ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES
ADDIS ABABA INSTITUTE OF TECHNOLOGY
SCHOOL OF CIVIL & ENVIRONMENTAL ENGINEERING

Right of Way Risk Management of Road Construction Projects in Urban Areas, A Case Study of Addis Ababa

A Thesis

By

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A Thesis submitted to School of Graduate Studies of Addis Ababa University
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ABSTRACT

Almost all Addis Ababa city road projects are exposed to time and cost overrun. Failure of roads also starts before the expected design period expires. The objective of this thesis is to identify the factors adversely affecting the objectives of AACRA road projects and to propose recommendation on how to deal with the problems.

To achieve the objectives of the thesis, case study of 10 road projects selected from Addis Ababa, desk studies relevant to the subject matter and 10 interview responses from professionals from the client, consultants and contractors that have been currently working with AACRA have been rigorously assessed.

The findings from the research show that the major problem for non-achieving project objectives of AACRA roads is the slow clearance of obstructions from ROW construction limit. There is no formal risk management entertained by any of the parties to address the issue.

This thesis also introduces a Project Definition Rating Index (PDRI) tool which is believed by the researcher helpful to assess scope definition completeness at various stages of AACRA road pre-project planning process.

Key Words: *Alignment of stakeholders, Front End Planning (FEP), Project Definition Rating Index (PDRI), Project Scope Definition, Right of Way (ROW) and Risk Management.*

TABLE OF CONTENTS

Chapter Page

LIST OF TABLES

Table Page

LIST OF FIGURES

ABBREVIATIONS

AACRA	:	Addis Ababa City Roads Authority
CII	:	Construction Industry Institute
CRBC	:	China Road and Bridge Corporation
CSA	:	Central Statistics Agency
FEP	:	Front End Planning
FIDIC	:	Federation Internationale Des Ingenieurs Conseils
GTP	:	Growth Transformation Plan
MoFED	:	Ministry of Finance and Economic Development
MoWUD	:	Ministry of Works and Urban Development
PDRI	:	Project Definition Review Index
PMBOK	:	Project Management Body of Knowledge
PMI	:	Program Management Institute
PPA	:	Public Procurement Agency
ROW	:	Right of Way

CAHPTER 1: INTRODUCTION

1.1 Background

Ethiopia is a country situated in East Africa and is the oldest independent nation in Africa with a population estimate of about 86 million, spread over a territory of 1.1 million km^2 (CSA, 2008). Agricultural activity is the primary resources of the country's economy. Nearly 83% of the population live in rural areas and depend on farming activities to earn their living (World Bank, 2010).

Ethiopia is currently one of the few fast growing countries in the world with the gross domestic product growth rate of about 10.7% (World Bank, 2010). The rate of this growth is expected for further rapid growth to achieve minimum 11.2% and maximum 14.9% by 2015 through the introduction of the five year Growth and Transformation Plan (GTP), in the period from 2010/11 to 2014/15 and at the end of the GTP it is aimed to reduce the total poverty head count of 29.2% to 22.2% by transforming the economy and lives of the citizens (MoFED, 2010). This five year plan provides government polices and strategies with visions, objectives and targets so that the industrial sector, especially the improvement of accessibility through increased road network, plays a key role in the economic growth of the country. So roads are the back bones of development efforts. Under the five year plan of GTP, the total road length of the country is targeted to increase from 48,800km to 64,500km in addition to the launching of Universal Rural Road Access Program (URRAP) through which it has been planned to construct all weather road with length of 71,523km to connect all rural kebeles with main roads (MoFED, 2010).

It is known that the policies and regulations for the above encouraging economic and social development of the country are mainly emanated from Addis Ababa. So the infrastructure development of the city has a significant role towards the achievement of the current GTP of the country. The plan pushes for the completion of the Millennium Development Goals, a set of anti-poverty goals meant to be reached by 2015. It also seeks to boost employment and achieve inclusive economic growth while safeguarding the environment and advancing peace and democracy.

Addis Ababa was founded in1887 by Emperor Menelik II and became the capital city of Ethiopia in 1889. Since then the city is the capital and the largest commercial center of the country. It is situated in central Ethiopia at an elevation about 2,400m above sea level and its high elevation gives the city a mild, pleasant climate. Its population is estimated at about 3.1 million[1] (CSA, 2008). The terrain coupled with lack of master plan had an adverse impact on the establishment of planed streets in the city during the early times of its establishment.

In 1963, the charter was signed in Addis Ababa that established the then Organization of African Unity (OAU) and the present African Union (AU), hence the city became the headquarter of Africa since then. The city is also the seat of the United Nations Economic Commission for Africa. As such the city is the scene of many international conferences.

At present, the Addis Ababa City Administration has set a plan to bring the city to middle level cities by 2020. The administration has also set a program to construct huge number of residential houses including condominiums where their development is rapidly progressing at the out skirt of the city leading to the increment of built up areas of the city. In addition large number of cars are being imported to the city.

The Addis Ababa City Roads Authority (AACRA) was established by the Addis Ababa City Administration in 1998 (AACRA 2012). The total length of roads constructed in the city till the establishment of the Authority in 15th March 1998 was 1300km of which 900 km was gravel road and the remaining 400 km was asphalt surfaced road. The Addis Ababa City Roads Authority has made significant improvements in the city roads expansion and upgrading since its establishment, particularly in the last 10 years. Today the city roads length reached 3,731 kms as measured in equivalent width of 7m or 13.7% of the city coverage. This figure is below the international standard of 25% for the cities. The Addis Ababa City Roads Authority has already set out a plan for the coming seven years by 2020 to reach 25% road coverage of the city (AACRA 2012). And later according to the annual summary report of the road construction accomplishment of AACRA, the road coverage was evaluated reaching 15.64% at the end of the Ethiopian fiscal year in July 2013.

On the other hand most of the existing city roads are unplanned, narrow and are not constructed adopting modern technology, hence they are not in a position to accommodate the vehicular

[1] The figure is for the year 2013, which is computed by projecting from a population census at 2007 with an annual growth rate of 2.1%.

movements in city. Talk less of rush hour commutes, it was becoming common to see traffic jams during normal working hours as well.

Experiences and literatures show that construction projects of Addis Ababa city roads are often subjected to long delays, increased costs and substandard quality. Several projects are terminated at the middle before completion and overtaken by another contractor or AACRA own force. Moreover mainly due to substandard quality works and design errors, huge amount of unexpected expenses are required for maintenance in order to keep the road operational after the completion of the project. Because of their nature of being prone to the delay in the clearance of obstructions from the Right of Way (ROW) limits, the road constructions challenges in urban areas are even worsen due to lesser productivity outputs that is eventually leading to time and cost overruns. The main causes can be grouped in to those risks during initial project development, risks during design, risks during tendering, risks during implementation and risks during operation and maintenance.

The delay witnessed on majority of the road construction projects in Addis Ababa is posing problems on daily transportation activities in the city. Apart from that some roads are left without getting maintenance for too long. Especially during rainy seasons traffic flow on some of the roads were observed stranded by stagnant storm water on the carriageway due to poor drainage system. These are some of the challenges causing the users to suffer which by far adversely affect the development activities of the country.

Therefore this study tries to find the source of problems for the delay of projects and related cost overrun and poor quality and to indicate possible solutions which lead towards the achievement of more road construction within the stipulated budgeted and contract time without compromising quality[2]. The study is therefore helpful for the stakeholders and concerned Public Agencies to use it as additional material while taking mitigation measures towards efforts to maintain smooth flow of traffic in urban areas in general and in Addis Ababa in particular.

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[2] It is obvious that though ROW obstructions do not have direct effect on the **quality** aspect of the project objectives, the title of the thesis was made more specific in the final stage of the thesis by including “ROW risks” following the results of the feedback from the informants of the interview.

1.2 Problem Statement

From the accomplishments of the Addis Ababa City Roads Authority since its establishment in 1998, it is noticed that almost all of the road projects constructed in the city resulted in cost and time overruns as tabulated in Table 1. Besides, some of the recently completed roads are also not operational as expected due to poor quality as presented in the following pages as Figure 1.

Generally the development of the construction industry in Ethiopia, especially in urban areas is affected by numerous problems. Almost all road projects in Addis Ababa city are completed ending with additional cost and time above the planned or signed agreement and with qualities below that was stipulated in the contract and leading to their deterioration before the designed lifecycle period. There are several causes for these problems and the main ones being the existence of obstructions in the ROW limit, lack of belongingness among the stakeholders, shortage of liquid asset and lack of experienced professionals faced during planning, designing, implementation and operation/maintenance of road projects and the lack of proper managements.

Table 1: Status of roads[3] accomplishment in Addis Ababa from AACRA (2012)

No	Projects	Total Length (km)	Width (m)	Physical (Length-km)		Financial (Million ETB)		Completion Time (month)		%		
				Plan	Accom	Bud-get	Disb.	Plan	Accom	Phy. Accom	Fin. Disb.	Compl. Time
1	Alert Hospital - Keranyo	2.3	20	2.3	2.3	20.2	32.2	3.4	27.4	100	159	806
2	Semen Bus Terminal - Karalo	5.4	30	5.4	5.2	57.6	58.2	3.4	42.6	96	101	1,253
3	Yerer Ber – Gurdshola – CMC	2.1	25	2.1	2.1	20.0	20.4	3.4	27.4	100	102	806
4	Yerer Ber – Yerer Goro - AAWSA Treatment Plant	6.0	30/20[4]	6.0	6.0	76.0	94.9	12.2	74.2	100	125	608

[3] All roads projects are surfaced with asphalt concrete.

[4] The figure 30/20 represents the roadway with varying width 30m for part of the road segment and 20m for the rest.

No	Projects	Total Length (km)	Width (m)	Physical (Length-km)		Financial (Million ETB)		Completion Time (month)		%		
				Plan	Accom	Bud-get	Disb.	Plan	Accom	Phy. Accom	Fin. Disb.	Compl. Time
5	Bus No. 3 Mazoria – Bisrate Gebriel – Lideta – Pushkin Square	4.1	30	4.1	4.1	89.5	120.3	18.1	42.5	100	134	234
6	Meskel Square – Kality Interchange	8.8	40	8.8	8.8	312.0	452.2	36.5	57.7	100	145	158
7	Bole Rwanda – Bole Michael	1.7	20	1.7	1.3	43.7	53.7	19.2	73.9	76	123	385
8	World Bank – Yeshi Debele	3.5	40	3.5	3.5	195.8	216.7	14.0	44.9	100	111	321
9	Wingate Michililand – Asko	2.3	25	2.3	2.3	154.5	180.1	11.0	38.7	100	117	352
10	Wingate - Asko Bridge	2.6	30	2.6	2.6	203.3	417.8	18.8	30.5	100	205	162

Figure 1: Pictures from recently completed road projects in Addis Ababa with poor quality.

Photo 1: Storm Water pond on Ring Road (Between Kadisco-Abo roundabouts)

Photo 2: Accident due to invisible pavement marking (Mekanisa-Jemo road)

Photo 3: Outer carriageway of the Ring Road hardly functional (Near "Koshe" area)

Photo 4: High speed carriageway used as bus stop (Near "Koshe" area)

Photo 5: Man Hole being clogged & not functional (Mekanisa-Jemo road)

Photo 6: Damage to street light pole leaving possibility for electric hazard (Mekanisa-Jemo road).

Figure 1: (Continued)

Photo 7: Retaining wall tilting, error likely in erecting formwork during construction (Wingate - Asko Bridge Road Project)

Photo 8: Damaged manhole cover on the walkway poor workmanship (Mekanisa-Jemo road)

Photo 9: Storm water entry gutters gully manhole cover stolen (Wolo sefer-Gotera Road)

Photo 10: Clogged gully manholes resulting in pond water (Wolo sefer-Gotera Road).

Photo 11: Two lane carriageway serving traffic as single lane (Mekanisa-Jemo road)

Photo 12: Manhole left open with exposed re-bar (Bole Rwanda- Bole Michael Road)

Hence in order to solve the above major problems the following research aim and objectives are developed

1.3 Aim, Objectives and the Research Questions

The aim of the research is to give a better understanding on the necessity of risk management in order to maximize the chance of a successful project objectives, which helps to accelerate the expansion of the road transport coverage of Addis Ababa city and to facilitate accessibility and mobility of traffic flow.

The main objective is to identify sources of risks contributing to cost and time overruns, and affect quality objectives of projects and propose the corresponding recommendation to be done based on the conclusions reached.

Therefore in order to reach the main objectives of the research, the following specific objectives are listed:

1. To assess performance and challenges of road construction in Addis Ababa and to raise the issue of concerns on the extent of the involvement of domestic contractors.
2. To evaluate the level of understanding by professionals and current practice of risk management system in urban road projects.
3. To identify risks in urban road construction projects, and to assess the frequency of occurrence and impacts of ROW risks
4. To employ the concept of the PDRI, its correlation with project success and its use as a ROW risk management tool.

From the preceding listed objectives, the following research questions are raised to answer the objectives of the research:

1. How are the existing performance and challenges of road construction in urban/ Addis Ababa rated to ensure the achievement stated in the target. What is the level of participation by the domestic contractors towards the achievement of the target?
2. What are the current practices to manage risks in urban road projects? Are there formal risk management systems?
3. What are the sources of risks and challenges special for the road constructions in the urban? Do ROW risks contribute to cost and time overruns, and poor quality of works?

4. How is the concept of PDRI correlated with success and used as a tool to manage ROW risks?

1.4 Scope of the Study

The thesis scope is limited to assessment of road construction performance and its risk management practices in urban area, a case study in Addis Ababa. The findings of the assessment are reviewed in light of previous research findings that could minimize various risks. Thus, specific tools and techniques of risk analysis are not dwelt in detail since the emphasis of this research is to enlighten the importance of risk management to achieve project objectives.

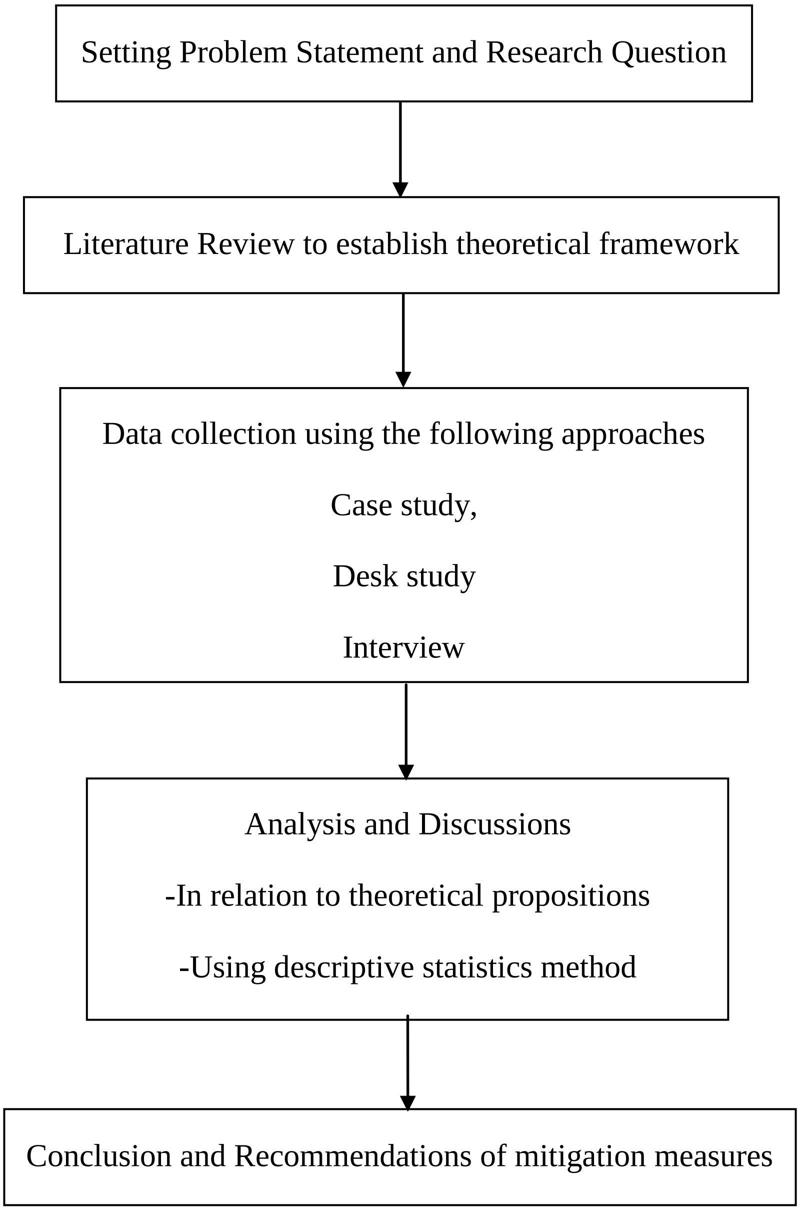
1.5 Structure of the Thesis

This research study is composed of five sections and two appendices. Section 1 is an introduction and back ground to the thesis which includes seven sub sections namely the background; problem statement; aim, objectives and research questions; scope of the study; structure of the thesis; methodology of the research; and contributions of the research. Section 2 presents the theoretical framework for the study. Section 3 focuses on the research design and methodology in detail. Section 4 the analysis of results. Section 5 is the conclusion and recommendation part of the research. At last there are appendices which contains the interview schedule and sample examples on PDRI tool.

1.6 Research Methodology

A visual representation of the pattern taken by the author to complete the research objectives is depicted in Figure 2 as follow.

Figure 2: Conceptual framework of the research



1.7 Contribution of the Research

The output of this research will enlighten those risks adversely affecting the achievement of project objectives, causing client and contractor relationships to be rivals. Hence the finding of the thesis will help to set a formal risk management system to control ROW risks thereby controlling time and cost overrun and enhancing quality. In particular the research benefits highly the Clients, in this case, AACRA, towards achieving its goal of constructing large number of roads in Addis Ababa city to catch up with the target set of 25% road coverage in 2020 (AACRA 2012).

CAHPTER 2: LITERATURE REVIEW

2.1 Introduction

The primary intent of this literature review was to gain insight into the theoretical frame work for the study and for the understanding of the research objectives. The literature review focuses on the identification as well as mitigation of risks adversely affecting a particular goal of a project. According to Caltrans (2007) all projects have four objectives - scope, schedule, cost and quality.

The delay in completion time, cost overruns and poor quality works of road projects in urban areas are caused as a result of several uncertain factors all of which are associated with some form of risk. According to Lewis (2010) all risk encountered on a project is related to failure of one or more of the following:

- To keep within the cost budget/forecast/estimate/tender;
- To keep within the time stipulated for the approvals, design construction and occupancy;
- To meet the required technical standards for quality, function, fitness for purpose, safety and environment preservation.

According to PMBOK (2013) project risk is an uncertain event or condition that, if it occurs, has a positive or negative effect on a project objectives such as scope, schedule, cost and quality.

Construction Industry Institute, CII (2010) suggests front end planning as a strategy to be used by the owners to address risk and decide to commit resources to maximize the chance for a successful project.

Hence the researcher of this thesis also emphasizes from PMBOK (2013) that for a project to be successful, the project management along with the stakeholders should be committed to address risk management proactively and consistently throughout the project life cycle.

2.2 Definition of Risk

Cambridge dictionary defines risk as “the possibility of something bad happening”. The Concise Oxford dictionary defines risk as “a situation involving exposure to danger or loss; the possibility that something unpleasant will happen.” That means in day to day activities of human beings, there are risks associated with the successful achievement of their preset objectives, vision or destiny. Ayele Tirfie (2013) clarifies risk as a chance that loss will occur. Twort and Rees (2004) define risk as the likelihood of potential harm from a hazard being realized. A hazard includes articles, substances, plant or machines, methods of work, the working environment and other aspects of work environment with the potential to cause harm.

In construction projects management context, projects are also exposed for risk towards achieving successfully their objectives. Caltrans (2007) also quotes PMBOK (2000) and defines a project risk as an uncertain event or condition that, if it occurs, has a positive or a negative effect on at least one project objective. Thus risk allows inclusion of opportunities as well as threats, since an opportunity is simply an uncertainty with a positive effect on an objective.

Opportunity is a positive event risk or outcome of proactive risk mitigation. It is a condition or situation favorable to the project, a positive set of circumstances, a positive set of events, a risk that will have a positive impact on project objectives, or a possibility for positive changes. Threat is a condition or situation unfavorable to the project, a negative set of circumstances, a negative set of events, a risk that will have a negative impact on a project objectives if it occurs, or a possibility for negative changes. A threat is the likelihood that something bad will happen that causes harm to an information asset. Threat is a risk for a measure of the probability and severity of undesired effects; it is often taken as the simple product of probability and consequence which is a combination of the probability of occurrence of harm and the severity of that harm. Whereas opportunity is a risk with positive consequences which is a product of the probability of an event occurring and its positive consequences on objectives (PMBOK 2000).

According to Lewis (2010), a risk is anything that may happen that could create an adverse effect on your schedule, cost, quality, or scope. Garvey (2009) defines risk as event that, if it occurs, adversely affects the ability of a project to achieve its outcome objectives. According to Clement and Gido (2006), risk is the possibility that an unwanted circumstance will occur that can result in some loss.

As per Acquisition Community Connection (2011), risk is a measure of future uncertainty in achieving program performance goals and objectives within defined cost, schedule and performance constraints. Risk can be associated with all aspects of a program (e.g., threat, technology maturity, supplier capability, design maturation, performance against plan) as these aspects relate across the Work Breakdown Structure (WBS) and Integrated Master Schedule (IMS). Risk addresses the potential variations in the planned approach and the expected outcomes.

Risk has three components:

- A future root cause (yet to happen), which, if eliminated or corrected, would prevent a potential consequence from occurring,
- The likelihood (or probability) assessed at the present time of that future root cause occurring, and
- The consequence (or impact) of that future occurrence.

A future root cause is the most basic reason for the presence of a risk. Accordingly, risks should be tied to future root causes and their effects.

For this study the definition of risk as forwarded by Caltrans (2007) is adapted which is summarized as an uncertain event or condition that, if it occurs, has a positive or negative effect on a project's objectives.

2.3 Project Risk Management

Risk management is a process of controlling the level of risk and to mitigate its effects (Shehu and Sommerville 2006). According to Flanagan & Norman (1993) risk management is a discipline for living with the possibility that future events may cause adverse effects. Project risk management includes the processes of conducting risk management planning, identification, analysis, response planning, and monitoring and control on a project (PMBOK 2008). Risk management is the part of project planning that identifies key risks and develops plans to prevent them and/or mitigate their adverse effects (Harvard Business Essentials 2004). Risk management includes identifying, assessing, and responding to project risks in order to minimize the likelihood and impact of the consequences of adverse events on the achievements of the project objectives (Clement and Gido 2006). According to Caltrans (2007), risk management is the systematic process of planning for, identifying, analyzing, responding to, and monitoring project risks. It involves processes, tools, and techniques that will help the project manager maximize the probability and results of positive events and minimize the probability and consequences of adverse events as indicated and appropriate within the context of risk to the overall project objectives of cost, time, scope and quality. Project risk management is most effective when first performed early in the life of the project and is a continuing responsibility throughout the project’s life cycle.

Risk management is a critical part of project management as unmanaged or unmitigated risks are one of the primary causes of project failure (Royer 2000 as cited in Lyons, T., & Skitmore, M. 2002).

According to PMBOK (2013), the objectives of risk management are to increase the likelihood and impact of positive events, and decrease the likelihood and impact of negative events in the project.

As per Caltrans (2007), the project risk management process helps project sponsors and project teams make informed decisions regarding alternative approaches to achieving their objectives and the relative risk involved in each, in order to increase the likelihood of success in meeting or exceeding the most important objectives (e.g. time) sometimes at the expense of other objectives (e.g. cost). Risk management encourages the project team to take appropriate measures to:

a) Minimize adverse impacts to project scope, cost, and schedule (and quality, as a result).
b) Maximize opportunities to improve the project's objectives with lower cost, shorter schedules, enhanced scope and higher quality.
c) Minimize management by crisis.

PMBOK (2000), recommends the responsibility of managing risks to the project manager who is required to form a separate department assigning a personnel-risk officer under the close follow up of the project manager. Thus organizations attempting to implement a formal structured approach to risk management need to treat the implementation itself as a project, requiring clear objectives and success criteria, proper planning and resourcing, and effective monitoring and control.

Walker, P and Greenwood D (2002), describe the processes of risk management to involve the following stages:

1. Identify
2. Analyze
3. Evaluate
4. Allocate
5. Manage.

Flanagan and Norman (1993) list the following general stages to deal with risk:

1. Risk identification
2. Risk classification
3. Risk analysis
4. Risk attitude
5. Risk response

Caltrans (2007) and PMBOK (2013), generally identify the following six steps for risk management processes:

1. Risk Management Planning
2. Risk Identification
3. Qualitative Risk Analysis
4. Quantitative Risk Analysis
5. Risk Response Planning
6. Risk Monitoring and Control

Potts k. (2008) considers risk management to have three stages: identification, analysis and response.

Lewis (2010) describes the risk management processes in the following three steps:

1. Identify risks and threats by asking, " What could go wrong?" or "What kind of threats are there?"
2. Quantify threats and risks by assigning a risk priority number to them.
3. Develop contingency plans to deal with risks that cannot be ignored.

For this study the procedures of risk management as forwarded by Caltrans (2007) and PMBOK (2013), is adapted which is described in detail in the following sections. The project risk management overview adopted from PMBOK (2013) is also depicted overleaf as Figure 3.

Figure 3: Project risk management overview adapted from PMBOK (2013)

Project Risk Management Overview

1. Plan Risk Management

1. Inputs
1.1 Project management plan
1.2 Project charter
1.3 Stakeholder register
1.4 Enterprise environmental factor
1.5 Organizational process assets

2. Tools & Techniques
2.1 Analytical techniques
2.2 Expert judgment
2.3 Meetings

3. Outputs
3.1 Risk management plan

2 Identify Risks

1. Inputs
1.1 Risk management plan
1.2 Cost management plan
1.3 Schedule management plan
1.4 Quality management plan
1.5 Human resource management plan
1.6 Scope baseline
1.7 Activity cost estimates
1.8 Activity duration estimates
1.9 Stakeholder register
1.10 Project documents
1.11 Procurement documents
1.12 Enterprise environmental factors
1.13 Organizational process assets

2. Tools & Techniques
2.1 Documentation reviews
2.2 Information gathering techniques
2.3 Checklist analysis
2.4 Assumptions analysis
2.5 Diagramming techniques
2.6 SWOT analysis
2.7 Expert judgment

3. Outputs
3.1 Risk register

3 Perform Qualitative Risk Analysis

1. Inputs
1.1 Risk management plan
1.2 Scope baseline
1.3 Risk register
1.4 Enterprise environmental factors
1.5 Organizational process assets

2. Tools & Techniques
2.1 Risk probability and impact assessment
2.2 Probability and impact matrix
2.3 Risk data quality assessment
2.4 Risk categorization
2.5 Risk urgency assessment
2.6 Expert judgment

3. Outputs
3.1 Project documents updates

4 Perform Quantitative Risk Analysis

1. Inputs
1.1 Risk management plan
1.2 Cost management plan
1.3 Schedule management plan
1.4 Risk register
1.5 Enterprise environmental factors
1.6 Organizational process assets

2. Tools & Techniques
2.1 Data gathering and representation techniques
2.2 Quantitative risk analysis and modeling techniques
2.3 Expert judgment

3. Outputs
3.1 Project documents updates

5 Plan Risk Responses

1. Inputs
1.1 Risk management plan
1.2 Risk register

2. Tools & Techniques
2.1 Strategies for negative risks or threats
2.2 Strategies for positive risks or opportunities
2.3 Contingent response strategies
2.4 Expert judgment

3 Outputs
3.1 Project management plan updates
3.2 Project documents updates

6 Control Risks

1. Inputs
1.1 Project management plan
1.2 Risk audits
1.3 Work performance data
1.4 Work Performance reports

2. Tools & Techniques
2.1 Risk reassessment
2.2 Risk audits
2.3 Variance and trend analysis
2.4 Technical performance measurement
2.5 Reserve analysis
2.6 Meetings

3. Outputs
3.1 Work performance information
3.2 Change requests
3.3 Project management plan updates
3.4 Project document updates
3.5 Organizational process assets updates

2.3.1 Risk Management Planning

Risk management planning is the process of defining how to conduct risk management activities for a project. The key benefit of this process is it ensures that the degree, type, and visibility of risk management are commensurate with both the risk and the importance of the project to the organization. The risk management plan is vital to communicate with and obtain agreement and support from all the stakeholders to ensure the risk management process is supported and performed effectively over the project life cycle. Careful and explicit planning enhances the probability of success of the other risk management processes. Planning is also important to provide sufficient resources and time for risk management activities and to establish an agreed upon basis for evaluating risks. Plan Risk Management process should begin when a project is conceived and should be completed early during project planning (PMBOK 2013).

According to Acquisition Community Connection (2011) risk Planning is developing and documenting organized, comprehensive, and interactive strategies and methods for identifying risks. It is also used for performing risk assessments to establish risk handling priorities, developing risk handling plans, monitoring the status of risk handling actions, determining and obtaining the resources to implement the risk management strategies. Risk planning is used in the development and implementation of required training and communicating risk information up and down the project stakeholder organization. At the start of this step, it is important to clearly understand and articulate the fundamental objectives of the project. Once the project goals and constraints are clearly articulated and agreed on, the next step is to determine and document project risk management goals and objectives. Alignment with overall organizational strategies, objectives and performance goals is required. To accomplish this there must be a common risk language, effective organizational structure, and appropriate enablement through systems, tools, and skills. There are several key elements in successfully implementing an effective risk management process and each is necessary for risk management planning. These key elements, as per Acquisition Community Connection (2011), are:

- Developing Project Objectives, Goals, and Constraints
- Risk Management Definitions
- Risk Management Process and Procedures Training
- Risk Management Roles and Responsibilities

- Developing Value-added Procedures for Identification, Assessment, Handling and Monitoring
- Risk Management Plan

It further elaborates that risk planning occurs during the concept exploration phase and is updated for each subsequent program phase. In risk planning fundamentals you will find information explaining what is involved with risk planning, basic risk planning information, and the first steps required to begin successful risk planning.

According to Caltrans (2007), the result of Risk Management Planning is a Risk Management Plan. The risk management plan identifies and establishes the activities of risk management for the project in the project plan.

Harvard Business Essentials (2004) suggests that just as every task on the project's schedule should have an owner, every key risk should be someone's responsibility. That person should monitor the assigned risk, sound the alarm if it appears to be moving from potential problem to real problem, and take charge of the consequences.

2.3.2 Risk Identification

Risk identification is the process of discovering the source and type of risks (Flanagan and Norman 1993). Risk identification is the process of determining which risks may affect the project and documenting their characteristics. The key benefit of this process is the documentation of existing risks and the knowledge and ability it provides to the project team to anticipate events (PMBOK 2013). The most obvious way to deal with risk is to conduct a systematic audit of all the things that could go wrong with your project (Harvard Business Essentials 2004). According to Clement and Gido (2006), risk identification involves the determination of which risks may adversely affect the project objectives and what the consequence of each risk might be if they occur.

According to Twort A and Rees G. (2004), among the most common risks encountered during the construction of a project by a civil engineering contractor under a standard type of construction contract, are the following:

- Design errors, quantification errors.
- Design changes found necessary, or required by the employer.
- Unforeseen physical conditions or artificial **obstructions**.

- Unforeseen price rises in labour, materials or plant.
- Theft or damage to the works, or materials and equipment on site.
- Weather conditions, including floods or excessive hot weather.
- Delay or inability to obtain materials or equipment required.
- Inability to get the amount or quality of labour required, or labour strikes.
- Errors in pricing by the contractor.

According to Caltrans (2007), the process of risk identification produces a project risk list. The project team then puts the risks into categories and assigns each risk to a team member. These risk lists are categorized as follows:

- Design risks
    - Design incomplete
    - Unexpected geotechnical or groundwater issues
    - Inaccurate assumptions on technical issues in planning stage
    - Surveys incomplete
    - Changes to materials/geotechnical/foundation
    - Bridge site data incomplete
    - Hazardous waste site analysis incomplete
    - Unforeseen design exceptions required
    - Consultant design not up to preset standards
    - Unresolved constructability items
    - Complex hydraulic features
    - Unable to meet Americans with Disabilities Act requirements
    - Project in a critical water shortage area and a water source agreement required
    - Incomplete quantity estimates
    - Unforeseen construction window and/or rainy season requirements
    - New or revised design standard

- Construction staging more complex than anticipated

- External risks
  - Landowners unwilling to sell
  - Local communities pose objections
  - Unreasonably high expectations from stakeholders
  - Political factors or support for project changes
  - Stakeholders request late changes
  - New stakeholders emerge and request changes
  - Threat of lawsuits
  - Increase in material cost due to market forces
  - Water quality regulations change
  - New permits or additional information required
  - Reviewing agency requires longer than expected review time
  - Changes to storm-water requirements
  - Permits or agency actions delayed or take longer than expected
  - New information required for permits
  - Environmental regulations change
  - Controversy on environmental grounds expected
  - Pressure to deliver project on an accelerated schedule
  - Labor shortage or strike
  - Construction or pile driving noise and vibration impacting adjacent businesses or residents
- Environmental risks
  - Environmental analysis incomplete
  - Availability of project data and mapping at the beginning of the environmental study is insufficient

- New information after Environmental Document is completed may require re-evaluation or a new document (i.e. utility relocation beyond document coverage)
- New alternatives required to avoid, mitigate or minimize impact
- Acquisition, creation or restoration of on or off-site mitigation
- Environmental clearance for staging or borrow sites required
- Historic site, endangered species, riparian areas, wetlands and/or public park present
- Design changes require additional Environmental analysis
- Unforeseen formal consultation is required
- Unexpected issues expected
- Unexpected native people concerns
- Unforeseen resources affected
- Project may encroach into the Coastal Zone
- Project may encroach onto a Scenic Highway
- Project may encroach to a Wild and Scenic River
- Unanticipated noise impacts
- Project causes an unanticipated barrier to wildlife
- Project may encroach into a floodplain or a regulatory floodway
- Project does not conform to the state implementation plan for air quality at the program and plan level
- Unanticipated cumulative impact issues

➢ Organizational risks

- Inexperienced staff assigned
- Losing critical staff at crucial point of the project
- Insufficient time to plan
- Unanticipated project manager workload

  - Internal formalities causes delay getting approvals, decisions
  - Functional units not available, overloaded
  - Lack of understanding of complex internal funding procedures
  - Priorities change on existing program
  - Inconsistent cost, time, scope and quality objectives
  - Overlapping of one or more project limits, scope of work or schedule
  - Funding changes for fiscal year
  - Lack of specialized staff (biology, anthropology, geotechnical, archeology, etc.)
  - Capital funding unavailable for right of way or construction
- Project management risks
  - Project purpose and need is not well-defined
  - Project scope definition is incomplete
  - Project scope, schedule, objectives, cost, and deliverables are not clearly defined or understood
  - No control over staff priorities
  - Consultant or contractor delays
  - Estimating and/or scheduling errors
  - Unplanned work that must be accommodated
  - Lack of coordination/communication
  - Underestimated support resources or overly optimistic delivery schedule
  - Scope creep
  - Unresolved project conflicts not escalated in a timely manner
  - Unanticipated escalation in right of way values or construction cost
  - Delay in earlier project phases jeopardizes ability to meet programmed delivery commitment

- Added workload or time requirements because of new direction, policy, or statute
- Local agency support not attained
- Public awareness/campaign not planned
- Unforeseen agreements required
- Priorities change on existing program
- Inconsistent cost, time, scope, and quality objectives

➢ Right of way risks

- Utility relocation requires more time than planned
- Unforeseen railroad involvement
- Resolving objections to Right of Way appraisal takes more time and/or money
- Right of Way datasheet incomplete or underestimated
- Need for "Permits to Enter" not considered in project schedule development
- Condemnation process takes longer than anticipated
- Acquisition of parcels controlled by a State or Federal Agency may take longer than anticipated
- Discovery of hazardous waste in the right of way phase
- Seasonal requirements during utility relocation
- Utility company workload, financial condition or timeline
- Expired temporary construction easements
- Inadequate pool of expert witnesses or qualified appraisers

➢ Construction risks

- Inaccurate contract time estimates
- Permit work window time is insufficient
- Change requests due to differing site conditions
- Temporary excavation and shoring system design is not adequate

- False work design is not adequate
- Unidentified utilities
- Buried man-made objects/unidentified hazardous waste
- Dewatering is required due to change in water table
- Temporary construction easements expire
- Electrical power lines not seen and in conflict with construction
- Street or ramp closures not coordinated with local community
- Insufficient or limited construction or staging areas
- Changes during construction require additional coordination with resource agencies
- Late discovery of aerially deposited lead
- Experimental or research features incorporated
- Unexpected paleontology findings
- Delay in demolition due to sensitive habitat requirements or other reasons
- Long lead time for utilities caused by design and manufacture of special components (steel towers or special pipe)

➢ Engineering services risks

- Foundations utilizing Cast-In-Drilled-Hole or Cast-In-Steel-Shell pile 30” in diameter or greater may require tunneling and mining provisions within the contract documents and early notification.
- Bridges constructed at grade and then excavated underneath may require tunneling and mining provisions within the contract documents and early notification to the concerned.
- Hazardous materials in existing structure or surrounding soil; lead paint, contaminated soil, asbestos pipe, asbestos bearings and shims
- Piles driven into fish habitat may require special noise attenuation to protect marine species

- Special railroad requirements are necessary including an extensive geotechnical report for temporary shoring system adjacent to tracks
- Access to adjacent properties is necessary to resolve constructability requirements
- Existing structures planned for modification not evaluated for seismic retrofit, scour potential and structural capacity
- Foundation and geotechnical tasks (foundation drilling and material testing) not identified and included in project work plan.
- Bridge is a habitat to bats or other species requiring mitigation or seasonal construction
- Condition of the bridge deck unknown
- For projects involving bridge removal, bridge carries traffic during staging
- Verify that all seasonal constraints and permitting requirements are identified and incorporated in the project schedule
- Complex structures hydraulic design requiring investigation and planning
- Assumptions upon which the Advance Planning Study is based on are realistic and verification of these assumptions prior to completion of the Project Report
- Design changes to alignment, profile, typical cross section, stage construction between Advance Planning Study and the Bridge Site Submittal
- Unexpected environmental constraints that impact bridge construction
- Unforeseen aesthetic requirements
- Delay due to permits or agreements, from Federal, State, or local agencies for geotechnical subsurface exploration
- Delay due to Right-of-Entry agreements for geotechnical subsurface exploration
- Delay due to traffic management and lane closure for geotechnical subsurface exploration.

