the road design and scope of works;

i) Delays in mobilizing equipment;

j) Poor site management.

5.5.28.3 Cost overrun

The total appraised project cost was $119.1 million, comprising $112.4 million for the Kazakh component and $6.7 million for the Kyrgyz component. The total project cost was expected to be $131 million, comprising Kazakh component completed in August 2007 at total cost of $123 million and the Kyrgyz component expected to close at $8 million in December 2007.

A contributing factor to cost overruns was the higher than anticipated price increasing for major construction inputs over a longer implementation period. Particularly, the price of bitumen increased by 50 percent per annum for the duration of the 2003–2007, and the rate of price escalation was high for steel, cement, and labor.

5.6 Summary of case studies

Table 4 shows the overview of projects based on the country which project implemented, project name, type of project, project's cost overrun in million $ which is over the estimated budget in feasibility report, time overrun in months and the banks which financed the project. Based on this table, these 28 projects have more than 1 $ billion cost overrun with 775 months of delay. The more detailed results will be discussed in chapter six.

Table 4 : Summary of studied projects

#	Country	Project name	Type	Cost overrun ($ Million)	Delay (months)	Financed by
1	Republic of Honduras	Road reconstruction and improvement project	R	11.4	18	WB
2	Republic of China	Shaanxi roads development project	R	208.5	44	ADB
3	republic of Nicaragua	Third road rehabilitation and maintenance project	R	1.3	18	WB
4	Government of Nepal	Road maintenance and development project	R	6.14	30	WB
5	Government of Philippines	Airport development project	R	16.4	56	ADB
6	Republic of India	Gujarat earthquake rehabilitation and reconstruction project	B	0	37	WB

#	Country	Project name	Type	Cost overrun ($ Million)	Delay (months)	Financed by
7	Lao People's Democratic Republic:	Xieng Khouang road improvement project	R	0	49	ADB
8	Islamic Republic of Iran	Tehran sewerage project-phase 1	W	17.77	24	WB
9	Republic of Korea	Pusan and Taejon sewerage project	W	6.5	18	WB
10	Pakistan	Karachi port modernization project	W	12	25	WB
11	Government of India	Second national highway project	R	32.69	18	WB
12	Republic of Paraguay	The eighth highways project	R	46.29	24	WB
13	Bangladesh	Jamuna bridge project	R	57.73	6	WB
14	Bangladesh	Jamuna bridge railway link project	R	96	35	ADB

#	Country	Project name	Type	Cost overrun ($ Million)	Delay (months)	Financed by
15	Nigeria	First multi-state water supply project	S	115	110	AFDB
16	Kazakhstan	Road rehabilitation project	R	1	22.5	ADB
17	Republic of Mozambique	Pemba-Montepuez road rehabilitation project	R	0	13	AFDB
18	Bangladesh	Jamuna bridge access roads project	R	0	12	ADB
19	Lesotho	Khamane – Oxbow road project	R	0.75	17	AFDB
20	Kingdom of Swaziland	Transport sector project	R	7	29	AFDB
21	Timor-Leste	Road sector improvement project	R	0	15	ADB
22	Cambodia	Primary roads restoration project	R	0	23	ADB
23	Afghanistan	Andkhoy – Qaisar road project	R	2.49	39	ADB

#	Country	Project name	Type	Cost overrun ($ Million)	Delay (months)	Financed by
24	Turkey	State and provincial roads project	R	270.9	6	WB
25	Kyrgyz Republic	Third road rehabilitation project	R	7.1	36	ADB
26	Mongolia	Roads development project	R	0	10	ADB
27	Republic of Cote D'Ivoire	Second highway sector project	R	82.5	12	WB
28	Kazakhstan and Kyrgyz Republic	Almaty–Bishkek regional road rehabilitation project	R	10.4	29	ADB
				Total	Total	
				1009.86	**775.5**	
	Average			**36.1**	**27.7**	

Chapter 6

RESULTS AND DISCUSSIONS

6.1 Introduction

This chapter explains the results and discussion of questionnaire survey and the discussion of case studies considering time and cost overruns, quality and health and safety from contractors, consultants and owner/client point of view. Microsoft Excel was used for statistical evaluation of questionnaires.

6.2 Categories of factors

Results of the questionnaire have been discussed based on the factors that cause time and cost overrun, low quality and health and safety issues. 46 factors were grouped into 7 categories. The groups are:

1) Management of work;
2) Economic factors;
3) Factors related to owner-client;
4) Factors related to consultant;
5) Factors related to contractor of the project;
6) Factors related to material, manpower and equipment;
7) External factors.

6.3 Ranking of factors

The 5 point scale stated in section 4.2 was changed to relative importance index for each factor to determine the ranks of the 46 questioned causes on time overrun, cost overrun, quality and health & safety. The relative importance index (RII) was evaluated using the following formula:

$$RII = \sum W / A.N \quad (9)$$

Where W is weighting specified to each factor by participants in the questionnaire. The range was between 1 and 5, where 1 is not significant and 5 is extremely significant, A is the highest weight which is 5 in this questionnaire and N is the total number of the participants.

6.3.1 Factor analysis of factors impacting time

In this part the factors which cause delay in the projects are analyzed and sorted by their relative importance index.

6.3.1.1 Management factors

Table 5 shows the management causes affecting time factor. Respondents ranked “Poor supervision and poor site management” in the first place with a relative importance index of 89.5%.

The second cause which was ranked by respondents was “Inadequate front-end planning of project” with RII = 88.6%. It is an important hint that poor preparation and setting up for the proposed project leads to significant delays in finishing the project at planned closing date.

In the 3rd rank, “Inaccurate initial project scope and cost estimate” with RII = 84.5% indicates that inaccurate or wrong estimation of project costs will cause major delays. When the estimated costs differ from real costs, it turns to big confusion and dispute between the client and contractor. Solving disputes and reaching to an agreement take time that leads to delay.

According to respondents the least important factor in this category is “Owner interference in the project” with RII = 75.9%. It means that in case of any interference of owner or client, it negatively impacts project estimated completion time. According to its RII, the possibility of any interference that lead to time under-run is about 25%. Also it has to be considered that cooperation in implementation of construction projects in some cases may help finishing the project on its estimated schedule.

Table 5 : Management causes affecting time factor

Rank	ID	Causes	RII
1	1-4	Poor supervision and poor site management	**0.895**
2	1-1	Inadequate front-end planning of project	**0.886**
3	1-2	Inaccurate initial project scope and cost estimate	**0.845**
4	1-7	Poor project management assistance	0.814
5	1-8	Poor contract management	0.805
6	1-9	Poor provision of information to project participants	0.800
7	1-3	Inadequacy communication between design and construction parties	0.791
8	1-5	Not communicating with all parties dealing the budget	0.759
9	1-6	Owner interference in the project	0.759

6.3.1.2 Economic factors

The first essential item in this category of causes ranked by engineers was “Failure to resolve change orders and prevent them from becoming claims/disputes” with a RII

equal to 89.1%. It is one of the clearest factors that leads to time overrun. Selecting this factor as the first economic factor implies that it is too important to solve all financial problems of the contractors because it directly impacts the time and closing date of the project. Disputes may result to slowness of construction implementation by the contractor or temporary closure of project site as well. Table 6 shows the sorted economic causes with respect to RII.

Table 6 : Economic causes affecting time factor

Rank	ID	Causes	RII
1	2-2	Failure to resolve change orders and prevent them from becoming claims/disputes	**0.891**
2	2-1	Inflation	0.736
3	2-3	Too many construction activities going on at the same time	0.668
4	2-4	No financial incentive to contractor to finish the project ahead of schedule	0.564

6.3.1.3 Owner-client factors

Table 7 indicates that participants in the questionnaire ranked "Financial difficulties of the owner" as the first cause that leads to delay in finishing the project at the scheduled time with a RII of 0.945. Financial condition of the owner in order to pay the payments to contractors and consultants of the project was selected the most critical factor because any difficulty of client in paying the payments influences ability of contractor and consultants to do their financial responsibilities like paying the salary of the staff and workers, purchasing materials like steel bars and cement for the project and purchasing or renting suitable equipments for work. Any difficulty in monetary issues will cause delay in payments resulting time overrun in the schedule of the project. Clients must make their responsibilities without any delay. Paying the expenses is considered as the

vital issue of contractor and consultant to finish the project on time. Consequently, the client should know about the importance of contractor's financial requests.

"Slowness of the owner's decision-making process" was ranked as the 2nd significant factor in this group of causes that makes delay. It shows the significance of client's decision making process speed. Slowness of decision making or giving orders to contractors directly impacts the time and duration that spares to wait for getting instructions and leads to major delay in beginning the current changed or next activity. Therefore clients/owners should have enough knowledge and experience to do all of their responsibilities quickly and with fast decisions because slow instructions lead to project time overrun.

Table 7 : Owner/Client causes affecting time factor

Rank	ID	Causes	RII
1	3-5	Financial difficulties of owner/Client	**0.945**
2	3-1	Slowness of the owner's decision-making process	**0.923**
3	3-2	Slow financial and payment procedures adopted by the client	0.905
4	3-4	Approval of drawings and material	0.877
5	3-7	Increase in quantity of work (Additional works)	0.877
6	3-3	Contract modifications(Replacement , addition and change)	0.859
7	3-6	Long period between time of bidding and contract award	0.818

6.3.1.4 Factors related to consultant

Table 8 indicates that respondents ranked "Design and work permit changes during construction" in the first row with RII = 93.6%. It states the high significance of this factor and impact of it on scheduling of project. Modification in the technical specifications, executive plans and changing work permits during construction would result in creation of disputes between the construction-related parties. In case of any dispute arising during implementation of the work, solving the problem to get new

agreements between teams takes extra time that affects duration and the closing date of the project.

"Poor contract management" was put in the second degree of importance with RII of 88.6% by respondents. It shows that poor contract management issues like weak pursuing of under progress works, incorrect instructions, poor or weak supervision of project, etc; causes various limitations leading to time overrun. With implementing an effective contract management by consultant, client gains the ability and results that are required to recover and face unforeseen conditions. Poor contract management decreases efficiency and productivity and increases contract review and renewal cycle.