According to Flanagan & Norman (1993), the following can be listed as a sources of risk:

- Inflation rising above the allowance in the estimate;
- Unforeseen adverse ground conditions;
- Exceptionally inclement weather;
- Late delivery of crucial materials, for instance after a fire at a suppliers' works;
- Incorrect design details, such as the wrong size beams being shown on the architect's drawings;
- Insolvency of the main contractor;
- No co-ordination, for instance between the mechanical services contractor's drawings and the suspended ceiling specialist's drawings.

Flanagan & Norman (1993) also describes the following as the most serious effects of risk:

- Failure to keep within the cost estimate;
- Failure to achieve the required completion date;
- Failure to achieve the required quality;
- Failure of the project to meet the required operation needs;
- Damage to the property as a result of fire or flood;
- Injury to a worker due to an inadequate system of working

According to Yoyjie (2001) the sources of risks for infrastructure projects can be broadly classified in to the following categorized.

- Technical, quality or performance risk: such as employment of inexperienced designers, changes to the technology used or to industry standards during the project.
- Organizational risks: such as cost, time and scope objectives that are internally inconsistent, lack of prioritization of projects, inadequacy or interruption of funding, and resource conflicts with other projects in the organization.
- External risks: such as shifting legal or regulatory environment (including institutional changes), poor geological conditions and weather, force majeure risks such as earthquake and floods.
- Project management risks: such as poor allocation of time and resources, inadequate quality of the project plan, poor use of project management disciplines

Acquisition Community Connection (2011) elaborates Risk Identification as discovering, defining, describing, documenting and communicating risks before they become problems and adversely affect a project. Accurate and complete risk identification is vital for effective risk management. In order to manage risks effectively, they must first be identified. The important aspect of risk identification is to capture as many risks as possible. During the risk identification process, all possible risks should be submitted. Not all risks will be acted upon. Once more details are known about each risk, the decision will be made by the project members as to the handling of each risk. There are various techniques that can be used for risk identification. Useful techniques include brainstorming methods as well as systematic inspections and process analysis. Regardless of the technique used, it is essential to include key functional area personnel to ensure no risks go undiscovered.

Risk Identification Techniques

- During risk identification, it is important to seek out the real risks which are likely to occur, where common sense and reasonableness must prevail when identifying risks. The most common approaches to identify the sources of risks are brainstorming and historical information from the past project (Clement and Gido 2006). Harvard Business Essentials (2004) emphasizes for the arrangement of brainstorming sessions that involve many people with different functions and perspectives as a best technique to conduct a risk identification. According to Acquisition Community Connection (2011), there are various methods and tools for capturing statements of risks. You want to search the realm of "what could happen" by a suitable method that is convenient for your team. Some examples of popular techniques are: brainstorming, surveys, interviews, working groups, experiential or documented knowledge, risk lists, lessons learned, risk trigger questions, outputs from risk-oriented analysis, historical information, engineering templates and critical path templates. This techniques may be used alone or combined, depending on the approach that is best for the team.

Acquisition Community Connection (2011) further elaborates the above lists of techniques as follows:

- Brainstorming is a technique that is best accomplished when the approach is unrestrained or unstructured (the facilitator accepts random inputs from the group). Group members verbally identify risks which provide the opportunity to build on each other’s ideas. To achieve the desired outcome it is essential to select participants that are familiar with the topics discussed, relevant documentation is provided and a facilitator that knows the risk process, leads the group. A note-taker should be appointed to capture the ideas that are being discussed. A structured brainstorming session, where each group member presents an idea in turn, may be used where not all group members are participating. Structured brainstorming ensures participation by all group members. Brainstorming can also be used during planning to generate a list of migration strategies, possible causes for the risk, or other areas of impact, however, it is not intended for in-depth risk analysis.

- Surveys is a technique where lists of questions are developed to seek out risk in a particular area. A constraint with this method is that people inherently don't like to complete surveys and may not provide accurate information. The survey process is inherently a hands-off process with no insight into the caveats that go with the answers. The value of the surveys may be difficult to determine due to subjectivity in the answers or the focus of the questions themselves.
- Interviews is an effective way to obtain risk areas. Group Interviews can assist in identify the baseline of risk on a project. The interview process is inherently a questioning process. It is limited by the effectiveness of the facilitator and the questions that are being asked. The interview can be conducted before or after the brainstorming session. However if it is accomplished before the brainstorming session, the results should be shared with the group after they have provided their inputs to the risk list. If the interview(s) are accomplished after the brainstorming session has been completed, the list of risks should be provided to all participants for comment before they are added to the risk list.
- Working groups is a great way to analyze a particular area or topic in a discussion process to surface risks that may not be obvious to the risk identification group. The working group is usually a separate group of people working a particular area within the project that is conducting the risk identification.
- Experiential knowledge is the collection of information that a person has obtained through their experiences. Caution must be used when using any knowledge based information to ensure it is relevant and applicable to the current situation.
- Documented knowledge is the collection of information or data that has been documented about a particular subject. This is a source of information that provides insight into the risks in a particular area of concern. Caution must be used when using any knowledge

based information to ensure it is relevant and applicable to the current situation. It is important to understand any caveats that may accompany the documented information.

- Risk lists are lists that have been found on similar programs and/or similar situations. Caution must be used when using this type of information to ensure it is relevant and applicable to the current program or situation. It is important to understand any caveats that may accompany the documented information.
- Risk trigger questions are lists of situations or events in a particular area of a program that can lead to risk for the program. These are situations or areas where risks have been discovered by other programs. These trigger questions may be grouped by areas such as performance, cost, schedule, software, programmatic, etc.
- Lessons learned is experiential knowledge that has been compiled into information that may be relevant to the present project or to other projects within the organization. This source of information may guide you in finding risk on your program. Caution must be used when using this type of information to ensure it is relevant and applicable to the current program or situation.
- Outputs from risk-oriented analysis is one of the various types of risk oriented analysis. Two such techniques are fault tree analysis and event tree analysis. These are top down analysis that attempts to determine want events, conditions, or faults could lead to a specific top level undesirable event. This event with the associated consequence could be a risk for your program. A look at any Risk-Oriented Analysis can reveal risk on your program or at least give you some insight into where risk may be found.
- Historical information which are basically the same as documented knowledge. The difference is that historical information is usually widely accepted as fact.
- Engineering templates are sets of flow charts for various aspects of the development process. These templates are preliminary in nature and are intended as general guidance to accomplish a top down assessment of activities. These templates describe the engineering activities and give a list of the inputs and outputs for each activity as well as listing some factors for consideration. Some valuable information can be obtained from these; however they may be incomplete. Care must be taken to ensure the missing critical aspects are not overlooked.

- Critical path templates are templates which help to show areas of risk and provide an outline for reducing risk for each area or function throughout the entire life-cycle.

Special attention is to be drawn to the need of risk identification phase. Skitmore and Lyons (2002) conclusions contrast previous statements. Their study showed that risk management processes are applied the most in the execution phase, not in the conceptual phase. Still their study and usage of different risk management techniques showed that identification is the most frequently used risk management element. This proves that risk identification needs to be a continuous process and an efficient identification process requires many iterative rounds in even the later stages of project execution to successfully meet the expected targets.

According to PMBOK (2008) participants in risk identification activities can include the following: project manager, project team members, risk management team (if assigned), customers, subject matter experts from outside the project team, end users, other project managers, stakeholders, and risk management experts. While these personnel are often key participants for risk identification, all project personnel should be encouraged to identify risks.

According to Caltrans (2007) the assigned project stakeholders identify the potential risks (threats and opportunities), using:

- The risk breakdown structure, suitably tailored to the project
- Their own knowledge of the project or similar projects;
- Consultation with others who have significant knowledge of the project or its environment;
- Consultation with others who have significant knowledge of similar projects

Methods and steps in identifying and categorizing risks are presented in (PMBOK, 2000) which generally include brainstorming, risk checklists, expert opinion/ structured interviews, questionnaires, historical data, previous experience, testing and modeling, evaluation of other projects, analyzing different scenarios and analyzing project plans.

Potts k. (2008) suggests that identification of the potential risks can be achieved by:

- Interviewing key members of the project team;
- Organizing brainstorming meetings with interested parties;
- Using the personal experience of the risk analyst;
- Reviewing past project experiences.

According to PMBOK (2013), the following are tools and techniques for identifying risks:

- **Documentation Reviews**: where a structured review may be performed of project documentation, including plans, assumptions previous project files, contracts, and other information. The quality of the plans, as well as consistency between those plans and the project requirements and assumptions, can be indicators of risk in the project.
- **Information Gathering Techniques:** some of the information gathering techniques used in identifying risk can include:
  - **Brainstorming.** The goal of brainstorming is to obtain a comprehensive list of project risks. The project team usually performs brainstorming, often with a multidisciplinary set of experts who are not part of the team. Ideas about project risk are generated under the leadership of a facilitator, either in a traditional free-form brainstorm session with ideas contributed by participants, or structured using mass interviewing techniques such as the nominal group technique. Categories of risk, such as a risk breakdown structure, can be used as a framework. Risks are then identified and categorized by type of risk and their definitions are refined.
  - **Delphi technique.** The Delphi technique is a way to reach a consensus of experts. Project risk experts participate in this technique anonymously. A facilitator uses a questionnaire to solicit ideas about the important project risks. The responses are summarized and are then re-circulated to the experts for further comment. Consensus may be reached in a few rounds of this process. The Delphi technique helps reduce bias in the data and keeps any one person from having undue influence on the outcome.
  - **Interviewing.** Interviewing experienced project participants, stakeholders, and subject matter experts helps to identify risks.
  - **Root cause analysis.** Root cause analysis is a specific technique used to identify a problem, discover the underlying causes that lead to it, and develop preventive action.
- **Checklist Analysis:** risk identification checklists can be developed based on historical information and knowledge that has been accumulated from previous similar projects and from other sources of information. The lowest level of the risk breakdown structure can

also be used as a risk checklist. While a checklist can be quick and simple, it is impossible to build an exhaustive one, and care should be taken to ensure the checklist is not used to avoid the effort of proper risk identification. The team should also explore the items that do not appear on the checklist. Additionally, the checklist should be pruned from time to time to remove or archive related items. The checklist should be reviewed during project closure to incorporate new lessons learned and improve it for use on future projects.

- **Assumptions Analysis:** every project and its plan is conceived and developed based on a set of hypotheses, scenarios, or assumptions. Assumptions analysis explores the validity of assumptions as they apply to the project. It identifies risks to the project from inaccuracy, instability, inconsistency, or incompleteness of assumptions.
- **Diagramming Techniques** may include:
    - **Cause and effect diagrams.** These are also known as Ishikawa or fishbone diagrams, and are useful for identifying causes of risks.
    - **System or process flow charts.** These show how various elements of a system interrelate and the mechanism of causation.
    - **Influence diagrams.** These are graphical representations of situations showing causal influences, time ordering of events, and other relationships among variables and outcomes.
- **SWOT Analysis:** this technique examines the project from each of the strengths, weaknesses, opportunities, and threats (SWOT) perspectives to increase the breadth of identified risks by including internally generated risks. The technique starts with identification of strengths and weaknesses of the organization, focusing on either the project, organization, or the business area in general. SWOT analysis then identifies any opportunities for the project that arise from organizational strengths, and any threats arising from organizational weaknesses. The analysis also examines the degree to which organizational strengths offset threats, as well as identifying opportunities that may serve to overcome weaknesses.
- **Expert Judgment:** risks may be identified directly by experts with relevant experience with similar projects or business areas. Such experts should be identified by the project manager and invited to consider all aspects of the project and suggest possible risks based

on their previous experience and areas of expertise. The experts' bias should be taken into account in this process.

2.3.3 Qualitative Risk Analysis

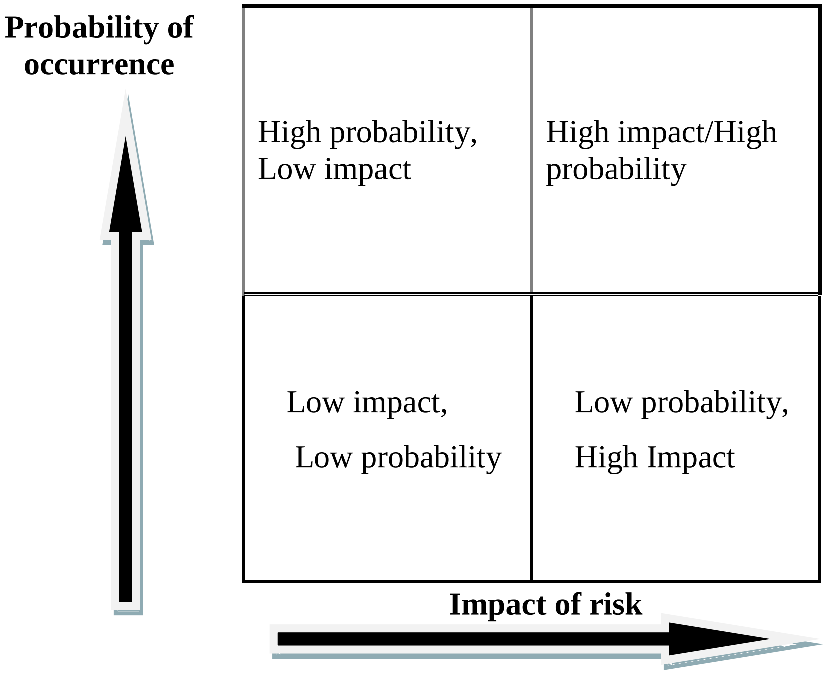
According to Flanagan and Norman (1993), there are two general types in the assessment of risk: qualitative and quantitative risk assessment and the use of risk analysis gives an insight into what happens if the project does not proceed according to plan. Qualitative risk assessment involves the direct judgment, ranking options, comparing options and descriptive analysis of the identified risks.

According to PMBOK (2013) qualitative Risk Analysis is usually a rapid and cost-effective means of establishing priorities for Plan Risk Responses and lays the foundation for Perform Quantitative Risk Analysis, if required. The Qualitative Risk Analysis process is performed regularly throughout the project's life cycle to stay current with changes in the project risks. This process can lead into Quantitative Risk Analysis or directly into Plan Risk Responses. techniques and tools include: risk probability and impact assessment, probability and impact matrix, risk data quality assessment, risk categorization, risk urgency assessment and expert judgment. Qualitative risk analysis is the process of prioritizing risks for further analysis or action by assessing and combining their probability of occurrence and impact. The key benefit of this process is that it enables project managers to reduce the level of uncertainty and to focus on high-priority risks. Qualitative Risk Analysis assesses the priority of identified risks using their relative probability or likelihood of occurrence, the corresponding impact on project objectives if the risks occur, as well as other factors such as the time frame for response and the organization's risk tolerance associated with the project constraints of cost, schedule, scope, and quality. Such assessments reflect the attitude of the project team and other stakeholders. Effective assessment therefore requires explicit identification and management of the risk approaches of key participants in the Qualitative Risk Analysis process. Where these risk approaches introduce bias into the assessment of identified risks, attention should be paid to evaluating bias and correcting for it. Establishing definitions of the levels of probability and impact can reduce the influence of bias. The time criticality of risk-related actions may magnify the importance of a risk. An evaluation of the quality of the available information on project risks also helps clarify the assessment of the risk's importance to the project.

According to Clement and Gido (2006) risk assessment/ process is a correlation between systematic identification of risks and rational management of the significant risks. The identified risks from risk identification process are the main input to risk analysis process and the two key variables in assessing the risk are probability and impact of identified risks. Both of these factors can be assigned a rating of High, Medium, or Low and in this respect the project manager, in consultation with appropriate team members, who are most knowledgeable about the potential risk, should determine a rating for each risk. Historical data from prior similar projects can also be helpful. Assessing each risk incorporates the determination of the likelihood that the risk event will occur and the degree of impact the event will have on the project objectives.

In this phase, based on the potential probability of occurrence and potential impact, the identified risk can then be prioritized for further consideration in developing risk response plan. Refer the following risk assessment matrix on Figure 4, which is adapted from (Walker, P and Greenwood D 2002).

Figure 4: Risk assessment matrixes from Walker, P and Greenwood D (2002)



As per Acquisition Community Connection (2011) the objective of this step of the Risk Management Process is to assess all the risks identified during the Identification step in order to determine their likelihood of occurrence and most probable impact. Risk Assessment can include both qualitative and quantitative assessments of the likelihood of the various risks occurring and the impact of these in terms of cost, schedule and/or performance. In some cases, particularly in the early stages of a project, there will be insufficient data available to enable a quantitative analysis to be conducted and reliance will have to be placed on qualitative analysis. Under normal circumstances the balance between qualitative and quantitative analysis will have to be considered and determined as part of the work necessary to develop the Project Risk Management Strategy/Risk Management Plan and agreement reached as to how reliable data will be captured and updated. Again accurate and comprehensive documentation of the work done during this stage is important. The relative significance of each of the risks identified should also be assessed in terms of the threat it poses to achievement of the project's objectives. A structured and analytical assessment method gives the best results. In the initial stages it is sensible and productive to restrict early effort to a qualitative approach. As more and better data becomes available it is possible to move on to quantitative analysis, but this is a serious decision and should not be taken lightly or without a clear understanding of why and how. The balance between qualitative and quantitative analysis will vary from project to project and have to be determined by the availability of data and the need to remain cost-effective. In some cases it will not be cost-effective to conduct quantitative analysis or it will add little or no value to the effective management of the project.

2.3.4 Quantitative Risk Analysis

According to Flanagan and Norman (1993), quantitative risk analysis is a way of numerically estimating the probability that a project will meet its cost and time objectives. The analysis is based on a simultaneous evaluation of the impact of all identified and quantified risks. A key purpose of quantitative risk analysis is to combine the effects of the various identified and assessed risk events into an overall project risk estimate. For quantitative risk assessment, probability analysis, sensitivity analysis, scenario analysis, simulation analysis, correlation analysis, portfolio theory, Delphi method, influence diagrams, decision trees, are lists of available techniques.

According to PMBOK (2013) quantitative Risk Analysis is the process of numerically analyzing the effect of identified risks on overall project objectives. The key benefit of this process is that it produces quantitative risk information to support decision making in order to reduce project uncertainty. Quantitative Risk Analysis is performed on risks that have been prioritized by the Perform Qualitative Risk Analysis process as potentially and substantially impacting the project’s competing demands. The Quantitative Risk Analysis process analyzes the effect of those risks on project objectives. It is used mostly to evaluate the aggregate effect of all risks affecting the project. When the risks drive quantitative analysis, the process may be used to assign a numerical priority rating to those risks individually. Quantitative Risk Analysis generally follows the

Perform Qualitative Risk Analysis process. In some cases, it may not be possible to execute the Perform Quantitative Risk Analysis process due to lack of sufficient data to develop appropriate models. The project manager should exercise expert judgment to determine the need for and the viability of quantitative risk analysis. The availability of time and budget, and the need for qualitative or quantitative statements about risk and impacts, will determine which method(s) to use on any particular project. Perform Quantitative Risk Analysis should be repeated, as needed, as part of the Control risks process to determine if the overall project risk has been satisfactorily decreased. Trends can indicate the need for more or less risk management action. Techniques and tools include: data gathering and representation techniques, quantitative risk analysis and modeling techniques and expert judgment.

2.3.5 Risk Response Planning

Plan Risk Responses is the process of developing options and actions to enhance opportunities and to reduce threats to project objectives. The key benefit of this process is that it addresses the risks by their priority, inserting resources and activities into the budget, schedule and project management plan as needed (PMBOK 2013). Risk response considers how the risk should be managed by either transferring it to another party or retaining it (Flanagan and Norman 1993).

According to Clement and Gido (2006), risk response planning includes developing an action plan to reduce the impact or likelihood of each risk, establishing a trigger point for when to implement the actions to address each risk, and assigning responsibility to specific individuals for implementing each response plan.

The Plan Risk Responses follows the Perform Quantitative Risk Analysis process (if used). Each risk response requires an understanding of the mechanism by which it will address the risk. It includes the identification and assignment of one person (the owner for risk response) to take responsibility for each agreed-to and funded risk response. Risk Responses should be appropriate for the significance of the risk, cost-effective in meeting the challenge, realistic within the project context, agreed upon by all parties involved, and owned by a responsible person. Selecting the best risk response from several options is often required (PMBOK 2013).

As per Acquisition Community Connection(2011) risk response planning is deciding what to do about each of the risks assessed as important to your project and documenting the planned response. Some risks may be considered potentially so damaging that the project chooses to avoid them completely, or they may seek to transfer the risk to another party more capable of accommodating the risk. Note that insurance should not be considered a transfer, because insurance only addresses the financial element of risk, not the underlying causes: insurance is an avoidance tactic. Some risks may be accepted with no further actions (low risks), but other risks may be accepted simply because there is no credible alternative (could be laws of physics or simply the practicality of budgets, personnel, or time). This second class of accepted risks will require that contingency actions be developed in case they occur. Many risk handling choices - generally, the default option - seek to mitigate the probability of the risk event or the scope of the consequence to an acceptable level. There will be situations that do not involve simple choices between clearly perceived alternatives. Some situations will involve a whole series of interrelated issues that have to be faced and no one option is a clear choice. In such cases, an effective approach is to re-examine the risk and break it down to constituent parts, because there is probably too much scope covered under a single risk. According to Clement and Gido (2006), a risk response plan can be to avoid the risk, mitigate the risk, or accept the risk. A structured approach for developing a risk handling strategy should be developed.

Risk Response Planning requires you to establish plans and decision points for what to do about each of the risks. It also includes the implementation of risk mitigation plans when decisions are made to execute them. Risk response options in construction projects include following four main risk response strategies (Flanagan and Norman 1993):

Risk retention

- Risk retention is suited for those risks that produce individually small, repetitive losses which are most suited to retention. For instance on a motor insurance policy many people tend to bear some fixed amount as an excess in return for a reduction in the premium and others may do the reveres; the level of retention is dictated by the financial circumstances and the likelihood of loss. Not all risk can be transferred, but even if they were capable of being transferred it may not prove to be economical to do so. The risk will then have to be retained. Besides, it is preferable to retain a portion of the risk in certain circumstances. For example, a reduction in an insurance premium with a corresponding retention in the form of limited excess provision in the event of a claim, may be preferred to full coverage; the gamble is between paying the premium and the probability of the event occurring and the consequential loss that would result. Many people take that risk every day by insuring their cars for third party, fire and theft in preference to fully comprehensive insurance cover. It might be they cannot afford the premium, or the value of the car does not warrant the cost of the premium, or they may feel they are such a good driver that there is a very low probability of them causing an accident and being held responsible.

Risk reduction

- One of the ways of reducing the risk exposure is to share risks with other parties. For instance, the general contractor will attempt to reduce his exposure to pay liquidated damages for late completion by imposing liquidated damages clauses in domestic sub-contract agreements. Similarly with the contractual arrangement, the use of management fee types of contract will remove the adverse attitude of contractors and should reduce the likelihood of claims from the contractor for direct loss and expense.
- Risk reduction falls into four basic categories. Firstly, education and training to alert the staff to potential risks. Secondly, physical protection to reduce the likelihood of loss. For example, a contractor could employ an independent quality assurance company to act as a second check on all its projects - it's an expensive option but it would reduce the incidence of defects going undetected. Thirdly, systems are needed to ensure consistency and to make people ask the 'what if questions. Finally, physical protection can be taken to protect people and property.
- In a building the typical case of risk reduction would involve the installation of a sprinkler system. Whilst the regulations might not require the sprinklers, the client would feel the need to reduce his likelihood of loss from fire damage by paying for the sprinkler installation.

Risk transfer

- Transferring risk does not reduce the criticality of the source of risk, it just removes it to another party. In some cases, transfer can significantly increase risk because the party to whom it is being transferred, may not be aware of the risk they are being asked to absorb. For example, the general contractor, when entering into a contract with a sub-contractor, may impose a liquidated and ascertained damages clause for late completion which includes both the damages for the main contract and an assessment of loss suffered by the general contractor. The sub-contractor may not be aware of the additional risk being transferred and he may well not be in the financial position to carry such risk. The commonest form of risk transfer is by means of insurance which changes an uncertain exposure to a certain cost. In the construction industry obtaining insurance cover is becoming more expensive.

Risk avoidance

- Risk avoidance is synonymous with refusal to accept risks. The refusal to contract is a simple example of risk avoidance. However, it is more relevant to consider the specific risks which can be avoided. Normally, risk avoidance is associated with pre-contract negotiations but it may well be extended to decisions made in the course of execution of the project. For example, when a contractor has committed a fundamental breach, the employer is entitled to annul the contract. However, the employer can waive this right of annulling and thus allow all the concomitant risks under the contract to continue. If the employer annuls, he is in fact avoiding any further risks by accepting that the contractor has repudiated the contract. A more pertinent example of risk avoidance is the use of exemption clauses, either to avoid certain risks or to avoid certain consequences flowing from the risks.

According to PMBOK (2013) as risks include threats and opportunities that can affect project success, and responses are discussed for each as follow:

Response strategies for negative risks or threats, which are described hereafter, include avoid, transfer, mitigate and accept.

- **Avoid**. Risk avoidance is a risk response strategy where by the project team acts to eliminate the threat or protect the project from its impact. It usually involves changing the project management plan to eliminate the threat completely. The project manager may also isolate the project objectives from the risk's impact or change the objective that is in jeopardy. Examples of this include extending the schedule, changing the strategy, or reducing scope. The most radical avoidance strategy is to shut down the project entirely. Some risks that arise early in the project can be avoided by clarifying requirements, obtaining information, improving communication, or acquiring expertise.
- **Transfer**. Risk transfer is a risk response strategy where by the project team shifts the impact of a threat to a third party, together with ownership of the response. Transferring the risk simply gives another party responsibility for its management—it does not eliminate it. Transferring does not mean disowning the risk by transferring it to a later project or another person without his or her knowledge or agreement. Risk transference

nearly always involves payment of a risk premium to the party taking on the risk. Transferring liability for risk is most effective in dealing with financial risk exposure. Transference tools can be quite diverse and include, but are not limited to, the use of insurance, performance bonds, warranties, guarantees, etc. Contracts or agreements may be used to transfer liability for specified risks to another party. For example, when a buyer has capabilities that the seller does not possess, it may be prudent to transfer some work and its concurrent risk contractually back to the buyer. In many cases, use of a cost-plus contract may transfer the cost risk to the buyer, while a fixed-price contract may transfer risk to the seller.

- **Mitigate.** Risk mitigation is a risk response strategy where by the project team acts to reduce the probability of occurrence or impact of a risk. It implies a reduction in the probability and/or impact of an adverse risk to be within acceptable threshold limits. Taking early action to reduce the probability and/or impact of a risk occurring on the project is often more effective than trying to repair the damage after the risk has occurred. Adopting less complex processes, conducting more tests, or choosing a more stable supplier are examples of mitigation actions. Mitigation may require prototype development to reduce the risk of scaling up from a bench-scale model of a process or product. Where it is not possible to reduce probability, a mitigation response might address the risk impact by targeting linkages that determine the severity.
- **Accept**. Risk acceptance is a risk response strategy where by the project team decides to acknowledge the risk and not take any action unless the risk occurs. This strategy is adopted where it is not possible or cost effective to address a specific risk in any other way. This strategy indicates that the project team has decided not to change the project management plan to deal with a risk, or is unable to identify any other suitable response strategy. This strategy can be either passive or active. Passive acceptance requires no action except to document the strategy, leaving the project team to deal with the risks as they occur, and to periodically review the threat to ensure that it does not change significantly. The most common active acceptance strategy is to establish a contingency reserve, including amounts of time, money, or resources to handle the risks.

Response strategies for positive risks or opportunities, which are described hereafter, include exploit, share, enhance, or accept.

- **Exploit.** The exploit strategy may be selected for risks with positive impacts where the organization wishes to ensure that the opportunity is realized. This strategy seeks to eliminate the uncertainty associated with a particular upside risk by ensuring the opportunity definitely happens. Examples of directly exploiting responses include assigning an organization's most talented resources to the project to reduce the time to completion or using new technologies or technology upgrades to reduce cost and duration required to realize project objectives.
- **Enhance.** The enhance strategy is used to increase the probability and/or the positive impacts of an opportunity. Identifying and maximizing key drivers of these positive-impact risks may increase the probability of their occurrence. Examples of enhancing opportunities include adding more resources to an activity to finish early.
- **Share.** Sharing a positive risk involves allocating some or all of the ownership of the opportunity to a third party who is best able to capture the opportunity for the benefit of the project. Examples of sharing actions include forming risk-sharing partnerships, teams, special-purpose companies, or joint ventures, which can be established with the express purpose of taking advantage of the opportunity so that all parties gain from their actions.
- **Accept**. Accepting an opportunity is being willing to take advantage of the opportunity if it arises, but not actively pursuing it. Risk acceptance is a risk response strategy for both threats and opportunities.

According to Clement and Gido (2006), a risk response plan must include a trigger point or warning flag for when to implement the action plan for each risk.

2.3.6 Risk Monitoring and Control

According to PMBOK (2013), risk control is the process of implementing risk response plans, tracking identified risks, monitoring residual risks, identifying new risks, and evaluating risk process effectiveness throughout the project. The key benefit of this process is that it improves efficiency of the risk approach throughout the project life cycle to continuously optimize risk responses. Planned risk responses that are included in the risk register are executed during the life cycle of the project, but the project work should be continuously monitored for new, changing, and outdated risks.

The Control Risks process applies techniques, such as variance and trend analysis, which require the use of performance information generated during project execution. Other purposes of the Control Risks process are to determine if:

- Project assumptions are still valid,
- Analysis shows an assessed risk has changed or can be retired,
- Risk management policies and procedures are being followed, and
- Contingency reserves for cost or schedule should be modified in alignment with the current risk assessment.

Control Risks can involve choosing alternative strategies, executing a contingency or fallback plan, taking corrective action, and modifying the project management plan. The risk response owner reports periodically to the project manager on the effectiveness of the plan, any unanticipated effects, and any correction needed to handle the risk appropriately. Control Risks also includes updating the organizational process assets, including project lessons learned databases and risk management templates, for the benefit of future projects.

According to Clement and Gido (2006) risk control and monitoring involves regularly reviewing the risk management matrix throughout the project, as it is important to evaluate all risks to determine if there are any changes to the likelihood of occurrence or the potential impact of any of the risks. According to Acquisition Community Connection (2011) risk monitoring is systematically tracking the process and evaluates the effectiveness of risk-handling actions against established metrics. Monitoring results may also provide a basis for developing additional handling options and identifying new risks. The key to the monitoring process is to establish a cost, schedule, and performance management indicator system over the entire program that the Project Manger uses to evaluate the status of the program. The indicator system should be designed to provide early warning of potential problems to allow management actions. Risk monitoring is not a problem-solving technique, but rather, a proactive technique to observe the results of risk handling and identify new risks.

2.5 Right of Way Risks

2.5.1 General

Right-of-way (ROW) clearance is defined as those instances where there is an interest in land acquired and include all necessary procedures to acquire the property. In some cases land and interests in land must be acquired outside existing ROW for or by the utility. ROW acquisition and utility adjustment are almost always on the critical path of an infrastructure project. It is important to identify and focus on all parcels within the ROW, but especially those that might cause delay, such as those that may require eminent domain acquisition or have other inherent problems. Utilities with a history of slow response in making adjustments should be aggressively managed. It should be noted that ROW and utility adjustment issues may be of concern even in cases where the parcel or utility is owned by a separate public entity. A strategy must be developed to address these problematic parcels and/or utility adjustment (Bingham, E. 2010).

According to Caltrans (2007), the process of right of way risk identification produces the following project risk list:

- Utility relocation requires more time than planned
- Unforeseen railroad involvement
- Resolving objections to Right of Way appraisal takes more time and/or money
- Right of Way datasheet incomplete or underestimated
- Need for “Permits to Enter” not considered in project schedule development
- Condemnation process takes longer than anticipated
- Acquisition of parcels controlled by a State or Federal Agency may take longer than anticipated
- Discovery of hazardous waste in the right of way phase
- Seasonal requirements during utility relocation
- Utility company workload, financial condition or timeline
- Expired temporary construction easements

The basic ground as a requirements of the authorities is striving to accomplish first, fair and equal treatment to all land owners and second, acquisition of right of way without excessive cost. For instance right of way acquisition in Indiana involves two basic functions, appraisal and negotiation, and each function is delegated to separate sections within the State Highway Department. If the value of the parcel to be acquired is $25,000.00 or more, two appraisals are made. All appraisals are submitted to a reviewing appraiser who examines each appraisal for accuracy and correctness and determines the fair cash market value of the parcel to be acquired. This determination of the offering price terminates the function of the appraisal section. The offering price is submitted to the negotiation section which thenceforth assumes the responsibility for procuring the parcel by sending a representative to contact the owner. Consequently, the representative's function is, in actuality, not one of negotiating but consists of 1) convincing the land owner that the offer represents the fair cash market value of his property and 2) persuading the land owner to accept the offer. (Indiana Law Journal 1960).

According to Bingham, E. (2010), issues to consider include:

- Identification and prioritization of long lead parcels and utilities
- Defining responsible party for parcel acquisition and utility adjustment
- Appraisal responsibility and performance
- Acquisition of parcels
- Relocation of displacees
- Abatement and removal of existing improvements
- Other user defined

Mark T. and Murray F. (2004) highlighted that in many cases, the ROW costs for new or expanded roadways exceed the cost for construction as it contributes many time related costs as a result of delay, cost of compensation and utility relocation. These researchers recommend designers to carefully consider every accesses point in every project in order to minimize design change after construction is started.

A report by the international law and labor organization about infrastructure reconstruction after Tsunami disaster in 2004 states that, although reconstruction of infrastructure benefits people majority of the people are reluctant to handover their land for public use. According to this report in many cases problems arise during processes of providing compensation to the community their land is handed over for infrastructure purpose. The report also indicated dispute between these communities and the government as a result of land accusation for infrastructure development was the most predominant issue on the ongoing rehabilitation and reconstruction processes. The report suggested law enforcement as one important solution to minimize dispute between land owners and the government. It further describes the community should be willing to provide land for infrastructure development and the government in turn should be committed in providing replacement land and appropriate compensation.

ROW problem is not limited to only land acquisition issues with the community. A report by Indiana road system utility reallocation task force indicated that utility reallocation becomes a major conflicting issue between transportation and utility industries, which are responsible for highway improvements and utility facilities. A study by Penn state university of American association of state highway and transportation officials cited in this report indicated that, road construction projects generally take longer and cost more when utility facilities need to be relocated. The study indicated that the reconstruction of road in Michigan was delayed more than a year by a number of problems including those arising from the relocation of utility facilities. One of the common problems which make relocating utility facility difficult is obtaining information about the location of utility facilities during design phase. After an in-depth study, the utility task forces organized by Indiana highway systems forward a recommendation which includes; improving awareness and better communication, new procedures to better coordinate relocation of utility facility and clarifying responsibility and to establish accountability to improve the situation.

Property Descriptions

According to Bingham, E. (2010), property descriptions are prepared as exhibits for the conveyance of property interests that will be affected. The property descriptions reflect a boundary survey showing ownership including legal descriptions, as well as parcel plat determinations. Property descriptions should be summarized from survey information into an appropriate documentation form that can be logged into project information systems. The level of confidence and validation of the documentation such as field verified versus scaled from existing maps should be noted.

Utility Service Lines

Utilities. Electric, communications, gas, water, and sewer lines will normally be located within the ROW of highways. In order to prevent utility maintenance from interfering with highway traffic, no underground utilities should be located beneath any part of the pavement, except where crossings are required. Where these underground utilities must cross beneath highways, they should be so designed and constructed as to minimize future repairs and consequent interference with traffic. Obstructions including signs and poles for overhead utilities shall be located outside the limits of usable shoulder on highways designed without barrier curbs. Generally, utility poles should not be located in medians on divided highways (General Provisions and Geometric Design for Roads, Streets, Walks and Open Storage Areas, 1987).