Table 8 : Consultant related causes affecting on time factor

Rank	ID	Causes	RII
1	4-1	Design and work permit changes during construction	0.936
2	4-5	Poor contract management	0.886
3	4-6	Poor provision of information to project participants	0.850
4	4-3	Inaccurate initial project scope and cost estimate	0.777
5	4-2	Inadequate front-end planning of project	0.714
6	4-4	Poor project management assistance	0.627

6.3.1.5 Factors related to contractor

According to table 9 "Financial difficulties of contractor" ranked as the most critical factor that lead to delay in the projects by respondents. It indicates the high importance of the monetary issues during construction phase. Any financial difficulties of contractor will be a root for many problems like slow steps forward in implementing activities and decrease in productivity resulting delay in finishing the activity on time.

Table 9 : Contractor related causes affecting on time factor

Rank	ID	Causes	RII
1	5-3	Financial difficulties of contractor	**0.955**
2	5-1	Equipment and manpower shortage and bad distribution on site	**0.945**
3	5-5	Inadequate contractor experience	**0.936**
4	5-4	Low productivity of labor	0.909
5	5-7	Delay in mobilization	0.882
6	5-6	Rework and wastage of materials	0.859
7	5-2	Poor communication with consultant and owner	0.782
8	5-8	Inadequate and incompetent subcontractors	0.782

Financial difficulties also lessen the ability of the contractor to be able to pay for required equipment for work. Furthermore, the monetary issues also cause financial dispute between material suppliers and construction related sellers that in turn, direct to reducing the speed of the work resulting time overrun in whole project. The appropriate explanation for this factor in brief is that the money is too important for contractors with no respect to the country that the project is going to be done.

Respondents ranked “Equipment and manpower shortage and bad distribution on site” in the second degree of importance with RII of 94.5%. Knowing that the finishing of different activities requires special types of equipments, and in the condition or places that shortage of the tools is a common problem, delay will happen which leads to extending the time of activity and therefore time overrun in the project.

“Inadequate contractor experience” was ranked as the 3rd significant factor that causes delay. Lack of work related experience and knowledge may force the contractor to postpone the activity or do it with lower speed than it should be. Hence, in such cases delay might occur and extra time will be added to the total implementation time of the

project. Contractors should have adequate experience in order to perform all their responsibilities based on the contract quickly and with high performance and quality.

The less degree of importance based on the participant's opinion belongs to "Inadequate and incompetent subcontractors" item with RII = 78.2%. It implies that the reason may be related to the condition that there are many ready to work contractors and few of projects ready to implement. Therefore the possibility of choosing any unskilled contractor for the projects decreases down and as a result the likelihood of delay at the end of the project reduces as well.

6.3.1.6 Factors related to material, manpower and equipment

Table 10 shows that respondents graded the impact of the "Unavailability of required materials in the local market on time" as the first cause for delay in the material, manpower and equipment category with the RII = 89.5%.

Unavailability of materials in the local market is one of the vital factors that cause time overrun in the projects. Difficulties in purchasing materials from local markets may have various reasons like monopoly of special types of materials, unavailability of specific size of steel bars and some limitations in import of special types of materials to implemented project's country.

It should be noted that, this survey was conducted in some countries like Iran, Northern Cyprus and Turkey which have not a great international markets, so contractors can get materials as easy as contractors in developed countries like United States and Canada. To solve this problem the simplest way is to purchase the required materials and store

them until the time to use them. This action supports the contractor for any shortage or lack of materials.

Table 10 : Material and equipment related causes affecting on time factor

Rank	ID	Causes	RII
1	6-2	Unavailability of required materials in the local market on time	**0.895**
2	6-5	Equipment availability and failure	**0.891**
3	6-1	Delay of material delivery to site of the project	**0.886**
4	6-7	Skilled labor shortage	0.850
5	6-3	Fluctuation and escalation in prices of materials and machinery	0.805
6	6-6	Lack of maintenance for the equipment	0.791
7	6-4	Monopolies of construction materials supply (Steel, cement…)	0.736

Another significant factor that was ranked by respondents in the second degree of importance was "Equipment availability and failure" with RII = 89.10%. Contractors should have their own stores in order to be able to store required construction materials of the project. The closures will lead to shortage of construction materials. If the contractor was not well prepared for such situation, the project will be delayed.

"Delay of material delivery to site of the project" with RII=88.6% is ranked as third important factor in this category. Each delay in providing materials in the project site implies the existence of unprofessional management by contractor. This type of behavior and not being successful in providing materials on time leads to loosing the hard work continuity and the time of completing the activity, then the delay in the completion of the related activity and therefore total time overrun will happen.

6.3.1.7 External factors

Table 11 shows that respondents ranked "Poor and unforeseen site conditions" in the first position with RII = 85%. It is the most important factor in this category that causes

delay in the closing date of the projects. Because of this factor's unpredictable and uncontrollable nature, delay in the completion of the project is subsequently out of control. For instance changing the executive plans in order to solve the problem encountered or shifting the activities and techniques to new and unplanned models will take time.

Table 11 : External related causes affecting on time factor

Rank	ID	Causes	RII
1	7-1	Poor and unforeseen site conditions	**0.850**
5	7-5	Changes in laws and regulations during the project-Obstacles from government	0.836
2	7-2	Severe weather problems (Hot, Cold, Snow, Rain)	0.823
3	7-3	Political issues-Changes	0.782
4	7-4	Poor health and safety condition on site	0.586

6.3.2 Factor analysis of factors impacting cost

In this part factors which cause cost overrun in the projects are analyzed and sorted by their RII.

6.3.2.1 Management factors

Table 12 shows that the respondents ranked "Inaccurate initial project scope and cost estimate" in the first rank with a RII = 88.6%, which signifies the high significance of cost estimation in appraisal stage. Feasibility cost estimations and scope of the project should be accurate, realistic and practical in order not to have any cost overrun in the finishing stage of the project. Incorrect estimating like budgeting for a project lower than the real expenditure of it will cause cost overrun in comparison to the feasibility cost estimations.

Table 12 : Management related causes affecting on cost factor

Rank	ID	Causes	RII
1	1-2	Inaccurate initial project scope and cost estimate	**0.886**
2	1-4	Poor supervision and poor site management	**0.855**
3	1-1	Inadequate front-end planning of project	0.818
4	1-5	Not communicating with all parties dealing the budget	0.795
5	1-8	Poor contract management	0.777
6	1-6	Owner interference in the project	0.764
7	1-3	Inadequacy communication between design and construction parties	0.736
8	1-7	Poor project management assistance	0.732
9	1-9	Poor provision of information to project participants	0.709

Lower cost estimation for materials, prediction based on the old or another area's prices is one of the other mistakes which lead to cost overrun. Also identification of additional works during the construction phase which is not considered and estimated in the feasibility cost report of the project is another common mistake causing cost overrun.

"Poor supervision and poor site management" with RII = 85.5% has been selected as the second important factor by respondents. As a result of poor site management and supervision, construction errors, delay in buying materials for the project in time, improper coordination of the engineers, subcontractors and workers and inappropriate timing for the beginning and finishing the activities during construction increase cost of the project dramatically that leads to cost overrun.

6.3.2.2 Economic Factors

Respondents of the questionnaires believed that the most important factor in this category was inflation with a RII = 92.2%. The majority of the cost overruns related with construction projects are the consequence of financial inflation that increases the price of materials, equipment and labor wages between the time when the original

prediction was made in appraisal phase and the time the project was finally constructed. Table 13 shows the rank of the factors according their RII.

Table 13 : Economic causes affecting on cost factor

Rank	ID	Causes	RII
1	2-1	Inflation	0.923
2	2-2	Failure to resolve change orders and prevent them from becoming claims/disputes	0.786
3	2-3	Too many construction activities going on at the same time	0.518
4	2-4	No financial incentive to contractor to finish the project ahead of schedule	0.486

6.3.2.3 Owner/Client factors

Table 14 shows that according to the respondents "Increase in quantity of work" is the most critical factor in increasing the final cost of the project. This factor is one of the clearest factors that lead to cost overrun through the additional works due to changing in the scope of the project, changing the drawing, unforeseen conditions which changing the cost estimated in the bill of quantity or estimation cost documents of the project.

Table 14 : Owner/Client causes affecting on cost factor

Rank	ID	Causes	RII
1	3-7	Increase in quantity of work (Additional works)	**0.868**
2	3-5	Financial difficulties of owner/Client	**0.836**
3	3-3	Contract modifications(Replacement , addition and change)	0.827
4	3-1	Slowness of the owner's decision-making process	0.782
5	3-2	Slow financial and payment procedures adopted by the client	0.755
6	3-6	Long period between time of bidding and contract award	0.755
7	3-4	Approval of drawings and material	0.723

The second significant factor in this category is "Financial difficulties of owner" with RII = 83.6%. Paying the costs of project to the consultant and contractor is vital due to its impact on the work stability through giving the ability to these parties to manage the

project, purchase materials and equipments and pay the salary of the engineers and workers on time that directly help the project to come to an end as budgeted.

6.3.2.4 Factors related to consultant

"Design and work permit changes during construction" with RII = 89.5% has been selected as a key critical factor in this category. Improper designs, incomplete plans, modification of plans, adding new activities by consultant and mistakes in the plans are the most frequent reasons for design changes by consultants in the projects resulting in increasing the cost of the project.

Table 15 : Consultant related causes affecting on cost factor

Rank	ID	Causes	RII
1	4-1	Design and work permit changes during construction	**0.891**
2	4-5	Poor contract management	**0.750**
3	4-3	Inaccurate initial project scope and cost estimate	0.732
4	4-4	Poor project management assistance	0.723
5	4-6	Poor provision of information to project participants	0.677
6	4-2	Inadequate front-end planning of project	0.627

"Poor contract management" with RII = 75% is the second critical factor leading to cost overrun in this category. It is one of the most important duties of any consultant to manage and control contractor's activities, cost related matters and overall site issues based on the contract. Any poor contract management will lead to irrecoverable cost increase in the project. Table 15 shows all the causes in this category sorted according to their RIIs.

6.3.2.5 Factors related to contractor

One of the clearest factors which causes cost overrun by contractors is "Rework and wastage of materials" which was chosen by respondents as the first with RII = 96.8%.

Table 16 : Contractor related causes affecting on cost factor

Rank	ID	Causes	RII
1	5-6	Rework and wastage of materials	**0.968**
2	5-5	Inadequate contractor experience	**0.905**
3	5-4	Low productivity of labor	0.832
4	5-1	Equipment and manpower shortage and bad distribution on site	0.823
5	5-3	Financial difficulties of contractor	0.800
6	5-7	Delay in mobilization	0.709
7	5-2	Poor communication with consultant and owner	0.677
8	5-8	Inadequate and incompetent subcontractors	0.677

It shows the importance of this factor that have to be considered by contractors in order to prevent big amount of cost overrun in the project. Purchasing new materials to replace with wasted one's, rework to solve the problems and correction of mistakes during construction phase, moving produced waste from the site of the project causes serious financial issues leading to cost overrun.