Right-of-Way Mapping & Site Issues

According to Bingham, E. (2010), a right-of-way map is a compilation of internal data, property descriptions (which includes field notes and parcel plats), appraisal information, and improvements related to the project. Right-of-way maps are typically internal planning and management documents, with significant impact on the project development process. Preparation of these maps normally begins after obtaining schematic design approval. Parcels that may cause difficulties in acquisition should be identified, including indications of specific site conditions or characteristics that may cause delays or problems. Issues to consider include:

- Parcel numbers and priority
- Existing site information:
- Improvements within right-of-way
- Previous uses of land
- Zoning
- Utility locations
- Record ownership data of adjacent properties
- Existing boundaries and limits
- Existing drainage channels and easements
- Design information:
- Access control lines
- Configuration of infrastructure project
- Hydraulics
- Maintenance access or connecting ramps
- Limit of flood pool

- Parcel information:
- Property owner name
- Parcel title requirements
- Parcel number
- Floodway identification
- Stockpiles and production sites
- Railroad and/or roadway interests
- Special use properties (e.g., government use, alcohol sales, cemeteries,
- Public park space
- Cultural resources
- Historical landmarks
- Archeologically sensitive sites

2.5.2 ROW Problems in the Context of Addis Ababa

In the context of Addis Ababa city road construction projects the ROW problem is related to land acquisition issue from the community for the purpose of the infrastructure development and relocating of utility facilities. The land required for these projects includes the land to be used for the construction of the road which includes appropriate ROW according to the requirements of the Addis Ababa city master plan standards and other part of the land which will be used by the contractors as local material sources such as quarry site, spoil area, and temporary land for material stock piling, pre-casting yards, warehouse, workshops, parking lots, etc. ROW obstructions are one of the prevailing risks hindering the progress of road construction in urban areas unless intensive intervention measures are adopted, AACRA (2012).

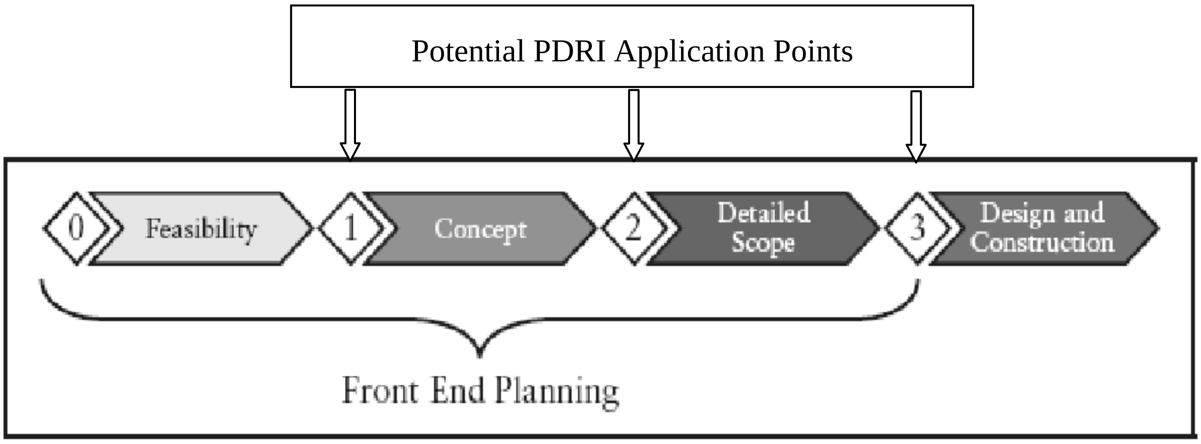
2.6 Project Scope Definition Rating Index as Tool for ROW Risk Reduction

2.6.1 Definitions of PDRI

PDRI is an acronym for Project Definition Rating Index which is defined as a score along a continuum representing the level of project scope definition emphasizing on front end planning, also known as pre- project planning (Gibson 1996). The Construction Industry Institute, CII

(2010) defines front end planning (FEP) as the important process of developing adequate strategic information with which owners can tackle risk and make decisions to assign resources in order to optimize the potential for successful project. *PDRI is hence a tool for risk management, as project risks must be identified and understood at early stage of the project so that proper contingencies can be allocated and maintained in order to mitigate unforeseen issues (CII-2010).* Figure 5 shows the project life cycle diagram.

Figure 5: Project life cycle diagram adapted from Gibson (1996)



Hence, while Front End Planning (FEP) is a critical process for uncovering project unknowns, CII developed effective risk management tool called the Project Definition Rating Index (PDRI) for construction projects.

“The PDRI can benefit owners, designers and constructors and provides numerous benefits to the project team. These include: a detailed checklist for work planning, standardized scope definition terminology, facilitation of risk assessment, assistance in progress monitoring, aid in communication of requirements between participants, method of reconciling differences between project participants, a training tool, and a benchmarking basis. (NASA Pre-Project Planning Team, 2000).

2.6.2 Historical Background of PDRI

According to Bingham, E. (2010), the Construction Industry Institute (CII), located at the University of Texas at Austine, has been pursuing research focused on front end planning also know as pre project planning for over two decades. The CII defines front end planning or FEP as the essential process of developing sufficient strategic information with which owners can address risk and make decisions to commit resources in order to maximize the potential for a successful project (Gibson 1996). In its efforts, CII has developed tools that assist project teams in the successful planning of projects. One such tool is the Project Definition Rating Index (PDRI). The first PDRI tool which was developed in 1994 by CII was the PDRI for Industrial Projects. The subsequent success of that tool and high demand led to the development of the PDRI for Building Projects in 1998. Like its predecessor, the PDRI for Building Projects has become highly valued within the CII membership and industry leaders.

The CII Research Team 268 was formed in 2008 to perform the task of completing a Project Definition Rating Index Tool for Infrastructure Projects. Accordingly the team organized consisting of select members of the CII from both owner and contractor organizations throughout the world. Members from academic institutions have also joined the team. The Research Team 268. consisted of professionals from all types infrastructure projects; their expertise, as well as the contributions of over 60 industry professionals improved the background and basis for the PDRI for Infrastructure. The team members together make up more than 1,300 years of experience working on infrastructure projects.

Hence the researcher of this thesis summarizes that CII has developed a user friendly tool to assist in defining project scope and maximizing the chance of project success. Project Definition Rating Index (PDRI) was first developed for industrial projects in 1996 and for building projects in 1999 and very recently developed for infrastructure projects in 2010.

2.6.3 PDRI Concepts in Infrastructure Projects

“An infrastructure project is defined as a capital project that provides transportation, transmission, distribution, collection or other capabilities supporting commerce or interaction of goods, service, or people. Infrastructure projects generally impact multiple jurisdictions, stakeholder groups and/or a wide area. They are characterized as projects with a primary purpose that is integral to the effective operation of a system. These collective capabilities provide a service and are made up of nodes and vectors into a grid or system (e.g., pipelines (vectors) connected with a water treatment plant (node)” (Gibson et al. 2010 as cited in Bingham, E. 2010).

According to CII (2010), infrastructure projects include widely varied, unique opportunities: pipelines, transmission lines, communications networks, highway, rail, water distribution and other projects that connect facilities such as production fields; industrial and manufacturing plants; businesses, cities, and public facilities. These projects are challenged by multiple jurisdictions in obtaining environmental and access permits and in negotiating public concerns.

According to Bingham, E. (2010) from the definitions infrastructure projects have a linear nature and can further be divided in to three categories notably projects that involve transportation of people and freight, energy and fluids. Projects that transport people and freight includes projects such as highway, railroads, access ramps, toll booths, tunnels, and airport runways. This type of infrastructure project can also be extended to linear projects meant to control people or freight, for example security fencing. An energy project is any project involved in the distribution, transmission, or collection, of energy or communications. Examples of these types of projects could include electricity transmission/distribution, fiber optic networks, electrical substations/switch gears, towers, wide area network (WAN), and many more. Fluids projects are linear in nature and transport substances like gas, water, steam, oil, sewage, and many more. Some projects that fall under this category could include pipelines, aqueducts, pumping and compressor stations, locks, reservoirs, meters and regulator stations, pig launchers and receivers, canals, water control structures, and levees. That gives the tool's application for general-use and the user is cautioned to customize the tool for the specific infrastructure project.

The CII research has found that tools for measuring project scope definition and facilitating alignment between project participants are an essential component of a good Front End Planning process. An analysis of 22 completed infrastructure projects representing over $6 billion of constructed cost showed that projects with scoring lower than 200 (out of 1000 total points), which reflects a well-defined scope, were significantly more successful than those that scored above 200, which reflects a less defined scope.

The research team IR 268-2 that was formed by CII has developed, PDRI: Project Definition Rating Index–Infrastructure Projects, a tool that helps project team members to identify critical planning issues and significantly promotes front end planning success. The tool provides critical project risk management through measurement of project scope development completeness on infrastructure projects. This tool helps owners and contractors better achieve business, operational, and project objectives. From E. Bingham, E. (2010), the following objectives were set by the research team towards developing PDRI tool for infrastructure projects:

- Improve predictability of project parameters
- Reduce the cost of design and construction
- Preserve schedule
- Reduce risk during project execution

- Improve project team alignment and communication
- Assure customer satisfaction
- Improve the probability of a successful project

2.6.4 Overview of PDRI in Infrastructure Project

Customer satisfaction is achieved by several ways one of the best ways is to assure by delivering a project on time, within budget, and without conflict with expectations. When used as a part of the FEP process the PDRI tool can improve schedule, reduce cost and provide reliable expectations for both the owner as well as the contractor. By reducing project unknowns project satisfaction increases.

Being the ability to improve project team alignment and communication is one of the greatest qualities of the PDRI tool. As shown in Figure 5 in the preceding page, the tool is designed for use by project teams at multiple stages (gates) within the front end panning project. PDRI assessment at each gate can be used as a measure of the teams progress and allow for allocation of team resource for further definition of poorly defined elements.

During project execution, the PDRI tool can also be used to reduce risk. The better a project team knows about a project the less risk they have and the more likely they will be able to manage unavoidable risk through mitigation steps. The detailed element descriptions provided through the PDRI tool can be taken as a checklist that project teams can use to identify the specific unknowns within a project. Then using the PDRI score results, the project team can then develop a plan to manage that risk (E. Bingham 2010).

2.6.5 Implementation

The project definition rating index (PDRI) is implemented at the end of the front end planning (FEP) phase, by measuring the level of project scope definition and then comparing the scope definition level to various management success metrics. Refer Figure 5, in the preceding page, for possible application gates of PDRI.

However depending on the nature of the evaluation mission, for internal scope definition practices and requirements, etc., one may wish to use a score other than 200 as a benchmark for beginning of construction document development (NASA Pre-Project Planning Team, 2000).

Capital project delivery risk is greatly affected by the quality of the front end planning effort. Hence Bingham, E. (2010) summarizes that the PDRI for Infrastructure projects can be used to improve the probability of a successful project. Although success can be measured in many ways, the factors most commonly attributed to success are: cost, schedule and changes.

CII research has shown that the PDRI can effectively be used to improve the predictability of project performance. However, the PDRI alone will not ensure successful projects. When combined with sound mission planning, alignment, and good project execution, it can greatly improve the probability of meeting or exceeding project objectives.

Limitations of PDRI

According to Bingham, E. (2010) research findings one limitation to the PDRI tool is that the data was provided from volunteers and does not necessarily represent a truly random sample. The researcher chose the methodology of gathering data based on a convenience sample. In other words, analyses were performed using data from industry volunteers. A truly random sample would be needed to imply that the PDRI would have the same results across the industry. Due to these limitations to the sample, caution should be used when using the data to project or predict future success. It should be noted that PDRI tool is not intended to forecast the percent of future cost overruns, but rather is a guide for project teams in the improvement of the front end planning process. When used in a team environment the individual scoring of scopes by team members should be noted. Different opinions in scoring represent a perceived definition of scope. This once again highlights the importance and advantages of using the PDRI for Infrastructure tool to promote team communication and alignment.

Project performance or success could be measured in terms of overruns in cost, overruns in schedule, and the amount of capital needed for changes in the form of change orders. On the other hand project objectives is measured in terms of cost, time and quality. PDRI couldn’t test directly the quality aspect of the project objectives.

CAHPTER 3: RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

As indicated in section 1 of this thesis, the main objective is to identify sources of risks contributing to cost and time overruns, and affect quality objectives of projects and propose the corresponding actions to be done based on the conclusions reached. And the aim of the research is to give a better understanding on the necessity of risk management in order to maximize the chance of a successful project objectives, which helps greatly to move forward the realization of road network coverage program of the country in general and of Addis Ababa city in particular.

In the subsequent sections, the research design and methodology to be followed are presented.

3.2 Research Design

A qualitative research of exploratory type which identifies a situation, evaluates options and propose new findings is used as a research strategy of this thesis. Case study, desk study, and interview are the methods of data collections adopted for the research. Analysis of the case study and the desk study were carried out with regard to theoretical aspects. Descriptive statistics method was carried out to analyze feedbacks from interview.

As briefly stated in section 1 of this thesis, the overall approach of this research study, establishing the basis of the research, it passes through three major processes of data collection, analysis and finally forwarding conclusions and recommendations based on the findings.

3.3 Data Collection

3.3.1 Interview

To successfully conduct this research it is mandatory to look into the issue from different perspectives and to collect views of professionals who have vast experience in road construction in Ethiopia in general and in Addis Ababa City, in particular.

Among the reasons for selection of interviews rather than questionnaire as a data collection tool is that based on the survey conducted in the UK construction industry, it has been established that among the various tools and techniques interviews, workshops, brainstorming master-program, personal experience and checklists are more acceptable than the others (Shehu and Sommerville 2006).

In this respect, careful attention was taken that all informants are civil engineers employed in those organizations engaged in connection with urban road construction projects for several years, whose participation is highly valuable for the result of the research. The interview schedule follows the sequence mentioned hereafter.

Section 1 of the interview schedule is about the general profile of the respondents. The questions in this section are related to the educational and work experience background of the respondents and their organization. The interviewees were requested to indicate their response by ticking (X or √) in the appropriate box (es) or by filling the blank spaces provided, as appropriate.

Accordingly the outcome of the respondents combination is as follows:

Table 2: Informant qualification and years of experience matrix

Descriptions	Experience in Urban Road Projects				Total
	< 5 years	**5-10 years**	**10-15 years**	**> 15 years**	
MSc	1	2	2	1	6
BSc	-	4	-	-	4
Total	1	6	2	1	10

The sections from 2 to 5 of the interview schedule focus on the following issues related to the performance assessment of road construction in Addis Ababa and measures to be taken as well as new technologies to be adopted.

Section 2 is about the general performance assessment and challenges of road projects in Addis Ababa. These questions were intended to achieve the 1st specific objective of the research which is to assess the challenges of road projects in Addis Ababa and to raise the issue of concerns on the extent of the involvement of domestic contractors. The respondents were requested to think in terms of their organization's experience and/or their knowledge and to indicate their response by ticking (X or √) in the appropriate box(es). Moreover, the interviewees were asked to provide further explanation and suggestion on the area that needs improvements at the appropriate space provided under each question. This helps to brief the respondent about the prevailing challenges of road construction projects in Addis Ababa. That is problems related with meeting the project objectives, like time and cost overruns as well as poor quality road. Emphasis was given to those projects executed by the domestic contractors. Opinions were also gathered to comment on the road coverage evaluation methods to measure the accomplishment currently reached as claimed by Addis Ababa City Roads Authority, AACRA.

Section 3 of the interview schedule is about the assessment of professional's perception and current practice of risk management in urban areas. The questions under this section are aimed to get the understanding of risk management by construction experts and its level of application on urban road projects. In addition respondents were advised to provide further explanation and suggestion on the level of application of risk management on urban road projects. These questions are aimed to achieve the 2nd specific objective of the research.

Section 4 is concerned with the identification of risks and their degree of impact and frequency of occurrence. Questions in this section are planned to address the 3rd specific objective of the research. This section is split in to two stages. Stage one being about sources of risks that are associated to the urban road construction which are identified from literature review and desk studies. The aim of the questions under this subsection was to evaluate the probability of occurrence (frequency) and impact of risks on the Addis Ababa road projects targeting on cost, time and quality objectives. The respondents were requested to think in terms of their organization's experience and/or their knowledge to identify from the list in the table and rank them in order of probability of occurrence and severity of impact. They were also invited to add to the list, other sources of risks, if any.

The other subsection under section 4 of the interview schedule is to identify further risks in details, under right of way (ROW). It is the hypothesis of the researcher that ROW is the major risk contributing for the time and cost overruns. The respondents were requested to rank the tabulated list of ROW risks in terms of probability of occurrence and severity of impact on time, cost, & quality. They were also encouraged to add more, if any.

And finally questions under section 5 are targeted to mitigate the impact of ROW by employing a tool PDRI thereby achieving the 4th specific objective of the research. PDRI is an acronym for Project Definition Rating Index which is defined as a score along a continuum representing the level of project scope definition emphasizing on front end planning (FEP), also known as pre-project planning. CII (2010) researches revealed that there is a direct correlation between FEP issues and project success. Hence in addition to scoring the completeness of definition levels during the pre-project planning, PDRI can be used to indicate the most probable outcome of the project performances. In this regard respondents were requested to rate definition levels of the projects they were engaged and estimate the PDRI score for the specific project using the weighted PDRI score sheet, provided in the interview schedule. The aim of the questions under this section is also to collect ideas on the need of pre-project planning as well as to introduce the respondents with the PDRI tool to measure the level of completeness of the pre-project planning. The opinions of the respondents on the merits and demerits of PDRI as well as how friendly the tool is to use on future projects were also requested.

3.3.2 Case Study

The case study on completed urban road projects was chosen as one of the tools to find out the answer for the questions, "What is the professional understanding of risk with respect to urban road project? What are the sources of risks and challenges special to the road constructions in Addis Ababa? Do ROW risks contribute to cost and time overruns, and poor quality of works?" These questions were intended to achieve the 2nd and the 3rd specific objectives of the research. In this respect thirteen projects were selected using the approach of Criterion-based sampling (Non probability of sampling) to discover the effect of ROW risks on the cost and time overruns.

3.3.3 Desk Study

The 4th research question scrutinizes "How is the concept of Project Definition Rating Index (PDRI) is correlated with success and used as a tool to manage ROW risks?" Desk study was chosen as one of the instruments to assess the practices from relevant studies, reports and documents. These questions were aimed to achieve the 4th specific objective of the research.

3.4 Data Analysis

The data analysis for the case study and the desk study were carried out with regard to theoretical propositions. Whereas the method used to analyze the interview data is descriptive statistics method using a qualitative research of exploratory type. This method assists to analyze the feedbacks from the respondents which can easily be tabulated in actual numbers.

CAHPTER 4: RESULTS AND DISCUSSIONS

4.1 Performance Assessment of Addis Ababa Road Projects

According to the feedback from the informants, the road projects being built in Addis Ababa are facing the following challenges to meet the project objectives. The major issues to be raised are:

- Delay in clearance of Right of Way (ROW)
- Capacity of the client, contractors and consultants

4.1.1 Delay in Clearance of Right of Way (ROW)

Because of the delay in clearance of ROW, ninety percent (90%) of the informants' feedback strongly agree that urban road projects are facing time and cost overrun and fifty percent (50%) of the feedback agree for its contribution on poor quality work. The main reason for the delay of ROW clearance is the underestimating of the consequences of ROW problems during the beginning of the project. ROW clearance is used to be performed mostly during the mobilization period of the contractor. By the time the contractor has finished its mobilization of resources, little progress is always achieved with regard to ROW clearance. Hence delay of project due to ROW starts at the beginning of the project period. According to CII IR 268-2 (2010) and AACRA annual publication (2012), the following are the major issues included under ROW:

- Delay in clearance of ROW properties which includes
  - houses,
  - fences,
  - trees,
  - crops and grazing lands, etc.
- Delay in relocation/protection of utilities which all overhead, surface or underground installations or systems to convey services to the public. Included under this are:
  - water supply lines,
  - waste water disposals systems,
  - electric power cables and poles,
  - telephone communication lines, etc.

- Lack of land for subsidiary (enabling) construction activities which includes:
    - land for source of construction materials,
    - land for disposal areas of surplus excavated materials,
    - land for crusher site, production yard of precast element and structural components,
    - land for Contractor's establishments (like warehouse, work shop, offices, etc),
    - land for storing hazardous/explosive materials, land for working space beyond the construction limit
    - land for access and detours/bypass construction, etc.

4.1.2 Capacity of the Client, Contractors and Consultants

Most of the response from the interviewees raise the question on the capacity of the domestic construction industry. The major issues of concern during urban road construction are mentioned as follows:

- Concerns on the capacity of the client
    - Absence of pre-project planning
    - Lack of strong contract Administration (better to allow all road projects including maintenance works to be done by contractors and focus on contract administration and ROW clearances)
    - Shortage of professionals competent enough to thoroughly check the designs submitted by the consultants
    - Frequent change of requirements
    - Delay in responding to queries raised by the contractors and consultants
    - To closely work with relevant offices so that master plan for road classifications needs to be verified based on the actual topographic data and traffic volume
    - Absence of updating traffic management study for road network based on the current developments
    - Lack of giving priority for road intersections, taxi bays, parking areas to minimize the prevailing traffic jams

    - Lack of updating integrated drainage network study in relation to the road networks,
    - Non standardization of drawings and details
    - Project procurement method to be revised to avoid award for lowest bid price offers, etc.
- Concerns on the capacity of the contractors
    - Management organization needs adjustment towards professionalism (the General Managers position of the construction company is to be hold by professionals like civil engineers related fields
    - Less effort towards curbing the prevailing high turnover of professionals and skilled workers
    - Poor recording keeping of activities related with construction
    - Financial capacity of the contractors to be built, financial institutions need to facilitate the liquid assets
    - Poor practice of subletting parts of the works to Subcontractors.
    - Little effort towards the establishment of specialized contractors like for asphalt work, concrete works, pipe production, prefabricated elements, quarry, crushed aggregate, formwork, earthwork, rock blasting, etc.
- Concerns on the short comings of the consultants
    - Faulty designs, errors in quantity estimation, discrepancy in the drawings and specifications, etc.
    - Lack of commitment and feeling ownership of the project
    - Follow the contractor's work accomplishment rather than proactively contributing valuable input towards the achieving the project objectives, etc.

4.2 Risks in Urban Road Construction Projects

The Informants were asked to identify the sources of the risks in the Addis Ababa city road construction projects, and the right of risks in particular. In order to rank the risks, the questions were devised to try to find responses in terms of probability of occurrences and impact of the risks on time, cost, and quality of the works. The feedbacks collected are tabulated hereafter.

4.2.1 Sources of Risks

Feedbacks from the informants with regard to sources of risks in urban road construction are presented in Table 3, as follows. The actual number of the responses are grouped in their respective categories.

Table 3: Ranking risk sources on urban road projects as per the respondents[5]

Identified Risks	Frequency			Degree of impact								
				Contribute to cost			Contribute to time			Contribute to quality		
	High	Medium	Low	High	Moderate	Low	High	Moderate	Low	High	Moderate	Low
Feasibility study, design and tender related risks	3	4	3	3	5	2	3	4	2	2	4	3
Right-of –way related risks (Please find also details in the Table under section 4.2)	8	1		9			9			2	5	2
Construction related risks	2	5	3	3	4	3	3	4	2	2	4	3
Legal and contract related risks	1	4	5	2	3	4	2	4	4	1	3	6
Financial related risks	4	4	2	5	2	2	4	2	3	3	2	5
Political related risks		3	7	3	1	6	2	1	6	2	1	7
Logistic related risks	2	5	3	4	3	3	4	3	3	3	3	4
Physical and Natural related risks	1	2	7	3	2	5	3	2	5	2	1	7
Operation and Environment related risks	2	3	5	3	3	3	2	4	4	1	3	6

The rankings by the respondents were analyzed and the corresponding mean scores of the feedbacks were arranged in the form of risk matrix; i.e. low impact-low probability of occurrence, high impact-low probability of occurrence, high impact-high probability of occurrence, and low impact-high probability of occurrence. The corresponding impact on time, cost, and quality are described in the risk matrices presented in the following Figures 6, 7 and 8, respectively.

[5] Some of the spaces provided for the frequency and degree of impact corresponding to the identified list of risks are not ranked/marked by the informants.

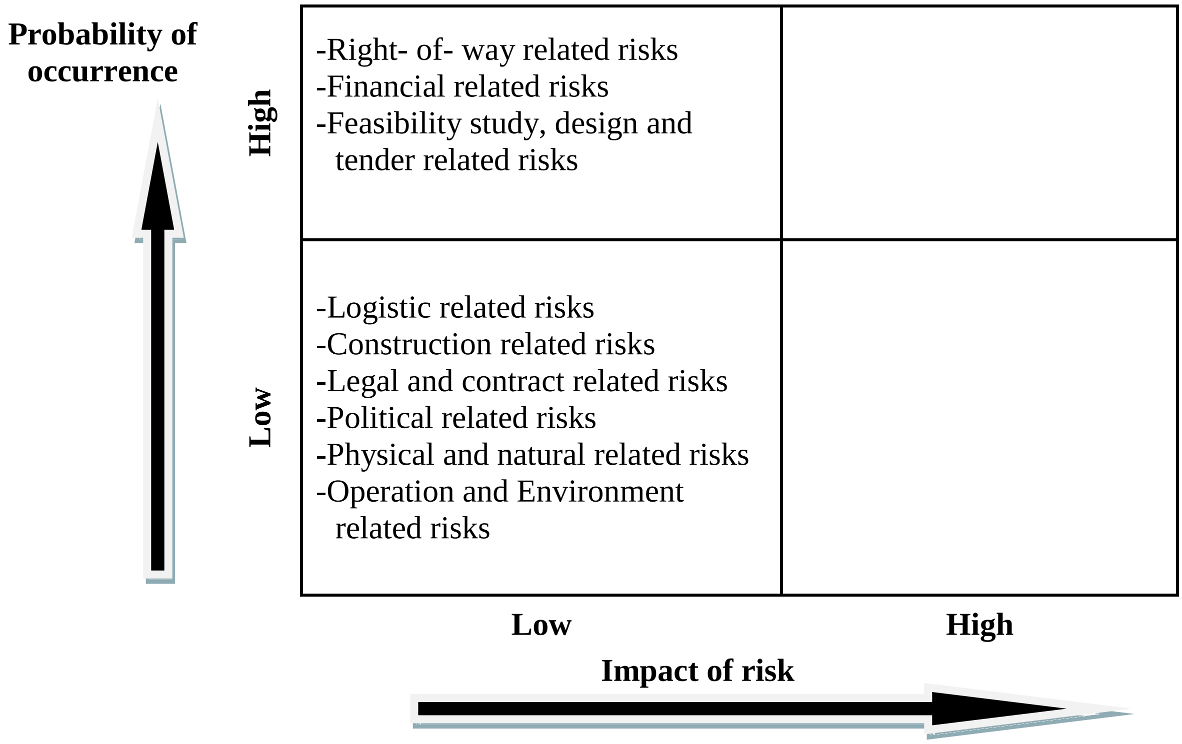
Figure 6: Risk sources having an impact on time

Probability of occurrence	Impact of risk: Low	Impact of risk: High
High	-Financial related risks	-ROW related risks -Feasibility study, design and tender related risks
Low	-Legal and contract related risks -Political related risks -Physical and Natural related risks	-Logistic related risks -Construction related risks

Figure 7: Risk sources having an impact on cost

Probability of occurrence	Impact of risk: Low	Impact of risk: High
High		-Right- of- way related risks -Financial related risks -Feasibility study, design and tender related risks
Low	-Legal and contract related risks -Political related risks -Physical and Natural related risks	-Logistic related risks -Construction related risks

Figure 8: Risk sources having an impact on quality of the road



From the matrices shown in Figures 6 and 7, right- of- way related risks, financial related risks and feasibility study, design and tender related risks are found out to be high impact-high probability of occurrence. Right- of- way and feasibility study, design and tender related risks are found to be the most significant sources which have an impact on time and cost of projects. Financial related risks are the other significant source of risk with high impact on cost. From the matrix shown in Figure 8, though quality of roads is a problem in urban roads, from the feedback of the informants right- of- way related risks, financial related risks and feasibility study, design and tender related risks are found out to be high probability of occurrence but low impact, on quality of the road.

Therefore, the need to look into the underlying causes of these risks is worthwhile in order to minimize the impacts. It is to be noticed that although the risks are dependent on one another, among the various causes of risks, ROW related risk is emerged as the major one and also the aim of this thesis lies on ROW risk management.

4.2.2 Sources of Right of Way Risks

The participants were asked to identify the causes of ROW risks in terms probability of occurrences and impacts. Feedbacks from the participants with regard to causes of ROW risks in urban road construction are presented in Table 4, as follows. The actual number of the responses are grouped in their respective categories.

Table 4: Ranking the causes of ROW risks on urban road projects as per the respondents.[6]

Identified Risks	**Frequency**			**Degree of impact**								
				Contribute to cost			**Contribute to time**			**Contribute to quality**		
	High	**Medium**	**Low**	**High**	**Moderate**	**Low**	**High**	**Moderate**	**Low**	**High**	**Moderate**	**Low**
Delay in clearance of ROW properties	7	1		8			8			1	5	2
Delay in relocation/protection of utilities	8			8			8			1	6	1
Lack of temporary land for subsidiary construction activities	5	3	2	4	4	2	5	3	2	3	4	4
Lack of establishing contractual agreements and responsibilities between the owners and utility Authority/ local public agencies	7	1		5	3		6	2		5	2	1
Changes in scope of Work (Clients new requirement due to ROW)	3	7		2	8		3	7		2	6	2
Unexpected sub-surface conditions (Inadequate ROW-Utility information)	6	3	1	5	5		6	4		4	3	3
Lack of coordination among ROW agents and utility Authority	9	1		7	3		7	3		4	3	3
Lack of coordination among ROW agents and local public agencies	7	3		6	4		7	3		4	3	3
Lack of commitment by ROW Agents	4	4	2	3	5	2	4	4	1	2	4	5
Lack of commitment by Utility Authorities	8	1	1	6	3	1	6	3	1	4	3	3
Lack of commitment by ROW Local Public Agencies	7	2	1	5	4	1	6	3	1	3	4	3
ROW Identification Errors/Omissions	2	4	3	3	4	3	3	5	2	2	4	5

[6] Some of the spaces provided for the frequency and degree of impact corresponding to the identified list of ROW risks are not ranked/marked by the informants.

The rankings by the respondents were analyzed and the corresponding mean scores of the feedbacks were arranged in the form of risk matrix; i.e. low impact-low probability of occurrence, high impact-low probability of occurrence, high impact-high probability of occurrence, and low impact-high probability of occurrence. The corresponding impact on time, cost, and quality are described in the risk matrices presented in the following Figures 9, 10 and 11, respectively.

Figure 9: ROW risks having an impact on time

Probability of occurrence	**Impact of risk: Low**	**Impact of risk: High**
High		-Delay in clearance of ROW properties -Delay in relocation/protection of utilities -Lack of temporary land for subsidiary (enabling) construction activities -Lack of establishing contractual agreements and responsibilities between the owners and utility Authority/ local public agencies -Unexpected sub-surface conditions -Lack of coordination among ROW obstruction clearance officer
Low	-ROW Identification Errors/Omissions	-Changes in scope of Work (Clients new requirement due to ROW)

Figure 10: ROW risks having an impact on cost.

Probability of occurrence	Impact of risk: Low	Impact of risk: High
High		-Delay in clearance of ROW properties -Delay in relocation/protection of utilities -Lack of temporary land for subsidiary (enabling) construction activities -Lack of establishing contractual agreements and responsibilities between the owners and utility Authority/ local public agencies -Unexpected sub-surface conditions -Lack of coordination among ROW obstruction clearance officers
Low	-ROW Identification Errors/Omissions	-Changes in scope of Work (Clients new requirement due to ROW)

Figure 11: ROW risks having an impact on quality of the road

Probability of occurrence	Impact of risk: Low	Impact of risk: High
High	-Delay in clearance of ROW properties -Delay in relocation/protection of utilities -Lack of temporary land for subsidiary (enabling) construction activities -Unexpected sub-surface conditions -Lack of coordination and commitment among ROW obstruction clearance officers	-Lack of establishing contractual agreements and responsibilities between the owners and utility Authority/ local public agencies
Low	-ROW Identification Errors/Omissions	-Changes in scope of Work (Clients new requirement due to ROW)

From the matrices shown in Figures 9, 10 and 11, the following source of risks are discovered as high impact-high probability of occurrence among the various causes of ROW risks that need risk management to be conducted on.

- Delay in clearance of ROW properties
- Delay in relocation/protection of utilities
- Lack of temporary land for subsidiary (enabling) construction activities
- Lack of establishing contractual agreements and responsibilities between the owners and utility authority/ local public agencies
- Unexpected sub-surface conditions (Inadequate ROW- Utility information)
- Lack of coordination and commitment among ROW obstruction clearance participants

Lack of establishing contractual agreements and responsibilities between the owners and utility authority/ local public agencies is found to be the most significant sources which have an impact on time, cost and quality of projects.

From the analysis of the interview responses, the ROW risks in general and lack of establishing contractual agreements and responsibilities between the owners and utility authority/ local public agencies in particular need to be dealt with in order to minimize the impacts on the project objectives of Addis Ababa city roads.

4.3 Case Study of Selected Road Projects in Addis Ababa

4.3.1 Road Project Implementation Practices

The key parties involved in road projects implementations in Addis Ababa city, the capital of Ethiopia, are the City Government of Addis Ababa represented by the Addis Ababa City Roads Authority (AACRA), Contractors and Consultants.

In 1993 the existing Ethiopian Government (EPRDF) has established regional governments and gave them power to administer their regions with autonomy. During this time Addis Ababa was also established as one of the regions. The Addis Ababa city administration during this period established the “bureau of works and urban development” and the bureau organized a department under it to carry out the road construction and maintenance works. The newly established road department constructed and maintained the city road till the establishment of the Addis Ababa City Roads Authority (AACRA) in 15th March 1998, to be administrated by Board of Directors, to construct, maintain and administer the road works in Addis Ababa. The total length of roads constructed in the city till the establishment of AACRA was 1,300km of which 900 km was gravel road and the remaining 400 km was asphalt surfaced road. AACRA has done substantial progress in the city roads expansion and upgrading since its establishment, especially in the last 10 years. According to the annual summary report of the road construction accomplishment of AACRA, the road coverage was evaluated reaching 15.64% of the total built-up area of Addis Ababa city, at the end of the Ethiopian fiscal year in July 2013.

Currently, the contractors taking part in road projects implementations are domestic and foreign companies. Most of the domestic contractors have limited capacity and rarely do meet the requirements of the contract document to complete the execution of the projects. Hence, foreign contractors, who executed majority of road construction in Addis Ababa city, have increased their participation in road projects in the last decade. Consultants, like contractors, will take the responsibility for the design and/or supervision services they render in accordance with the contract document. Unlike the contractors, local consultants are participating in the design as well as in the supervision of majority of the road projects currently under construction in Addis Ababa city.

The project delivery method widely practiced by AACRA is the traditional design-bid-build approach. This approach has three separate phases. First, selecting the road standard from the city’s master plan, the design of a project is undertaken by a Consultant, then a bid is floated to procure a contractor, and finally the selected contractor completes the construction. In most cases, the consultancy services for the design and supervision phases of a road project in Addis Ababa was undertaken by the same consulting firm.

4.3.2 Case Study of the Selected Road Projects

A desk study was conducted, on contractual documents and progress reports of the respective projects found in AACRA’s archive, to supplement the result from questionnaire survey and to have an overview on the extent of the problem. From the desk study it is revealed that most renown domestic contractors are not interested to participate in Addis Ababa city road construction projects due to the prevailing ROW problem.

For the purpose of the case study, selection of road projects was made from two perspectives based on their performances. The first group includes those projects exposed for cost and time overrun due to poor performance and in this respect ten road projects were selected from Addis

Ababa city. The second group includes those road projects in Addis Ababa achieving outstanding performance for their successful accomplishment within the agreed contract cost and time and in this respect selection was made to two projects. Attempt was also made, during selection of projects for case study, to include those projects, the client had contracted with contractors from domestic as well as foreign, in the last ten years.

The selected Addis Ababa city roads projects experiencing time and cost overrun are listed as follows in their chronological order of construction commencement date:

1. Alert Hospital-Keranyo
2. Semen Bus Terminal-Karalo
3. Yerer Ber -Gurdshola-CMC
4. Wingate Michililand –Asko
5. World Bank -Yeshi Debele
6. Meskel Square- Kality Interchange
7. Bole Michael Ring Road Roundabout – Bole Rwanda Road
8. Bus No.3 Mazoria -Bisrate Gebriel -Desie Hotel and Tele-Pushkin Square
9. Yere Ber-Yerer Goro -AAWASA Treatment Plant
10. Wingate -Asko Bridge

The following two projects can be taken as exceptions which are successfully completed in the last 10 years since the establishment of AACRA within the budget and time:

11. Wollo Sefer – Gotera Interchange
12. Meskel Square - Bole Road

The project delivery type of all the selected roads were Design – Bid- Build delivery method. The procurement of services and works were made on a national competitive bidding. The basic contractual data and brief history of these urban road projects are described as follows:

4.3.2.1 Alert Hospital – Keranyo Road

- Client: Addis Ababa City Roads Authority
- Contractor: China Road and Bridge Corporation (CRBC)

- Consultant: MH Engineering Plc
- Nature of works: Asphalt Concrete surfacing road with length of 2.29km and width of 20m including walkway.
- Original project cost---ETB 20,246,901
- Revised project cost ---ETB 32,219,219
- Original contract time ---------------------------------------102 calendar days
- Revised contract time --------------------------------------882 calendar days
- Commencement date --------------------------------------20th March 2005
- Contractual completion date -------------------------------30th June 2005
- Actual completion date--------------------------------------20th June 2007

The project contract time was extended by nearly 2 years. The main reasons for the delay was ROW problem. The Client was also experiencing shortage of budget for the timely settling payment to the Contractor.

From the contractual data of the project just listed before, it is to be underlined that the original contract time of 102 calendar days has been extended to 882 calendar days. The actual project duration is more than 8 times the original project duration. As such it can be suggested by the researcher that AACRA, during the early period of its establishment, likely seemed to have had little knowledge about the complexities of road construction in cities and the significant adverse effect of ROW obstructions on the progress of the road construction project in Addis Ababa.

The causes for the congregated additional cost of ETB 11,972,318 is attributed from the variation and supervision costs for the extended time due to the presence of the ROW problem.