"Inadequate contractor experience" with RII = 90.5% is the second major factor that causes cost overrun in the construction projects based on the opinion of the respondents. This outcome makes clear that the experience of contractor in constructing similar projects will let the contractor to construct the work more cost effective and within budget. Due to the same reason, it is understandable that the failure of any activity caused by inexperienced contractor leads to high cost overruns in the projects. Any unsuccessful activity makes the contractor to rework and accordingly increase in the cost of the project. Table 16 shows all the causes in this category sorted according to their RIIs.

6.3.2.6 Factors related to material, manpower and equipment

"Fluctuation and escalation in prices of materials, labor and machinery" placed in the first rank with RII = 90.5%. It is obvious that growth in prices has an important impact on final cost of the project. Most of the times contractor predicted prices of activities to be executed based on the current prices at local markets. One of the earliest phases in the projects is tendering and awarding phase. If awarding process for any reason is extended the probability of price fluctuation will increase. In this case, cost of the project will inevitably increase.

Table 17 : Material and equipment related causes affecting on cost factor

Rank	ID	Causes	RII
1	6-3	Fluctuation and escalation in prices of materials and machinery	**0.905**
2	6-7	Skilled labor shortage	**0.809**
3	6-4	Monopoly of construction materials supply (Steel, cement)	0.805
4	6-6	Lack of maintenance for the equipment	0.800
5	6-2	Unavailability of required materials in the local market on time	0.791
6	6-5	Equipment availability and failure	0.786
7	6-1	Delay of material delivery to site of the project	0.677

The second critical factor in this category is "Skilled labor shortage" with RII = 80.9%. The skilled labor directly affects the cost of the project through facilitating the handing of the completed project as scheduled and executes the work successfully with less time overrun, good quality and less health and safety issues which reduces the possibility of the cost overrun. Table 17shows all the causes in this category sorted according to their RIIs.

6.3.2.7 External factors

According to table 18the most critical cause for cost overrun in this category is "Poor and unforeseen site condition" that selected by respondent with RII = 85%. It shows the high importance of accuracy in pre-investigation stage at project's site.

Table 18 : External causes affecting on cost factor

Rank	ID	Causes	RII
1	7-1	Poor and unforeseen site conditions	0.850
5	7-5	Changes in laws and regulations during the project-Obstacles from government	0.836
2	7-2	Severe weather problems	0.823
3	7-3	Political issues-Changes	0.782
4	7-4	Poor health and safety condition on site	0.586

In large projects unexpected changes in the existing conditions like finding undiscovered rock shapes beneath the site lead to cost overrun. The unexpected conditions under the surface of the site sometimes require fundamental redesign of projects or changing the machinery of contractor with high expense. It is vital to study and realize all the factors in the project site, before conduction and inception of any activities by project parties.

6.3.3 Factor analysis of factors impacting quality

Table 19 shows the ten most important factors leading to low quality of work by respondents. “Lack of quality assurance”, “Poor supervision and site management”, “skilled labor shortage” and “Inadequate contractor experience” are the most significant causes rated by survey participants with RII of 94.1%, 93.6%, 93.6% and 93.2% respectively.

Table 19 : Causes affecting on quality factor of the projects

Rank	ID	Causes	RII
1	4-4	Lack of quality assurance control	0.941
2	1-4	Poor supervision and poor site management	0.936
3	6-7	Skilled labor shortage	0.936
4	5-5	Inadequate contractor experience	0.932
5	4-3	Lack of technical and managerial skills of consultant's staff	0.877
6	5-3	Financial difficulties of contractor	0.836
7	4-5	Poor documentation - Incomplete drawings	0.832
8	5-4	Low productivity of labor	0.814
9	4-2	Absence of consultant's staff in the site of the project	0.805
10	5-2	Poor communication with consultant and owner	0.805

Quality assurance control for the construction projects is one of the most significant tools for clients to build a construction with good quality specifications as expected and planned. Inspection and quality assurance controls play a significant role in maintaining and improving the quality of construction. The meaning of "quality assurance" is to construct projects right and with the best quality in the first time. It is known that defects and failures in constructed projects may result in very large delays, costs and health and safety problems. This control prevents construction defects like poor implementation based on drawings or specifications, rework of activities, delays and bad quality of projected construction. Therefore clients and consultants as the clients' representative should have a plan to control the quality of the activities during the construction phase.

The second significant factor is "Poor supervision and site management" that lead the construction to a specification containing low quality of work. Since the quality of any type of civil engineering project normally depends on the materials used and the construction procedure and developments followed, lack of skilled supervisor and managers in the project can lead to insufficient control and managing of activities resulting in low quality of work. It also increases the number of errors that needed to be low or bad quality of works that needed to do reworks in order to make better quality.

Skilled workers are serious enough in any construction project especially in critical activities to affect the quality of the work. Shortage of skilled workers is in a direct relation with the quality of the work that leads to bad or low quality of work. Skilled labors influence the quality of work directly through facilitating submitting the works successfully with high quality.

The contractor must have a well-organized and experienced project manager and staffs to execute the work at the site of the project. Poor predicting time and type of resources like materials to be used in the project due to low experience of contractor leads to the quality related issues like rework.

6.3.4 Factor analysis of factors impacting health & safety

Table 20 shows the first 10 causes that influence health and safety in the construction projects. “Poor health and safety condition in site”, “Inadequate contractor experience” “Skilled labor shortage” and “Poor supervision and site management” are the first four causes with RII = 92.3%, 87.3%, 85.9% and 81.4%.

Table 20 : Causes affecting on Health & safety factor on cost of the projects

Rank	ID	Causes	RII
1	7-4	Poor health and safety condition on site	**0.923**
2	5-5	Inadequate contractor experience	**0.873**
3	6-7	Skilled labor shortage	**0.859**
4	1-4	Poor supervision and poor site management	0.814
5	6-6	Lack of maintenance for the equipment	0.705
6	5-3	Financial difficulties of contractor	0.691
7	7-2	Severe weather problems (Hot, Cold, Snow, Rain)	0.664
8	5-1	Equipment and manpower shortage and bad distribution on site	0.659
9	4-3	Lack of technical and managerial skills of consultant's staff	0.655
10	4-4	Lack of quality assurance -Control	0.655

The objective of occupational health and safety programs is to provide a safe work environment for engineers, staff, workers, neighbors and people who are impacted by executing the project. The Factor 7-4 is the clearest cause that increases the likelihood of the accidents in the construction projects. Disability injuries on the construction site are the common health and safety issue. These kinds of incidents result by poor health & safety condition.

The second critical cause in this category is “Inadequate experience of contractor”. It is an important factor and it could be linked to lack of considering the ability and existence of contractor’s past experiences in awarded type of project, at awarding procedure where most projects were awarded to the lowest bidder not experienced bidder. A contractor with insufficient experience could not be able to plan and supervise the projects properly and this can lead to terrible consequences.

“Skilled labor shortage” ranked as the third important factor by the respondents. Shortage of expert workers particularly in welding, work at height, work with equipments like cranes, steel bars cutting and hazardous activities increases the likelihood of accidents in the construction projects. Accidents during construction phase by unprofessional workers leads to unrecoverable and irreparable injuries. Employing professional and skilled labors prevents the possibility of such incidents even with high amount of wage for them.

6.3.5 Overall ranking of causes affecting time of project

Table 21 shows the top 10 important causes affecting duration of the projects according to their RII. It indicates that the first 2 most critical and important causes are financial difficulties of the contractor and client. This type of cause is strong enough to make long delays to any project. Also clients’ financial difficulties have a big role in the timing of any project by impacting the scheduling towards the extent of it.

Based on this table, it can easily be understood that the most critical causes that impact the time of the project arise by contractors. 4 out of the first 10 causes belong to the contractor’s category. Its also can be obtained that the cost management is a key factor

for the both contractor and client of the project. With good supervision of cost the likelihood of delay in the project will reduce significantly.

Table 21 : Overall ranking of causes affecting time of the project

Rank	ID	Causes	RII
1	5-3	Financial difficulties of contractor	0.955
2	3-5	Financial difficulties of owner/Client	0.945
3	5-1	Equipment and manpower shortage and bad distribution on site	0.945
4	4-1	Design and work permit changes during construction	0.936
5	5-5	Inadequate contractor experience	0.936
6	3-1	Slowness of the owner's decision-making process	0.923
7	5-4	Low productivity of labor	0.909
8	3-2	Slow financial and payment procedures adopted by the client	0.905
9	1-4	Poor supervision and poor site management	0.895
10	6-2	Unavailability of required materials in the local market on time	0.895

6.3.6 Overall ranking of causes affecting cost of project

Table 22 shows 10 important causes that creates cost overrun in the construction projects. "Reworks and wastage of material", "Inflation" and "inadequate contractor experience" are the most three most important causes that clients and contractors should be aware of.

Table 22: Overall ranking of causes affecting cost of the project

Rank	ID	Causes	RII
1	5-6	Rework and wastage of materials	0.968
2	2-1	Inflation	0.923
3	5-5	Inadequate contractor experience	0.905
4	6-3	Fluctuation and escalation in prices of materials and machinery	0.905
5	4-1	Design and work permit changes during construction	0.891
6	1-2	Inaccurate initial project scope and cost estimate	0.886
7	7-1	Poor and unforeseen site conditions (Location, ground, ETC)	0.877
8	3-7	Increase in quantity of work (Additional works)	0.868
9	1-4	Poor supervision and poor site management	0.855
10	3-5	Financial difficulties of owner/Client	0.836

6.3.7 Overall ranking of causes affecting quality of project

Lack of quality assurance in construction projects ranked as the first defect that impacts the quality of work. It is essential to control the quality in different stages of the work from design to implementation and execution phase of project. In addition, table 23 indicates that having good management on work and availability of skilled workers on the site of the project will totally help to complete it with good quality. This table also shows that the most responsible parties for quality are consultants and contractors.

Table 23 : Overall ranking of causes affecting quality of project

Rank	ID	Causes	RII
1	4-4	Lack of quality assurance -Control	0.941
2	1-4	Poor supervision and poor site management	0.936
3	6-7	Skilled labor shortage	0.936
4	5-5	Inadequate contractor experience	0.932
5	4-3	Lack of technical and managerial skills of consultant's staff	0.877
6	5-3	Financial difficulties of contractor	0.836
7	4-5	Poor documentation - Incomplete drawings	0.832
8	5-4	Low productivity of labor	0.814
9	4-2	Absence of consultant's staff in the site of the project	0.805
10	5-2	Poor communication with consultant and owner	0.805

6.3.8 Overall ranking of causes affecting health & safety of project

Table 24 indicates high importance indexes of having good health and safety condition on construction site. The role of taking good care of health & safety for workers and staffs, good knowledge on related type of work by contractors and using skilled workers are really remarkable in reducing the amount of accidents. It is considerably important to take the significance of these causes into account in order to prevent incidents that make time and cost overrun as well. Therefore it is reasonable to pay for providing a good

enough safety conditions on the site of projects and experienced contractors as a client and using skilled labor as a contractor.

Table 24 : Overall ranking of causes affecting health & safety of project

Rank	ID	Causes	RII
1	7-4	Poor health and safety condition on site	0.923
2	5-5	Inadequate contractor experience	0.873
3	6-7	Skilled labor shortage	0.859
4	1-4	Poor supervision and poor site management	0.814
5	6-6	Lack of maintenance for the equipment	0.705
6	5-3	Financial difficulties of contractor	0.691
7	7-2	Severe weather problems (Hot, Cold, Snow, Rain)	0.664
8	5-1	Equipment and manpower shortage and bad distribution on site	0.659
9	4-3	Lack of technical and managerial skills of consultant's staff	0.655
10	4-4	Lack of quality assurance -Control	0.655

6.3.9 Overall ranking of causes

Table 25 shows the overall ranking of the causes based on their RIIs. According to this table, “Inadequate contractor experience” with average RII (AVRII = 91.1%) is the most important and key factor among 46 causes that affects time, cost, quality and health & safety of construction projects. For purpose of controlling the main factors, owners should select the experienced qualified contractors in the specific fields. This table also indicates the high significance of supervision and site management as well as using skilled labors and contracting with strong financial support contractors. Any negligence and inattention to the causes with greater AVRII in this table will lead to unrecoverable and irreparable damages in the projects.

Table 25 : Overall ranking of causes

Rank	ID	Causes	AVRII	RT	RIIT	RC	RIIC	RQ	RIIQ	RH	RIIH
1	5-5	Inadequate contractor experience	0.911	5	0.936	3	0.905	4	0.932	2	0.873
2	1-4	Poor supervision and poor site management	0.875	9	0.895	9	0.855	2	0.936	4	0.814
3	6-7	Skilled labor shortage	0.864	22	0.850	15	0.809	3	0.936	3	0.859
4	5-3	Financial difficulties of contractor	0.820	1	0.955	17	0.800	6	0.836	6	0.691
5	5-1	Equipment and manpower shortage and bad distribution on site	0.802	3	0.945	13	0.823	11	0.782	8	0.659
6	5-4	Low productivity of labor	0.794	7	0.909	11	0.832	8	0.814	12	0.623
7	6-6	Lack of maintenance for the equipment	0.767	33	0.791	18	0.800	13	0.773	5	0.705
8	4-3	Lack of technical and managerial skills of consultant's staff	0.760	37	0.777	33	0.732	5	0.877	9	0.655
9	7-1	Poor and unforeseen site conditions	0.760	23	0.850	7	0.877	26	0.664	11	0.650
10	5-6	Rework and wastage of materials	0.759	20	0.859	1	0.968	19	0.718	20	0.491
11	6-5	Equipment availability and failure	0.756	12	0.891	22	0.786	18	0.736	14	0.609
12	4-1	Design and work permit changes during construction	0.750	4	0.936	5	0.891	14	0.764	31	0.409
13	3-5	Financial difficulties of owner/Client	0.738	2	0.945	10	0.836	20	0.705	22	0.464
14	7-2	Severe weather problems (Hot, Cold, Snow, Rain)	0.738	26	0.823	27	0.764	21	0.700	7	0.664
15	4-4	Lack of quality assurance -Control	0.736	44	0.627	35	0.723	1	0.941	10	0.655
16	4-5	Poor documentation - Incomplete drawings	0.732	14	0.886	30	0.750	7	0.832	25	0.459
17	1-7	Poor project management assistance	0.720	28	0.814	32	0.732	17	0.750	15	0.586
18	3-7	Increase in quantity of work (Additional works)	0.714	18	0.877	8	0.868	39	0.573	17	0.536
19	1-8	Poor contract management	0.710	29	0.805	24	0.777	12	0.773	21	0.486
20	1-2	Inaccurate initial project scope and cost estimate	0.707	24	0.845	6	0.886	22	0.691	32	0.405
21	1-9	Poor provision of information to project participants	0.707	31	0.800	37	0.709	16	0.755	16	0.564

Rank	ID	Causes	AVRII	RT	RIIT	RC	RIIC	RQ	RIIQ	RH	RIIH
22	5-2	Poor communication with consultant and owner	0.695	34	0.782	40	0.677	10	0.805	19	0.518
23	4-2	Absence of consultant's staff in the site of the project	0.691	42	0.714	43	0.627	9	0.805	13	0.618
24	7-4	Poor health and safety condition on site	0.691	45	0.586	44	0.614	30	0.641	1	0.923
25	1-3	Inadequacy communication between design and construction parties	0.685	32	0.791	31	0.736	15	0.755	24	0.459
26	2-1	Inflation	0.684	40	0.736	2	0.923	24	0.668	30	0.409
27	6-3	Fluctuation and escalation in prices of materials and machinery	0.683	30	0.805	4	0.905	23	0.686	41	0.336
28	1-1	Inadequate front-end planning of project	0.681	13	0.886	14	0.818	35	0.600	28	0.418
29	2-2	Failure to resolve change orders and prevent them from becoming claims/disputes	0.670	11	0.891	21	0.786	25	0.664	39	0.341
30	3-1	Slowness of the owner’s decision-making process	0.666	6	0.923	23	0.782	37	0.582	34	0.377
31	3-2	Slow financial and payment procedures adopted by the client	0.665	8	0.905	28	0.755	32	0.627	35	0.373
32	6-2	Unavailability of required materials in the local market on time	0.658	10	0.895	20	0.791	33	0.618	43	0.327
33	3-3	Contract modifications(Replacement , addition and change)	0.651	19	0.859	12	0.827	38	0.577	40	0.341
34	5-7	Delay in mobilization	0.651	16	0.882	38	0.709	40	0.550	23	0.464
35	1-6	Owner interference in the project	0.650	39	0.759	26	0.764	27	0.655	27	0.423
36	3-4	Approval of drawings and material	0.647	17	0.877	34	0.723	31	0.632	37	0.355
37	5-8	Inadequate and incompetent subcontractors	0.642	35	0.782	41	0.677	29	0.650	26	0.459
38	1-5	Not communicating with all parties dealing the budget	0.636	38	0.759	19	0.795	34	0.609	33	0.382

Rank	ID	Causes	AVRII	RT	RIIT	RC	RIIC	RQ	RIIQ	RH	RIIH
39	7-5	Changes in laws and regulations during the project-Obstacles from government	0.627	25	0.836	25	0.768	44	0.486	29	0.418
40	6-4	Monopolies of construction materials supply (Steel, cement…)	0.613	41	0.736	16	0.805	36	0.591	45	0.318
41	4-6	Slow inspection of completed works	0.606	21	0.850	39	0.677	41	0.532	36	0.364
42	6-1	Delay of material delivery to site of the project	0.602	15	0.886	42	0.677	42	0.527	44	0.318
43	2-3	Too many construction activities going on at the same time	0.593	43	0.668	45	0.518	28	0.655	18	0.532
44	3-6	Long period between time of bidding and contract award	0.586	27	0.818	29	0.755	43	0.486	46	0.286
45	7-3	Political issues-Changes	0.569	36	0.782	36	0.714	46	0.427	38	0.355
46	2-4	No financial incentive to contractor to finish the project ahead of schedule	0.464	46	0.564	46	0.486	45	0.477	42	0.327

Where:

AVRII: Average of the relative importance indexes of time, cost, quality and health & safety.

T: Time RT: Rank for time RIIT: Relative Importance for Time

C: Cost RC: Rank for cost RIIC: Relative Importance Index for Cost

Q: Quality RQ: Rank for quality RIIQ: Relative Importance Index for Quality

H: Health and safety RH: Rank for health & safety RIIH: Relative Importance Index for Health & Safety

6.4. Results of studied projects

In this study twenty eight construction projects were collected which were implemented in some developing countries like Nepal, India, Iran, Nigeria, Bangladesh, Turkey and China. The data was collected based on the completion reports of WB, ADB and AFDB. Evaluation was conducted on project completion reports and post evaluation results were the core data for this study. Summarized data of collected information was obtained by focusing on the factors influence and have impact on time and cost of these projects.

6.4.1 Feasibility reports, cost and time overrun

According to chapter 5 twenty eight large projects with time and cost overrun were investigated. Figure 7 shows that 75% of these projects have total cost of between 50 and 500 million dollars, while 14% of them are projects with total costs less than 50 million dollars and 11% are very large projects with more than 500 million dollars of total cost.

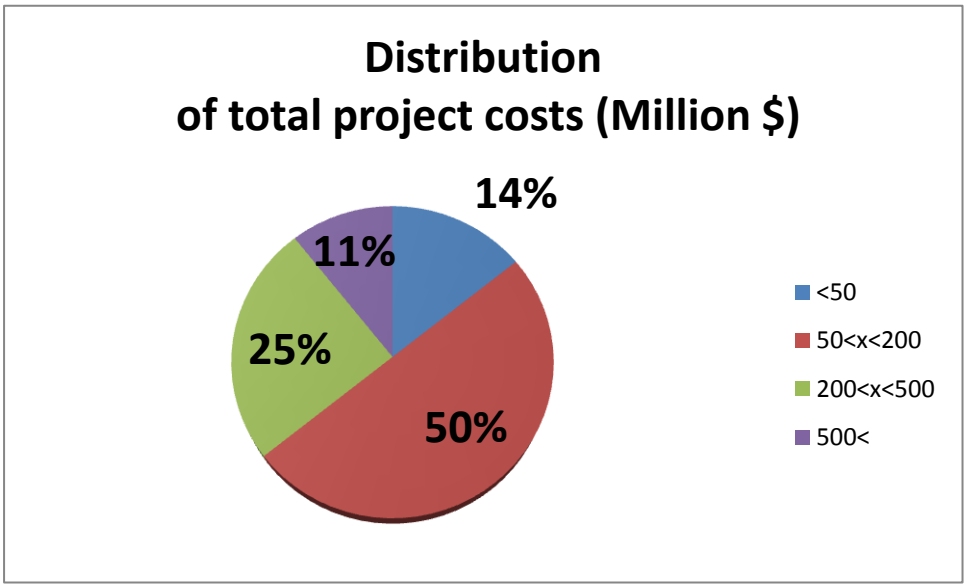


Figure 7 : Distribution of total cost of the projects

The largest investigated project is Shaanxi roads development project in China (#2 in table 4) with actual cost of 965.5 million dollars with an overrun of 208.5 million dollars which means 27.5% of cost overrun.