It is the opinion of the researcher that if risks were identified before the start of the project and intervention measures were implemented during front end planning process by allowing the project scope definition to pass through PDRI tool, then it is most likely that the project might not fulfill the threshold of the PDRI set for commencement and even to the extent that the original contract time would have been set longer.

4.3.2.2 Semen Bus Terminal- Karalo Road

- Client: Addis Ababa City Roads Authority

- Contractor: SUR Construction
- Consultant: MH Engineering Plc
- Nature of works: Asphalt Concrete surfacing road with length of 5.4km and width of 30m including walkway.
- Original project cost--ETB 57,589,928
- Revised project cost--ETB 58,242,793
- Original contract time ---------------------------------------102 calendar days
- Revised contract time --------------------------------------1,278 calendar days
- Commencement date --------------------------------------20th March 2005
- Contractual completion date ------------------------------30th June 2005
- Actual completion date--------------------------------------8th September 2008

The project delayed by more than 3 years. The main reasons for the delay was ROW problem.

From the contractual data of the project just listed before, it is to be underlined that the original contract time of 102 calendar days has been extended to 1,278 calendar days. The actual project duration is more than 12 times the original project duration. As such it can be suggested by the researcher that AACRA, during the early period of its establishment, likely seemed to have had little knowledge about the complexities of road construction in cities and the significant adverse effect of ROW obstructions on the progress of the road construction project in Addis Ababa.

The causes for the congregated additional cost of ETB 652,865 is attributed from the variation and supervision costs for the extended time due to the presence of the ROW problem. Due to the continued presence of outstanding ROW obstructions, the Contractor had made negotiation with the Client to quit the project. As a result the contract was amicably terminated on 18th June 2008 leaving some road stretch incomplete on both ends of the project road where the Semen Terminal end was later completed by AACRA own force and the Karalo end was completed by a Contractor which was already under a signed contract agreement with the Ethiopian Roads Authority.

It is the opinion of the researcher that if risks were identified before the start of the project and intervention measures were implemented during front end planning process by allowing the project scope definition to pass through PDRI tool, then it is most likely that the project might not fulfill the threshold of the PDRI set for commencement and even to the extent that the original contract time would have been set longer.

4.3.2.3 Yerer Ber -Gurdshola-CMC Road

- Client: Addis Ababa City Roads Authority
- Contractor: Sunshine Construction Plc
- Consultant: MH Engineering Plc
- Nature of works: Asphalt Concrete surfacing road with length of 2.1km and width of 25m including walkway.
- Original project cost--ETB 20,018,258
- Revised project cost--ETB 20,367,238
- Original contract time --------------------------------------102 calendar days
- Revised contract time --------------------------------------882 calendar days
- Commencement date --------------------------------------20th March 2005
- Contractual completion date ------------------------------30th June 2005
- Actual completion date --------------------------------------20th June 2007

The project contract time was extended by nearly 2 years. The main reasons for the delay was ROW problem.

From the contractual data of the project just listed before, it is to be underlined that the original contract time of 102 calendar days has been extended to 882 calendar days. The actual project duration is more than 8 times the original project duration. As such it can be suggested by the researcher that AACRA, during the early period of its establishment, likely seemed to have had little knowledge about the complexities of road construction in cities and the significant adverse effect of ROW obstructions on the progress of the road construction project in Addis Ababa.

The causes for the congregated additional cost of ETB 348,980 is attributed from the variation and supervision costs for the extended time due to the presence of the ROW problem.

It is the opinion of the researcher that if risks were identified before the start of the project and intervention measures were implemented during front end planning process by allowing the project scope definition to pass through PDRI tool, then it is most likely that the project might not fulfill the threshold of the PDRI set for commencement and even to the extent that the original contract time would have been set longer.

4.3.2.4 Yere Ber - Yerer Goro - AAWASA Treatment Plant Road

- Client: Addis Ababa City Roads Authority
- Contractor: MIDROC Construction Plc
- Consultant: Engineer Zewdie Eskinder & Co. plc
- Nature of works: Asphalt Concrete surfacing road with length of 6.0km and an average width of 25m including walkway.
- Original project cost--ETB 75,986,488
- Revised project cost --ETB 94,949,854
- Original contract time ---------------------------------------366 calendar days
- Revised contract time --------------------------------------2,225 calendar days
- Commencement date --------------------------------------28th March 2006
- Contractual completion date -------------------------------29th March 2007
- Actual completion date--------------------------------------30 April 2012

The project delayed by more than five years. The main reasons for the delay was ROW problem.

From the contractual data of the project just listed before, it is noticed that the original contract time of 366 calendar days has been extended to 2,225 calendar days. The actual project duration is about 6 times the original project duration. As such it can be suggested by the researcher that AACRA, during the early period of its establishment, likely seemed to be having little knowledge about the complexities of road construction in cities and the significant adverse effect of ROW obstructions on the progress of the road construction project in Addis Ababa. According to the desk studies contractor’s internal management, particularly in connection with commitment, was also reported as another contributing factor for the delay of the project.

The causes for the congregated additional cost of ETB 18,963,366 is attributed from the variation, price escalation and supervision costs for the extended time due to the presence of the ROW problem.

Based on the feedback from an informant, the project's scope definition level was tried to be rated using the PDRI score sheet and the result was found to be 492 which is above 200[7] (a threshold set by CII), which reflects a less defined scope. According to the opinion of the researcher the project should not have been decided by AACRA for implementation until the project scope was reached a well defined level during front end planning process. The PDRI Score sheet with rating is attached for this project as example in appendix at the end of this thesis.

4.3.2.5 Bus No.3 Mazoria - Bisrate Gebriel - Dessie Hotel and Tele - Pushkin Square Road

- Client: Addis Ababa City Roads Authority
- Contractor: Originally BERTA Construction and later China Road and Bridge Corporation (CRBC)
- Consultant: BEZA Consulting Engineers plc
- Nature of works: Asphalt Concrete surfacing road with length of 4.1 km and width of 30m including walkway.
- Original project cost--ETB 89,490,473
- Revised project cost --ETB 120,342,946
- Original contract time ---------------------------------------544 calendar days
- Revised contract time --------------------------------------1,274 calendar days
- Commencement date --------------------------------------15th May 2006 Berta/ 6th July 2007 CRBC
- Contractual completion date ------------------------------31st December 2008
- Actual completion date-------------------------------------31st December 2010

The project delayed by 3 years. The main reasons for the delay was ROW problem and under capacity of the previous Contractor- BERTA Construction, who commenced the work on 15th

[7] The PDRI score 200 (out of 1000 total points) is set by CII as a bench mark. But one may wish to use a score other than 200 as a threshold for beginning of construction document development by considering several factors which are particular to the project.

May 2006 and was terminated just after a year period on 15th May 2007 following Clause 63 of the Standard Conditions of Contract for construction of civil works (MOWUD 1994). Immediately after termination, AACRA made another agreement with CRBC on 15th June 2007, by direct invitation, for the continuation of the project. Then the project resumed on 6th July 2007.

The causes for the congregated additional cost of ETB 30,852,473 is attributed from the variation, price escalation and supervision costs for the extended time due to the presence of the ROW problem and under capacity of the previous Contractor. Major portion of the variation of ETB 17,000,000 includes the amount for the provision of Grade separation (overpass) instead of the originally proposed At-Grade (T-junction) intersection at Pushkin Square.

There was no feedback from any of the informants regarding rating the scope definition level using the PDRI score sheet for this particular project.

4.3.2.6 Meskel Square - Kality Interchange Road

- Client: Addis Ababa City Roads Authority
- Contractor: China Road and Bridge Corporation (CRBC)
- Consultant: Engineer Zewdie Eskinder & Co. Plc
- Nature of works: Asphalt Concrete surfacing road with length of 8.8km and width of 40m including walkway.
- Original project cost---ETB 312,017,473
- Revised project cost ---ETB 452,151,389
- Original contract time ---------------------------------------1,095 calendar days
- Revised contract time ---------------------------------------1,730 calendar days
- Commencement date --6th July 2007
- Contractual completion date -------------------------------5th July 2010
- Actual completion date--------------------------------------31st March 2012

The project delayed by more than a year. The main reasons for the delay was ROW problem.

From the contractual data of the project just listed before, it is noticed that the original contract time of 1,095 calendar days has been extended to 1,730 calendar days. The actual project duration is nearly 2 times the original project duration. As such it can be suggested by the researcher that the client, AACRA, likely seemed to have had little knowledge about the significant adverse effect of ROW obstructions on the progress of the road construction project in Addis Ababa.

The causes for the congregated additional cost of ETB 140,133,916 is attributed from the variation, price escalation and supervision costs for the extended time due to the presence of the ROW problem.

There was no feedback from any of the informants regarding rating the scope definition level using the PDRI score sheet for this particular project.

4.3.2.7 Bole Michael Ring Road Roundabout – Bole Rwanda Road

- Client: Addis Ababa City Roads Authority
- Contractor: HAZIII General Construction Plc
- Consultant: Engineer Zewdie Eskinder & Co.Plc
- Nature of works: Asphalt Concrete surfacing road with length of 1.7km and width of 20m including walkway.
- Original project cost--ETB 43,718,163
- Revised project cost--ETB 56,295,165
- Original contract time --------------------------------------576 calendar days
- Revised contract time --------------------------------------2,217 calendar days
- Commencement date --------------------------------------6th July 2007
- Contractual completion date -------------------------------1st February 2009
- Actual completion date--------------------------------------31st July 2013

The project delayed by more than 4 years. The main reasons for the delay was ROW problem and under capacity of the Contractor.

From the contractual data of the project just listed before, it is to be underlined that the original contract time of 576 calendar days has been extended to 2,217 calendar days. The actual project duration is nearly 4 times the original project duration. As such it can be suggested by the researcher that the client, AACRA, likely seemed to have had little knowledge about the significant adverse effect of ROW obstructions on the progress of the road construction project in Addis Ababa. In addition, being the contractor was newly emerging to the construction industry, the client's original intention and expectation seems became unsuccessful in meeting its program of building the capacity of domestic contractors.

The causes for the congregated additional cost of ETB 12,577,002 is attributed from the variation, price escalation and supervision costs for the extended time due to the presence of the ROW problem. The causes for the variation is the insertion of special manholes and gullies due to the shift of the side drain pipes from the walkway to the carriageway due to the presence of the ROW problem.

Only 1.3 km out of the 1.7km long stretch of the project road could be substantially completed due to the presence of ROW obstruction clearance. Consensus was reached by AACRA and the Contractor to terminate the contract for the rest of the road segment with ROW obstruction.

From the Contractor's payment certificate no. 17, approved by the consultant in the month of November 2013 it is seen that the price escalation was about ETB 10 Million, while the value of works executed was about ETB 21 Million, so that it can be easily observed that the Price escalation has reached about 52% of the value of works executed. This price escalation increased due to the delay of the project mainly by ROW related issues.

Based on the researcher's rating the scope definition level using the PDRI score sheet, the result was found to be 666 which is above 200 (a threshold set by CII), which reflects a less defined scope. According to the opinion of the researcher the project should not have been decided by AACRA for implementation until the project scope was reached a well-defined level during front end planning process. The PDRI Score sheet with rating is attached for this project as example in appendix at the end of this thesis.

4.3.2.8 World Bank - Yeshi Debele Road

- Client: Addis Ababa City Roads Authority
- Contractor: Enyi Construction Plc
- Consultant: Highway Engineers and Consultants Plc
- Nature of works: Asphalt Concrete surfacing road with length of 3.5km and width of 40m including walkway.
- Original project cost--ETB 195,783,942
- Revised project cost --ETB 216,696,662

- Original contract time --420 calendar days
- Revised contract time --------------------------------------1,348 calendar days
- Commencement date ---------------------------------------22nd July 2008
- Contractual completion date --------------------------------15th September 2009
- Actual completion date--------------------------------------31st March 2012

The project delayed by more than 2 years. The main reasons for the delay was ROW problem.

From the contractual data of the project just listed before, it is to be underlined that the original contract time of 420 calendar days has been extended to 1,348 calendar days. The actual project duration is more than 3 times the original project duration. As such it can be suggested by the researcher that the client, AACRA, likely seemed to have had little knowledge about the significant adverse effect of ROW obstructions on the progress of the road construction project in Addis Ababa.

The causes for the congregated additional cost of ETB 20,912,720 is attributed from the price escalation and supervision costs for the extended time due to the presence of the ROW problem.

As per the rating of the scope definition level using PDRI scoring sheet by a respondent for this project, the result was found to be 482 (which is more than the threshold of 200 set by CII), which shows less defined scope definition. According to the opinion of the researcher the project should not have been decided by AACRA for implementation until the project scope was reached a well defined level during front end planning process. The PDRI Score sheet with rating is attached for this project as example in appendix at the end of this thesis.

4.3.2.9 Wingate Michililand – Asko Road

- Client: Addis Ababa City Roads Authority
- Contractor: Geom Leigi Varnero Construzioni
- Consultant: Highway Engineers and Consultants Plc
- Nature of works: Asphalt Concrete surfacing road with length of 2.3km and width of 25m including walkway.
- Original project cost---ETB 154,486,787
- Revised project cost ---ETB 180,136,898

- Original contract time --330 calendar days
- Revised contract time --------------------------------------1,162 calendar days
- Commencement date ---------------------------------------23rd February 2009
- Contractual completion date --------------------------------19th January 2010
- Actual completion date--------------------------------------30th April 2012

The project delayed more than 2 years. The main reasons for the delay was ROW problem.

From the contractual data of the project just listed before, it is noticed that the original contract time of 330 calendar days has been extended to 1,162 calendar days. The actual project duration is more than 3 times the original project duration. As such it can be suggested by the researcher that the client, AACRA, likely seemed to have had little knowledge about the significant adverse effect of ROW obstructions on the progress of the road construction project in Addis Ababa.

The causes for the congregated additional cost of ETB 25,650,111 is attributed from the price escalation and supervision costs for the extended time due to the presence of the ROW problem.

As per the rating of the scope definition level using PDRI scoring sheet by a respondent for this project, the result was found to be 416 (which is more than the threshold of 200 set by CII), which shows less defined scope definition. According to the opinion of the researcher the project should not have been decided by AACRA for implementation until the project scope was reached a well defined level during front end planning process. The PDRI Score sheet with rating is attached for this project as example in appendix at the end of this thesis.

4.3.2.10 Wingate - Asko Bridge Road

- Client: Addis Ababa City Roads Authority
- Contractor: TIDHAR Earth Moving Equipment
- Consultant: United Consulting Engineers
- Nature of works: Asphalt Concrete surfacing road with length of 2.6km and width of 30m including walkway.
- Original project cost---ETB 203,348,059
- Revised project cost ---ETB 417,787,112
- Original contract time --563 calendar days

- Revised contract time ---------------------------------------914 calendar days
- Commencement date ---------------------------------------27th December 2010
- Contractual completion date --------------------------------12th July 2012
- Actual completion date---------------------------------------28th June 2013

The project delayed by about 2 years. The main reasons for the delay was ROW problem.

From the contractual data of the project just listed before, it is to be underlined that the original contract time of 563 calendar days has been extended to 914 calendar days. The actual project duration is nearly 2 times the original project duration. As such it can be suggested by the researcher that the client, AACRA, likely seemed to have had little knowledge about the significant adverse effect of ROW obstructions on the progress of the road construction project in Addis Ababa.

The causes for the congregated additional cost of ETB 214,439,053 is attributed from the variation, price escalation and supervision costs for the extended time due to the presence of the ROW problem.

As shown in the photo no. 7 of this thesis, the retaining wall constructed as a provision for splitting the carriageway at one location shows defective in slope of the exposed face against its verticality has raised concerns on its stability. The endeavor to gather information from the client and the consultant to find out the causes was failed due to their reasoning that the issue was under investigation. But the researcher suggests that the cause for the tilting of the retaining wall is very likely due to the following:

a) Loose bracing of the formwork, where during concreting and vibration the erected formwork would be exposed for bulging and tilting and sometimes bursting.

b) The position of formworks might not be checked against the design coordinates

c) Sometimes after performing all the required checking on the formworks, concreting would not start due to several reasons like shortage of materials, breakdown of equipments, adverse weather condition, and so on, where in such cases the formwork position checking need to be done once again immediately before concrete pouring.

It is the concern of the researcher that unless urgent remedial action is taken by AACRA, the tilted retaining wall may collapse by the additional pressure created by the eccentricity for which the structure was not originally designed for.

There was no feedback from any of the informants regarding rating the scope definition level using the PDRI score sheet for this particular project.

4.3.2.11 Gottera - Wollosefer Asphalt Road Upgrading Project

- Client: Addis Ababa City Roads Authority
- Contractor: China Road and Bridge Corporation (CRBC)
- Consultant: Transport Construction Design Share company
- Nature of works: Asphalt Concrete surfacing road with length of 2.21km and width of 30m including walkway.
- Original project cost---ETB 30,000,000
- Revised project cost ---ETB 32,219,219
- Original contract time---180 calendar days
- Revised contract time--------------------------------------99 calendar days
- Commencement date--25th September 2003
- Contractual completion date--------------------------------22nd March 2004
- Actual completion date--------------------------------------2nd January 2004

The project is named as Ethio-China Friendship Avenue as the source of the budget is the China Government. The project completed in the contract period of three months. The issues with ROW problem are timely solved by AACRA with close assistance from the higher government officials.

The causes for the congregated additional cost of ETB 3,484,278 is attributed from the variation and price escalation.

As per the rating of the scope definition level using PDRI scoring sheet by a respondent for this project, the result was found to be 189 (which is less than the threshold of 200 set by CII), which shows well-defined scope definition. According to the opinion of the researcher from the figure the decision of AACRA for implementation of the project was correct. The PDRI Score sheet with rating is attached for this project as example in appendix at the end of this thesis.

4.3.2.12 Meskel Square -Bole Road

- Client: Addis Ababa City Roads Authority

- Contractor: China Communication Construction Company LTD (CCCC)
- Consultant: Engineer Zewdie Eskinder & Co.Plc
- Nature of works: Asphalt Concrete surfacing road with length of 4.3km and width of 40m including walkway.
- Original project cost---ETB 860,000
- Revised project cost ---ETB 860,000
- Original contract time ---------------------------------------912 calendar days
- Revised contract time --------------------------------------492 calendar days
- Commencement date--10th February 2012
- Contractual completion date -------------------------------10th August 2014
- Actual completion date--------------------------------------16 June 2013

The project was funded by a loan from the Export-Import Bank of China (60mln USD @12.47 exchange rate to Birr becomes 748.2mln ETB). And an advance payment of 30% of the Contract amount which is18mln USD or 224.46mln ETB was paid to the Contractor. The work was subcontracted to China Road and Bridge Corporation (CRBC) and the project was substantially completed one year before the contractual completion period, with a cost of 47mln USD or 586.09mln ETB.

Those ROW problems, delaying project completion on other projects, are here made part of the project so that the contractor would be paid for relocating and protection of utilities by subcontracting with the utility authorities. In addition there is a weekly ROW clearance progress review meeting at the presence of top management staffs of the stakeholders.

There is no time and cost overrun as the contractor was executing works 24hrs. The work is also very automated so that the workers, for instance, enjoy the facilitated concrete works. One of the interviewee said that the coordination work was really like a fire fighting operation, with the aim to open the road to traffic for the 50th Anniversary of African Union.

Furthermore, very high unit rates were fixed by the Contractor. The work was given to the Contractor by direct negotiation. For instance C-30 concrete is ETB 5,500 per cubic meter. But the average unit rate filled by the local Contractor in similar time for the same is about ETB 4,000 per cubic meter. It shows that the rate of CRBC is nearly 30% to 40% higher than the average cost of local contractors.

As per the rating of the scope definition level using PDRI scoring sheet by a respondent for this project, the result was found to be 363 (which is more than the threshold of 200 set by CII), which shows less defined scope definition. But it is the opinion of the researcher that due to the close follow-up of the stakeholders and concern for the 50th Anniversary of African Union, very high attention was given during the construction of the road to settle ROW obstructions so that the project could be completed within the allocated contract time. The PDRI Score sheet with rating is attached for this project as example in appendix at the end of this thesis.

4.4 Summary of the Case Study

The case study conducted on the selected Addis Ababa city roads can be summarized that ROW obstructions are contributing the major role for the delay and cost overrun of road projects in Addis Ababa.

There are also other factors for the cause of the prevailing poor quality of the road projects.

- Design errors by the design consultants
- Lack of design details
- Using substandard quality construction materials and negligence by supervision consultant
- Under capacity of the domestic contractor
- Poor master plan
- Omission and addition of works
- Poor drainage assessment
- Poor specification
- Errors in estimation of quantities

As it is clearly indicated in Table 3, the cause is ranked first by all respondents’ from consultants, contractors and the employer. This implies that ROW is one of the serious problems which results delay and cost overrun. According to my informal interviews with professionals participated in Addis Ababa city road construction, the common problems with ROW emanates from both perspectives. These are possession of land from land owners and relocation of utility facilities such as electric power, water supply and telephone lines, which has the same nature in what is discussed in the above paragraphs from literatures.

The common problems which are associated with land acquisition issues include; lack of awareness by the community, the fast growth of population which results in critical shortage of land resources and aggravate the land issue to be sensitive, estimation for compensation, the processes in AACRA to finalize the compensation submitted by the sub cities committee members, which varies from sub city to sub city and unfair in the eyes of the implementing agent, AACRA and lack of law enforcement etc. As a result the road construction progress is adversely affected, to the extent of omitting section of the road length from the contract, which is shown in this thesis in one of the projects selected as case study.

On the other hand problems related with relocation of utility facilities such as water supply, electricity and telephone lines are resulted from lack of proper coordination between utility companies and the road sector implementing agent, AACRA, and lack of information on underground utility lines even by the utility companies itself since there is no proper map which indicates the exact location of these lines.

In agreement with literature the consequential effects of this problem is delay in completion time, increase in project cost and dispute between the stakeholders. It is obvious since the estimation and compensation issue takes much time, besides increasing the project cost and time schedule thorough the specified processes the situation would push the work/activity to unfavorable seasons, opening a room for substandard quality works during rainy season. This may further exposes contracting parties' to escalated cost of materials and labor.

4.5 Recommendations on the Findings of the Results and Discussions

4.5.1 General

According to the FIDIC (1987) Clause 42.1, the Employer will, from time to time as the Works proceed, give to the Contractor possession of such further portions of the Site as may be required to enable the Contractor to proceed with the execution of the Works with due dispatch in accordance with such program or proposals, as the case may be."

And regarding failure to give possession FIDIC Clause 42.2 states " If the Contractor suffers delay and/or incurs costs from failure on the part of the Employer to give possession in accordance with the terms of Sub-Clause 42. 1, the Engineer shall, after due consultation with the Employer and the Contractor, determine:

- (a) any extension of time to which the Contractor is entitled under Clause 44, and
- (b) the amount of such costs, which shall be added to the Contract Price, and shall notify the Contractor accordingly, with a copy to the Employer.

In case of Ethiopia, Clause 21.1 of PPA (January 2006), the following are cited with regard to the possession of the site:

"The Employer shall give possession of the site to the contractor, as defined in the contractor's approved work program. If possession of a part is not given by the date stated in the approved work program, the employer will be deemed to have delayed the start of the relevant activities, and this will be a compensation Event."

It is also provided by sub-article 3 of Article 40 of the Constitution of the Federal Democratic Republic of Ethiopia (1995) that land is the property of the state and the peoples of the Ethiopia and that its use shall be subject to the specific regulation by law. In accordance with sub-article 8 of the same Article, the government may expropriate private property, for public purposes subject to payment in advance of compensation commensurate to the value of the property.

According to the provision of sub-article (2) of Article 27 of the proclamation No. 271/2011 of Ethiopia, (Federal Negarit Gazeta, 2011) the time for the process of clearance of land for construction from the holders shall be at least ninety days by paying commensurate compensation fee to the properties situated on the land and by providing a substitute plot of land for the displaced person.

Under the expropriation proceedings of Article 1470 of the Civil Code of Ethiopia (1960), it is mentioned that within one month from having been served with expropriation order, the owner of the property needs to inform the competent authorities, in this case the implementing agency is AACRA, of the amount of compensation they claim Article. In accordance with sub-article (5) of Article 1478 of the Civil Code of Ethiopia, where the amount of compensation is in dispute or the owner is not willing to receive the payment, the implementing agency may take possession of the immovable after having deposited the amount in dispute.

From the preceding two paragraphs, a total of four months are at least required to clear the properties from the RoW. On the other hand from the current AACRA practice and works contract documents, three months were given by AACRA for the removal of obstruction to coincide with the Contractor's mobilization period. AACRA is required to take in to consideration the same while setting the time put aside for clearance of obstructions from RoW.

a. Previous Practices of AACRA in ROW obstruction clearance

The previous practice was that AACRA starts to remove majority of the ROW obstructions during the three months mobilization period. In doing so the client will give access to the site for the road segments part by part. But the clearance delays in most cases.

b. Current Practices of AACRA in ROW obstruction clearance

According to the report of AACRA during the annual stakeholders meeting (2013) that current updated practices is, to introduce as a regulatory and permitting requirements, not to proceed the bidding of urban road projects for construction before at least 80% of ROW obstruction removal is achieved. For the implementation of the same, contracts will be signed between AACRA and the sub cities during handover of the identified ROW obstructions. Then the sub cities clear the obstructions and report the same to AACRA for takeover of the site substantially cleared from ROW obstructions.

The following are generally expected from the main stakeholders for the achievement of the above regulation:

4.5.2 Expectation from Clients

An employer is an initiator of a construction project, where the primary responsibility is vested on him. From inception through the construction life of a project, what the client shall consider attentively are recognized as listed as follows:

- AACRA should reconsider the need for re-structuring its organization based on the resources on its hand
- AACRA should make clear the way they want things to go and continue to have a role in promoting, that is, must set clear objective and provide clear terms of reference,
- AACRA should set and prioritize the three main objectives, (cost, time, and quality/performance) for procurement of any project,
- proper assessment of risk should be carried out,
- should initiate the participation of all stakeholders and be cooperative,

- should clear sites before hand,
- pay compensations in advance of project commencement,
- to have qualified and competent professionals to work as a counterpart with the consultants and contractors, and take part in project management, having or preparing clear program for the design of the project,

4.5.3 Expectation from Consultants

Consultant is responsible to translate the client's idea into plan and specifications. This obligation shall be accomplished professionally and ethically. The consultant or the engineer has responsibility to fulfill its commitment in collaboration with the client. The respondents identify these facts:

- the consultant should prepare list of ROW obstructions vigilantly so that no repeated marking is made on the properties.
- taking time preparing clear and detailed design and contract document,
- the clients and consultants should operate as a team to avoid the institutional risk of incomplete commitment and inconsistent decisions,
- consultants must assign competent personnel to produce acceptable design document and supervise the construction work
- should be impartial, should be ethical, clear its firm from corruption, to behave its personnel in good professional conduct, etc
- should let the client immediately know when issues arise
- acting as a good facilitators by avoiding fault finding role, assigning construction site professionals with good professional ethics,
- to decide on claims on time being impartial to client and contractor,
- to arrange for amicable resolutions on time between the parties,

4.5.4 Expectation from Contractors

When a construction contractor enters to a contractual obligation for execution of a project, the contractor shall properly analyze its capacity, present assignments, the contract documents, conditions of contract and compressive work atmosphere. Ethiopian construction contractors shall give attention to the following comments by those who gave their opinion during this thesis survey. These points give awareness and precaution to avoid and/or reduce the incidence of dispute and/or conflict that may arise due to inattention of a construction contracting firm.

- Contractors should include ROW department and officer in their organizational structure,
- Contractors should fill rates considering the actual performance outputs of the allocated resource combinations in urban areas in such an order to carry out works in short road segments; because from past practices possession of the site for road construction in urban areas is made available by the client to the contractors portion by portion,
- In Ethiopian construction industry, some contractors lack contract administration knowledge, they must equip themselves with this primary facts,
- Contractors assign unqualified people on the project in trying to save a lot. They should give serious attention to assign proper professionals appropriately,
- They should be innovative,
- Should immediately let the consultant know when problems arise,
- Should consider the consultant as partner than adversary,
- Build their capacity with respect to financial and project management,
- Reformation on the workmanship of contract item,
- Performance as per schedule of the contract, utilization of the project finance as per schedule, perform the work according to schedule,
- Supplying materials with standard quality and carry out the works according to design and specification,
- Avoid corruption,
- Be well organized in equipment and professionals,
- Fulfill quality management of works.

4.5.5 Anticipation from Government - Policy Makers

Construction industry need to have appropriate policy for efficient performance of construction projects. Government policy makers have to consider what the participants of this research have raised:

- To strengthen the sub cities in adequate and competent officers related to ROW clearance,
- Training to officers and professionals should be at top priority objective,
- To pass control of standard conditions to professional associations,
- Revise/update contract documents and should examine current procedures used in planning and implementation of projects, because some of these are causing unnecessary delay, avoidable costs and poor performance,
- To elevate capacity of contractors and consultants,
- Cooperative in the fulfillment of project needs on cases of ROW clearance, customs, banks, etc.

4.6 Opinions on PDRI Concepts

According to CII (2013), Urban Road projects are challenged by multiple jurisdictions in obtaining environmental and access permits and in negotiating public concerns. A correct project definition that addresses these and other unique challenges is essential for success. Moreover, conceiving, designing, and constructing an urban road project is a complex undertaking. Change is inevitable throughout the process, but change must be controlled to ensure the project parameters (cost, schedule, quality, and safety) remain under control. Changes may create all sorts of adverse impacts such as interruption of work flow and rework. These impacts cause extra costs to be incurred and project schedules to lengthen, generating claims and resulting in litigation. CII research has found that tools for measuring project scope definition and facilitating alignment between project participants are an essential component of a good Front End Planning process. The construction industry needs a user-friendly tool to assist in defining project scope and maximizing the chance of project success for infrastructure projects. A quantitative understanding of scope definition issues during front end planning (FEP) is necessary for decisions to go forward to implementation so that frequently occurring suffers during constructions from poor or incomplete project scope definition could be minimized. A multi-disciplinary research team at the Construction Industry Institute (CII) representing all the key participants in the project process including owners, engineers and constructors is working to develop a PDRI that is both user friendly and effective.

The researcher of this thesis also tried to discuss with the main stakeholders and suggest that though the concepts of PDRI are very general, they give clue where to focus in improving the delays related to the ROW obstruction for the urban road projects under considerations. It is essential to consider concepts related to PDRI tool before proceeding to the design and construction of urban road projects. It is to be underlined that passing projects through PDRI tool involves the participation of high government authorities including those from AACRA, Addis Ababa master plan institute, sub cities, utility service authorities, think tanks, along with experienced construction personnel during the pre planning phase. The research findings promotes the significance of the implementation of PDRI in reducing urban road project durations, cost overruns and quality problems. On the other hand, the existing practice of AACRA dealing with ROW obstruction did not address the problems that affect the achievement of project objectives.

PDRI tool score sheet table and element descriptions/definitions are contained in Appendix, as part of an interview schedule.

CAHPTER 5: CONCLUSIONS AND RECOMMENDATIONS

As mentioned in Chapter I, the aim of this research was to show how ROW related problems are affecting the objectives of road projects in Addis Ababa and propose possible ways and tools to resolve the challenges. Finally the following conclusions and recommendations are proposed.

5.1 Conclusions

Urban Road projects are challenged by multiple jurisdictions in obtaining environmental and access permits and in negotiating public concerns. A correct project definition that addresses these and other unique challenges is essential for success.

The following major findings are drawn from this research.

In an aim to address the first specific objective which was to assess performance and challenges of road construction in Addis Ababa city and to raise the issue of concerns on the extent of the involvement of domestic contractors, the following conclusions are forwarded.

a) The finding further indicated that the domestic contractors are less interested in participating in AACRA road projects. This led to the participation of new inexperienced and incapable local contractors, exposing them again for their failure to complete the project. Though time extension has been granted, financial compensation has not been granted so far to the domestic contractors. The main reason on the contractor sides was lack of contemporary recording evidences for those resources made idle where this is in turn attributed by the frequent professional turnover,

b) On the other hand it is discovered from the research that though no financial compensation was entertained so far to the local contractors, the client was losing extra cost due to payment for the supervision consultants and price escalation. The contractor was also being suffered from losing huge amount of money due to inflation as the price escalation considers to revise price changes on few work items like reinforcement steel, cement, fuel and bitumen,

c) To manage the problems that arise from lack of skill, awareness, and knowledge where the losses in quality, cost, and time could substantially be reduced or avoided through proper and balanced contract administration practice. This is better handled by the client, in order to promote the competence of the domestic construction sector as well.

The second specific objective was to evaluate the level of understanding by professionals and current practice of risk management system in urban road projects are as follow:

a) The findings from the research show that the major problem for non achieving project objectives of AACRA roads is the slow clearance of obstructions from the ROW limit, due to lack of alignment among the stakeholders,
b) There is no formal risk management entertained by any of the parties.

The third specific objective was to identify risks in urban road construction projects, and to assess the frequency of occurrence and impacts on time, cost and quality. Accordingly the finding reveals that, out of the major factors selected, ROW related risks are found to be with high probability of occurrence and high impact on time and cost on urban road projects. And the major factors selected as a source of high ROW related risks are as follows:

a) Delay in clearance of ROW properties,
b) Delay in relocation/protection of utilities,
c) Lack of temporary land for subsidiary (enabling) construction activities,
d) Lack of establishing contractual agreements and responsibilities between the owners and utility authority/ local public agencies,
e) Unexpected sub-surface conditions (Inadequate ROW- Utility information),
f) Lack of coordination and commitment among ROW obstruction clearance participants.

The fourth specific objective was to suggest to employ the concept of the Project Definition Rating Index (PDRI), its correlation with project success and its use as a risk management tool. According to the feedback from the respondents, the PDRI modified to AACRA-specific research is believed to provide wide ranging benefits when utilized at the recommended process points and some of the benefits include:

a) Can be used as a checklist through the various processes before construction starts
b) Means to monitor progress at various stages during the planning process
c) A tool that aids in communication and promotes alignment between planning operations and the detailed design personnel
d) A means of standardizing scope definition terminology throughout project implementations.

Hence the primary objective of this thesis is to give a better understanding on the necessity of ROW risk management in order to maximize the chance of a successful project objectives, which has a contribution in helping to accelerate the expansion of the road transport coverage of Addis Ababa and contributes in facilitating accessibility and mobility of traffic flow.

5.2 Recommendations

Based on the understanding of the main causes of cost and time overrun and poor quality of urban road projects, important suggestions are proposed. So in an effort to fully address the ROW risks, the following are recommended to be considered by all stake holders of the Addis Ababa City Road projects:

1. The activity of ROW clearance is to be taken as an independent phase or package to be inserted between design and construction phases, indeed before construction tendering to ensure the removal of houses/fences and relocation/protection of utility services.
2. AACRA is required to undergo a restructuring of its organization to focus on the clearance of obstructions, Administration and maintenance of the Addis Ababa city roads by developing mechanisms in order to increasing the level of participation by the domestic Contractors towards the achievement of the target.
3. The concept of Project Definition Rating Index (PDRI) is to be adopted by AACRA for front end planning. In coordination with the academic institutions like Addis Ababa University and international engineering/construction research institutes like CII, AACRA-specific modified PDRI is to be developed to highlight poorly defined areas and determine the project's major risk issues. In particular, as a means to combat the prevailing ROW risks in AACRA, PDRI scores can be used as one of the intervention measures as a regulatory and permitting requirements towards the start of project implementations.
4. The stakeholders in the city roads construction sector have to work on the preparations of relevant standards and procedures in the following areas:
   - Highlight poorly defined areas in the scope of project definition,
   - Determine the project's major risk issues,
   - Provide a constructive exchange of ideas and promote alignment among the stakeholders.

5. Consultants are required to be committed in producing designs that do not cause repeated change of marking on obstructions proposed to be removed. Drainage facilities in roundabouts need to be specially treated using detail drawings to avoid consequences of traffic jam resulting from deterioration by stagnant water. Pavement is to be properly constructed with the material as per the specification to prolong the life of the road as per the design period.
6. Contractors should fill rates in such an order to carry out works on the project portion by portion as possession of the site is made available part by part to the Contractor. The quarries, stockpiling sites and spoil site locations are also taken in to consideration in the breakdown of the unit rates of the relevant work items.
7. Safety issues and traffic management are to be included in the bill of quantities of the works contract as pay work items.
8. Formal risk management systems is to be implemented in AACRA for each project.
9. As one of the stakeholders in the Addis Ababa city development, academic institutions, specially Addis Ababa University should include the courses on risk management at least in the schools of post graduate studies, as long term plan. And as a short term measure, intensive trainings, workshops, seminars etc. should be arranged.
10. Standardization of drawings is to be developed and those standard drawings already available need revisions and updating incorporating the feedback from the completed projects.
11. The road network depicted in the Master plan of Addis Ababa is to be revised and updated considering the current topographic feature of the land. In addition drainage system and traffic volumes are to be analysed forecasting the direction of the city's land development considering business centers, road intersections, parking lots, freight terminals, condominium and real-estate development, horticulture and agro-industry, small and micro business and industrial zones.

The following areas of study are suggested for further studies as part of the extension of this research work:

1. Assessment of management of Master Plan of urban roads in general comparing with the current rate of development, taking Addis Ababa City as a case study. Issues

related with traffic volume generated due to real state and condominium houses and effects on the existing access and mobility roads,

2. Bench marking is to be applied in measurable way to other projects based on those projects that have best performed and achieved the project objectives,
3. Assessment of cost estimate in urban road construction, taking selected roads in Addis Ababa (Equipment performance output per hour is very low due to constricted working space and watchful/care for subsurface utilities). The chance for engaging on concurrent activities at various areas is also not encouraged since it affect the public,
4. Assessment of price escalation versus inflation during the extended contract time. (Inflation affecting Contractor) verses price escalation(affecting Client) on delayed projects),
5. Finally the author highly recommends that future research be done using the PDRI by creating collaborative partnership with CII. PDRI can be modified by adapting to fit the present construction situations of our country in a manner to improve front end planning so as to achieve better project performance.