The second investigated largest project is Jamuna bridge project (#13 in Table 4) in Bangladesh with a total cost of $753.73m and with $57.73m cost overrun which is 8.3% over the estimated cost of the project.

The third large project is State and provincial roads project (#24 in table 4) in Turkey with total cost of 750.9 million dollars and having $270.90 million of cost overrun which is equal to 56.4% over the predicted total cost of the project.

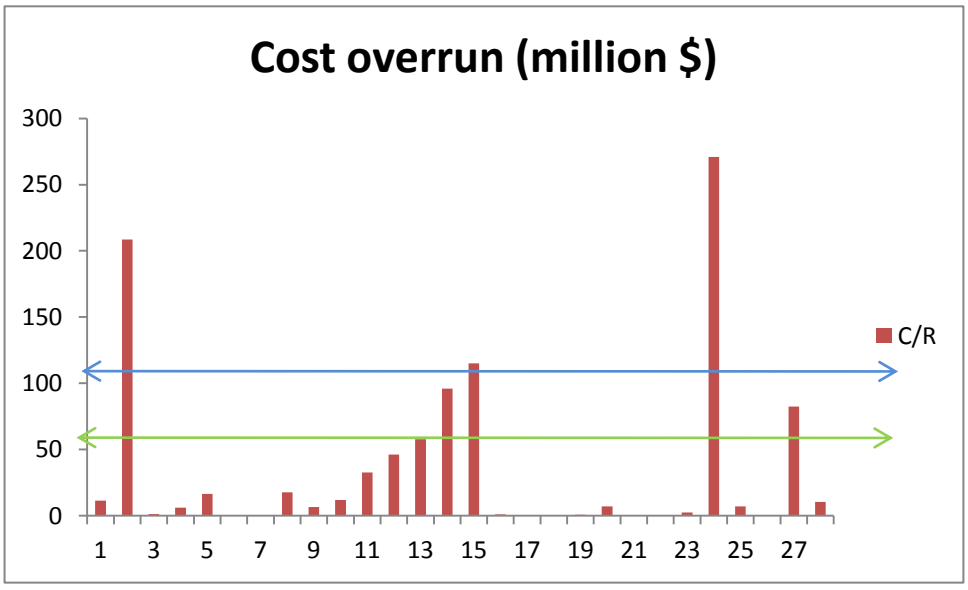


Figure 8 : Comparison of cost overrun in projects

Figure 8 indicates that the worst project in terms of cost overrun factor is 24th project "State and provincial roads project" in Turkey in which, increasing the quantities of

work or additional works and design changes were the major causes for this high amount of cost overrun (5.5.24.3).

Based on Figure 8 the second highest cost overrun among studied projects is project #2 (Table 4) which is Shaanxi roads development project in Republic of China which has $208.5 million of cost overrun. The main reasons of this amount of cost overrun as mentioned in 5.5.2.3 of chapter five, are related to additional works, unforeseen site conditions, design changes during construction and financial difficulties of owner.

Figure 9 shows the comparison of cost overrun percentage based on the feasibility report's estimations and actual costs. This figure shows that about 53% of projects have no cost overrun or a cost overrun between 0 and 10%. Also more than 20% of studied projects have cost overrun of more than 50%. 17.86% of the investigated projects have cost overrun between 10 to 25 percent.

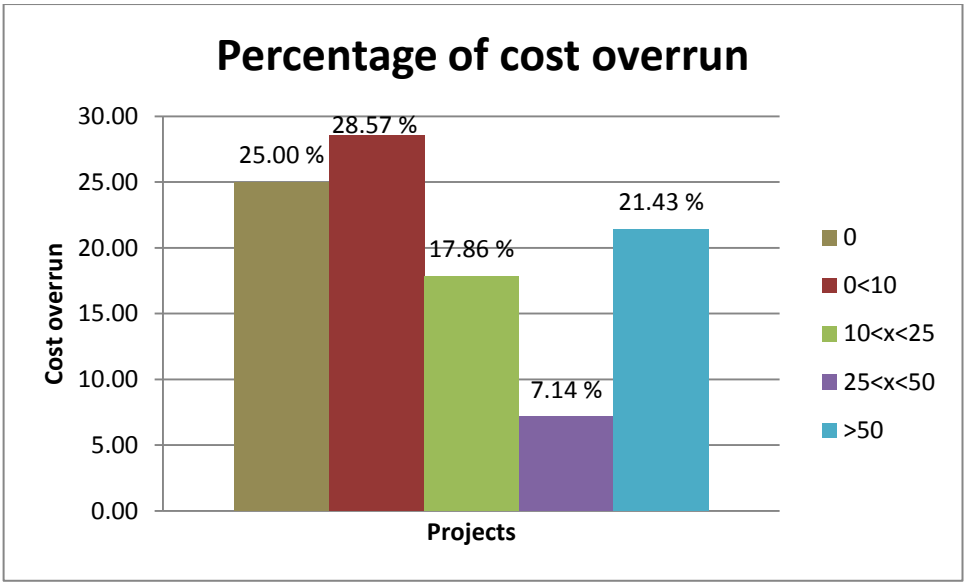


Figure 9 : Comparison of cost overrun percentage in studied projects

In terms of delay and according to Table 4 the longest delay belongs to "First multi-state water supply" project in Nigeria (# 15). This much of delay is attributed to critical factors like increase in the quantity of works or additional works, lack of technical and managerial expertise of consultants' staff, long period between time of bidding and award of contract, inadequate front-end planning and slow financial and payment procedures of owner as indicated in 5.5.15.2.

Second project with a long time overrun is "Airport development project" (#5 in Table 4) at Philippines with 56 months of delay. This much of delay is attributed to no communicating with all parties dealing the budget, poor contract management, slowness of the owner's decision-making process, design and work permit changes during construction, rework and wastage of materials, delay of material delivery to site of the project, severe weather problems and increasing the quantity of works or additional works.

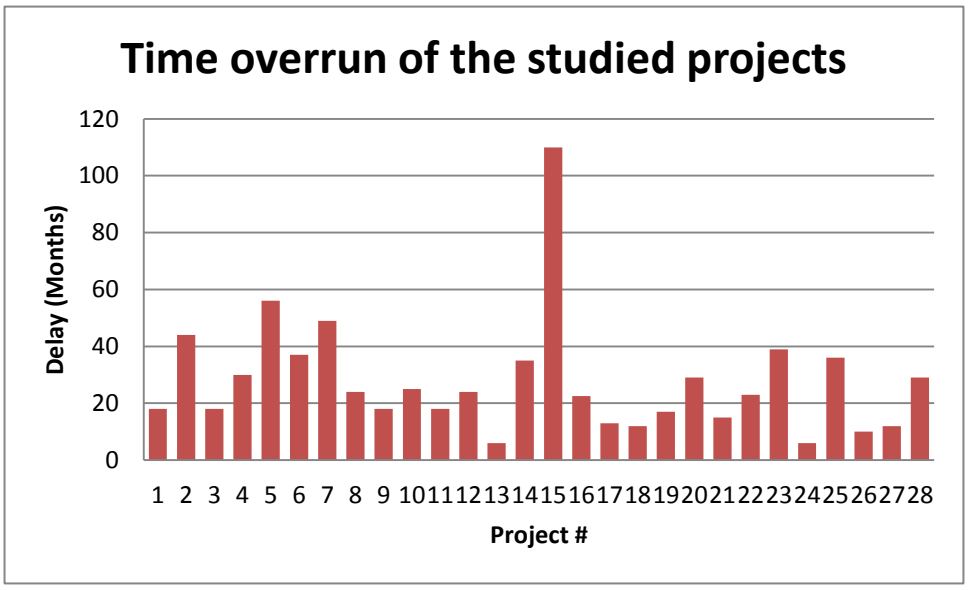


Figure 10 : Studied projects with respect to time overrun

More than 20% of the studied projects have time overrun longer than 36 months and near 40 percent of the projects have delay between one to two years as figure 11 shows.

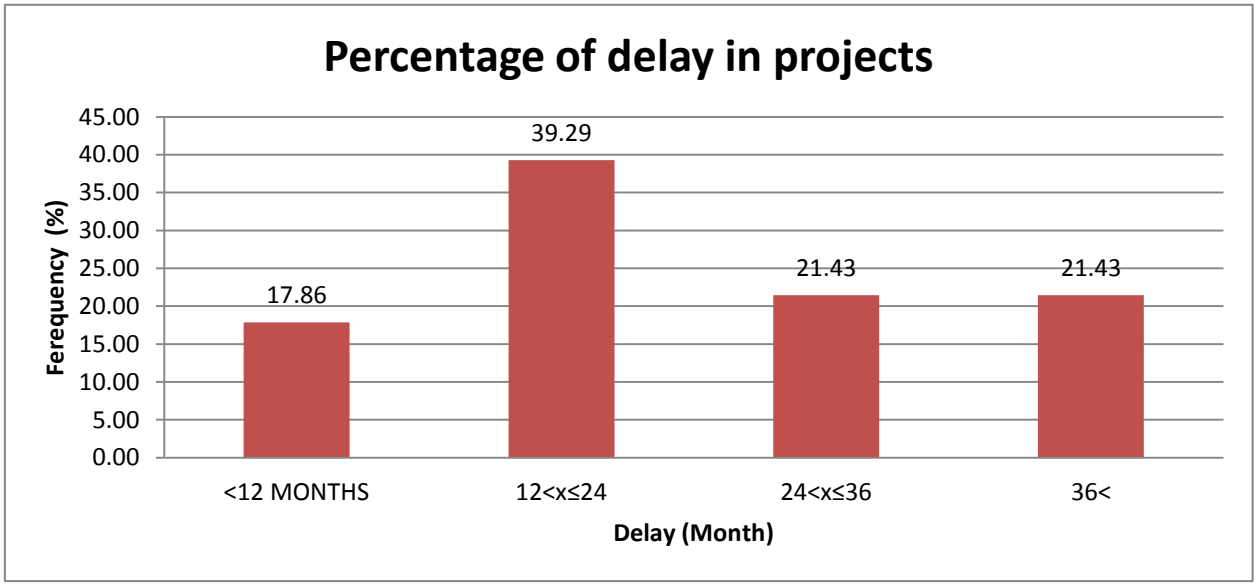


Figure 11 : Ferequency of time overrun in selected projects

Based on the Table 4 total cost of 28 projects is about 6.5 billion dollar with 15% average of cost overrun and 27.6 months of delay.