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APPENDICES

Appendix A: Interview Schedule

Date: ___________________

Dear Participant:

Subject: Interview Schedule

I am undertaking a research on the title, 'Right of Way Risk Management of Road Projects in Urban Areas: A Case Study of Addis Ababa', as partial fulfillment of MSc. Degree in Construction Technology and Management. The main objective of the research is to assess the risks contributing to cost and time overruns as well as substandard quality of projects in urban areas, and to propose actions to be taken based on the conclusions. Hence the questions in this interview schedule are prepared in a semi-structured type to obtain information from key respondents.

It is known that promising achievements are being seen at present in road coverage of Addis Ababa, as compared to those two decades ago. However, much still needs to be done to accelerate the road coverage as majority of road projects in the city are completed with time and cost overrun and lower quality standard. This repeated failure of urban road projects to achieve project objective is an indication of poor project management, which is highly affecting implementation of road infrastructure development program of the capital and the country at large. Risk management has crucial role in project management towards achieving the project objectives (time, cost and quality). The negative effects of the significant risk that contribute to delay, cost overrun and substandard quality could be minimized as appropriate risk management is applied to the life cycle of the project. Hence, it is necessary to investigate the significant risks to take proactive action towards increasing the level of control of risk and to achieve project objectives. This research is aimed to indentify, analyze and rank the significant risks of the Ethiopia urban road projects, particularly in Addis Ababa, based on their frequency and impact on the projects time, cost and quality targets and to forward subsequent recommendation towards minimizing their negative effect. As a risk management tool, a project definition rating index (PDRI) scoring is employed and applied on selected projects which are substantially completed, for comparing the correlations between scope definition levels completeness against the project success.

To successfully conduct this research it is mandatory to look into the issue from different perspectives and to collect views of professionals who have vast experience in road construction in

Ethiopia in general and in Addis Ababa City, in particular. In this respect, your participation is highly valuable for the result of the research.

I would like to confirm that your feedback will be used strictly for the academic purpose.

Thank you very much,

Temesgen Tegabu
Post Graduate Student, Construction Technology and Management

A.A University, A.A Institute of Technology, School of Civil & Environmental Engineering

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E-mail: temesgentegabu@yahoo.com

Addis Ababa, Ethiopia

Section 1: General profile of the respondent

The questions below are related to your organization and yourself. Please indicate your response by ticking (X or √) in the appropriate box (es) or by filling the blank spaces provided, as appropriate.

1.1 Name *(Optional):*___________________________________

1.2 Position :___________________________________

1.3 Organization : ___________________________________

1.4 Address : ___________________________________

1.5 Educational Status?

☐ BSc ☐ MSc ☐ Others (Please specify): ______________

1.6 How long have you worked in the Road Sector?

☐ < 5 years ☐ 5 – 10 years ☐ 10 – 15 years ☐ > 15 years

1.7 Your work experience in urban road projects

☐ < 5 years ☐ 5 – 10 years ☐ 10 – 15 years ☐ > 15 years

1.8 Using a scale of 1 to 5, how successful do you feel that these urban road project were? *(please circle)*

1 2 3 4 5

Very poor--------------------------------Average--------------------------------Outstanding

Section 2: General performance assessment of road projects in urban/ Addis Ababa in the last 10 years

The following questions are aimed to assess the performance of road projects in Addis Ababa. Please think in terms of your organization's experience and/or your knowledge and indicate your response by ticking (X or √) in the appropriate box(es). Moreover, could you please give further explanation and suggestion on the area that needs improvements at the space provided under each question?

As per the publications of Addis Ababa City Roads Authority, AACRA, in its special edition on the occasion of celebrating the 125th anniversary of Addis Ababa, it was mentioned that during the beginning of 1990s the road coverage of Addis Ababa was 5%. It was also mentioned that it was planned to reach the middle level cities in the world which is 20% road coverage by 2020. Finote Addis, 2005EC. According to annual progress report of AACRA evaluating on road construction accomplishment of the 2012/13 fiscal year, the road coverage reached 15.64%.

2.1. In your opinion do you think the above percentage (cumulative of the area of road per built up area of the town) as a criteria help to evaluate and compare the status of road development in the cities?

☐ Strongly agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly disagree

____
____
____

2.2. Do you have any other suggestions of parameter or index which better measures the performance of road construction in urban? ☐ Yes ☐ No

If yes, please list and provide any areas that need improvements on the current urban road agency's practice assessing progresses

____
____
____

2.3. In your opinion do you think the existing performance of road construction in Addis Ababa ensures the achievement stated 20% target by 2020?

☐ Strongly agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly disagree

____
____
____

2.4. As per the Consultant's monthly progress report no. 16 of the project and Ethiopian Herald 23 May 2013 edition, a road project in Addis, the Maskal Square –Bole Ring Road, has been substantially completed and opened to traffic towards the end of May 2013. It was also highlighted that all the stakeholders and the public have contributed their share in the effort to complete the project prior to the celebration of the 50th Golden Jubilee of the OAU/AU. The project was substantially completed one year and three months before its contractual completion time. In your opinion, do you think that the participation of stakeholders and the public have significant influence for the achievement? How do you compare the share of the stakeholders contribution for other road -projects in Addis Ababa?

☐ Strongly agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly disagree

____

____

____

2.5. In your opinion do you think the domestic contractors' involvement is sharing the leading part in the current road constructions in urban/Addis Ababa?

☐ Strongly agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly disagree

____

____

____

2.6. If you disagree, what could be done in your opinion to bring the domestic contractors involvement more than the present share in the current road construction in Addis Ababa?

____

____

____

2.7. Do you have any comments regarding any causes and effects on delay of urban road projects?

☐ Yes ☐ No,

If yes, please describe

____

兩____

2.8. Do you have any comments regarding any causes and effects on the cost overrun of urban road projects? ☐ Yes ☐ No

If yes, please describe

____

2.9. Do you have any comments regarding any causes and effects on the substandard quality of urban road projects? ☐ Yes ☐ No,

If yes, please describe

____

2.10. In your opinion how do you rate the requirement of these projects for significant right-of-way acquisition? ☐Very low ☐ Low ☐ Moderate ☐ High ☐ Very high

____

Section 3: Current practice of risk management

The following questions are aimed to get the level of current practices of risk management in relation to urban road projects. Please think in terms of your organization's experience and/or your knowledge and indicate your response by ticking (X or √) in the appropriate box (es). Moreover, could you please give further explanation and suggestion on the area that needs improvements at the space provided under each question? *Please note that risk management in the research refers to the process of identification of the source of the risk, analysis of the likelihood of occurrence and its impact on cost, time, and quality of a project; and then the adoption of appropriate response to reduce and control the negative effect of risk on the project targets.*

3.1 In your opinion who is most responsible for managing risk related issues in your organization/ for the urban road projects? (Please give weight with 1 for the least responsible to 5 for most responsible)

( ) Executives ( ) Project Managers ( ) Designers/Planners ( ) Workers ( ) All

____

3.2 In your opinion which process of risk management framework is widely used in Ethiopia road construction industry, in urban areas in particular? (Please give weight with 1 for the least used and to 5 for most used)

( ) Risk identification ( ) Risk analysis ( ) Risk response ( ) Risk monitoring
( ) Others, please specify ____

____

____

3.3 In your opinion which type of risk response mechanism is more dominantly used in your organization/ in urban road construction? (please give weight with 1 for the least used and to 5 for most used)

( ) Risk retention ( ) Risk transfer ( ) Risk reduction ( ) Risk avoidance

( ) Other (please specify) ____

____

____

3.4 There are two types of risk management action; preventive and remedial actions. Which risk preventive action is more implemented in your organization and in the urban road construction? (please give a weight with 1 for the least important to 5 for most important)
( ) Make more accurate time estimation through quantitative risk analysis techniques,
( ) Make proper time estimation & produce a proper programme with subjective judgment,
( ) Produce a proper schedule by getting updated project information,
( ) Plan alternative methods/options as stand-by,
( ) Transfer or share risk to/with other parties,
( ) Others, please specify____

____

____

3.5 Which risk remedial action is more implemented in your organization/ in the urban road construction? (please give a weight with 1 for the least important to 5 for most important)
( ) Increase working hour, manpower and/or equipment,
( ) Change the construction method,
( ) Change the sequence of work by overlapping activities,
( ) Provide close supervision to subordinates for minimizing abortive work, and

( ) Others, please specify____

____

____

3.6 To what extent can the following factors influence the risk management in Ethiopian construction industry, in urban areas in particular? (Please give a weight with 1 for the least important to 5 for most important)

( ) The availability of knowledge and expertise of risk management

( ) The attitude of contractors and employers

( ) The cost of risk management

( ) Others, please specify _______________________________________

____

____

3.7 Which risk identification technique you are familiar with? (please give a weight with 1 for the least important to 5 for most important)

( ) Brainstorming ( ) Checklist of risk based on previous project ( ) Desk studies

( ) Others, please specify ____

____

____

3.8 Does your organization have a formal risk management system noted above? ☐ Yes ☐ No

3.9 If your organization has a formal risk management system, how do you rate its application?

☐ Very low ☐ Low ☐ Moderate ☐ High ☐ Very high

____

____

3.10 If your organization doesn't have a formal risk management system, how does it control risks that affect cost, time, and quality of a project?

____

____

Section 4: Identification of risks and their degree of impact and frequency of occurrence

4.1 Sources of risks in road construction

The following list of risks associated to the urban road construction is identified from literature review and desk studies. The aim of the questions below is to evaluate the probability of occurrence (frequency) and impact of risks on the urban projects targets viz on cost, time and quality objectives. Please think in terms of your organization's experience and/or your knowledge to identify from the list in the following table and rank them in order of probability of occurrence and severity of impact by indicating your response using ticking (X or √) in the appropriate spaces. You can add other sources of risks to the list, if any.

No	Identified Risks	Frequency			Degree of impact								
					Contribute to cost			Contribute to time			Contribute to quality		
		High	Medium	Low	High	Moderate	Low	High	Moderate	Low	High	Moderate	Low
I. Feasibility study, design and tender related risks													
1	Incomplete definition of scope of work												
2	Defectives in design												
3	Insufficiency in drawings and specifications												
4	Delay in issuing Drawings and documents												
5	Owners' need for change of design												
6	Unfair imposed tight schedule by owners												
7	Client's requirement changes												
8	Absence or high turnover of professionals												

No	Identified Risks	Frequency			Degree of impact								
					Contribute to cost			Contribute to time			Contribute to quality		
		High	Medium	Low	High	Moderate	Low	High	Moderate	Low	High	Moderate	Low
9	Deficient in cost estimate												
10	Unfair practice in tendering												
11	Lack of knowledge/appropriate technology												
12	Lack of Commitment by professionals												
13	Incomplete Master Plan												
	Additional identified risks, if any												
II. Right-of –way related risks (Please find also details in the Table under section 4.2)													
III. Construction related risks													
1	Substandard quality of work												
2	Construction site accident												
3	Deficiency in defect identification												
4	Poor planning and management												
5	Good practice in method of construction												

No	Identified Risks	Frequency			Degree of impact								
					Contribute to cost			Contribute to time			Contribute to quality		
		High	Medium	Low	High	Moderate	Low	High	Moderate	Low	High	Moderate	Low
6	Untimely drawing supply												
7	Coordination problem												
8	Incompetence of contractor												
9	Impediments in approvals												
10	Absence or high turnover of professionals												
11	Unpredicted technical problems in construction												
12	Unforeseeable site conditions												
13	Substandard quality of construction Materials												
14	Inefficient labour productivity												
15	Inefficient equipment productivity												
16	Lack of skills/techniques												
17	Improper interventions by owners												
18	Significant quantity variation												
19	Poor organizational structure												
	Additional identified risks, if any.												

No	Identified Risks	Frequency			Degree of impact								
					Contribute to cost			Contribute to time			Contribute to quality		
		High	Medium	Low	High	Moderate	Low	High	Moderate	Low	High	Moderate	Low
IV. Legal and contract related risks													
1	Disputes and claims												
2	Discrepancies in documents												
3	Violation of contracts by owners												
4	Violation of contracts by contractors												
5	Untimely settlement of contractual issues and disputes												
6	Disputes among stakeholders												
7	Strikes and disputes by labour												
8	Problems related to duty and customs clearances												
	Additional identified risks, if any												
V. Financial related risks													
1	Securing adequate funds												
2	Shortage of Cash flow												
3	Delay of contractor’s payment by owners												

No	Identified Risks	Frequency			Degree of impact								
					Contribute to cost			Contribute to time			Contribute to quality		
		High	Medium	Low	High	Moderate	Low	High	Moderate	Low	High	Moderate	Low
4	Bankruptcy of owners												
5	Price increase (inflation)												
6	Fluctuations in exchange rate												
7	Insufficient foreign currency												
	Additional identified risks, if any												
VI. Political related risks													
1	Political instability and intimidation of war												
2	Bribes and corruption practices												
3	Legislation changes												
	Additional identified risks, if any												
VII. Logistic related risks													
1	Inadequate supply of construction materials												
2	Inadequate availability of manpower												
3	Inadequate deployment of												

No	Identified Risks	Frequency			Degree of impact								
					Contribute to cost			Contribute to time			Contribute to quality		
		High	Medium	Low	High	Moderate	Low	High	Moderate	Low	High	Moderate	Low
	equipment												
4	Damage or loss by transportation												
	Additional identified risks, if any												
VIII. Physical and Natural related risks													
1	Unexpected adverse weather												
2	Flood, landslide and earth quack												
3	Damages or losses by fire												
	Additional identified risks, if any												
IX. Operation and Environment related risks													
1	Environmental pollution and damage												
2	Instability in market demand												
3	Safety in operation and maintenance												
	Additional identified risks, if												

No	Identified Risks	Frequency			Degree of impact								
					Contribute to cost			Contribute to time			Contribute to quality		
		High	Medium	Low	High	Moderate	Low	High	Moderate	Low	High	Moderate	Low
	any												

4.2 Right-of-way risks

From the experience of your organization and/or your knowledge, would you please rank the following right-of-way (ROW) risks in urban road construction in terms of probability of occurrence and severity of impact on time, cost, & quality? You can describe additional relevant risks, if any. In the context of this research, the word "utility" includes all overhead, surface or underground installations or systems to convey services like water supply, waste water disposals, electric power, telephone communication, etc. to the public.

No	Identified Risks	Frequency			Degree of impact								
					Contribute to cost			Contribute to time			Contribute to quality		
		High	Medium	Low	High	Moderate	Low	High	Moderate	Low	High	Moderate	Low
Delay in clearance of ROW properties													
Delay in relocation/protection of utilities													
Lack of temporary land for subsidiary (enabling) construction activities													
1	Delay/shortage of acquisition of land for source of construction materials												
2	Delay/shortage of acquisition of land for disposal areas of surplus												

No	Identified Risks	Frequency			Degree of impact								
					Contribute to cost			Contribute to time			Contribute to quality		
		High	Medium	Low	High	Moderate	Low	High	Moderate	Low	High	Moderate	Low
	excavated materials												
3	Delay/lack of land for crusher site, production yard of precast element and structural components												
4	Delay/lack of land for Contractor's establishments like warehouse, work shop,												
5	Delay/lack of land for storing hazardous/explosive materials												
6	Inadequate/lack of working space beyond the construction limit												
7	Shortage of land for access and detours/bypass construction												
	Additional identified risks, if any												
Lack of establishing contractual agreements and responsibilities between the owners and utility Authority/ local public agencies													
Changes in scope of Work (Clients new requirement due to ROW)													
Unexpected sub-surface conditions (Inadequate ROW- Utility information)													

No	Identified Risks	Frequency			Degree of impact								
					Contribute to cost			Contribute to time			Contribute to quality		
		High	Medium	Low	High	Moderate	Low	High	Moderate	Low	High	Moderate	Low
	Lack of coordination among ROW agents and utility Authority												
	Lack of coordination among ROW agents and local public agencies												
	Lack of commitment by ROW Agents												
	Lack of commitment by Utility Authorities												
	Lack of commitment by ROW Local Public Agencies												
	Additional identified risks, if any												
	ROW Identification Errors/Omissions												
1	Inaccurate identification and repeated marking of properties												
2	Fault of Appraisers during cost estimating ROW												
3	Lack of identification and prioritization of long lead (delay prone) parcels and utilities set priorities												
4	Overlooking ROW impacts due to Open channels, tunnels, and outfall structures												
5	Negligence for the downstream settlements due absence of												

No	Identified Risks	Frequency			Degree of impact								
					Contribute to cost			Contribute to time			Contribute to quality		
		High	Medium	Low	High	Moderate	Low	High	Moderate	Low	High	Moderate	Low
	Storm water containment/ Storm water runoff control												
6	Absence of ROW planning Officer												
	Additional identified risks, if any												

Adapted from CII IR 268-2 (2010) and AACRA annual publication (2011/12).

Please describe from your experience additional major right- of- way issues encountered in urban areas and measures to be taken, if any.

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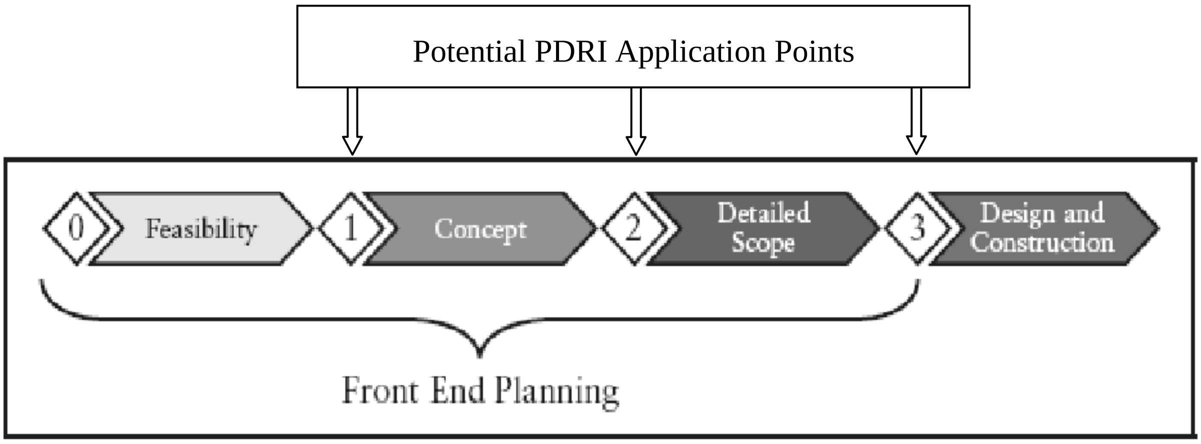
Section 5: Professionals' concept on PDRI

A. Current practices on PDRI

This section explores the opinions of informants on PDRI concepts. PDRI is an acronym for Project Definition Rating Index which is defined as a score along a continuum representing the level of project scope definition emphasizing on front end planning, also known as pre- project planning. The Construction Industry Institute (CII) defines front end planning (FEP) as the important process of developing adequate strategic information with which owners can tackle risk and make decisions to assign resources in order to optimize the potential for successful project

(Gibson 1996). PDRI is hence a tool for risk management (CII-2010), as Project risks must be identified and understood at early stage of the project so that proper contingencies can be allocated and maintained in order to mitigate unforeseen issues. The following figure shows the project life cycle diagram.



Project Life Cycle Diagram adapted from Gibson (1996)

While Front End Planning (FEP) is a critical process for uncovering project unknowns, CII developed effective risk management tool called the Project Definition Rating Index (PDRI) for construction projects. PDRI was first developed for industrial projects in 1996 and for building projects in 1999 and very recently developed for infrastructure projects which include highway projects in 2010.

Researches show that a finite and specific list of issues related to scope definition of infrastructure projects can be developed. The research report also concludes that the PDRI score indicates the current level of scope definition and corresponds to project performance. Infrastructure projects with low PDRI scores, (well defined); outperform projects with high PDRI scores. PDRI Score of 200 Point is used as a Cutoff, which was determined by the statistical analysis of 22 completed projects. An analysis on these completed infrastructure projects representing over $6 billion of constructed cost showed that projects with scoring lower than 200 (out of 1000 total points), which reflects a well-defined scope, were significantly more successful than those that scored above 200, which reflects a less defined scope. Another CII research has also revealed that tools for measuring project scope definition and facilitating alignment between project participants are an essential component of a good Front End Planning process.

However depending on the nature of the evaluation mission, for internal scope definition practices and requirements, etc., one may wish to use a score other than 200 as a benchmark for beginning of construction document development (NASA Pre-Project Planning Team, 2000).

5.1 How do you rate the correlation between front end planning issues and project success?

☐ Very low ☐ Low ☐ Moderate ☐ High ☐ Very high

____

____

5.2 In your opinion what is the chance of success when thorough front end planning is performed?

☐ Very low ☐ Low ☐ Moderate ☐ High ☐ Very high

____

____

5.3 What do you think the type of pre-project planning activity carried out by the key stake holders to authorize the project?

____

____

5.4 In your opinion is feasibility study/Investment studies parameters used in AACRA current practice for decision to design and construct a project (e.g., Internal Rate of Return, Benefit/Cost Ratio, Net Present Worth, Payback Period, etc.)? ☐ Yes ☐ No

If no, please describe:

____

____

5.5 In your opinion, does AACRA encourage practice of pre project planning? ☐ Yes ☐ No

If no, please describe the reason of not practicing it:

____

____

5.6 How do you rate your experience in practicing FEP on your job?

Very low ______ Low______ Moderate ______ High ______ Very high ________

____

____

5.7 What is your concept of PDRI?____

Very low _______ Low______ Moderate ______ High _____ Very high ________

____

____

5.8 How do you rate the knowledge and skill of professionals and decision makers about FEP and PDRI towards risk management in your organization/the construction industry?

Very low _______ Low______ Moderate ______ High _____ Very high ________

____

____

5.9 How do you rate the need for FEP and PDRI training and workshops to the construction professionals urgently?

Very low _____ Low ______ Neutral______ High_____ Very high _______

____

____

5.10 In your opinion do you think FEP and PDRI can help and add value to your work particularly in managing construction projects?

Strongly agree _____ Agree ____ Neutral______ Disagree____ Strongly disagree______

____

____

5.11 In your opinion do you think lack of proper FEP has significant effect towards achieving the project's objective particularly cost and time targets?

Strongly agree _____ Agree ____ Neutral_____ Disagree_____ Strongly disagree______

____

____

5.12 In your opinion do you think adequate attention is given to FEP before the authorization of the project in Ethiopia road construction sector, in particular in urban areas?

Strongly agree______ Agree _____ Neutral______ Disagree____ Strongly disagree______

____
____

5.13 In your opinion do you think in Ethiopian road construction, in urban areas in particular, there is a condition for **alignment** of appropriate project participants to meet and work in order to develop a uniformly defined set of project objectives?

Strongly agree______ Agree _____ Neutral____ Disagree____ Strongly disagree______

____
____

B. PDRI score sheet-weighted

The tables in the subsequent pages show PDRI Score sheet (weighted), which consists of 3 main sections broken down to 13 categories and further into 68 elements, based on the scope definition of infrastructure projects. Scoring is performed by evaluating and rating the individual elements. Elements are rated numerically from 0 to 5 based on its level of definition, at the point in time prior to beginning detailed design for the project (phase gate 3, as shown in figure-1, in the preceding page). Elements that were as well defined as possible will receive a perfect rating of "one" and those that were completely undefined will receive a rating of "five". All other elements will receive a "two", "three", or "four" depending on their levels of definition. Those elements deemed not applicable for the project under consideration will receive a "zero". To rate an element, its definition and check lists, *separate attachments with this interview schedule*, need to be read first.

SECTION I. BASIS OF PROJECT DECISION									
CATEGORY Element			**Definition Level**						**Score**
			0	**1**	**2**	**3**	**4**	**5**	
A	**PROJECT STRATEGY (Maximum = 112)**								
	A.1	Need & Purpose Documentation	0	2	13	24	35	44	
	A.2	Investment Studies & Alternatives Assessments	0	1	8	15	22	28	
	A.3	Key Team Member Coordination	0	1	6	11	16	19	
	A.4	Public Involvement	0	1	6	11	16	21	
CATEGORY A TOTAL									
B	**OWNER/OPERATOR PHILOSOPHIES (Maximum = 67)**								
	B.1	Design Philosophy	0	2	7	12	17	22	
	B.2	Operating Philosophy	0	1	5	9	13	16	
	B.3	Maintenance Philosophy	0	1	4	7	10	12	
	B.4	Future Expansion & Alteration	0	1	5	9	13	17	
CATEGORY B TOTAL									
C	**PROJECT FUNDING AND TIMING (Maximum = 70)**								
	C.1	Funding & Programming	0	1	6	11	16	21	
	C.2	Preliminary Project Schedule	0	2	7	12	17	22	
	C.3	Contingencies	0	2	8	14	20	27	
CATEGORY C TOTAL									
D	**PROJECT REQUIREMENTS (Maximum = 143)**								
	D.1	Project Objectives Statement	0	1	6	11	16	19	
	D.2	Functional Classification & Use	0	1	6	11	16	19	
	D.3	Evaluation of Compliance Requirements	0	1	6	11	16	22	
	D.4	Existing Environmental Conditions	0	1	6	11	16	22	
	D.5	Site Characteristics Available vs. Required	0	1	5	9	13	18	
	D.6	Dismantling & Demolition Requirements	0	1	4	7	10	11	
	D.7	Determination of Utility Impacts	0	1	6	11	16	19	
	D.8	Lead/Discipline Scope of Work	0	1	4	7	10	13	
CATEGORY D TOTAL									
E	**VALUE ANALYSIS (Maximum = 45)**								
	E.1	Value Engineering Procedures	0	1	3	5	7	10	
	E.2	Design Simplification	0	0	3	6	9	11	
	E.3	Material Alternatives Considered	0	1	3	5	7	9	
	E.4	Constructability Procedures	0	1	5	9	13	15	
CATEGORY E TOTAL									
(Section I Maximum Score = 437)			**SECTION I TOTAL**						

Definition Levels

0 = Not Applicable 2 = Minor Deficiencies 4 = Major Deficiencies

1 = Complete Definition 3 = Some Deficiencies 5 = Incomplete or Poor Definition

SECTION II. BASIS OF DESIGN

CATEGORY Element			Definition Level 0	1	2	3	4	5	Score
F	**SITE INFORMATION (Maximum = 119)**								
	F.1	Geotechnical Characteristics	0	2	7	12	17	21	
	F.2	Hydrological Characteristics	0	1	4	7	10	13	
	F.3	Surveys & Mapping	0	1	4	7	10	14	
	F.4	Permitting Requirements	0	1	5	9	13	15	
	F.5	Environmental Documentation	0	1	5	9	13	18	
	F.6	Environmental Commitments & Mitigation	0	1	4	7	10	14	
	F.7	Property Descriptions	0	1	3	5	7	10	
	F.8	Right-of-Way Mapping & Site Issues	0	1	4	7	10	14	
								CATEGORY F TOTAL	
G	**LOCATION and GEOMETRY (Maximum = 47)**								
	G.1	Schematic Layouts	0	1	4	7	10	13	
	G.2	Horizontal & Vertical Alignment	0	1	4	7	10	13	
	G.3	Cross-Sectional Elements	0	1	4	7	10	11	
	G.4	Control of Access	0	1	3	5	7	10	
								CATEGORY G TOTAL	
H	**ASSOCIATED STRUCTURES and EQUIPMENT (Maximum = 47)**								
	H.1	Support Structures	0	1	4	7	10	11	
	H.2	Hydraulic Structures	0	1	3	5	7	9	
	H.3	Miscellaneous Elements	0	1	3	5	7	7	
	H.4	Equipment List	0	1	4	7	10	11	
	H.5	Equipment Utility Requirements	0	1	3	5	7	9	
								CATEGORY H TOTAL	
I	**PROJECT DESIGN PARAMETERS (Maximum = 80)**								
	I.1	Capacity	0	1	6	11	16	22	
	I.2	Safety & Hazards	0	1	4	7	10	12	
	I.3	Civil/Structural	0	1	5	9	13	15	
	I.4	Mechanical/Equipment	0	1	3	5	7	10	
	I.5	Electrical/Controls	0	1	3	5	7	10	
	I.6	Operations/Maintenance	0	1	4	7	10	11	
								CATEGORY I TOTAL	
	(Section II Maximum Score = 293)							**SECTION II TOTAL**	

Definition Levels

0 = Not Applicable 2 = Minor Deficiencies 4 = Major Deficiencies

1 = Complete Definition 3 = Some Deficiencies 5 = Incomplete or Poor Definition

SECTION III. EXECUTION APPROACH									
CATEGORY Element			**Definition Level**						**Score**
			0	**1**	**2**	**3**	**4**	**5**	
J	**LAND ACQUISITION STRATEGY (Maximum = 60)**								
	J.1	Local Public Agencies Contracts & Agreements	0	1	4	7	10	14	
	J.2	Long-Lead Parcel & Utility Identification & Acquisition	0	1	5	9	13	15	
	J.3	Utility Agreement & Joint-Use Contracts	0	1	4	7	10	12	
	J.4	Land Appraisal Requirements	0	1	3	5	7	10	
	J.5	Advance Land Acquisition Requirements	0	1	3	5	7	9	
								CATEGORY J TOTAL	
K	**PROCUREMENT STRATEGY (Maximum = 47)**								
	K.1	Project Delivery Method & Contracting Strategies	0	1	5	9	13	15	
	K.2	Long-Lead/Critical Equipment & Materials Identification	0	1	4	7	10	13	
	K.3	Procurement Procedures & Plans	0	1	4	7	10	11	
	K.4	Procurement Responsibility Matrix	0	0	2	4	6	8	
								CATEGORY K TOTAL	
L	**PROJECT CONTROL (Maximum = 80)**								
	L.1	Right-of-Way & Utilities Cost Estimates	0	1	3	5	7	10	
	L.2	Design & Construction Cost Estimates	0	2	8	14	20	25	
	L.3	Project Cost Control	0	1	5	9	13	15	
	L.4	Project Schedule Control	0	1	5	9	13	17	
	L.5	Project Quality Assurance & Control	0	1	4	7	10	13	
								CATEGORY L TOTAL	
M	**PROJECT EXECUTION PLAN (Maximum = 83)**								
	M.1	Safety Procedures	0	1	4	7	10	12	
	M.2	Owner Approval Requirements	0	1	3	5	7	10	
	M.3	Documentation/Deliverables	0	1	3	5	7	9	
	M.4	Computing & CADD/Model Requirements	0	1	3	5	7	7	
	M.5	Design/Construction Plan & Approach	0	1	4	7	10	14	
	M.6	Intercompany & Interagency Coordination & agreements	0	1	4	7	10	13	
	M.7	Work Zone and Transportation Plan	0	1	3	5	7	9	
	M.8	Project Completion Requirements	0	1	3	5	7	9	
								CATEGORY M TOTAL	
	(Section III Maximum Score = 270)							**SECTION III TOTAL**	
(Maximum Score = 1000)				**PDRI TOTAL SCORE**					

Definition Levels

0 = Not Applicable 2 = Minor Deficiencies 4 = Major Deficiencies

1 = Complete Definition 3 = Some Deficiencies 5 = Incomplete or Poor Definition

PDIR weighted score sheet for infrastructure projects, adapted from CII IR 268-2 (2010).

5.14 In case PDRI scoring is adopted for urban road projects in Ethiopian, what is your opinion on the following?

5.14.1 Having a look into the element weights, one can easily rank the level of importance and applications of the PDRI elements. Would you compare the above ranking against the priority of importance being practiced in Ethiopian Construction industry, in urban areas in particular?

____

____

5.14.2 Is the list of 68 elements complete? ☐ Yes ☐ No ☐

If not complete, please list all others that should be added

____

____

5.14.3 Are any of the elements redundant? ☐ Yes ☐ No ☐

If yes, please list and provide any recommended changes added

____

____

5.14.4 Are any of the definitions unclear or incomplete? ☐ Yes ☐ No

If yes, please list and provide any recommended changes

____

____

5.14.5 Please rate the following on a scale from 1 to 5 with 1 being little and 5 being a lot of benefits that you would gain in connection with the implementation of PDRI. *(Circle one)*

- Was the knowledge about PDRI added during the interview? **1 2 3 4 5**
- Would you use this tool on future projects? **1 2 3 4 5**

Section 6: General comments and suggestions on the research

____

____

____

Thank you for your *cooperation!!!*

Appendix B: Sample Examples on PDRI Tool

1. Project: Yere Ber - Yerer Goro - AAWASA Treatment Plant Road

SECTION I. BASIS OF PROJECT DECISION										
CATEGORY Element			**Definition Level**						**Score**
			0	**1**	**2**	**3**	**4**	**5**	
A	**PROJECT STRATEGY (Maximum = 112)**								
	A.1	Need & Purpose Documentation	0	2	13	24	35	44	35
	A.2	Investment Studies & Alternatives Assessments	0	1	8	15	22	28	22
	A.3	Key Team Member Coordination	0	1	6	11	16	19	6
	A.4	Public Involvement	0	1	6	11	16	21	16
								CATEGORY A TOTAL	**79**
B	**OWNER/OPERATOR PHILOSOPHIES (Maximum = 67)**								
	B.1	Design Philosophy	0	2	7	12	17	22	17
	B.2	Operating Philosophy	0	1	5	9	13	16	5
	B.3	Maintenance Philosophy	0	1	4	7	10	12	4
	B.4	Future Expansion & Alteration	0	1	5	9	13	17	5
								CATEGORY B TOTAL	**31**
C	**PROJECT FUNDING AND TIMING (Maximum = 70)**								
	C.1	Funding & Programming	0	1	6	11	16	21	6
	C.2	Preliminary Project Schedule	0	2	7	12	17	22	7
	C.3	Contingencies	0	2	8	14	20	27	8
								CATEGORY C TOTAL	**21**
D	**PROJECT REQUIREMENTS (Maximum = 143)**								
	D.1	Project Objectives Statement	0	1	6	11	16	19	16
	D.2	Functional Classification & Use	0	1	6	11	16	19	6
	D.3	Evaluation of Compliance Requirements	0	1	6	11	16	22	6
	D.4	Existing Environmental Conditions	0	1	6	11	16	22	11
	D.5	Site Characteristics Available vs. Required	0	1	5	9	13	18	5
	D.6	Dismantling & Demolition Requirements	0	1	4	7	10	11	4
	D.7	Determination of Utility Impacts	0	1	6	11	16	19	6
	D.8	Lead/Discipline Scope of Work	0	1	4	7	10	13	7
								CATEGORY D TOTAL	**61**
E	**VALUE ANALYSIS (Maximum = 45)**								
	E.1	Value Engineering Procedures	0	1	3	5	7	10	5
	E.2	Design Simplification	0	0	3	6	9	11	9
	E.3	Material Alternatives Considered	0	1	3	5	7	9	5
	E.4	Constructability Procedures	0	1	5	9	13	15	9
								CATEGORY E TOTAL	**28**
	(Section I Maximum Score = 437)							**SECTION I TOTAL**	**220**

SECTION II. BASIS OF DESIGN									
CATEGORY Element			**Definition Level**						**Score**
			0	**1**	**2**	**3**	**4**	**5**	
F	**SITE INFORMATION (Maximum = 119)**								
	F.1	Geotechnical Characteristics	0	2	7	12	17	21	12
	F.2	Hydrological Characteristics	0	1	4	7	10	13	7
	F.3	Surveys & Mapping	0	1	4	7	10	14	7
	F.4	Permitting Requirements	0	1	5	9	13	15	5
	F.5	Environmental Documentation	0	1	5	9	13	18	18
	F.6	Environmental Commitments & Mitigation	0	1	4	7	10	14	14
	F.7	Property Descriptions	0	1	3	5	7	10	3
	F.8	Right-of-Way Mapping & Site Issues	0	1	4	7	10	14	7
CATEGORY F TOTAL									**73**
G	**LOCATION and GEOMETRY (Maximum = 47)**								
	G.1	Schematic Layouts	0	1	4	7	10	13	4
	G.2	Horizontal & Vertical Alignment	0	1	4	7	10	13	4
	G.3	Cross-Sectional Elements	0	1	4	7	10	11	7
	G.4	Control of Access	0	1	3	5	7	10	3
CATEGORY G TOTAL									**18**
H	**ASSOCIATED STRUCTURES and EQUIPMENT (Maximum = 47)**								
	H.1	Support Structures	0	1	4	7	10	11	7
	H.2	Hydraulic Structures	0	1	3	5	7	9	3
	H.3	Miscellaneous Elements	0	1	3	5	7	7	7
	H.4	Equipment List	0	1	4	7	10	11	4
	H.5	Equipment Utility Requirements	0	1	3	5	7	9	5
CATEGORY H TOTAL									**26**
I	**PROJECT DESIGN PARAMETERS (Maximum = 80)**								
	I.1	Capacity	0	1	6	11	16	22	6
	I.2	Safety & Hazards	0	1	4	7	10	12	7
	I.3	Civil/Structural	0	1	5	9	13	15	5
	I.4	Mechanical/Equipment	0	1	3	5	7	10	0
	I.5	Electrical/Controls	0	1	3	5	7	10	0
	I.6	Operations/Maintenance	0	1	4	7	10	11	7
CATEGORY I TOTAL									**25**
(Section II Maximum Score = 293)								**SECTION II TOTAL**	**142**

SECTION III. EXECUTION APPROACH

CATEGORY Element			Definition Level 0	1	2	3	4	5	Score
J	**LAND ACQUISITION STRATEGY (Maximum = 60)**								
	J.1	Local Public Agencies Contracts & Agreements	0	1	4	7	10	14	4
	J.2	Long-Lead Parcel & Utility Identification & Acquisition	0	1	5	9	13	15	13
	J.3	Utility Agreement & Joint-Use Contracts	0	1	4	7	10	12	10
	J.4	Land Appraisal Requirements	0	1	3	5	7	10	3
	J.5	Advance Land Acquisition Requirements	0	1	3	5	7	9	3
								CATEGORY J TOTAL	**33**
K	**PROCUREMENT STRATEGY (Maximum = 47)**								
	K.1	Project Delivery Method & Contracting Strategies	0	1	5	9	13	15	5
	K.2	Long-Lead/Critical Equipment & Materials Identification	0	1	4	7	10	13	4
	K.3	Procurement Procedures & Plans	0	1	4	7	10	11	4
	K.4	Procurement Responsibility Matrix	0	0	2	4	6	8	4
								CATEGORY K TOTAL	**17**
L	**PROJECT CONTROL (Maximum = 80)**								
	L.1	Right-of-Way & Utilities Cost Estimates	0	1	3	5	7	10	5
	L.2	Design & Construction Cost Estimates	0	2	8	14	20	25	14
	L.3	Project Cost Control	0	1	5	9	13	15	5
	L.4	Project Schedule Control	0	1	5	9	13	17	9
	L.5	Project Quality Assurance & Control	0	1	4	7	10	13	1
								CATEGORY L TOTAL	**34**
M	**PROJECT EXECUTION PLAN (Maximum = 83)**								
	M.1	Safety Procedures	0	1	4	7	10	12	10
	M.2	Owner Approval Requirements	0	1	3	5	7	10	3
	M.3	Documentation/Deliverables	0	1	3	5	7	9	3
	M.4	Computing & CADD/Model Requirements	0	1	3	5	7	7	3
	M.5	Design/Construction Plan & Approach	0	1	4	7	10	14	7
	M.6	Intercompany & Interagency Coordination & agreements	0	1	4	7	10	13	10
	M.7	Work Zone and Transportation Plan	0	1	3	5	7	9	5
	M.8	Project Completion Requirements	0	1	3	5	7	9	5
								CATEGORY M TOTAL	**46**
	(Section III Maximum Score = 270)							**SECTION III TOTAL**	**130**

(Maximum Score = 1000)	**PDRI TOTAL SCORE**	**492**

Definition Levels

0 = Not Applicable 2 = Minor Deficiencies 4 = Major Deficiencies

1 = Complete Definition 3 = Some Deficiencies 5 = Incomplete or Poor Definition

2. Project: Bole Michael Ring Road Roundabout – Bole Rwanda Road

SECTION I. BASIS OF PROJECT DECISION									
CATEGORY Element			**Definition Level**						**Score**
			0	**1**	**2**	**3**	**4**	**5**	
A	**PROJECT STRATEGY (Maximum = 112)**								
	A.1	Need & Purpose Documentation	0	2	13	24	35	44	2
	A.2	Investment Studies & Alternatives Assessments	0	1	8	15	22	28	28
	A.3	Key Team Member Coordination	0	1	6	11	16	19	16
	A.4	Public Involvement	0	1	6	11	16	21	16
								CATEGORY A TOTAL	**62**
B	**OWNER/OPERATOR PHILOSOPHIES (Maximum = 67)**								
	B.1	Design Philosophy	0	2	7	12	17	22	17
	B.2	Operating Philosophy	0	1	5	9	13	16	16
	B.3	Maintenance Philosophy	0	1	4	7	10	12	12
	B.4	Future Expansion & Alteration	0	1	5	9	13	17	17
								CATEGORY B TOTAL	**62**
C	**PROJECT FUNDING AND TIMING (Maximum = 70)**								
	C.1	Funding & Programming	0	1	6	11	16	21	16
	C.2	Preliminary Project Schedule	0	2	7	12	17	22	17
	C.3	Contingencies	0	2	8	14	20	27	20
								CATEGORY C TOTAL	**53**
D	**PROJECT REQUIREMENTS (Maximum = 143)**								
	D.1	Project Objectives Statement	0	1	6	11	16	19	19
	D.2	Functional Classification & Use	0	1	6	11	16	19	6
	D.3	Evaluation of Compliance Requirements	0	1	6	11	16	22	16
	D.4	Existing Environmental Conditions	0	1	6	11	16	22	16
	D.5	Site Characteristics Available vs. Required	0	1	5	9	13	18	13
	D.6	Dismantling & Demolition Requirements	0	1	4	7	10	11	7
	D.7	Determination of Utility Impacts	0	1	6	11	16	19	11
	D.8	Lead/Discipline Scope of Work	0	1	4	7	10	13	7
								CATEGORY D TOTAL	**95**
E	**VALUE ANALYSIS (Maximum = 45)**								
	E.1	Value Engineering Procedures	0	1	3	5	7	10	7
	E.2	Design Simplification	0	0	3	6	9	11	9
	E.3	Material Alternatives Considered	0	1	3	5	7	9	5
	E.4	Constructability Procedures	0	1	5	9	13	15	9
								CATEGORY E TOTAL	**30**
	(Section I Maximum Score = 437)							**SECTION I TOTAL**	**302**

SECTION II. BASIS OF DESIGN									
CATEGORY Element			**Definition Level**						**Score**
			0	**1**	**2**	**3**	**4**	**5**	
F	**SITE INFORMATION (Maximum = 119)**								
	F.1	Geotechnical Characteristics	0	2	7	12	17	21	12
	F.2	Hydrological Characteristics	0	1	4	7	10	13	10
	F.3	Surveys & Mapping	0	1	4	7	10	14	7
	F.4	Permitting Requirements	0	1	5	9	13	15	9
	F.5	Environmental Documentation	0	1	5	9	13	18	13
	F.6	Environmental Commitments & Mitigation	0	1	4	7	10	14	10
	F.7	Property Descriptions	0	1	3	5	7	10	5
	F.8	Right-of-Way Mapping & Site Issues	0	1	4	7	10	14	7
							CATEGORY F TOTAL		**73**
G	**LOCATION and GEOMETRY (Maximum = 47)**								
	G.1	Schematic Layouts	0	1	4	7	10	13	7
	G.2	Horizontal & Vertical Alignment	0	1	4	7	10	13	7
	G.3	Cross-Sectional Elements	0	1	4	7	10	11	10
	G.4	Control of Access	0	1	3	5	7	10	7
							CATEGORY G TOTAL		**31**
H	**ASSOCIATED STRUCTURES and EQUIPMENT (Maximum = 47)**								
	H.1	Support Structures	0	1	4	7	10	11	7
	H.2	Hydraulic Structures	0	1	3	5	7	9	7
	H.3	Miscellaneous Elements	0	1	3	5	7	7	5
	H.4	Equipment List	0	1	4	7	10	11	10
	H.5	Equipment Utility Requirements	0	1	3	5	7	9	5
							CATEGORY H TOTAL		**34**
I	**PROJECT DESIGN PARAMETERS (Maximum = 80)**								
	I.1	Capacity	0	1	6	11	16	22	11
	I.2	Safety & Hazards	0	1	4	7	10	12	10
	I.3	Civil/Structural	0	1	5	9	13	15	9
	I.4	Mechanical/Equipment	0	1	3	5	7	10	7
	I.5	Electrical/Controls	0	1	3	5	7	10	7
	I.6	Operations/Maintenance	0	1	4	7	10	11	10
							CATEGORY I TOTAL		**54**
	(Section II Maximum Score = 293)						**SECTION II TOTAL**		**192**

SECTION III. EXECUTION APPROACH									
CATEGORY Element			**Definition Level**						**Score**
			0	**1**	**2**	**3**	**4**	**5**	
J	**LAND ACQUISITION STRATEGY (Maximum = 60)**								
	J.1	Local Public Agencies Contracts & Agreements	0	1	4	7	10	14	7
	J.2	Long-Lead Parcel & Utility Identification & Acquisition	0	1	5	9	13	15	9
	J.3	Utility Agreement & Joint-Use Contracts	0	1	4	7	10	12	7
	J.4	Land Appraisal Requirements	0	1	3	5	7	10	5
	J.5	Advance Land Acquisition Requirements	0	1	3	5	7	9	7
								CATEGORY J TOTAL	**35**
K	**PROCUREMENT STRATEGY (Maximum = 47)**								
	K.1	Project Delivery Method & Contracting Strategies	0	1	5	9	13	15	9
	K.2	Long-Lead/Critical Equipment & Materials Identification	0	1	4	7	10	13	10
	K.3	Procurement Procedures & Plans	0	1	4	7	10	11	7
	K.4	Procurement Responsibility Matrix	0	0	2	4	6	8	6
								CATEGORY K TOTAL	**32**
L	**PROJECT CONTROL (Maximum = 80)**								
	L.1	Right-of-Way & Utilities Cost Estimates	0	1	3	5	7	10	5
	L.2	Design & Construction Cost Estimates	0	2	8	14	20	25	14
	L.3	Project Cost Control	0	1	5	9	13	15	9
	L.4	Project Schedule Control	0	1	5	9	13	17	13
	L.5	Project Quality Assurance & Control	0	1	4	7	10	13	10
								CATEGORY L TOTAL	**51**
M	**PROJECT EXECUTION PLAN (Maximum = 83)**								
	M.1	Safety Procedures	0	1	4	7	10	12	10
	M.2	Owner Approval Requirements	0	1	3	5	7	10	5
	M.3	Documentation/Deliverables	0	1	3	5	7	9	3
	M.4	Computing & CADD/Model Requirements	0	1	3	5	7	7	5
	M.5	Design/Construction Plan & Approach	0	1	4	7	10	14	7
	M.6	Intercompany & Interagency Coordination & agreements	0	1	4	7	10	13	10
	M.7	Work Zone and Transportation Plan	0	1	3	5	7	9	7
	M.8	Project Completion Requirements	0	1	3	5	7	9	7
								CATEGORY M TOTAL	**54**
	(Section III Maximum Score = 270)							**SECTION III TOTAL**	**172**
	(Maximum Score = 1000)							**PDRI TOTAL SCORE**	**666**

Definition Levels

0 = Not Applicable 2 = Minor Deficiencies 4 = Major Deficiencies

1 = Complete Definition 3 = Some Deficiencies 5 = Incomplete or Poor Definition

3. Project: World Bank - Yeshi Debele Road

SECTION I. BASIS OF PROJECT DECISION									
CATEGORY Element			**Definition Level**						**Score**
			0	**1**	**2**	**3**	**4**	**5**	
A	**PROJECT STRATEGY (Maximum = 112)**								
	A.1	Need & Purpose Documentation	0	2	13	24	35	44	35
	A.2	Investment Studies & Alternatives Assessments	0	1	8	15	22	28	22
	A.3	Key Team Member Coordination	0	1	6	11	16	19	19
	A.4	Public Involvement	0	1	6	11	16	21	21
CATEGORY A TOTAL									**97**
B	**OWNER/OPERATOR PHILOSOPHIES (Maximum = 67)**								
	B.1	Design Philosophy	0	2	7	12	17	22	12
	B.2	Operating Philosophy	0	1	5	9	13	16	9
	B.3	Maintenance Philosophy	0	1	4	7	10	12	7
	B.4	Future Expansion & Alteration	0	1	5	9	13	17	13
CATEGORY B TOTAL									**41**
C	**PROJECT FUNDING AND TIMING (Maximum = 70)**								
	C.1	Funding & Programming	0	1	6	11	16	21	1
	C.2	Preliminary Project Schedule	0	2	7	12	17	22	12
	C.3	Contingencies	0	2	8	14	20	27	2
CATEGORY C TOTAL									**15**
D	**PROJECT REQUIREMENTS (Maximum = 143)**								
	D.1	Project Objectives Statement	0	1	6	11	16	19	16
	D.2	Functional Classification & Use	0	1	6	11	16	19	1
	D.3	Evaluation of Compliance Requirements	0	1	6	11	16	22	6
	D.4	Existing Environmental Conditions	0	1	6	11	16	22	0
	D.5	Site Characteristics Available vs. Required	0	1	5	9	13	18	1
	D.6	Dismantling & Demolition Requirements	0	1	4	7	10	11	1
	D.7	Determination of Utility Impacts	0	1	6	11	16	19	19
	D.8	Lead/Discipline Scope of Work	0	1	4	7	10	13	7
CATEGORY D TOTAL									**51**
E	**VALUE ANALYSIS (Maximum = 45)**								
	E.1	Value Engineering Procedures	0	1	3	5	7	10	3
	E.2	Design Simplification	0	0	3	6	9	11	3
	E.3	Material Alternatives Considered	0	1	3	5	7	9	5
	E.4	Constructability Procedures	0	1	5	9	13	15	5
CATEGORY E TOTAL									**16**
(Section I Maximum Score = 437)			**SECTION I TOTAL**						**220**

SECTION II. BASIS OF DESIGN									
CATEGORY Element			**Definition Level**						**Score**
			0	**1**	**2**	**3**	**4**	**5**	
F	**SITE INFORMATION (Maximum = 119)**								
	F.1	Geotechnical Characteristics	0	2	7	12	17	21	7
	F.2	Hydrological Characteristics	0	1	4	7	10	13	4
	F.3	Surveys & Mapping	0	1	4	7	10	14	1
	F.4	Permitting Requirements	0	1	5	9	13	15	1
	F.5	Environmental Documentation	0	1	5	9	13	18	18
	F.6	Environmental Commitments & Mitigation	0	1	4	7	10	14	14
	F.7	Property Descriptions	0	1	3	5	7	10	1
	F.8	Right-of-Way Mapping & Site Issues	0	1	4	7	10	14	4
CATEGORY F TOTAL									**50**
G	**LOCATION and GEOMETRY (Maximum = 47)**								
	G.1	Schematic Layouts	0	1	4	7	10	13	4
	G.2	Horizontal & Vertical Alignment	0	1	4	7	10	13	4
	G.3	Cross-Sectional Elements	0	1	4	7	10	11	4
	G.4	Control of Access	0	1	3	5	7	10	5
CATEGORY G TOTAL									**17**
H	**ASSOCIATED STRUCTURES and EQUIPMENT (Maximum = 47)**								
	H.1	Support Structures	0	1	4	7	10	11	7
	H.2	Hydraulic Structures	0	1	3	5	7	9	3
	H.3	Miscellaneous Elements	0	1	3	5	7	7	5
	H.4	Equipment List	0	1	4	7	10	11	11
	H.5	Equipment Utility Requirements	0	1	3	5	7	9	9
CATEGORY H TOTAL									**35**
I	**PROJECT DESIGN PARAMETERS (Maximum = 80)**								
	I.1	Capacity	0	1	6	11	16	22	0
	I.2	Safety & Hazards	0	1	4	7	10	12	7
	I.3	Civil/Structural	0	1	5	9	13	15	5
	I.4	Mechanical/Equipment	0	1	3	5	7	10	0
	I.5	Electrical/Controls	0	1	3	5	7	10	0
	I.6	Operations/Maintenance	0	1	4	7	10	11	0
CATEGORY I TOTAL									**12**
(Section II Maximum Score = 293)					**SECTION II TOTAL**				**114**

SECTION III. EXECUTION APPROACH									
CATEGORY Element			**Definition Level**						**Score**
			0	**1**	**2**	**3**	**4**	**5**	
J	**LAND ACQUISITION STRATEGY (Maximum = 60)**								
	J.1	Local Public Agencies Contracts & Agreements	0	1	4	7	10	14	14
	J.2	Long-Lead Parcel & Utility Identification & Acquisition	0	1	5	9	13	15	9
	J.3	Utility Agreement & Joint-Use Contracts	0	1	4	7	10	12	12
	J.4	Land Appraisal Requirements	0	1	3	5	7	10	0
	J.5	Advance Land Acquisition Requirements	0	1	3	5	7	9	0
								CATEGORY J TOTAL	**35**
K	**PROCUREMENT STRATEGY (Maximum = 47)**								
	K.1	Project Delivery Method & Contracting Strategies	0	1	5	9	13	15	13
	K.2	Long-Lead/Critical Equipment & Materials Identification	0	1	4	7	10	13	10
	K.3	Procurement Procedures & Plans	0	1	4	7	10	11	10
	K.4	Procurement Responsibility Matrix	0	0	2	4	6	8	8
								CATEGORY K TOTAL	**41**
L	**PROJECT CONTROL (Maximum = 80)**								
	L.1	Right-of-Way & Utilities Cost Estimates	0	1	3	5	7	10	10
	L.2	Design & Construction Cost Estimates	0	2	8	14	20	25	8
	L.3	Project Cost Control	0	1	5	9	13	15	9
	L.4	Project Schedule Control	0	1	5	9	13	17	9
	L.5	Project Quality Assurance & Control	0	1	4	7	10	13	7
								CATEGORY L TOTAL	**43**
M	**PROJECT EXECUTION PLAN (Maximum = 83)**								
	M.1	Safety Procedures	0	1	4	7	10	12	0
	M.2	Owner Approval Requirements	0	1	3	5	7	10	3
	M.3	Documentation/Deliverables	0	1	3	5	7	9	3
	M.4	Computing & CADD/Model Requirements	0	1	3	5	7	7	3
	M.5	Design/Construction Plan & Approach	0	1	4	7	10	14	7
	M.6	Intercompany & Interagency Coordination & agreements	0	1	4	7	10	13	10
	M.7	Work Zone and Transportation Plan	0	1	3	5	7	9	0
	M.8	Project Completion Requirements	0	1	3	5	7	9	3
								CATEGORY M TOTAL	**29**
	(Section III Maximum Score = 270)							**SECTION III TOTAL**	**148**
	(Maximum Score = 1000)							**PDRI TOTAL SCORE**	**482**

Definition Levels

0 = Not Applicable	2 = Minor Deficiencies	4 = Major Deficiencies
1 = Complete Definition	3 = Some Deficiencies	5 = Incomplete or Poor Definition

4. Project: Wingate Michililand – Asko Road

SECTION I. BASIS OF PROJECT DECISION									
CATEGORY Element			**Definition Level**						**Score**
			0	**1**	**2**	**3**	**4**	**5**	
A	**PROJECT STRATEGY (Maximum = 112)**								
	A.1	Need & Purpose Documentation	0	2	13	24	35	44	13
	A.2	Investment Studies & Alternatives Assessments	0	1	8	15	22	28	15
	A.3	Key Team Member Coordination	0	1	6	11	16	19	16
	A.4	Public Involvement	0	1	6	11	16	21	11
CATEGORY A TOTAL									**55**
B	**OWNER/OPERATOR PHILOSOPHIES (Maximum = 67)**								
	B.1	Design Philosophy	0	2	7	12	17	22	7
	B.2	Operating Philosophy	0	1	5	9	13	16	9
	B.3	Maintenance Philosophy	0	1	4	7	10	12	10
	B.4	Future Expansion & Alteration	0	1	5	9	13	17	9
CATEGORY B TOTAL									**35**
C	**PROJECT FUNDING AND TIMING (Maximum = 70)**								
	C.1	Funding & Programming	0	1	6	11	16	21	1
	C.2	Preliminary Project Schedule	0	2	7	12	17	22	7
	C.3	Contingencies	0	2	8	14	20	27	2
CATEGORY C TOTAL									**10**
D	**PROJECT REQUIREMENTS (Maximum = 143)**								
	D.1	Project Objectives Statement	0	1	6	11	16	19	6
	D.2	Functional Classification & Use	0	1	6	11	16	19	11
	D.3	Evaluation of Compliance Requirements	0	1	6	11	16	22	11
	D.4	Existing Environmental Conditions	0	1	6	11	16	22	16
	D.5	Site Characteristics Available vs. Required	0	1	5	9	13	18	9
	D.6	Dismantling & Demolition Requirements	0	1	4	7	10	11	10
	D.7	Determination of Utility Impacts	0	1	6	11	16	19	11
	D.8	Lead/Discipline Scope of Work	0	1	4	7	10	13	7
CATEGORY D TOTAL									**81**
E	**VALUE ANALYSIS (Maximum = 45)**								
	E.1	Value Engineering Procedures	0	1	3	5	7	10	5
	E.2	Design Simplification	0	0	3	6	9	11	6
	E.3	Material Alternatives Considered	0	1	3	5	7	9	5
	E.4	Constructability Procedures	0	1	5	9	13	15	9
CATEGORY E TOTAL									**25**
(Section I Maximum Score = 437)						**SECTION I TOTAL**			**206**

SECTION II. BASIS OF DESIGN									
CATEGORY Element			**Definition Level**						**Score**
			0	**1**	**2**	**3**	**4**	**5**	
F	**SITE INFORMATION (Maximum = 119)**								
	F.1	Geotechnical Characteristics	0	2	7	12	17	21	7
	F.2	Hydrological Characteristics	0	1	4	7	10	13	4
	F.3	Surveys & Mapping	0	1	4	7	10	14	4
	F.4	Permitting Requirements	0	1	5	9	13	15	5
	F.5	Environmental Documentation	0	1	5	9	13	18	9
	F.6	Environmental Commitments & Mitigation	0	1	4	7	10	14	7
	F.7	Property Descriptions	0	1	3	5	7	10	5
	F.8	Right-of-Way Mapping & Site Issues	0	1	4	7	10	14	10
								CATEGORY F TOTAL	**51**
G	**LOCATION and GEOMETRY (Maximum = 47)**								
	G.1	Schematic Layouts	0	1	4	7	10	13	4
	G.2	Horizontal & Vertical Alignment	0	1	4	7	10	13	1
	G.3	Cross-Sectional Elements	0	1	4	7	10	11	1
	G.4	Control of Access	0	1	3	5	7	10	3
								CATEGORY G TOTAL	**9**
H	**ASSOCIATED STRUCTURES and EQUIPMENT (Maximum = 47)**								
	H.1	Support Structures	0	1	4	7	10	11	4
	H.2	Hydraulic Structures	0	1	3	5	7	9	3
	H.3	Miscellaneous Elements	0	1	3	5	7	7	5
	H.4	Equipment List	0	1	4	7	10	11	7
	H.5	Equipment Utility Requirements	0	1	3	5	7	9	3
								CATEGORY H TOTAL	**22**
I	**PROJECT DESIGN PARAMETERS (Maximum = 80)**								
	I.1	Capacity	0	1	6	11	16	22	6
	I.2	Safety & Hazards	0	1	4	7	10	12	7
	I.3	Civil/Structural	0	1	5	9	13	15	5
	I.4	Mechanical/Equipment	0	1	3	5	7	10	5
	I.5	Electrical/Controls	0	1	3	5	7	10	5
	I.6	Operations/Maintenance	0	1	4	7	10	11	7
								CATEGORY I TOTAL	**35**
	(Section II Maximum Score = 293)							**SECTION II TOTAL**	**117**

SECTION III. EXECUTION APPROACH

CATEGORY Element			Definition Level 0	1	2	3	4	5	Score
J	**LAND ACQUISITION STRATEGY (Maximum = 60)**								
	J.1	Local Public Agencies Contracts & Agreements	0	1	4	7	10	14	7
	J.2	Long-Lead Parcel & Utility Identification & Acquisition	0	1	5	9	13	15	9
	J.3	Utility Agreement & Joint-Use Contracts	0	1	4	7	10	12	7
	J.4	Land Appraisal Requirements	0	1	3	5	7	10	5
	J.5	Advance Land Acquisition Requirements	0	1	3	5	7	9	5
								CATEGORY J TOTAL	**33**
K	**PROCUREMENT STRATEGY (Maximum = 47)**								
	K.1	Project Delivery Method & Contracting Strategies	0	1	5	9	13	15	5
	K.2	Long-Lead/Critical Equipment & Materials Identification	0	1	4	7	10	13	4
	K.3	Procurement Procedures & Plans	0	1	4	7	10	11	4
	K.4	Procurement Responsibility Matrix	0	0	2	4	6	8	2
								CATEGORY K TOTAL	**15**
L	**PROJECT CONTROL (Maximum = 80)**								
	L.1	Right-of-Way & Utilities Cost Estimates	0	1	3	5	7	10	5
	L.2	Design & Construction Cost Estimates	0	2	8	14	20	25	8
	L.3	Project Cost Control	0	1	5	9	13	15	5
	L.4	Project Schedule Control	0	1	5	9	13	17	5
	L.5	Project Quality Assurance & Control	0	1	4	7	10	13	4
								CATEGORY L TOTAL	**27**
M	**PROJECT EXECUTION PLAN (Maximum = 83)**								
	M.1	Safety Procedures	0	1	4	7	10	12	1
	M.2	Owner Approval Requirements	0	1	3	5	7	10	3
	M.3	Documentation/Deliverables	0	1	3	5	7	9	3
	M.4	Computing & CADD/Model Requirements	0	1	3	5	7	7	3
	M.5	Design/Construction Plan & Approach	0	1	4	7	10	14	1
	M.6	Intercompany & Interagency Coordination & agreements	0	1	4	7	10	13	1
	M.7	Work Zone and Transportation Plan	0	1	3	5	7	9	3
	M.8	Project Completion Requirements	0	1	3	5	7	9	3
								CATEGORY M TOTAL	**18**
	(Section III Maximum Score = 270)							**SECTION III TOTAL**	**93**

(Maximum Score = 1000)	**PDRI TOTAL SCORE**	**416**

Definition Levels

0 = Not Applicable 2 = Minor Deficiencies 4 = Major Deficiencies

1 = Complete Definition 3 = Some Deficiencies 5 = Incomplete or Poor Definition

5. Project: Gottera - Wollosefer Asphalt Road

SECTION I. BASIS OF PROJECT DECISION									
CATEGORY Element			**Definition Level** 0	1	2	3	4	5	**Score**
A	**PROJECT STRATEGY (Maximum = 112)**								
	A.1	Need & Purpose Documentation	0	2	13	24	35	44	2
	A.2	Investment Studies & Alternatives Assessments	0	1	8	15	22	28	0
	A.3	Key Team Member Coordination	0	1	6	11	16	19	1
	A.4	Public Involvement	0	1	6	11	16	21	6
								CATEGORY A TOTAL	**9**
B	**OWNER/OPERATOR PHILOSOPHIES (Maximum = 67)**								
	B.1	Design Philosophy	0	2	7	12	17	22	2
	B.2	Operating Philosophy	0	1	5	9	13	16	1
	B.3	Maintenance Philosophy	0	1	4	7	10	12	4
	B.4	Future Expansion & Alteration	0	1	5	9	13	17	1
								CATEGORY B TOTAL	**8**
C	**PROJECT FUNDING AND TIMING (Maximum = 70)**								
	C.1	Funding & Programming	0	1	6	11	16	21	1
	C.2	Preliminary Project Schedule	0	2	7	12	17	22	2
	C.3	Contingencies	0	2	8	14	20	27	8
								CATEGORY C TOTAL	**11**
D	**PROJECT REQUIREMENTS (Maximum = 143)**								
	D.1	Project Objectives Statement	0	1	6	11	16	19	1
	D.2	Functional Classification & Use	0	1	6	11	16	19	1
	D.3	Evaluation of Compliance Requirements	0	1	6	11	16	22	1
	D.4	Existing Environmental Conditions	0	1	6	11	16	22	6
	D.5	Site Characteristics Available vs. Required	0	1	5	9	13	18	5
	D.6	Dismantling & Demolition Requirements	0	1	4	7	10	11	4
	D.7	Determination of Utility Impacts	0	1	6	11	16	19	6
	D.8	Lead/Discipline Scope of Work	0	1	4	7	10	13	1
								CATEGORY D TOTAL	**25**
E	**VALUE ANALYSIS (Maximum = 45)**								
	E.1	Value Engineering Procedures	0	1	3	5	7	10	1
	E.2	Design Simplification	0	0	3	6	9	11	0
	E.3	Material Alternatives Considered	0	1	3	5	7	9	1
	E.4	Constructability Procedures	0	1	5	9	13	15	1
								CATEGORY E TOTAL	**3**
	(Section I Maximum Score = 437)							**SECTION I TOTAL**	**56**

SECTION II. BASIS OF DESIGN									
CATEGORY Element		**Definition Level**						**Score**
		0	**1**	**2**	**3**	**4**	**5**	
F	**SITE INFORMATION (Maximum = 119)**								
	F.1	Geotechnical Characteristics	0	2	7	12	17	21	7
	F.2	Hydrological Characteristics	0	1	4	7	10	13	7
	F.3	Surveys & Mapping	0	1	4	7	10	14	1
	F.4	Permitting Requirements	0	1	5	9	13	15	1
	F.5	Environmental Documentation	0	1	5	9	13	18	5
	F.6	Environmental Commitments & Mitigation	0	1	4	7	10	14	4
	F.7	Property Descriptions	0	1	3	5	7	10	3
	F.8	Right-of-Way Mapping & Site Issues	0	1	4	7	10	14	4
								CATEGORY F TOTAL	**32**
G	**LOCATION and GEOMETRY (Maximum = 47)**								
	G.1	Schematic Layouts	0	1	4	7	10	13	1
	G.2	Horizontal & Vertical Alignment	0	1	4	7	10	13	1
	G.3	Cross-Sectional Elements	0	1	4	7	10	11	1
	G.4	Control of Access	0	1	3	5	7	10	5
								CATEGORY G TOTAL	**8**
H	**ASSOCIATED STRUCTURES and EQUIPMENT (Maximum = 47)**								
	H.1	Support Structures	0	1	4	7	10	11	4
	H.2	Hydraulic Structures	0	1	3	5	7	9	3
	H.3	Miscellaneous Elements	0	1	3	5	7	7	3
	H.4	Equipment List	0	1	4	7	10	11	4
	H.5	Equipment Utility Requirements	0	1	3	5	7	9	3
								CATEGORY H TOTAL	**17**
I	**PROJECT DESIGN PARAMETERS (Maximum = 80)**								
	I.1	Capacity	0	1	6	11	16	22	1
	I.2	Safety & Hazards	0	1	4	7	10	12	1
	I.3	Civil/Structural	0	1	5	9	13	15	5
	I.4	Mechanical/Equipment	0	1	3	5	7	10	1
	I.5	Electrical/Controls	0	1	3	5	7	10	1
	I.6	Operations/Maintenance	0	1	4	7	10	11	4
								CATEGORY I TOTAL	**13**
	(Section II Maximum Score = 293)							**SECTION II TOTAL**	**70**

SECTION III. EXECUTION APPROACH									
CATEGORY Element			**Definition Level**						**Score**
			0	**1**	**2**	**3**	**4**	**5**	
J	**LAND ACQUISITION STRATEGY (Maximum = 60)**								
	J.1	Local Public Agencies Contracts & Agreements	0	1	4	7	10	14	7
	J.2	Long-Lead Parcel & Utility Identification & Acquisition	0	1	5	9	13	15	5
	J.3	Utility Agreement & Joint-Use Contracts	0	1	4	7	10	12	4
	J.4	Land Appraisal Requirements	0	1	3	5	7	10	3
	J.5	Advance Land Acquisition Requirements	0	1	3	5	7	9	3
								CATEGORY J TOTAL	**22**
K	**PROCUREMENT STRATEGY (Maximum = 47)**								
	K.1	Project Delivery Method & Contracting Strategies	0	1	5	9	13	15	1
	K.2	Long-Lead/Critical Equipment & Materials Identification	0	1	4	7	10	13	4
	K.3	Procurement Procedures & Plans	0	1	4	7	10	11	1
	K.4	Procurement Responsibility Matrix	0	0	2	4	6	8	0
								CATEGORY K TOTAL	**6**
L	**PROJECT CONTROL (Maximum = 80)**								
	L.1	Right-of-Way & Utilities Cost Estimates	0	1	3	5	7	10	3
	L.2	Design & Construction Cost Estimates	0	2	8	14	20	25	2
	L.3	Project Cost Control	0	1	5	9	13	15	5
	L.4	Project Schedule Control	0	1	5	9	13	17	1
	L.5	Project Quality Assurance & Control	0	1	4	7	10	13	4
								CATEGORY L TOTAL	**15**
M	**PROJECT EXECUTION PLAN (Maximum = 83)**								
	M.1	Safety Procedures	0	1	4	7	10	12	4
	M.2	Owner Approval Requirements	0	1	3	5	7	10	3
	M.3	Documentation/Deliverables	0	1	3	5	7	9	3
	M.4	Computing & CADD/Model Requirements	0	1	3	5	7	7	1
	M.5	Design/Construction Plan & Approach	0	1	4	7	10	14	1
	M.6	Intercompany & Interagency Coordination & agreements	0	1	4	7	10	13	4
	M.7	Work Zone and Transportation Plan	0	1	3	5	7	9	3
	M.8	Project Completion Requirements	0	1	3	5	7	9	1
								CATEGORY M TOTAL	**20**
	(Section III Maximum Score = 270)							**SECTION III TOTAL**	**63**
	(Maximum Score = 1000)							**PDRI TOTAL SCORE**	**189**

Definition Levels

0 = Not Applicable 2 = Minor Deficiencies 4 = Major Deficiencies

1 = Complete Definition 3 = Some Deficiencies 5 = Incomplete or Poor Definition

6. Project: Meskel Square –Bole Road

SECTION I. BASIS OF PROJECT DECISION									
CATEGORY Element			**Definition Level**						**Score**
			0	**1**	**2**	**3**	**4**	**5**	
A	**PROJECT STRATEGY (Maximum = 112)**								
	A.1	Need & Purpose Documentation	0	2	13	24	35	44	2
	A.2	Investment Studies & Alternatives Assessments	0	1	8	15	22	28	1
	A.3	Key Team Member Coordination	0	1	6	11	16	19	1
	A.4	Public Involvement	0	1	6	11	16	21	0
								CATEGORY A TOTAL	**4**
B	**OWNER/OPERATOR PHILOSOPHIES (Maximum = 67)**								
	B.1	Design Philosophy	0	2	7	12	17	22	7
	B.2	Operating Philosophy	0	1	5	9	13	16	9
	B.3	Maintenance Philosophy	0	1	4	7	10	12	7
	B.4	Future Expansion & Alteration	0	1	5	9	13	17	13
								CATEGORY B TOTAL	**36**
C	**PROJECT FUNDING AND TIMING (Maximum = 70)**								
	C.1	Funding & Programming	0	1	6	11	16	21	1
	C.2	Preliminary Project Schedule	0	2	7	12	17	22	2
	C.3	Contingencies	0	2	8	14	20	27	2
								CATEGORY C TOTAL	**5**
D	**PROJECT REQUIREMENTS (Maximum = 143)**								
	D.1	Project Objectives Statement	0	1	6	11	16	19	6
	D.2	Functional Classification & Use	0	1	6	11	16	19	6
	D.3	Evaluation of Compliance Requirements	0	1	6	11	16	22	1
	D.4	Existing Environmental Conditions	0	1	6	11	16	22	11
	D.5	Site Characteristics Available vs. Required	0	1	5	9	13	18	5
	D.6	Dismantling & Demolition Requirements	0	1	4	7	10	11	7
	D.7	Determination of Utility Impacts	0	1	6	11	16	19	11
	D.8	Lead/Discipline Scope of Work	0	1	4	7	10	13	4
								CATEGORY D TOTAL	**51**
E	**VALUE ANALYSIS (Maximum = 45)**								
	E.1	Value Engineering Procedures	0	1	3	5	7	10	1
	E.2	Design Simplification	0	0	3	6	9	11	3
	E.3	Material Alternatives Considered	0	1	3	5	7	9	7
	E.4	Constructability Procedures	0	1	5	9	13	15	5
								CATEGORY E TOTAL	**16**
	(Section I Maximum Score = 437)							**SECTION I TOTAL**	**112**

SECTION II. BASIS OF DESIGN									
CATEGORY Element			**Definition Level**						**Score**
			0	**1**	**2**	**3**	**4**	**5**	
F	**SITE INFORMATION (Maximum = 119)**								
	F.1	Geotechnical Characteristics	0	2	7	12	17	21	7
	F.2	Hydrological Characteristics	0	1	4	7	10	13	10
	F.3	Surveys & Mapping	0	1	4	7	10	14	4
	F.4	Permitting Requirements	0	1	5	9	13	15	1
	F.5	Environmental Documentation	0	1	5	9	13	18	5
	F.6	Environmental Commitments & Mitigation	0	1	4	7	10	14	7
	F.7	Property Descriptions	0	1	3	5	7	10	7
	F.8	Right-of-Way Mapping & Site Issues	0	1	4	7	10	14	7
								CATEGORY F TOTAL	**48**
G	**LOCATION and GEOMETRY (Maximum = 47)**								
	G.1	Schematic Layouts	0	1	4	7	10	13	4
	G.2	Horizontal & Vertical Alignment	0	1	4	7	10	13	4
	G.3	Cross-Sectional Elements	0	1	4	7	10	11	7
	G.4	Control of Access	0	1	3	5	7	10	7
								CATEGORY G TOTAL	**22**
H	**ASSOCIATED STRUCTURES and EQUIPMENT (Maximum = 47)**								
	H.1	Support Structures	0	1	4	7	10	11	7
	H.2	Hydraulic Structures	0	1	3	5	7	9	5
	H.3	Miscellaneous Elements	0	1	3	5	7	7	5
	H.4	Equipment List	0	1	4	7	10	11	1
	H.5	Equipment Utility Requirements	0	1	3	5	7	9	3
								CATEGORY H TOTAL	**21**
I	**PROJECT DESIGN PARAMETERS (Maximum = 80)**								
	I.1	Capacity	0	1	6	11	16	22	6
	I.2	Safety & Hazards	0	1	4	7	10	12	12
	I.3	Civil/Structural	0	1	5	9	13	15	9
	I.4	Mechanical/Equipment	0	1	3	5	7	10	5
	I.5	Electrical/Controls	0	1	3	5	7	10	5
	I.6	Operations/Maintenance	0	1	4	7	10	11	10
								CATEGORY I TOTAL	**47**
	(Section II Maximum Score = 293)							**SECTION II TOTAL**	**138**

SECTION III. EXECUTION APPROACH									
CATEGORY Element			**Definition Level**						**Score**
			0	**1**	**2**	**3**	**4**	**5**	
J	**LAND ACQUISITION STRATEGY (Maximum = 60)**								
	J.1	Local Public Agencies Contracts & Agreements	0	1	4	7	10	14	0
	J.2	Long-Lead Parcel & Utility Identification & Acquisition	0	1	5	9	13	15	15
	J.3	Utility Agreement & Joint-Use Contracts	0	1	4	7	10	12	0
	J.4	Land Appraisal Requirements	0	1	3	5	7	10	0
	J.5	Advance Land Acquisition Requirements	0	1	3	5	7	9	0
								CATEGORY J TOTAL	**15**
K	**PROCUREMENT STRATEGY (Maximum = 47)**								
	K.1	Project Delivery Method & Contracting Strategies	0	1	5	9	13	15	5
	K.2	Long-Lead/Critical Equipment & Materials Identification	0	1	4	7	10	13	4
	K.3	Procurement Procedures & Plans	0	1	4	7	10	11	7
	K.4	Procurement Responsibility Matrix	0	0	2	4	6	8	2
								CATEGORY K TOTAL	**18**
L	**PROJECT CONTROL (Maximum = 80)**								
	L.1	Right-of-Way & Utilities Cost Estimates	0	1	3	5	7	10	3
	L.2	Design & Construction Cost Estimates	0	2	8	14	20	25	2
	L.3	Project Cost Control	0	1	5	9	13	15	5
	L.4	Project Schedule Control	0	1	5	9	13	17	5
	L.5	Project Quality Assurance & Control	0	1	4	7	10	13	1
								CATEGORY L TOTAL	**16**
M	**PROJECT EXECUTION PLAN (Maximum = 83)**								
	M.1	Safety Procedures	0	1	4	7	10	12	10
	M.2	Owner Approval Requirements	0	1	3	5	7	10	7
	M.3	Documentation/Deliverables	0	1	3	5	7	9	3
	M.4	Computing & CADD/Model Requirements	0	1	3	5	7	7	3
	M.5	Design/Construction Plan & Approach	0	1	4	7	10	14	4
	M.6	Intercompany & Interagency Coordination & agreements	0	1	4	7	10	13	7
	M.7	Work Zone and Transportation Plan	0	1	3	5	7	9	7
	M.8	Project Completion Requirements	0	1	3	5	7	9	1
								CATEGORY M TOTAL	**42**
	(Section III Maximum Score = 270)							**SECTION III TOTAL**	**91**
(Maximum Score = 1000)								**PDRI TOTAL SCORE**	**341**

Definition Levels

0 = Not Applicable 2 = Minor Deficiencies 4 = Major Deficiencies

1 = Complete Definition 3 = Some Deficiencies 5 = Incomplete or Poor Definition

PDRI ELEMENT DESCRIPTIONS FOR INFRASTRUCTURE PROJECTS

(Developed by Construction Industry Institute, CII, in 2010 at the University of Texas, USA)

The following descriptions have been developed to help generate a clear understanding of the terms used in the Un-weighted Project Score Sheet. Some descriptions include checklists of sub-elements to clarify concepts and facilitate ideas when assessing each element. Note that these checklists are not all-inclusive and the user may supplement these lists when necessary.