By evaluation of 28 projects, it is concluded that in total there are 775.5 months of delay and more than 1 billion dollars cost overrun with respect to feasibility reports.

775 months of delay means the existence of 186’000 hours of time wastage. In terms of manpower wage and with average of 10$ per person per hour (engineer, skilled worker, unskilled workers, helpers,…) and assumption that there are 100 person working in these large projects, it is calculated an amount of $ 186,000,000 which this much of

money is large enough for completion of 18 projects out of 28 large project listed in Table 4.

6.4.2 Reasons of cost and time overrun in studied projects

Table 26 shows the reasons for delay and cost overrun in the studied projects. There are 46 factors impacting time and cost which are collected in 7 categories. Categories are as same as the questionnaire's categories including management of work, economic factors, factors related to owner-client, factors related to consultant, factors related to contractor of the project, factors related to material, manpower and equipment and external factors.

According to this table, the most critical factors in the management of work category are

1) Inaccurate initial project scope and cost estimate
2) Poor supervision and poor site management
3) Poor contract management
4) Estimates reduced by mandate date or cost

32.1% of studied projects faced with 'Inaccurate initial project scope and cost estimate". Inaccurate cost estimation usually causes financial failure, loss of potential contracts and failure of reliability in the projects. The main reasons for poor or inaccurate cost estimation would be attributed to use of too straightforward methods to estimate total costs of the project, increases in building material prices and lack of collection of enough information about past similar projects.

Inflation and failure to resolve change orders and prevent them from becoming claims are two important factors which impact studied projects with time and cost overrun in the economic factors with 14 percent.

In the second group which is related to client or owners, the most critical factors are additional works with 64.2% of frequency, long period between time of bidding and contract award with 43% and slow financial and payment procedures adopted by owner or client with 25%.

In the category related to consultants of the project, the most critical factor is design and work permit changes during construction with frequency of 43%.

Delay in mobilization with 25% and inadequate contractor experience with 18% are the most important reasons in the category of contractor related factors.

The most important factors in the group of materials are fluctuation and escalation in prices of materials and machinery with 14% of frequency, unavailability of required materials in the local market on time with 10.7% and delay of material delivery to site of the project as well.

Severe weather conditions like hot and cold weather and severe climate changes with 43% and political issues and unforeseen conditions with 21% are most important factors in the external factors group.

Table 26: Reasons of time and cost overrun in studied projects

#	Factors / Project no	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	Total
1	Inadequate front-end planning of project														D					D				D		D			D	**5**
2	Inaccurate initial project scope and cost estimate	C			D	C	D	D				C			C						C	C								**9**
3	Inadequacy communication between design and construction parties							D												D										**2**
4	Poor supervision and poor site management							D									D							D					D	**4**
5	No communicating with all parties dealing the budget					D																								**1**
6	Owner interference in the project																													**0**
7	Poor project management assistance																													**0**
8	Poor contract management					D							D				D									D				**4**
9	Poor provision of information to project participants																										C			**1**
10	Inflation								C														C			C		C		**4**

#	Factors / Project no	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	Total
11	Failure to resolve change orders and prevent them from becoming claims/disputes								D							C				C				D					**4**
12	Too many construction activities going on at the same time																													**0**
13	No financial incentive to contractor to finish the project ahead of schedule																													**0**
14	Slowness of the owner's decision-making process	D				D		D			D			D							D									**6**
15	Slow financial and payment procedures adopted by the client											D			D	D	D	D							D		D			**7**
16	Contract modifications(Replacement , addition and change)														C															**1**
17	Slowness in approval of drawings and material						D													D										**2**
18	Financial difficulties of owner/Client		D	D									D					D										D	D	**6**
19	Long period between time of bidding and contract award	D						D			D	D			D	D	D	D			D	D		D		D				**12**

#	Factors / Project no	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	Total
20	Increase in quantities of work-Additional work	C	C		D	C	D					C	C		C	C	D	D	D		D		D		D	c	D		D	**18**
21	Design and work permit changes during construction	C	C			C				D		D		D					D		C			D	C		C		D	**12**
22	Absence of consultant's staff in the site of the project																													**0**
23	Lack of technical and managerial skills of consultant's staff															D														**1**
24	Lack of quality assurance -Control													D																**1**
25	Poor documentation - Incomplete drawings											D					C													**2**
26	Slow inspection of completed works											D																		**1**
27	Equipment and manpower shortage and bad distribution on site							D					D													D			D	**4**
28	Poor communication with consultant and owner																													**0**
29	Financial difficulties of contractor						D																			D				**2**

#	Factors / Project no	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	Total
30	Low productivity of labor						D								D		D									D				**4**
31	Inadequate contractor experience						D						D		D											D			D	**5**
32	Rework and wastage of materials					D								D																**2**
33	Delay in mobilization							D				D					D			D				D			D		D	**7**
34	Inadequate and incompetent subcontractors																													**0**
35	Delay of material delivery to site of the project					D																	D						D	**3**
36	Unavailability of required materials in the local market on time								D						C					C										**3**
37	Fluctuation and escalation in prices of materials and machinery											C				C										c			C	**4**
38	Monopolies of construction materials supply (Steel, cement…)																													**0**
39	Equipment availability and failure							D									D													**2**

#	Factors / Project no	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	Total
40	Lack of maintenance for the equipment																													**0**
41	Skilled labor shortage																													**0**
42	Poor and unforeseen site conditions (Location, ground cond.)		C						D	D		D	C	D																**6**
43	Severe weather problems (Hot, Cold, Snow, Rain)			D		D	D	D					D				D	D	D	D		D		D			D			**12**
44	Political issues-Changes			D	D						D		D									D		D						**6**
45	Poor health and safety condition on site																							C						**1**
46	Changes in laws and regulations during the project-Obstacles from government																					D								**1**
	Total	**5**	**4**	**3**	**3**	**9**	**7**	**9**	**4**	**2**	**3**	**10**	**8**	**5**	**9**	**6**	**10**	**5**	**3**	**7**	**5**	**5**	**3**	**9**	**3**	**10**	**6**	**2**	**10**	**0**

C: Cost overrun D: Delay

6.4.3 Ranking of factors in studied projects

Table 27 shows the first eleven factors ranked by frequency of occurring of each factor in studied projects. It means that these factors have more probability of occurrence among 46 factors in large projects. Also these factors are most critical factors which impacted the studied projects with delay and cost overrun.

Table 27 : Ranking of factors in studied projects

#	Factor Name	Factor Category	Frequency
1	Increase in quantities of work-Additional work	Owner/Client	18
2	Long period between time of bidding and contract award	Owner/Client	12
3	Design and work permit changes during construction	Consultant	12
4	Severe weather problems (Hot, Cold, Snow, Rain)	External	12
5	Inaccurate initial project scope and cost estimate	Consultant	9
6	Slow financial and payment procedures adopted by the client	Owner/Client	7
7	Delay in mobilization	Contractor	7
8	Slowness of the owner's decision-making process	Owner/Client	6
9	Financial difficulties of owner/Client	Owner/Client	6
10	Poor and unforeseen site conditions (Location, Ground)	External	6
11	Political issues-Changes	External	6

The most critical problems are "Increase in quantities of work" or "Additional works" and "Long period between time of bidding and contract" which belongs to management of works factors. The next important factors are "Design changes during construction"

belonging to consultant factors and "Severe weather problems" from external factors. Additional works like increase in amount of road improvements, construction of additional bridges under the contracts and removing facilities in the project area are the most important factors impacted highly the projects duration and estimation of their cost. These factors are common problems in developing countries and have high impact on time and cost overrun of the projects especially in large projects.

Factors that have less influence than the first four factors are "Slow financial and payment procedures" adopted by the client, "Slowness of the owner's decision-making process" and "Financial difficulties of owner/client". Delay in approving the contracts, delay in recruitment of consultants for detailed design work and construction supervision and delay of client in paying the debts to contractors of the project are another three client related factors which lengthen the time and put the cost of it up.

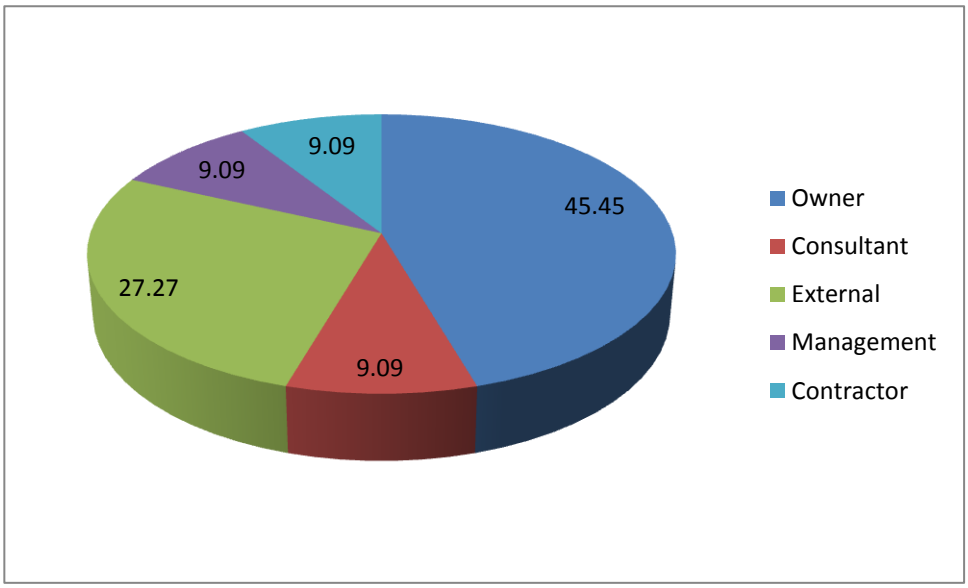


Figure 12 : Percentage of occurrence of the factors according to categories

Figure 12 shows the percentage of occurrence of the factors by their category in the studied projects.