The descriptions are listed in the same order as they appear in the Un-weighted or Weighted Project Score Sheet. They are organized in a hierarchy by section, category, and element. The Score Sheet consists of three main sections, each of which is a series of categories that have elements. Note that some of the elements have issues listed that are specific to projects that are renovations and revamps and are identified as "Additional items to consider for Renovation & Revamp projects." Use these issues for discussion if applicable. Scoring is performed by evaluating the definition level of each element.

It should be noted that this tool and these descriptions have been developed to address a variety of types of infrastructure projects that are "horizontal" in nature and connect nodes in different types of infrastructure systems. Three basic varieties of projects are addressed in this tool; those that convey people and freight (such as highways and railroads), those that convey fluids (such as pipelines and open channels), and those that convey energy (such as transmission lines or microwave corridors). For example, a pipeline project may connect a tank farm to a port facility, or transmission lines may connect a power plant to a substation and then to a home or business. Throughout the descriptions, the user will see sub-elements that relate to the variety of projects the tool is meant to encompass. These sub-elements are provided in the order in which they are discussed above. If the sub-element is not applicable to the project that the user is assessing, then it should be ignored. Note: the PDRI-Building Projects (CII Implementation Resource 152-2) and the PDRI-Industrial Projects (CII Implementation Resource 113-2) should be used singly or combined for the vertical (node) aspects of the infrastructure project as deemed appropriate. Detailed user information is provided in Chapter 1 of this document. Particular focus should be maintained to ensure no gaps develop at the interfaces of the vertical and horizontal elements during the FEP process by the project management team. The sections, categories, and elements are organized as follows.

SECTION I – BASIS OF PROJECT DECISION

This section consists of information necessary for understanding the project objectives. The completeness of this section determines the degree to which the project team will be able to achieve alignment in meeting the project's business objectives.

Categories:

A – Project Strategy

B – Owner/Operator Philosophies

C – Project Funding and Timing

D – Project Requirements

E –Value Analysis

SECTION II – BASIS OF DESIGN

This section consists of geotechnical, hydrological, environmental, structural, and other technical design elements that should be evaluated to fully understand their impact on the project and its risk.

Categories:

F – Site Information

G – Location and Geometry

H – Associated Structures and Equipment

I. – Project Design Parameters

SECTION III – EXECUTION APPROACH

This section consists of elements that should be evaluated to fully understand the requirements of the owner's execution strategy and approaches for detailed design, right of way acquisition, utility adjustments, and construction.

Categories:

J – Land Acquisition Strategy

K – Procurement Strategy

L – Project Control

M – Project Execution Plan

The following pages contain detailed descriptions for each element in the PDRI.

SECTION I – BASIS OF PROJECT DECISION

A. PROJECT STRATEGY

A.1 Need & Purpose Documentation

The need for a project may be identified in many ways, including suggestions from operations and maintenance personnel, engineers, planners, local elected officials, developers, and the public. These projects may also be determined by current market needs or future growth. This process typically includes site visits and seeking input from individuals and/or agencies with relevant knowledge. Documentation should result in assessing the need and purpose of a potential project based on factual evidence of current and future conditions, including why the project is being pursued. It will eventually serve as the basis for identifying, comparing, and selecting alternatives. Issues may include:

- High-level project scope and definition
- Capacity improvement needs:
    - Existing levels of service
    - Modeling of futuredemands
    - Trend analysis and forecasted growth)
- Profitability or benefit analysis
- Facility multi-modal or other multi-use capabilities, including interface options
- Current and future economic development needs
- Community concerns and critical issues, such as impact on cultural resources, adjacent facilities, land use, traffic, visual and so on
- Environmental and/or sustainability drivers
- Mitigation and remediation issues
- Constraints such as geographic, institutional, political, or technical
- Conformance with current geometric, general owner, or other jurisdictional standards

- Existing infrastructure conditions
- Safety improvements needs and expectations (including event frequency, severity, and hazards mitigation, as well as compliance requirements)
- Vulnerability assessment
- Input into any required planning documents such as a "Need & Purpose Statement" or other
- Other user defined

** Additional items to consider for Renovation & Revamp projects **

- Renovation & revamp project's compatibility with existing facilities

A.2 Investment Studies & Alternatives Assessments

Various studies address possible alternatives when the solution is unknown. In some cases, these studies may show that the project is not economically justifiable, or that it has so many environmental or social impacts that it is not viable. Early determination of these findings will avoid unnecessary expenditures on preliminary engineering and related costs and will also confirm the viability of proceeding with the selected option. These studies may take the form of feasibility/route studies or major investment studies. This economic model, sometimes known as the regulatory regime, sets the economic rules guiding decision making on the project. Issues to consider include:

- Profitability or value/benefit
- Identification of "show stoppers"
- Alternatives requirement determinations such as routes, acquisition strategy or technology
- Stakeholder identification and management
- Consultant reviews and selection
- Corridor selection and major alternatives
- Location of nodes such as interchanges, stations, control points and depots
- Preliminary surveys:
    - Population densities
    - Trends in land use and development
    - Existing Infrastructure

- Environmental conditions
- Existing demand
- Directional distribution and volumes
- Economic, safety, security and social conditions
- Use of geographic information systems (GIS), satellite imaging, and light detection and ranging (LIDAR) technologies)

- Existing data at governmental levels (e.g., local, regional, national)
- Alternative profile layouts and preliminary mapping
- Project corridor preservation
- Investment and financing requirements, including public or private funds, and tax implications
- Availability of insurance/bonding
- Cost estimate of sufficient quality to support the selected option
- Preliminary project schedule of sufficient depth for alternative duration comparison
- Coordination with other relevant planning efforts, short, medium and long term
- Other user defined

A.3 Key Team Member Coordination

Establishing a positive alliance among all key project team members facilitates the potential for an efficient, successful outcome, particularly if this alliance is achieved early during the planning process. The project manager is typically a central figure in this coordination. Definition of the roles and responsibilities of each key team member should be documented. Infrastructure projects typically involve many different stakeholders existing in both the public and private sectors. All key team members must be competent in the project at hand, informed of project decisions, and given the opportunity to attend project planning meetings in order to minimize the impacts on subsequent activities. Key team members may include:

- Planners and programmers
- Project management
- Design engineering

- Project controls
- Right-of-way planning
- Environmental planning
- Construction engineering
- Operations and maintenance
- Procurement
- Marketing/business
- Public relations
- Consultants
- Local, regional, and national governmental authorities, agencies, and officials
- Budgeting officers
- Safety
- Other user defined

Input into any expected meetings such as a "Feasibility Scoping Meeting", "Project Concept Conference", "Utility Coordination Meetings," or other should be considered when choosing key team members.

A.4 Public Involvement

Public involvement is an integral part of project development and should be planned and managed. Most infrastructure projects have to afford some level of public involvement to inform the public of project scope issues and to measure public attitudes regarding the development process. The level of public involvement and transparency of operations is dependent upon a number of social,

economic, and environmental factors, along with the type and complexity of the project. In general, public involvement, input and interaction are important components of successful infrastructure planning. Community involvement efforts may include meetings with key stakeholders, including contact with affected governmental and non-governmental organizations (NGO), first nation or native inhabitants, property owners, business interests, public meetings, and public hearings. Issues to consider include:

- Policy determinations regarding public involvement

- Notification procedures and responsibilities
- Identification of key stakeholders
- Identification of utility providers
- Types of public involvement:
  - Press releases and notices
  - Public meetings/hearings
  - Individual or group meetings with affected property owners)
- Local support and/or opposition
- Public involvement strategies after project approval
- Available website content
- Input of public involvement information into any typical deliverables such as an “Environmental Impact Statements”, “Public Hearing Notices,” or other
- Other user defined

B. OWNER/OPERATOR PHILOSOPHIES

B.1 Design Philosophy

A list of general design principles should be developed to achieve a successful project that fulfills the functional requirements and assimilates into the existing infrastructure system. Issues to consider include:

- Design life
- Configuration strategy
- Reliability
- Failure modes
- Design risk analysis
- Life cycle cost studies
- Safety improvement requirements, (Safety, Health and Environmental (SH&E), including event frequency, severity, and hazards mitigation, as well as compliance with applicable jurisdictional requirements)

- Security/anti-terrorism enhancements based project vulnerabilities
- Sustainability guidelines
- Use of existing or new technology
- Automation philosophy
- Compatibility with other uses or adjacent projects and facilities
- Aesthetics or image requirements
- Compatibility with long-range goals and other infrastructure improvement Programs
- Environmental sustainability
- Access management
- Geometric/alignment
- System validation
- Commissioning
- Decommissioning strategies
- Other user defined

B.2 Operating Philosophy

A list of general design principles should be developed to preserve the level of service desired and at a sufficient capacity over an extended period of time. This particularly focuses on developing strategic operations plans to prevent suboptimal capacity-related problems. Issues to consider include:

- Daily level of service requirements
- Capacity change requirements
- Operating schedules or time-tables
- Technological needs assessment
- Future improvement schedule
- Flexibility to change layout
- Owner/operator of the facility through its life

- Third party operations personnel
- Safety strategy for hazards mitigation
- Training requirements
- Control requirements
- Personnel and equipment requirements
- Alternate operating procedures, including manual versus automated modes
- Utilities location in relation to facility
- Operationalsecurity
- Other user defined

B.3 Maintenance Philosophy

A list of general design principles should be developed to lay out guidelines to maintain adequate and safe operations over an extended period of time. Furthermore, a specific operation control and maintenance plan should be in place, including interface and maintenance procedures. Issues to consider include:

- Monitoring requirements
- Equipment access needs and provisions
- Government regulated maintenance
- Safety strategy
- Documentation and training requirements
- Personnel and equipment requirements
- Third party maintenance personnel
- Environmental conservation programs
- Selection of materials for design and construction to minimize maintenance activities
- Warrantees
- Output quality or serviceability level
- Maintenance and repair cycles, preventative and planned

- Reliability:
  - Spare equipment
  - Commonality of parts
  - System redundancy
  - Intermediate storage to permit independent shutdown
  - Mechanical/structural integrity
  - Scheduled shut-down frequencies and durations
  - Response for unplanned shutdowns and outages)
- Efficiency of process
- Other user defined

** Additional items to consider for Renovation & Revamp projects **

- Potential impacts to existing operations
- Maintenance impact of renovation projects
- Common/ spare parts (repair vs. replace existing components)
- Interruptions to existing and adjacent facilities during R&R work
- Compatibility of maintenance philosophy for new systems and equipment with existing use and maintenance philosophy
- Coordination of the project with any maintenance projects

B.4 Future Expansion & Alteration Considerations

The possibility of expansion and/or alteration of this infrastructure facility and site should be evaluated. These considerations consist of a list of items that will facilitate the potential expansion or evolution of facility use. Issues to consider may include:

- Regional / local infrastructure / capacity plans
- Interface with other future infrastructure projects
- Expected population densities along corridor and/or capacity needs
- Future changes in demand

- Availability for added capacity and/or widening:
  - Vertical added capacity
  - Horizontal added capacity
- Availability for project enhancement and/or expansion such as interchanges, pumping stations, turbines, clarifiers, access ramps, frontages, pumping stations, taxi-ways, rail sidings, switchgear, transformers, additional land, etc.)
- Pending and future facility and product quality constraints and regulations
- Corridor preservation (i.e., sloped to grade, with potential for retaining walls in the future)
- Other user defined

C. PROJECT FUNDING AND TIMING

C.1 Funding & Programming

Authorization of projects within national, regional and local regulatory agencies is a typical requirement prior to executing funding agreements. As part of the authorization process, initial cost estimates must be prepared, assessing funding provided for planning, design, construction, right-of-way acquisition, utility adjustment, maintenance, and other project expenses. Funding can be provided by the project//t owner or from a third party. For public projects, this is normally the government but can include elements of private financing. Third parties for private projects can be financial institutions or other private investors. As such, strategic measures must be in place for determining the sources, levels, and forms of funding available to the project, as it competes against others for limited funds, whether public or private. Issues to consider include:

- Sources and forms of funding:
  - Internal funding, equity or debt
  - Public private partnerships (PPP)
  - Private entities
  - Local government entities
  - Federal and regional agencies
  - Donations
  - Economically disadvantageous community funding

- Congruity with local infrastructure projects and programs
- Other funding sources

- Comparisonof funding options
- The impact of available project funds on project phasing and sequencing, as well as risk profile of project participants
- Cash flow spend plan for project
- Congruity with local infrastructure programs
- Breakdown of funding participation
- Franchise or operating periods before transfer
- Tax credits or liability of funding options
- Cost drivers, such as environmental/mitigation costs, major work elements, limiting work conditions, or major equipment procurement
- Estimates:
  - Initial construction cost estimates
  - Initial right-of-way cost estimates
  - Initial operating and maintenance cost estimates
- Input into any required planning documents such as a "Programming Assessment Study", "Advance Funding Agreement" or other
- Other user defined

C.2 Preliminary Project Schedule

A preliminary project schedule should be developed, analyzed, and agreed upon by the major project participants factoring in major risk components. It should include milestones, unusual schedule considerations and appropriate master schedule contingency time (float), procurement plan (long-lead or critical pacing equipment/material and contracting), and required submissions and approvals. The project schedule is created to determine a timetable for the program and to assess its constructability. It should be maintained and updated throughout the course of front end planning with additional detail added as knowledge is gained, including work breakdown structure (WBS). It should be periodically updated and modified to show progress and ensure that tasks are completed on time. Third-party activities that are required to carry out the project need to be included in the project schedule with the appropriate relationships to determine the critical path. It becomes the basis for detailed scheduling of design and construction activities. Note that Project Schedule Control is addressed in Element L.4. This schedule should involve obtaining early input from and assign responsibility to:

- Owner/Operations
- Program/Project Management
- Design/Engineering
- Construction
- Procurement
- Other user defined

** Additional items to consider for Renovation & Revamp (R&R) projects **

- The schedule should contain input from the traffic or flow control management to coordinate disruptions R&R projects require a high level of planning to minimize risk because they interface with existing operations and are many times performed in conjunction with other on-going projects. Shutdowns/turnarounds/outages are special cases in that they are particularly constrained in terms of time and space, requiring very detailed plans and schedules.

C.3 Contingencies

Project risks must be identified and understood so that proper contingencies can be allocated and maintained in order to mitigate unforeseen issues. The contingency management process should effectively communicate the contingency magnitude and confidence level to all appropriate stakeholders. Estimates are used to plan and budget the project from the earliest stages of planning, and are essential in managing project contingency. It is important to have estimates of the proper accuracy, consistency, and clarity at the right phase of the planning process. Contingencies are forecasted and adjusted throughout the planning process based on level of confidence in the current estimate accuracy. It is also important to assign ownership of the different contingency allocations (such as management reserve, project contingency and contractor contingency) for the project, as well as authority to release these funds. (Note that final Cost Estimates for the planning phase are covered in Elements L1. and L.2 Project Cost Control is addressed in Element L.3.) Issues to consider:

Estimates evolve in terms of accuracy and may be based on:

- Order-of-magnitude cost model
- Benchmarks
- Parametric cost estimates (e.g., $/unit)
- Unit Price estimate
- Detailed element cost estimate

Contingency set aside may include funds and/or schedule for uncertainty in:

- Weather
- Scope Changes
- Unforeseen site conditions
- Extended overhead for potential project delays
- Critical Path impact
- Market conditions
- Commodity pricing
- Currency exchange rates
- Escalation pricing
- Contracting strategy
- Labor availability
- Labor competency
- Project location
- Political stability
- Definition of project
- Other user defined

D. PROJECT REQUIREMENTS

D.1 Project Objectives Statement

This statement defines the project objectives and priorities for meeting the business strategy, including project need and purpose. It should be clear, concise, measurable, and specific to the project. It is desirable to obtain consensus from the entire project team regarding these objectives and priorities to ensure alignment. Specifically, the priorities among cost, schedule, and value-added quality features should be clear. To ensure the project is aligned to the applicable objectives, the following should be considered:

- Stakeholder's understanding of objectives, including questions or concerns
- Constraints or limitations placed on the project
- Typical objectives with associated performance metrics:
    - Safety
    - Quality
    - Cost
    - Schedule including milestones
    - Technology usage
    - Capacity or size
    - Startup or commissioning
    - Communication
    - Operational performance
    - Maintainability
    - Security
    - Sustainability, including possible certification
- Other user defined

D.2 Functional Classification & Use

An essential step in the design process is to determine the functions that the project is to serve, including how the product or service will be conveyed throughout the infrastructure system.

Important in this classification is whether the project is for private or public use. Examples of functional types include:

- Capacities or volumes
- Intrastate or interstate
- Domestic or international
- Urban/Suburban/ Rural
- Underground or above ground
- On-shore or off-shore
- Modes of conveyance:
  - Automobiles and trucks
  - Aircraft
  - Trains
  - Barge
  - Ship
  - Conveyors (gravity, power, belt, and so on)
  - Pressure or gravity
  - Conduction
  - Electromagnetic
- Product(s) to be conveyed:
  - Freight
  - Pedestrians
  - Fluids
  - Gases
  - Solids
  - Power
  - Information or data

- Types of conveyance:
  - Rail
  - Road
  - Runway
  - Conveyer belts
  - Pedestrian movers (escalators, moving walkways, and so on
  - Pipe, gravity or pressure
  - Open channel
  - Harbor or reservoir
  - Lines or cable
  - Energy (microwave, infrared, sound, etc)
- Other user defined

D.3 Evaluation of Compliance Requirements

A fundamental part of decision making is an understanding of adherence requirements to various local, regional, and national plans. As part of project development, determine, document, and understand applicable requirements. (Note: Compliance requirements for permitting and environmental issues are addressed in more detail in Category F). Issues to consider for compliance include:

- Compliance with existing plans, codes, and standards, including:
  - Coastal zone management
  - Security and anti-terrorism
  - Wetlands encroachment
  - Intracoastal waterways
  - Metropolitan planning
  - Regional transportation plans
  - Statewide transportation improvement program
  - Federal directives)

- National, regional or local requirements defined and understood including input from:
    - Regional highway departments
    - Municipal departments
    - Public utilities commission
    - Public housing authorities
    - Railroad companies
    - Transit authorities
    - Governmental councils or regulatory commissions
    - General counsel
- Utilization of Design Standards:
    - Owner's
    - Contractor's
    - Mixed
- Construction and operations residuals management (such as handling of excess excavated soils, sludge handling, and so on)
- Other user defined

Additional items to consider for Renovation & Revamp projects

- Clearly define controlling specifications, especially where new codes and regulations will override older requirements
- Ensure that specifications support replacement of any obsolete systems or equipment

D.4 Existing Environmental Conditions

Decision making requires an understanding of existing environmental conditions which must be obtained from a variety of sources, including previous surveys, geographic information systems, and resource agency databases. Identifying problematic issues at an early stage in the project development process enables better decision making as well as adequate time to address and mitigate these concerns. (Note: many of these issues are addressed in more detail in Category F). Issues to consider include:

- Natural resource surveys:
    - Endangered species
    - Wetland status
    - Bodies of water
    - Existing and potential park system land
    - Permit requirements
- Cultural resource surveys:
    - Historical preservation
    - Existence of cemeteries
    - Archaeological sites
    - Local customs
- Air quality surveys:
    - Mobile source pollutants
    - Air quality analysis
    - Congestion mitigation-air quality
- Noise surveys including evaluation of need for abatement
- Hazardous materials:
    - Existing land use (for example, the existence of an underground storage tank)
- Contaminated material, not classified as hazardous
- Climatic data
- Site visits
- Local inhabitant interviews
- Socioeconomic impacts
- Other user defined

D.5 Site Characteristics Available vs. Required

An assessment of the available versus the required site characteristics is needed. The intent is to ensure that the project team has taken into consideration the need to improve or upgrade existing site utilities and support characteristics. Issues to consider should include:

- Capacity:
  - Utilities
  - Fire water
  - Cooling water
  - Power
- Waste treatment/disposal
- Storm water containment and/or transport system
- Type of buildings/structures
- Land area
- Amenities:
  - Food service
  - Change rooms
  - Medical facilities
  - Recreation facilities
  - Ambulatory access
- Product shipping facilities
- Material receiving facilities
- Material or product storage facilities
- Security:
  - Setbacks
  - Sight lines
  - Clear zones

- Access and egress
- Fencing, gates, and barriers
- Security lighting

- Other user defined

** Additional items to consider for Renovation & Revamp projects **

- Complete condition assessment of existing facilities and infrastructure
- As-Built accuracy and availability (update/verify as-built documentation prior to project initiation)
- Worksiteavailability and access for R&R activities
- Existing space available to occupants during renovation work
- Uncertainty of "as-found" conditions, especially related to:
    - Structural integrity: steel or concrete loading
    - Sub-base conditions
    - Piping capacity/ integrity/ routing
    - Location, condition, and capacity of electrical systems components
    - Installed equipment
    - Condition of required isolation points
- Investigation tools to assist in the documentation of existingconditions:
    - Photographs / Video
    - Remote inspection
    - Laser scanning
    - Infrared scanning
    - Ground Penetrating Radar
    - Ultrasonic Testing
    - Hydro-excavation)
    - Other user defined

D.6 Dismantling & Demolition Requirements

A scope of work has been defined and documented for the decommissioning and dismantling of existing equipment/piping/structures/pavements that may be necessary for completing new construction. This scope of work should support an estimate for cost and schedule. Evaluation criteria should include:

- Timing/sequencing
- Permits
- Approval
- Safety and security requirements
- Hazardous operations and/or materials
- Plant/operations requirements
- Storage or disposal of dismantledequipment/materials
- Narrative (scope of work) for each system
- Environmental assessment
- Are the systems or items that will be decommissioned/dismantled:
    - Named and marked on process flow diagrams piping and instrumentation diagrams (P&IDs), or flow schematics
    - Denoted on line lists and equipment lists
    - Denoted on piping plans or photo-drawings
    - Delineated by zone or boundary
- Sustainability issues, including reuse of materials
- Other user defined

** Additional items to consider for Renovation & Revamp projects **

- Use of photographs, video records, etc. in scope documents to ensure existing conditions clearly defined
- Physical identification of extent of demolition to clearly define limits

- Segregation of demolition activities from new construction, and operations (e.g., physical disconnect or “air gap”)
- Establish decontamination and purge requirements to support dismantling.

D.7 Determination of Utility Impacts

Infrastructure projects often necessitate the adjustment of utilities to accommodate the design and construction of the proposed project. Failure to mitigate utility conflicts in the design process or to relocate facilities in a timely manner can result in unwarranted delays and increased project costs. Issues to consider include:

- Field verification of existing utilities facilities and capacity
- Field verification with proposed alignment or project footprint
- Necessary utility facility repair and modernization, or expansion
- Physical constraints to utility placement
- Schedule/cost impacts of utility relocations and adjustments
- Determination of utility location in existing right-of-way or boundaries
- Local ordinances or industry standards
- Safety clearance or physical separation requirements
- Availability of alternate right-of-ways
- Action plans for utility adjustments
- Regional or local regulations related to utility adjustment
- Other user defined

** Additional items to consider for Renovation & Revamp projects **

- Determination of utility locations or relocations in relation to renovation work
- Accessibility to utilities for relocation work

D.8 Lead/Discipline Scope of Work

Project manager's complete narrative description of the project laying out the major components of work to be accomplished, generally discipline oriented, should be developed and oriented towards the architect/engineer/contracting agent. This narrative should be tied to a high level Work Breakdown Structure (WBS) for the project. Items to consider would include:

- Background information
- Project summary
- High level WBS
- Level of requirements development by each discipline
- Sequencing of work
- Interface issues for various contractors, contracts, or work packages
- Exclusions and limitations to the scope of work
- Other user defined

** Additional items to consider for Renovation & Revamp projects **

- Identification of specific interface or coordination efforts withoperations and owner's staff

E. VALUE ANALYSIS

E.1 Value Engineering Procedures

Procedures for conducting Value Engineering (VE) during front end planning and later in the project during design and construction need to be in place. VE methodology should be used to assess a project's overall effectiveness or how well the project meets identified needs. VE is designed to gather expertise and experience of individuals to produce the most effective solution to the conveyance need. For instance, study findings may show that redesign of an alternative is needed, in which case concepts or schematics may require revisions. Issues to consider include:

- Policy requirements and procedures
- Team member and team leader identification
- Session attendance requirements
- Frequency of assessments
- Documentation requirements
- Strategic resource collection and studies:
    - Lessons learned review

- Redundancy factors
- Over capacity factors
- Life-cycle and replacement costs
- Environmental impact resolution

- Report preparation and recommendations
- Approved response submittals
- Planning document revisions
- Other user defined

E.2 Design Simplification

Procedures for conducting design simplification during front end planning and later in the project need to be in place. Identify and document activities or strategies (through studies, reviews) for reducing the number of process steps, number of interchanges, number of bridges, length of route, extent of right-of way, or the amount of equipment needed in the design in order to optimize performance without compromising safety, function, reliability and security. Items to evaluate include:

- Redundancies
- Overcapacity
- Horizontalor vertical alignment
- Above or below ground or water
- Retaining walls versus embankments
- Commonality
- Flexibility
- Discretionary scope issues
- Discretionary spares
- Controls simplification
- Other user defined

E.3 Material Alternatives Considered

A structured approach should be in place to consider and select among material alternatives, including sustainability considerations during front end planning and as the project progresses. Rejected material alternatives should be documented. Material evaluation should include:

- Cost effective materials of construction
- Life-cycle analysis, including operations and maintenance considerations
- Modularized or pre-fabricated components
- Ease or cost effectiveness during construction
- Sustainability considerations (such as use of local materials, pollution abating concrete, recycled materials, LED lighting, and so on)
- Environment in which materials are to be installed or operated (such as heat, humidity, corrosive, etc.)
- Other user defined

E.4 Constructability Procedures

A structured process and procedures should be in place for constructability analysis during front end planning and as the project proceeds into design and construction. CII defines constructability as, "the optimum use of construction knowledge and experience in planning, design, procurement, and field operations to achieve overall project objectives. Maximum benefits occur when people with construction knowledge and experience become involved at the very beginning of a project." Provisions have been made to provide this on an ongoing basis. This process includes examining design options that minimize construction costs while maintaining standards of safety, security, quality, and schedule. This process should be initiated in the front end planning process during concept or detailed scope definition. Elements of constructability during front end planning include:

- Constructability program in existence
- Construction knowledge/experience used in project planning
- Early construction involvement in contracting strategy development
- Developing a construction-sensitive project schedule (with operations input and considering operational needs)

- Considering major construction methods in basic design approaches
- Developing site layouts for efficient construction
- Early identification of project team participants for constructability analysis
- Usage of advanced information technologies
- Other userdefined

** *Additional items to consider for Renovation & Revamp projects* **

- Install-ability (e.g., smaller components/modules/pre-assembly to facilitate installation in congested areas)
- Opportunities to perform as much work as possible outside of shutdowns or Outages
- Developing an operations-sensitive project schedule (e.g., minimization of Shutdown/Turnaround work and hot work in operating areas, reduction of traffic disruption at high volume times, etc.)

SECTION II – BASIS OF DESIGN

F. SITE INFORMATION

F.1 Geotechnical Characteristics

Geotechnical and soil test evaluations of the project footprint should be developed. Ways in which the project will be impacted by geotechnical characteristics should be considered. Items to evaluate and consider include:

- General site descriptions (e.g., terrain, spoil removals, areas of hazardous waste)
- Collection of all previous geotechnical investigation data
- Soil composition and strata structure
- Potential soil expansion considerations
- Soil densities and compaction requirements
- Seismic requirements, including liquefaction potential
- Foundation requirements:
    - Allowable bearing capacities
    - Pier/pile capacities

- Water table
- Groundwater flow rates and directions
- Soil percolation rate and conductivity
- Karst formations, caves or mines
- Man-made/abandoned facilities
- Existing foundations or subsurface structures
- Existing or abandoned landfills
- Existing or abandoned cemeteries
- Site characterization to identify areas of hazardous or toxic soils
- Soil treatment and remediation needs
- Soil boring tests and test pits
- Horizontal directional drilling versus open cut
- Geological Baseline Reports (GBR)
- Other user defined

F.2 Hydrological Characteristics

Hydraulic information should be reviewed and analyzed at a high level prior to selection of alternatives and detailed design. This information is necessary for determining hydraulic structural requirements and detention facilities, as well as preliminary right-of-way requirements. Issues to consider include:

- Drainage basin characteristics:
  - Size, shape, and orientation
  - Slope of terrain
  - Groundwater
  - Watershed development potential
  - Geology
  - Surface infiltration

- Antecedent moisture condition
- Storage potential (e.g., overbank, wetlands, ponds, reservoirs, channels))

- Flood plain characteristics
- Waves, tides, and currents
- Soil types and characteristics
- Cathodic protection requirements
- Ground cover and erosion concerns, including scour susceptibility
- Meteorological characteristics:
    - Precipitation types and amounts
    - Peak flow rates
    - Hydrographs
    - Special precipitation concerns
    - Storm water runoff control
- Potential impacts of future development
- Impacted communities or agencies such as watershed districts/regulations
- Other user defined

F.3 Surveys & Mapping

Once it has been determined that a corridor or site needs to be studied, a reconnaissance of the corridor/site should be conducted. This includes a study of the entire area. The study facilitates the development of one or more routes or corridors or location options in sufficient detail to enable appropriate officials to recommend which will provide the optimum location. Issues to consider include:

- Existing geographic/mapping information from general sources or previous study, including geographical information system data
- Right-of-entry requirements
- Surveying consultant requirements
- Aerial photography from general sources or previous studies and surveys

- Regional demographic maps, identifying areas of special impact
- Existing right-of-way maps/inventory, including easements
- Preliminary survey, including recovery of existing monuments
- Topography (contours)
- Existing structurelocations
- Grid ticks and centerlines
- Geotechnical summaries
- Utility information
- Special property owner concerns
- Other user defined

F.4 Permitting Requirements

Permitting usually begins concurrently with surveys and continues throughout project construction. Personnel responsibilities should be specific to each permit and clearly delineated, including a listing of all organizations that may require permitting. In many cases, permits must be obtained before further approval of project development activities and site access; in some cases permits may have schedule constraints. Issues to consider include:

- Noise
- Traffic
- Building
- Navigation
- Land use or zoning
- Operating
- Approved points of discharge permits
- Grading and erosion permits
- Local, regional, or national jurisdictional permits
- Construction
- Utility

- Crossing
- Flora and fauna permits
- Resource agency permits
- Historic and cultural association permits
- Pollutant and emissions permits
- Other user defined

** Additional items to consider for Renovation & Revamp projects **

- Original intent of codes and regulations and any “grandfathered” requirements

F.5 Environmental Documentation

Funding sources and project environmental classification drive the type of environmental documentation that is required. Environmental documentation should provide a brief summary of the results of analysis and coordination, as well as information about of the social, economic, and environmental impacts of a project. This includes a determination of what decision should be made on a project’s construction, location, and design. In addition, the document should describe early interagency coordination and preliminary public involvement, including estimates of time required for milestones. Typical types of environmental documentation include:

- Environmental Assessments (EA)
- Environmental Impact Statements (EIS)
- Environmental Impact Report (EIR)
- Categorical Exclusions (CE)
- Potential Outcomes:
    - Findings of No Significant Impact (FONSI)
    - Notice of Intent (NOI)
    - Record of Decision (ROD)
    - Categorical Exclusion (CE))
- Section 4F Documentation (e.g., parks and recreation areas, refuges, cultural resources, and other sites)

- Environmental monitoring
- Environmental constraints should be incorporated into preliminary right-of way maps and schematics
- Other user defined

(Note: All jurisdictions have specific environmental policies and requirements that need to be understood by planners. For example, the U. S. National Environmental Policy Act (NEPA) requires three levels of environmental analysis. At the first level, an undertaking may be categorically excluded (CE) from a detailed environmental analysis if it meets certain criteria that a federal agency has previously determined as having no significant environmental impact. At the second level of analysis, a federal agency prepares a written Environmental Assessment (EA) to determine whether or not a federal undertaking would significantly affect the environment. If this is not the case, the agency issues a Finding of No Significant Impact (FONSI). An Environmental Impact Statement (EIS) is a more detailed evaluation of the proposed action and alternatives. A Notice of Intent (NOI) announces an agency's decision to prepare an EIS for a particular action and must be published in the Federal Register. The public, other federal agencies and outside parties may provide input into the preparation of an EIS and then comment on the draft EIS when it is completed. Following the Final EIS, the agency will prepare a Record of Decision (ROD).)

F.6 Environmental Commitments & Mitigation

Environmental commitments determine what a project's involved parties can and cannot do to protect the environment. Environmental commitments begin at the earliest phase of project development, although completion of commitments may not occur until the operation and maintenance phase of a project. Because there is a substantial time gap between the beginning and end of a commitment, it is imperative that commitments are communicated from environmental clearance through detailed design, pre-bid conference, project letting, maintenance, and operation. Issues to consider include:

- Avoidance commitments
- Compensation commitments
- Enhancements commitments
- Minimization commitments

- Habitat mitigation
- Water quality facilities management
- Wetlandmitigation
- Storm water management plans
- Cultural resources mitigation
- Noise abatement remediation
- Hazardous materials abatement locations
- Environmental remediation plans
- Other user defined

F.7 Property Descriptions

Property descriptions are prepared as exhibits for the conveyance of property interests that will be affected. The property descriptions reflect a boundary survey showing ownership including legal descriptions, as well as parcel plat determinations. Property descriptions should be summarized from survey information into an appropriate documentation form that can be logged into project information systems. The level of confidence and validation of the documentation such as field verified versus scaled from existing maps should be noted. Information needed includes:

- Type of property or businesses affected
- Historical data used in preparing the survey
- Parcel plats
- Parcel size and area
- Control reference point data
- Easements
- Centerline station ties
- Control of access lines
- Gates, fences and barriers
- County, city, federal or other jurisdictional boundary lines
- Review of existing right-of-way maps from previous projects

- On-site canvas of the proposed affected properties
- Appraisal maps and records
- Abstractor's indices
- Real property records
- Mineral and water rights
- Other user defined

F.8 Right-of-Way Mapping & Site Issues

A right-of-way map is a compilation of internal data, property descriptions (which includes field notes and parcel plats), appraisal information, and improvements related to the project. Right-of-way maps are typically internal planning and management documents, with significant impact on the project development process. Preparation of these maps normally begins after obtaining schematic design approval. Parcels that may cause difficulties in acquisition should be identified, including indications of specific site conditions or characteristics that may cause delays or problems. Issues to consider include:

- Parcel numbers and priority
- Existing site information:
    - Improvements within right-of-way
    - Previous uses of land
    - Zoning
    - Utility locations
    - Record ownership data of adjacent properties
    - Existing boundaries and limits
    - Existing drainage channels and easements
- Design information:
    - Access control lines
    - Configuration of infrastructure project
    - Hydraulics

    - Maintenance access or connecting ramps
    - Limit of flood pool
- Parcel information:
    - Property owner name
    - Parcel title requirements
    - Parcel number
    - Parent tract
    - Type of conveyance, if known (e.g., donation, negotiation, condemnation)
    - Station to station limits and offset
    - Area in acres and/or square feet
    - Area of uneconomic remainders
    - Property lines
    - Bearing and distance tocontrol points
    - Property descriptions
- Inherent parcel issues that may cause difficulties in right-of-way acquisition:
    - Landfill and superfund records
    - Hazardous material exposure, such as Poly-chlorinated biphenyls (PCB) transformers or underground storage tank locations)
    - Wetlands identification
    - Floodway identification
    - Endangered species locations
    - Stockpiles and production sites
    - Outfall locations
    - Oil and gas well piping
    - Railroad and/or roadway interests
    - Special use properties (e.g., government use, alcohol sales, cemeteries, etc.)