6.5 Comparison of the results in questionnaire and studied projects

Comparing the results of the questionnaires with the results obtained form 28 studied projects, it can be concluded that there are some similarities in the significant factors influencing time and cost of projects. Considering studied project's results and the questionnaire respondent's answers, common important causes are:

a) The Cause 4-1: "Design and work permit changes during construction",
b) The cause 3-5: "Financial difficulties of owner/client",
c) The cause 3-7: "Increase in quantity of work",
d) The cause 1-2: "Inaccurate initial project scope and cost estimate",
e) The cause 7-1: "Poor and unforeseen site conditions",
f) The cause 3-1: "Slowness of owners' decision-making process".

The mentioned conformity between the questionnaire and studied project's results proves the importance of affection of these factors on time and cost of projects.

Table 28 shows the rank of first 15 out of 46 causes and sorted based on their average of RII (AVRII) for cost and time factors and comprising them with rank of studied projects (RSP).

Table 28 : Comparing important causes of questionnaire and studied projects

Rank	ID	Causes	AVRII	RT	TRII	RC	CRII	RSP
1	5-5	Inadequate contractor experience	0.920	5	0.936	3	0.905	-
2	5-6	Rework and wastage of materials	0.914	20	0.859	1	0.968	-
3	4-1	Design and work permit changes during construction	0.914	4	0.936	5	0.891	3
4	3-5	Financial difficulties of owner/client	0.891	2	0.945	10	0.836	9
5	5-1	Equipment and manpower shortage and bad distribution on site	0.884	3	0.945	13	0.823	-
6	5-3	Financial difficulties of contractor	0.877	1	0.955	17	0.800	-
7	1-4	Poor supervision and poor site management	0.875	9	0.895	9	0.855	-
8	3-7	Increase in quantity of work (Additional works)	0.873	18	0.877	8	0.868	1
9	5-4	Low productivity of labor	0.870	7	0.909	11	0.832	-
10	1-2	Inaccurate initial project scope and cost estimate	0.866	24	0.845	6	0.886	5
11	7-1	Poor and unforeseen site conditions (Location, ground, etc)	0.864	23	0.850	7	0.877	10
12	6-3	Fluctuation and escalation in prices of materials and machinery	0.855	30	0.805	4	0.905	-
13	1-1	Inadequate front-end planning of project	0.852	13	0.886	14	0.818	-
14	3-1	Slowness of the owner’s decision-making process	0.852	6	0.923	23	0.782	8
15	6-2	Unavailability of required materials in the local market on time	0.843	10	0.895	20	0.791	-

AVRII: Average relative importance index

T: Time RT: Rank for Time TRII: Time Relative Importance Index

C: Cost RC: Rank for Cost CRII: Cost Relative Importance Index

RSP: Rank of studied projects

6.6 Cost and time satisfactory indicator

Assessing projects and developing a satisfaction value for construction projects is beneficial to both owners and contractors. Assessment of the project conducted by owner and executed by contractor, helps to make advanced contractors with better performance. The importance of time and cost is increasing in all fields of civil engineering projects due to limitation of budget; need to finish the projects on time, competition between contractors and more demanding for new infrastructures and buildings arising with population growth. It is essential to employ experienced contractors with good knowledge of engineering and management techniques that finish their projects at the estimated time and budgeted cost. One of the advantages of having a satisfaction value for projects is facilitating owners to select the most suitable and reliable contractors for their infrastructure projects or national projects for governments. It also encourages the companies to compete for better results of time and cost satisfaction values in their projects. This competition distinguishes better companies form their opponents. In addition for having completed projects with good quality, utilization contractors who can gain satisfactory results in time and cost points of view are vital.

Comparison between estimated and actual costs, similarly for predicted closing date and actual date of completion, could be a good formula for developing a satisfactory indicator for construction projects. Table 29 is shows data of studied projects with their cost and time specifications for this purpose.

Table 29 : Comparison between estimated and actual cost and time of the projects

#	Project name	PEC m$	PAC m$	SFC	PED (m)	PAD (m)	SFT	Es.S	Es.F	Ac.St	Ac.F
1	Road reconstruction and improvement project	107	118	0.90	54	72	0.75	6 November 2001	31 March 2006	6 November 2001	30 September 2007
2	Shaanxi roads development project	757	966	0.78	42	80	0.52	1 July 2002	1 December 2005	1 December 2002	1 July 2009
3	Third road rehabilitation and maintenance project	87.4	88.7	0.99	53	71	0.74	31 August 2001	31 December 2005	31 August 2001	30 June 2007
4	Road maintenance and development project	53	59.1	0.90	59	90	0.66	21 February 2000	31 December 2004	21 February 2000	30 June 2007
5	Airport development project	105	121	0.86	41	90	0.45	1 February 1996	1 June 1999	1 September 1996	31 January 2004
6	Gujarat earthquake rehabilitation and reconstruction project	481	481	1.00	40	77	0.52	15 July 2002	31 October 2005	15 July 2002	31 October 2008

#	Project name	PEC m$	PAC m$	SFC	PED (m)	PAD (m)	SFT	Es.S	Es.F	Ac.St	Ac.F
7	Xieng Khouang road improvement project	60.7	60.7	1.00	23	83	0.28	1 April 1999	1 March 2001	13 March 1999	28 December 2005
8	Tehran sewerage project-phase 1	341	359	0.95	68	92	0.74	28 November 2000	30 June 2006	28 November 2000	30 June 2008
9	Pusan and Taejon sewerage project	272	279	0.98	31	47	0.65	29 June 1992	31 December 1994	26 August 1992	30 June 1996
10	Karachi port modernization project	143	155	0.92	59	85	0.69	6 February 1992	1 December 1996	6 February 1992	31 January 1999
11	Second national highway project	385	418	0.92	108	126	0.85	31 August 1992	30 June 2001	31 August 1992	31 December 2002
12	The eighth highways project	90	136	0.66	60	84	0.72	20 July 1994	30 June 1999	20 July 1994	15 June 2001
13	Jamuna bridge project	696	754	0.92	62	66	0.95	26 May 1994	30 June 1999	12 August 1994	31 December 1999
14	Jamuna bridge railway link project	269	365	0.74	44	75	0.59	30 September 1997	4 May 2001	30 October 1997	20 December 2003

#	Project name	PEC m$	PAC m$	SFC	PED (m)	PAD (m)	SFT	Es.S	Es.F	Ac.St	Ac.F
15	First multi-state water supply project	172	287	0.60	48	133	0.36	1 January 1993	1 December 1996	1 January 1995	1 December 2005
16	Road rehabilitation project	77	78	0.99	7	23	0.31	1 January 1997	31 July 1997	1 October 1999	14 August 2001
17	Pemba-Montepuez road rehabilitation project	35.9	35.9	1.00	30	27	1.11	1 December 1998	1 June 2001	1 April 2000	1 July 2002
18	Jamuna bridge access roads project	170	170	1.00	7	12	0.59	1 March 1997	1 October 1997	1 June 2001	1 June 2002
19	khamane – oxbow road project	4.25	5	0.85	7	17	0.37	1 February 1987	15 August 1987	1 February 1989	9 July 1990
20	Transport sector project	96.5	103	0.93	14	29	0.48	1 September 1993	1 November 1994	1 August 1996	1 January 1999
21	Road sector improvement project	12.4	12.4	1.00	24	37	0.67	1 January 2006	31 December 2007	30 September 2006	30 September 2009
22	Primary roads restoration project	87	87	1.00	38	43	0.88	1 March 2000	1 April 2003	1 December 2000	1 June 2004
23	Andkhoy – Qaisar road project	80	82.5	0.97	36	39	0.95	1 January 2005	31 December 2007	1 September 2007	30 October 2010

#	Project name	PEC m$	PAC m$	SFC	PED (m)	PAD (m)	SFT	Es.S	Es.F	Ac.St	Ac.F
24	State and provincial roads project	480	751	0.64	64	69	0.93	28 September 1991	31 December 1996	8 November 1991	30 June 1997
25	Third road rehabilitation project	50	57.1	0.88	43	46	0.94	30 May 2002	10 December 2005	1 November 2003	30 July 2007
26	Roads development project	27.4	27.4	1.00	45	54	0.83	1 January 1996	1 September 1999	30 January 1996	27 June 2000
27	Second highway sector project	231	313	0.74	16	29	0.57	24 February 1988	30 June 1989	24 February 1988	30 June 1990
28	Almaty–Bishkek regional road rehabilitation project	112	123	0.92	29	40	0.73	1 February 2002	30 June 2004	21 August 2003	1 December 2006

PEC: Project Estimated Cost PED: Project Estimated Duration ES.S: Estimated Start

PAC: Project Actual Cost PAD: Project Actual Duration ES.F: Estimated Finish

SFC: Satisfaction Factor for Cost SFT: Satisfaction factor for Time ACS: Actual Start ACF: Actual Finish

A satisfaction factor where is between 0 to 0.49 represents unsatisfactory rating, between 0.50 to 0.75 represents satisfactory and 0.76 up to 1 and greater than 1 as highly satisfactory. It means that if more than 50% of targets of project were fulfilled, that project is satisfactory. If more than 75% of project's target were met, it is highly satisfactory where less than 50% means less than half of objectives were met where it is totally unsatisfied. Equations are:

$$\text{SFC} = \frac{Estimated\ cost}{Actual\ cost} \tag{10}$$

$$\text{SFT} = \frac{Estimated\ duration}{Actual\ duration} \tag{11}$$

$$\text{PSF} = ½\ (\text{SFC}+\text{SFT}) \tag{12}$$

A factor result more than 1 means that there is cost under-run and finishing the project before the closing date or without any delay for SFC and SFT respectively.

Table 29 shows the studied projects satisfactory condition based on the above formulas.

According to table 30, 64% of projects were highly satisfactory, where 32% were satisfactory. The only unsatisfactory project was project #15 "First multi-state water supply project" in Nigeria. It had 60% of cost overrun and 85 months of delay.

Table 30: Satisfaction rating for the projects

#	Project name	SFC	SFT	SF	Rate
1	Road reconstruction and improvement project	0.90	0.75	0.82	HS
2	Shaanxi roads development project	0.78	0.52	0.65	S
3	Third road rehabilitation and maintenance project	0.99	0.74	0.86	HS
4	Road maintenance and development project	0.90	0.66	0.78	HS
5	Airport development project	0.86	0.45	0.66	S
6	Gujarat earthquake rehabilitation and reconstruction project	1.00	0.52	0.76	HS
7	Xieng Khouang road improvement project	1.00	0.28	0.64	S
8	Tehran sewerage project - phase 1	0.95	0.74	0.84	HS
9	Pusan and Taejon sewerage project	0.98	0.65	0.81	HS
10	Karachi port modernization project	0.92	0.69	0.81	HS
11	Second national highway project	0.92	0.85	0.89	HS
12	The eighth highways project	0.66	0.72	0.69	S
13	Tamuna bridge project	0.92	0.95	0.93	HS
14	Jamuna bridge railway link project	0.74	0.59	0.66	S
15	First multi state water supply project	0.60	0.36	0.48	US
16	Road rehabilitation project	0.99	0.31	0.65	S
17	Pemba-Montepuez road rehabilitation project	1.00	1.11	1.06	HS
18	Jamuna bridge access roads project	1.00	0.59	0.79	HS
19	Khamane – Oxbow road project	0.85	0.37	0.61	S
20	Transport sector project	0.93	0.48	0.71	S
21	Road sector improvement project	1.00	0.67	0.83	HS
22	Primary roads restoration project	1.00	0.88	0.94	HS
23	Andkhoy – Qaisar road project	0.97	0.95	0.96	HS
24	State and provincial roads project	0.64	0.93	0.79	HS
25	Third road rehabilitation project	0.88	0.94	0.91	HS
26	Roads development project	1.00	0.83	0.92	HS
27	Second highway sector project	0.74	0.57	0.66	S
28	Almaty–Bishkek regional road rehabilitation project	0.92	0.73	0.82	HS

Chapter 7

CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

The existence of time and cost overrun defects in large construction projects in different countries was proved through an investigation on the selected 28 construction projects with the finance of some international banks. According to the investigation, existence of the causes for cost and time overruns in studied projects are as follows:

a) Increase in quantities of work - additional work;
b) Long period between time of bidding and contract award;
c) Design and work permit changes during construction;
d) Severe weather problems (hot, cold, snow, rain).

Based on the investigations on questionnaire's results, the key points responsible for time and cost overrun, low quality and health & safety issues are as following:

a) Important factors affecting the time in construction projects

Outcomes of index analysis for time factor indicates that "Financial difficulties of contractor" and "Financial difficulties of owner/client" have been ranked as the first and the second by the respondents. These results prove the high importance of financial status of contractors and owners in management of time. Any financial weakness will affect the projects implementation time through increasing the time progress, decreasing the purchasing power of contractor and influencing the relations between contractors and

suppliers. Therefore the most obvious sign of financial difficulties in construction projects is delay.

b) Most important factors affecting cost in construction projects

According to the results "Rework and wastage of materials" and "Inflation" are two most important critical factors between 46 factors that leading to cost overrun. Failure in quality or mistakes in implementation means rework. Rework needs extra materials and money and leads to cost overrun.

"Inflation" represents the second major cause for cost overrun according to the index analysis of the cost factor among the 46 factors. It is highly affecting different phases of the project especially increasing actual total cost in the countries with positive rate of inflation.

c) Factors highly affecting both time and cost

"Inadequate contractor experience" and "Rework and wastage of materials" are highly affecting both time and cost. These two factors have a tight correlation to each other in creating delay and extra costs.

d) Factors highly affecting quality

"Lack of quality control" and "Poor supervision and site management" emphasize the importance of quality control during the construction project. It also states that good management and supervision severely influence the quality of the project. Quality control in construction is an important activity to reduce the quality defects.

Poor supervision also has negative impacts on quality of works as well as its effect on time, cost and health and safety. It has to be considered that, with good supervision on all construction activities, quality failures will be reduced.

e) Factors highly affecting health & safety

A construction project will successfully be completed when the lowest human losses and minimal injuries made during construction. “Poor health and safety condition on site” and “Inadequate contractor experience” are the most important critical factors that affect the projects by causing health and safety problems. An experienced contractor will finish the work with minimal incidents attributed to compliance with health and safety standards, using experienced staff and workers and utilize suitable equipment.

7.2 Satisfaction Indicator

Lots of functions are performed by indicators. Better judgment and more successful decision makings can be done based on indicators. In construction industry indicators could take part in helping the owners to make decision and create preference for the contractors.

A satisfaction indicator was developed for every project based on the data of cost and time of the studied 28 projects. This indicator helps to recognize the level of satisfaction in the construction projects in the view points of cost and duration. The satisfaction indicator can be added to resume of the contractors as a measure of their success.

7.3 Recommendations

The following suggestions and recommendations are proposed. These recommendations have been established according to the results of studied projects and questionnaires on time and cost overrun, quality and health & safety factors

a) Recommendations to owners

In order to complete construction projects in the specified time and within the budget with good quality and less health and safety issues, the following recommendations are specified to owners:

a) Avoid employing contractors with an inadequate experience in the field of the project. Employing such contractors may cause delay and cost overrun, low quality of work and accidents in the site of project.
b) Use contractors with high level of management and supervision experience in the field of the work. Weak management and supervision on work leads to time and cost overrun and influences quality and health & safety.
c) It is particularly important to consider the financial status of the contractor before awarding the job. Contractors with strong financial status have the ability to do their duties on time and budget with good quality and providing good health & safety conditions for engineers and workers.
d) Employ experienced consultants instead of consultants with low salary. Consultants with good technical offices and professional managerial engineers will help owners to run their projects with no or low time and cost overrun with good quality.

b) Recommendations to contractors

The followings are recommended to contractors in order to have successful construction projects in terms of finishing the project in specific time and within total budgeted cost with good quality and less health and safety issues:

a) It is highly recommended to be aware of employing unqualified and unskilled staff without proper experience in order to be able in doing managerial and

experienced-based parts of the project. Unskilled employees impose slow progress of work, health and safety issues, low quality and cost overrun.

b) It is highly advised to use top and senior managers with good level of related work experience and also knowledge on management in critical conditions. Good managers have the ability to run the project successfully with respect to time frame and cost limitations.

c) Evaluate the total cost before undertaking a construction project contract. A contract price should not be over the financial ability of the company. Any financial problem in the project expenditure and payments will cause delay and cost overrun accordingly. Quality and health & safety issues are also highly influenced under these circumstances.

d) It is recommended to be responsive about construction equipments, therefore purchasing the equipments before beginning any construction activities is preferred. Shortage of equipment always leads to time and cost overrun. Quality is also affected by this through implementing project with unsuitable equipments in the lack or shortage of the right one.

e) It is recommended to use labors with standard performance and high productivity in order to prevent time and cost overrun and avoiding slow progress of works.

7.4 Further works

For developing the idea of the satisfactory indicator it should be suggested to add some criteria like external factors such as weather conditions and economic factors for each country.

Making a mathematical model for time and cost with respect to quality and health and safety is remained for further works.

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APPENDIX

Appendix 1

Questionnaire

Many projects experience extensive delays and thereby exceed initial time and cost estimates. In addition to imparting the economic feasibility of capital projects, extensive delays provide a fertile ground for costly disputes and claims. Our endeavor is to study the main causes of delay and to find out if they are mutually inclusive that being the case to study the impact of one cause over the other. I see you as a professional with vast experience in construction. We request you to kindly fill up this questionnaire which will be of immense help in my study. I assure you that this study is solely intended for academic purposes and confidentiality of your response is guaranteed.

Name		**Age**		**Major type of work**		**Education**	
Surname		**Gender**		**Work in**		**Country**	
Company		**Work Exp.**		**Position**			

Please rate effect of each listed factors that leads to delay, cost overrun, low quality of work and health and safety issues.

Not significant		**Slightly Significant**	**Middle**	**Very Significant**		**Extremely Significant**	
0		1	2	3		4	

ID	Factors related to management of work (all points of view)	D	C	Q	HS
1-1	Inadequate front-end planning of project				
1-2	Inaccurate initial project scope and cost estimate				
1-3	Inadequacy communication between design and construction parties				
1-4	Poor supervision and poor site management				
1-5	Not communicating with all parties dealing the budget				
1-6	Owner interference in the project				
1-7	Poor project management assistance				
1-8	Poor contract management				
1-9	Poor provision of information to project participants				
ID	**Factors related to management of work (all points of view)**	**D**	**C**	**Q**	**HS**
2-1	Inflation				
2-2	Failure to resolve change orders and prevent them from becoming claims/disputes				
2-3	Too many construction activities going on at the same time				
2-4	No financial incentive to contractor to finish the project ahead of schedule				

ID	Factors related to Owner-Client	D	C	Q	HS
3-1	Slowness of the owner's decision-making process				
3-2	Slow financial and payment procedures adopted by the client				
3-3	Contract modifications(Replacement , addition and change)				
3-4	Approval of drawings and material				
3-5	Financial difficulties of owner/Client				
3-6	Long period between time of bidding and contract award				
3-7	Increase in quantity of work (Additional works)				
ID	**Factors related to consultant**	**D**	**C**	**Q**	**HS**
4-1	Design and work permit changes during construction				
4-2	Absence of consultant's staff in the site of the project				
4-3	Lack of technical and managerial skills of consultant's staff				
4-4	Lack of quality assurance –Control				
4-5	Poor documentation - Incomplete drawings				
4-6	Slow inspection of completed works				

ID	Factors related to contractor	D	C	Q	HS
5-1	Equipment and manpower shortage and bad distribution on site				
5-2	Poor communication with consultant and owner				
5-3	Financial difficulties of contractor				
5-4	Low productivity of labor				
5-5	Inadequate contractor experience				
5-6	Rework and wastage of materials				
5-7	Delay in mobilization				
5-8	Inadequate and incompetent subcontractors				
ID	**Factors related to material , manpower and equipment**	**D**	**C**	**Q**	**HS**
6-1	Delay of material delivery to site of the project				
6-2	Unavailability of required materials in the local market on time				
6-3	Fluctuation and escalation in prices of materials and machinery				
6-4	Monopoly of construction materials supply (Steel, cement)				
6-5	Equipment availability and failure				

6-6	Lack of maintenance for the equipment				
6-7	Skilled labor shortage				
ID	**External factors**	**D**	**C**	**Q**	**HS**
7-1	Poor and unforeseen site conditions (Location, ground, ETC)				
7-2	Severe weather problems (Hot, Cold, Snow, Rain)				
7-3	Political issues-Changes				
7-4	Poor health and safety condition on site				
7-5	Changes in laws and regulations during the project- Obstacles from government				