- Beautification and signage
- Land use impacts
- Socioeconomic impacts
- Economic development/speculation
- Legal (lawyer) activity in area
- Title curative issues
- National, regional or locally owned properties
- Number of partial takings
- Splitting of parcels
- Landlocked parcels
- Existing easements
- Cultural issues
- Public park space
- Cultural resources
- Historical landmarks
- Archeologically sensitive sites

- Other user defined

G. LOCATION and GEOMETRY

G.1 Schematic Layouts

The submission of schematic layouts should include basic information necessary for the proper review and evaluation of the proposed improvement. The schematic is essential for use in public meetings and coordinating design features. Format and delivery should be tailored to the audience. Issues to consider include:

- General project information (e.g., boundary limits, speed or volume, classification)
- Location of structures such as interchanges, main lanes, frontages, ramps, levees, channels, ditches, dam structures, towers, utilities, drainage structures, and so on
- Signage schematics

- Profiles and alignments
- Overhead and underground right-of-way
- Added or future capacity analyses
- Tentative right-of-way limits
- Geometrics
- Location of retaining and noise abatement walls
- Projected capacities
- Control of access during and after construction
- Existing structures and removal of improvements
- Master plan zoning map
- Soils Maps
- Cut and fill balance
- Jurisdictional map
- Watershed / water basin delineation
- Other user defined

Location/arrangement drawings identify the location of each major project item including equipment, support structure or miscellaneous elements. These *drawings should .include:*

- Location, including coordinates
- Coordination of location among all items
- Setbacks
- Interface
- Elevation views
- Visibility or line of sight
- Access
- Other user defined

** Additional items to consider for Renovation & Revamp projects **

- Renovation work in relation to existing structures and demolition
- Detours or bypasses
- Temporary conveyance facilities
- Clearly identify existing systems and equipment to be removed or rearranged, or to remain in place

G.2 Horizontal & Vertical Alignment

Due to the near permanent nature of the right-of-way alignment once the infrastructure project is constructed, it is important that the proper alignment be selected considering design speed, pressure pipe hydraulics, open channel hydraulic parameters, existing and future roadside or adjacent development, subsurface conditions, topography, etc. Issues to consider include:

- Horizontal geometry
- Vertical geometry
- Design exceptions or waivers identified and validated
- Pipeline or power line corridors and easements
- Sight distances
- Geometry referenced to a surveying control system
- Crossover grades and profiles
- Vertical lift
- Vertex data
- Grade restrictions
- Access to target users or market
- Proximity to raw materials
- Natural corridors
- Upstream and downstream control structures/parameters
- Social/political constraints
- Constrained right-of-way zones areas (choke points)
- River, lake or ocean crossings, including landfall or transitions

- Existing above-ground and underground utilities, especially in dense urban areas
- Horizontal Directional Drilling (HDD) / tunneling feasibility
- Other user defined

G.3 Cross-Sectional Elements

Cross-sections are an important design element related to cost and schedule of the proposed project. The width of the right-of-way will be controlled by the proposed design. Examination of the typical cross-section will indicate those elements of design affecting the width of proposed right-of-way and utility adjustments among other factors. Issues to consider include:

- Maintenance access
- Cut or fill slopes
- Easements
- Horizontal clearances to obstructions
- Pavement cross slopes
- Frontage roads and ramp radii
- Sidewalks and pedestrian elements
- Noise abatement (for example walls, structures, or operating limitations)
- Number and width of road lanes
- Width of median
- Width of shoulder
- Pipeline support berm width
- Extent of berm areas
- Channel levee widths
- Cross drainage structures
- Extent of side slopes and ditches, including levees and dams
- Linear profile for hydraulic/hydrostatic testing
- Channel routing models

- Other user defined

G.4 Control of Access

Maintaining access to specific portions of the infrastructure project is developed in front end planning for both construction and permanent access. Planners need to address the concerns of controlled access limits to and from adjacent property or facilities. Access control should be coordinated with right-of way acquisition including access deeds and restrictions. Issues to consider include:

- Entrance/exit locations and length
- Growth capacity
- Access deed restrictions
- Safety and security of access
- Trunk tie-ins
- Special required access lanes:
  - Bike and pedestrian lanes
  - High Occupancy Vehicle (HOV)/High Occupancy Toll (HOT) lanes
  - Truck-only lanes
  - Crossover lanes or access
  - Turnarounds
- Frontage road requirements
- Controlled access systems, including life safety requirements
- Split-parcel access requirements
- Driveway access requirements
- Waiting lanes or rails
- Bypasses
- Access to runways
- Intermodal interface
- Pumping or support stations

- Valve tie-ins
- Pig access
- Cleanouts
- Pretreatment, including bar screens, grit removal, grinders and compactors
- Desalting and settling tanks
- Manholes
- Transformer location
- Switching stations
- Data security
- Integration and compatibility
- Other user defined

H. ASSOCIATED STRUCTURES and EQUIPMENT

H.1 Support Structures

Support structures for conveyance requirements along the extent of right-of way for a project are often necessary (such as bridges for freight, people, or pipelines). As a result, right-of-way requirements must take into account the impacts of structure design on the affected corridor. For example, pipelines may need to span a gap while maintaining a specified grade, while transportation and distribution facilities must span long gaps while maintaining a specified clearance above a transportation corridor. The following should be addressed:

- Structure locations
- Materials of construction
- Foundation requirements
- Seismic requirements
- Right of way impacts
- Towers
- Stringing requirements
- Toll plazas

- Safety tolerances:
    - Maximum height
    - Maximum clearance
    - Maximum loads and capacities
    - Clear roadway width
- Utilities attached to bridge structures
- Turnarounds
- Access requirements
- Maintenance of right-of-way
- Retaining walls and abutments
- Vertical and horizontal alignment
- Fencing
- Lightning protection
- Safety lighting
- Maintenance accessibility
- Pipe racks
- Cable trays
- Span gap
- Special load requirements, such as ice, wind, heavy load, etc.
- Thrust blocks
- Valve and pumping stations/enclosures
- Other user defined

** Additional items to consider for Renovation & Revamp projects **

- Current condition and life expectancy
- Temporary signage
- Maximum construction bridge loading

- Bypasses or temporary conveyance
- Detour bridge requirements or lane rerouting

H.2 Hydraulic Structures

In analyzing or designing drainage facilities, the investment of time, expense, concentration, and completeness should be influenced by the relative importance of the facility. Some of the basic components inherent in the design or analysis of any pipeline, channel, or highway drainage facility include data such as surveys of existing characteristics, estimates of future characteristics, engineering design criteria, discharge estimates, structure requirements and constraints, and receiving facilities. Issues to consider include:

- Open channels, tunnels, and outfall structures:
    - Right-of-way impact
    - Environmental impact
- Storm drain systems
- Emergency spillways
- Collection basins
- Culverts
- Fluid energy abatement
- Inlets/outlets
- Irrigation controls
- Street cleaning requirements
- Special required easements
- Hydraulic routing
- Hydraulic channel controls
- Wildlife crossing structures
- Life-cycle maintenance considerations and costs
- Multipurpose requirements (flood control plus power generation, etc.)
- Erosion control

- Other user defined

** Additional items to consider for Renovation & Revamp projects **

- Current condition and life expectancy
- Bypasses or temporary conveyance

H.3 Miscellaneous Elements

In addition to typical pipeline, water channel, energy, and/or roadway design elements, the following features may require consideration and planning and in some cases the acquisition of additional right-of-way. These items should be identified and listed and may include:

- Longitudinal barriers
- Rip-rap / gabions / soil retaining structures
- Fencing
- Emergency management issues
- Noise abatement walls
- Visual architectural blending structures
- Maintenance and storage yards
- Toll-way structures
- Border and immigration structures
- Parking
- Rest areas and stops
- Blast deflection devices
- Signage, delineation, roadway markings, historical markers
- Extended shoulders for service
- Truck weigh stations
- Pedestrian separations and ramps
- Emergency median openings and widths
- Runaway vehicle lanes

- Hazardous material traps
- Storm interceptors and other storm water control devices
- Emergency spillway area
- Berms or containment structures
- Other user defined

H.4 Equipment List

Project-specific installed equipment should be defined and listed. In some cases, equipment may have to be manufactured and purchased specifically for construction of the facility. In situations where owners are furnishing equipment, the equipment should be properly defined and purchased. Items may include:

- Traffic control devices:
  - Low-volume roads
  - School zones
  - Highway-rail or -light rail transit grade crossings
  - Bicycles
  - Temporary)
- Intelligent transportation systems devices:
  - Cameras
  - Loop detectors
  - Sensors
  - Monitors
- Specialized equipment such as tunnel boring machines (TBM), dredges, cranes, etc.
- Electronic signage
- Highway traffic signals
- Toll equipment
- Rest area requirements

- Turbines
- Compressors
- Pumps
- Conveyor systems
- Grinders
- Clarifiers
- Tanks or basins
- Filtering
- Transformers
- Electrical substations (breakers, disconnect switches, protection and control equipment)
- Spares and commonality requirements
- Other user defined

Training requirements for equipment operation have been *defined and responsibility established in areas such as:*

- Control systems
- Information systems and technology
- Equipment operation
- Maintenance of systems
- Training materials and equipment (e.g., manuals, simulations)
- Safety
- Other user defined

** Additional items to consider for Renovation & Revamp projects **

- Identify systems and equipment as new, existing or relocate, existing or in place, remove, etc.
- Clearly define any modifications to existing systems and equipment

H.5 Equipment Utility Requirements

A tabulated list of utility requirements for all major installed equipment items should be developed in order to understand overall utility load and distribution for the facility. As part of this requirements determination it may be appropriate to perform a utility optimization study. Items to consider include:

- Power:
    - Hard line
    - Solar
    - Auxiliary or backup
- Water
- Air and specialty gasses
- Steam
- Communications, including cables or fiber-optics
- Fuel
- Other user defined

I. PROJECT DESIGN PARAMETERS

I.1 Capacity

In general, a capacity study is required for scope definition of many infrastructure projects. These studies provide a description of the related process flows and interactions allowing the planning team to ensure adequate facility capacity, while guarding against over- or under-design. The capacity study should fit within the need and purpose of the project as defined in element A.1. Capacity studies generally include flow diagrams and are often referred to by different organizations as:

- EFDs– Engineering Flow Diagrams
- MFDs– Mechanical Flow Diagrams
- PMCDs– Process & Mechanical Control Diagrams
- P&IDs– Process and Instrumentation Diagrams

- CCS Corridor Capacity Study
- SLD Single Line Diagrams

Capacity studies should address the following *areas:*

- Flow of resources and outputs
- Contractual requirements
- Primary control loops for the major equipment items
- Capacity constraints and growth considerations
- Major equipment items
- Utilities
- Instrumentation
- Safety/security systems
- Sustainability concerns
- Special notations
- Level of service
- Level of flow
- Standard component size
- Service/industry standards
- Other user defined

Typical items to consider for people and freight *type projects:*

- Traffic capacitystudies
- Passenger or freight handling
- Interchanges
- Signage
- Security check points
- Tolling
- Vehicle parking

- Rail switch location
- Siding rails and spurs
- Corridor capacity
- Taxiways and parking aprons
- Instrumentation and lighting
- Runway orientation
- Controlled air space
- Airport/port layout plan
- Lock capacity

Typical Items to consider for fluid type projects:

- Piping
- Hydraulic profile
- Flow rate
- Containment and storage
- Open channel
- Dewatering systems
- Leakage
- Friction and head loss
- Valves
- Equipment
- Control
- Piping specialty items

Typical Items to consider for energy type projects:

- Grid integration
- Transmission line capacity
- Resistance and impedance

- Generation
- Bandwidth capacity
- Tie-ins or interchanges
- Transformers and switching gear
- Telecommunication media (fiber-optic, power line carrier (PLC), or microwave)

** Additional items to consider for Renovation & Revamp projects **

- Definition of owner's requirements for updating existing flow diagrams.
- Tie-in points
- Accuracy of existing capacity studies and flow diagrams (field verify)
- Scope of Work on existing flow diagrams (clouding or shading to indicate: new, refurbished, modified, and/or relocated equipment, piping, instruments, and controls).

Since incomplete information in capacity studies can cause project escalation, it is important to understand level of completeness. These studies *generally evolve as the project scope definition is developed. However, the study documents must be complete enough to support the accuracy of estimate required*

I.2 Safety and Hazards

This element refers to a formal process for identification and mitigation of safety and environmental hazards. This process is used to identify potential risk of injury to the environment or populace for certain types of infrastructure projects. Many jurisdictions (or organizations) will have their specific compliance requirements (for example, in the U.S., OSHA Regulation 1910.119 compliance is required for oil and gas conveyance). The important issue is whether the owner has clearly communicated the requirements, methodology, and responsibility for the various activities. If the analysis has not been conducted, the team should consider the potential of risks that could affect the schedule and cost of the project. Issues to consider include:

- Handling of nuclear materials
- Cleanup requirements in case of spills
- Containment requirements
- Confined space

- Air monitoring
- Hazardous Operations (HAZOP) requirements
- Other user defined

I.3 Civil/Structural

A clear statement of civil/structural requirements should be identified or developed, and then documented as a basis of design. This documentation should include issues such as the following:

- Client specifications (e.g., basis for design loads, capacity, vulnerability and risk assessments)
- Future expansion considerations
- Physical requirements
- Seismic requirements
- Safety considerations
- Construction materials (eg., concrete, steel, client standards, etc.)
- Sustainability considerations, including certification
- Standard or customized design
- Define nomenclature and documentation requirements for civil drawings including:
    - Overall project site plan
    - Project phasing requirements
    - Interim traffic or by-pass control plans
    - Structures
    - Location of equipment and facilities
    - Utilities
    - Roads and paving
    - Grading/drainage/erosion control/landscaping
    - Corrosion control / protective coatings
    - Minimum clearances
    - Architectural theme

- Other user defined

** Additional items to consider for Renovation & Revamp projects **

- Existing structural conditions (e.g., foundations, building framing, harmonics /vibrations, etc)
- Potential affect of noise, vibration and restricted headroom in installation of piling and on existing operations
- Underground interference (utilize shallow depth designs)

I.4 Mechanical /Equipment

A clear statement of mechanical and equipment design requirements should be identified or developed, and then documented as a basis of design. This documentation should include issues such as:

- Life cycle costing basis
- Energy conservation
- Sustainability considerations, including certification
- Equipment/space special requirements with respect to environmental conditions (e.g., air quality, special temperatures)
- System redundancy requirements
- Special ventilation or exhaust requirements
- Acoustical requirements
- Water treatment
- Auxiliary/emergency power requirements
- System zones and control strategy
- Air circulation requirements
- Outdoor design conditions (e.g., minimum and maximum yearly temperatures)
- Indoor design conditions (e.g, temperature, humidity, pressure, air quality)
- Emissions control
- Utility support requirements
- Plumbing requirements

- Special piping requirements
- Seismic requirements
- Fire protection systems requirements
- Other userdefined

** Additional items to consider for Renovation & Revamp projects**

- Consider how renovation project alters existing mechanical design assumptions
- Potential reuse of existing equipment and systems for renovation project
- New by-passes and tie-in requirements

I.5 Electrical/Controls

A clear statement of electrical design requirements should be identified or developed, and then documented as a basis of design. This documentation should include issues such as:

- Life cycle costing basis
- Electrical classification based on environment
- Programmable logic controllers (PLC) versus Distributed Control System (DCS)
- Local versus remote control
- Automated versus manual control
- Energy consumption/conservation
- Sustainability, including certification
- Power sources with available voltage/amperage
- Electrical substations, transformers, switching gear
- Uninterruptable power source (UPS) and/or emergency power requirements
- Lightning/grounding requirements
- Code and safety requirements
- Alternate energy systems (solar, wind, etc.)
- Flow measuring and monitoring

- Special lighting considerations (e.g., security, lighting levels, exterior/security, use of day lighting, color rendition, signage or traffic lights)
- Voice, data and video communications requirements
- Telecommunication and data systems
- Instrumentation
- Advanced audio/visual (A/V) connections
- Personnel sensing
- Security/access control systems
- Other user defined

** Additional items to consider for Renovation & Revamp projects **

- Integration of new technology with existing systems, including interface issues
- Safety systems potentially compromised by any new technology
- How renovation project alters existing electrical design assumptions
- Potential reuse of existing equipment and systems for renovation project

I.6 Operations/Maintenance

A clear statement of operations/maintenance design requirements should be identified or developed, and then documented as part of the basis of design. Operations and maintenance activities are related to the performance of routine, preventive, predictive, scheduled, and unscheduled actions aimed at preventing equipment failure or decline in order to maintain the correct level of efficiency, reliability, and safety. Operational efficiency represents the life-cycle cost effective mix of preventive, predictive, and reliability-centered maintenance technologies, coupled with equipment calibration, tracking, and computerized maintenance management capabilities all targeting reliability, safety, occupant comfort, and system efficiency. Sustainability concerns should be addressed as appropriate. Design parameters for operations/maintenance should be considered for infrastructure components such as levees, utilities, roadway structures, drainage structures, traffic control devices, vegetation, and other infrastructure project related items. To the extent practical, utilization of desirable design criteria regarding maximum side-slope ratios and ditch profile grades will reduce maintenance and make required maintenance operation easier to accomplish. Items to consider include:

- Accessibility:
    - Access roads, gates, ramps
    - Seasonal access requirements
    - Restricted access
    - Surveillance and intrusion detection systems
    - Elevated and subsurface access
    - Valve and pumping station
    - Barriers / obstructions / berms / fences
- Egress and access structures:
    - Manholes
    - Platforms
    - Vaults
    - Underground walk-able tunnels
    - Steam stations
- Safety:
    - Confined space permitting
    - Fall protection
    - Overhead power lines
    - Underground utilities
    - Emergency response evacuation and communications system)
- Detour or by-pass options
- Temporary structures for maintenance
- Repair parts storage and fabrication facilities
- Surface finishes (paint, hot-dip galvanized, etc.)
- Right-of-way vegetative clearing and maintenance
    - Types ofvegetation

- Overhead interferences

- Remote monitoring capabilities
- Other user defined

SECTION III - EXECUTION APPROACH

J. LAND ACQUISITION STRATEGY

J.1 Local Public Agencies Contracts & Agreements

Contractual agreements with local public agencies (LPA) participants may be required. The execution of contractual agreements establishes responsibilities for the acquisition of right of way, adjustment of utilities and cost sharing between the LPA(s) and the project owner. The type of contract to be used is determined by whether the LPA desires to administer right of way activities and payments or defer those responsibilities to the owner. In some cases an agreement must be entered into before a project is released for right-of-way acquisition. Issues to consider include:

- Master agreement governing local agency project advance funding
- Cost participation and work responsibilities between the owner and LPAs or others
- Reimbursement to the Local Public Agencies (LPA) or others for purchasedparcels
- Lender requirements or stipulations
- Prerequisites to secure right-of-way project release on non-federal-aid projects
- Request for determination of eligibility
- Compatibility with local regulations and procedures
- Long term operation and maintenance responsibility
- Other user defined

J.2 Long-lead Parcel & Utility Adjustment Identification and Acquisition

Right-of-way acquisition and utility adjustment are almost always on the critical path of an infrastructure project. It is important to identify and focus on all parcels within the right-of-way (ROW), but especially those that might cause delay, such as those that may require eminent domain acquisition or have other inherent problems (as identified in Element F.7). Utilities with a history of slow response in making adjustments should be aggressively managed. It should be noted that ROW and utility adjustment issues may be of concern even in cases where the parcel or utility is owned by a separate public entity. A strategy must be developed to address these problematic parcels and/or utility adjustments. Issues to consider include:

- Identification and prioritization of long lead parcels and utilities
- Defining responsible party for parcel acquisition and utility adjustment
- Appraisal responsibility and performance
- Acquisition of parcels
- Relocation of displaces
- Abatement and removal of existing improvements
- Other user defined

J.3 Utility Agreement & Joint-Use Contracts

Prioritizing utility agreements may be essential to insure that the concurrent review and approval processes are coordinated and efficient. The utility agreements and joint-use contracts effectively enable the utility to share space on public or private right-of-way and complete utility adjustments. Note that utilities are sometimes owned and controlled by separate public entities and must be coordinated. Issues to consider include:

- Utility agreements, plans, and estimates
- Public or private utilities
- Crossing permits for highways, railroads, canals, etc.
- Supporting documentation
- Transmittal memo from district to division
- Crossing and parallel encroachment permits
- Compatibility with jurisdictional regulatory and approval processes
- Other user defined

J.4 Land Appraisal Requirements

Acquisition should not begin until a formal right-of-way release or organizational go-ahead is obtained. An early step in acquisition is to determine the value of parcels for reimbursement. Ensuring appraisal occurs in a timely manner is essential. Appraisal requirements include:

- Pre-appraisal contacts
- Determination of number of appraisers required
- Determination of appraisal assignments
- Use of in-house or contract appraisers
- Prioritization of parcel appraisals, if required
- Other user defined

J.5 Advance Land Acquisition Requirements

Advance acquisition is defined as right-of-way acquisition that occurs before normal release for acquiring right-of-way is given for the project. Advance acquisition requirements need to be identified and addressed as soon as possible in the project. Although this process bypasses detailed environmental scoping, consideration for environmental effects should be made in determining parcels for advance acquisition. (Note: this is not the acquisition of long-lead parcels that occurs through the normal release process.) Examples of advance acquisition include the following:

- Protective buying to prevent imminent parcel development that would materially increase right-of-way costs
- Hardship acquisition of a parcel at the property owner's request
- Donation of land for right-of-way purposes for no consideration
- Acquisition of parcels with multiple, sometimes undivided owners or unknown owners
- Other user defined

K. PROCUREMENT STRATEGY

K.1 Project Delivery Method & Contracting Strategies

The methods of project design and construction delivery, including fee structure and risk allocation for the project should be identified. Types of project delivery methods and contract strategies to consider include:

- Owner self-performed
- Selected methods (e.g., design/build, construction management (CM) at risk, competitive sealed proposal, bridging, design-bid-build, multi-prime, sole source negotiated)
- Requirements under franchises,concessions, or other agreements

- Designer and constructor qualification selection process
- Compensation arrangement (e.g., lump sum, cost-plus, negotiated)
- Design/build scope package considerations
- Solicitation package is competitive in themarket place ("bid ability")
- Craft labor studies
- Small business and disadvantaged business contract requirements
- Local content requirements
- Other user defined

K.2 Long-Lead/Critical Equipment & Materials Identification

Installed equipment and material items with long lead times may impact the design and construction schedule. These items should be identified and tracked. A strategy should be developed to expedite these items if possible. Examples may include:

- Engineered components
- Toll equipment
- Electronic information boards
- Bridge or tower structural components
- Pre-cast elements
- Directional lighting systems
- Computer and/or software systems
- Pumps, piping and valves
- Transformers and switchgear
- Cable
- Structural steel
- Other user defined

K.3 Procurement Procedures & Plans

Procurement procedures and plans include specific guidelines, special requirements, or methodologies for accomplishing the purchasing, expediting, and delivery of equipment and materials required for the project. Issues to consider include:

- Responsibility for performing procurement
- Listing of approved vendors, if applicable
- Client or contractor purchase orders
- Reimbursement terms andconditions
- Equipment / material specifications
- Guidelines for supplier alliances, single source, or competitive bids
- Guidelines for engineering/construction contracts and approval
- Responsibility for owner-purchased items, including:
- Financial
- Shop inspection documentation (e.g., factory acceptance tests))
- Expediting and tracking
- Tax strategy, including:
- Depreciation capture
- Local sales and use tax treatment
- Investment tax credits
- Local regulations (e.g., tax restrictions, tax advantages))
- Definition of source inspection requirements and responsibilities
- Definition of traffic/insurance responsibilities
- Definition of procurement status reporting requirements
- Additional/special owner accounting requirements
- Definition of spare parts requirements
- Incentive/penalty strategy for contracts

- Delivery requirements
- Receiving, staging and storage
- Warranty
- Operating manual requirements and training
- Restricted distribution of construction documents for security and antiterrorism reasons
- Other user defined

K.4 Procurement Responsibility Matrix

A procurement responsibility matrix has been developed showing authority and responsibility for procurement. This matrix should outline responsibilities for:

- Engineering, design and professional services
- Engineered equipment
- Construction
- Bulk materials
- Fabrication/modularization
- Consulting services
- Commissioning and startup materials
- Source inspection
- Other

** Additional items to consider for Renovation & Revamp projects **

- Utilization of reused and existing equipment, materials, lines, electrical and instrumentation, etc.
- Availability of procurement support during time-constrained R&R work, especially where expedited material services are required

L. PROJECT CONTROL

L.1 Right-of-Way & Utilities Cost Estimates

Right-of-way costs are defined as those instances where there is an interest in land acquired and include all costs necessary to acquire the property. In some cases land and interests in land must be acquired outside existing right-of-way for or by the utility. The cost estimates in some cases are prepared by the utility and submitted in support of the utility agreement and plans required for the proposed work. These estimates should cover only the work for clearing infrastructure project construction. Issues to consider include:

- Cost of right-of-way
- Amounts paid to fee appraisers for appraisal of the right-of-way
- Costs normally paid that are incidental to land acquisition
- Payment of property damages and losses to improvements
- Recording costs
- Deed fees
- Salaries and expenses of employees engaged in the valuation and negotiation
- Right-of-way costs incurred by a utility
- Cost of utility adjustment and bringing necessary utilities to site
- Other user defined

L.2 Design & Construction Cost Estimates

The project cost estimates should address all costs (excluding right-of-way acquisition and utility adjustment costs that are addressed in element L.1) necessary for completion of the project. These cost estimates may include the following:

- Design costs
- Construction contract estimate
- Professional fees
- Construction management fees
- General conditions costs
- Trades resource plan
- Administrative costs
- Inspection costs
- Environmental monitoring

- Public relations
- Contingencies
- Cost escalation for labor and materials
- Cost escalation for elements outside the project cost estimates
- Startup and commissioning costs
- Capitalized overhead
- Safety, health, and environmental items
- Site-specific insurance requirements
- Incentives
- Miscellaneous expenses including but not limited to:
    - Specialty consultants
    - Inspection and testing services
    - Bidding costs
    - Site clearance
    - Environmental impact mitigation measures
    - Jurisdictional permit fees
    - Sureties
- Taxes:
    - Capitalized/expensed
    - Tax incentives
    - Contractors' sales tax
- Utility costs during construction (this will be a cost to the project whether paid by owner or contractor
- Interest on borrowed funds (cost of money)
- Site surveys, soils tests
- Availability of construction lay-down and storage at site or in remote or rented facilities

- Licensing
- Other user defined

L.3 Project Cost Control

Procedures for controlling project cost need to be outlined and responsibility assigned. These may include cost control requirements such as:

- Financial (client/regulatory)
- Phasing or area sub-accounting
- Capital versus non-capital expenditures
- Report requirements
- Payment schedules and procedures
- Cash flow projections/draw down analysis
- Cost code scheme/strategy
- Costs for each project phase
- Periodic control check estimates
- Change order management procedure, including scope control and interface with information systems
- Costs pertaining to right-of-way acquisition and utility adjustment during project execution
- Project and financial control software
- Other user defined

L.4 Project Schedule Control

The project schedule is created to show progress and ensure that the project is completed on time. The schedule is necessary for design and construction of the facility. A schedule format and control procedures should be developed during front end planning, including responsibilities. Typical items to consider include:

- Milestones
- Required submissions and/or approvals
- Resource loading requirements

- Required documentation/responsible party
- Baseline schedule versus progress-to-date schedule
- Critical path activities, including field surveys
- Contingency or “float time”
- Force majeure
- Permitting or regulatory approvals
- Activation and commissioning
- Liquidated damages/incentives
- Unusualschedule considerations
- Unscheduled delays because adverse weather delay days
- The owner must also identify how special project issues will be scheduled.

These items may include:

- Selection, procurement, and installation of equipment
- Stages of the project that must be handled differently than the rest of the project
- Tie-ins, service interruptions, and road closures
- Other user defined

L.5 Project Quality Assurance & Control

Quality assurance and quality control procedures for the project need to be established, including responsibilities for approvals. These procedures may include:

- Administration of contracted professional services
- Responsibility during design and construction
- Testing of materials and workmanship
- Quality management system requirements, including audits (e.g., ISO 9000)
- Environmental quality control
- Submittals
- Inspection reporting requirements, including “hold or witness” points

- Progress photos
- Reviewing changes and modifications
- Communication documents (e.g., Requests for Information, Requests for Qualifications)
- Lessons-learned feedback
- Correction of impaired materials, equipment and construction
- Jurisdictional quality control requirements
- Other user defined

M. PROJECT EXECUTION PLAN

M.1 Safety Procedures

Safety procedures and responsibilities must be identified for design consideration and construction. Safety issues to be addressed may include:

- Staging area for material handling
- Transportation of personnel and material to/from off-site storage
- Environmental safety procedures, including hazardous material handling
- Right-of-way needs for safe construction
- Safety in utility adjustment
- Interaction with the public/ securing site
- Working at elevations/fall hazards
- Excavation
- Evacuation plans and procedures
- Drug testing
- First aid stations
- Location and/or availability of medical facilities
- Accident reporting and investigation, including incident management
- Pre-task planning
- Safety for motorists and workers, including work zone safety

- Requirements for safety personnel (designated/dedicated, third party)
- Safety orientation and planning
- Safety communication
- Safety incentives
- Owner Controlled Insurance Program (OCIP)
- Development of site specific safety plan
- Crane action plans
- Contractor requirements
- Sub-contractor requirements
- Other special or unusual safety issues

M.2 Owner Approval Requirements

All documents that require owner approval should be clearly defined. These documents maybe developed in planning or during design or construction. These may include:

- Project objectives statement
- High level scope and project definition
- Design philosophy
- Operating philosophy
- Maintenance philosophy
- Project milestone or resource loaded schedule
- Corridor selection
- Permit responsibility matrix
- Schematic design approval
- Project design parameters
- Land acquisition strategy, including acquisition release
- Milestones for drawing approval:
    - Comment

    - Approval
    - Bid issued
    - Construction)
- Electronic model reviews
- Durations of approval cycle compatible with schedule
- Individual(s) responsible for reconciling comments before return
- Types of drawings that require formal approval
- Purchase documents:
    - Data sheets
    - Inquiries
    - Bid tabs
    - Purchase orders
- Change management approval authority
- Quality assurance/quality control plan
- Vendor information
- Other

M.3 Documentation/Deliverables

Deliverables during design, construction, and commissioning of the facility should be identified. The following items should be included in a list of deliverables:

- Field surveying books
- Estimates
- Required submissions and/or approvals
- Drawings
- Project correspondence
- Permits
- Project data books (quantity, format, contents, and completion date)

- Equipment folders (quantity, format, contents, and completion date)
- Design calculations (quantity, format, contents, and completion date)
- Procuring documents
- As-built documents
- Quality assurance documents
- Updated information systems and databases
- Operations and maintenance manuals
- Plans, specifications &estimates (PS&E) checklist and data sheet
- Other user defined

M.4 Computing & CADD/Model Requirements

Computing hardware, software and Computer Aided Drafting and Design (CADD) requirements to support planning, design, and construction should be defined. These requirements should include any hard or soft model needs and computing guidelines. Evaluation criteria should include:

- Handling of life cycle facility data including asset information, models, and electronic documents
- Civil Information System (CIS) requirements
- Geographical Information System (GIS) requirements
- Building Information Modeling (BIM) requirements
- Owner/contractor standard symbols, file formats and details
- Information technology infrastructure to support electronic modeling systems, including uninterruptible power systems (UPS) and disaster recovery
- Application software preference (e.g., 2D or 3D CADD, application service provider (ASP)), including licensing requirements
- Configuration and administration of servers and systems documentation defined
- Compatibility requirements of information systems (e.g. design information system, construction information system)

- Security and auditing requirements defined
- Physical model requirements
- Other user defined

M.5 Design/Construction Plan & Approach

A documented plan should be developed identifying specific approaches to be used in designing and constructing the project. This plan should include items such as:

- Organizational structure
- Work Breakdown Structure (WBS)
- Interface with other projects or facilities, including coordination
- Responsibility matrix
- Subcontracting strategy
- Project labor agreements
- Work week plan/schedule, including weekend and night work
- Permitting requirements and action plan
- Design and approval of sequencing with parcel acquisition
- Construction sequencing of events
- Site logistics plan
- Integration of safety requirements/program with plan
- Identification of critical activities that have potential impact on facilities (i.e., existing facilities, traffic flows, utility shut downs and tie-ins)
- Quality assurance/quality control (QA/QC) plan
- Environmental monitoring plan
- Design and approvals sequencing of events
- Integration of permitting, design, right-of-way acquisition, utility adjustment, and construction
- Materials management, including field equipment and materials transportation, receiving, warehousing, staging, maintenance, and control

- Contractor meeting/ reporting schedule
- Partnering or strategic alliances
- Alternative dispute resolution
- Furnishings, equipment, and built-ins responsibility
- Public relations, community communications
- Other user defined

M.6 Intercompany and Interagency Coordination & Agreements

Coordination with appropriate private owners, contractors, resource agencies, local governmental entities, and the public plays a vital role in project execution planning of proposed infrastructure projects. Both public and private entities may be responsible for coordination during project execution and agreements should be in place to assure efficient project delivery. Coordination is initiated at the appropriate levels. Coordination entities to consider may include:

- Owner/funding sources
- Key contractors and suppliers
- State historic preservation offices
- Natural resource conservation services
- Environmental protection agencies,
- Air quality boards
- Fish and wildlife services
- International boundary and water commissions
- Offices of habitat conservation
- Law enforcement agencies
- Immigration agencies
- Parks and wildlife agencies
- Federal, state and municipal building departments
- Railroad agencies
- Flood control district

- Departments of transportation
- Utility companies
- Special districts (such as municipal utility districts (MUDs) and roadway utility districts (RUDs)
- Other user defined

M.7 Work Zone and Transportation Plan

A preliminary work zone and transportation plan should be developed to understand logistics and safety. The plan should clearly show provisions for safe and efficient operation of all modes of transportation adjacent or concurrent with the project during construction, including safety of construction workers and inspection personnel. The plan should address use of heavy equipment and equipment or material delivery and storage during construction. The plan should be compliant with national, regional and local jurisdictional requirements. Issues to consider include:

- Compliance with requirements (for example, a Department of Transportation's Manual of Uniform Traffic Control Devices (MUTCD or other))
- Control plan, including provisions to minimize disruption of services or functionality (for example, lane rental requirements for a road construction project or liquidated damages for service down-time)
- Detours or by-pass plans
- Appropriate signs, markings, and barricades per the traffic control plan
- Safety equipment, such as:
    - Barrels
    - Signage
    - Flagmen
    - Positive barriers
    - Vertical panels)
- Clear zone protection devices, such as:
    - Concrete traffic barriers
    - Metal beam guard fencing

- Appropriate end treatments

- Other appropriate warning devices
- Special permitting (for instance, for moving equipment or materials across a levee or beach)
- Hazardous material movement
- Pedestrian safety
- Oversized loads
- Heavy hauls and lifts
- Transportation, including barges, sea-lifts, rail, trailers and other equipment
- Remote location access
- Other user defined

M.8 Project Completion Requirements

Issues dealing with project completion should be addressed to make sure that the project has a smooth transition to operations. The owner's required sequence for turnover of the project for pre-commissioning, testing, and startup activation should be developed. It is to include items such as:

- Sequence of turnover, including system identification and priority
- Contractor's and owner's required level of involvement in:
  - Pre-commissioning
  - Training
  - Testing
- Clear definition of mechanical/electrical acceptance/approval requirements.

Startup requirements have been defined and responsibility established. A process is in place to ensure that startup planning will be performed. Issues include:

- Startup goals
- Leadership responsibility
- Sequencing of startup
- Technology start-up support on-site, including information technology

- Feedstock/raw materials
- Off-grade waste disposal
- Quality assurance/quality control
- Work force requirements

Substantial Completion (SC) is the point in time when the facilities are ready to be used for their intended purposes. Preliminary requirements for substantial completion *need to be determined to assist the planning and design efforts. The following may need to be addressed:*

- Specificrequirements for SC responsibilities developed and documented
- Warranty, permitting, insurance, and tax implication considerations
- Technology start-up support on-site, including information technology and systems
- Equipment/systems startup and performance testing
- Occupancy phasing
- Final code inspection
- Calibration
- Verification
- Documentation
- Training requirements for all systems
- Community acceptance
- Landscape requirements
- Punch list completion plan and schedule
- Substantial completion certificate
- Other user defined