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Public Investment Models

Case Studies for Iran, Germany, Australia,
South Africa in comparison with Norway

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Master in Science of Project Management
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PUBLIC INVESTMENT MODELS

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PREFACE:

This thesis report is submitted in partial fulfillment of the requirement for degree of Master of Science in Project Management. The project has been carried out in five-month in Norwegian University of Science and Technology, Trondheim in January-June, 2016 under supervision of Professor Nils Olsson in Institute of Production and Quality Engineering.

Investigating different governance frameworks of public projects and their comparison in order to understand the differences between them, with respect to cost estimation and user involvement, was one of the focal motivations of carrying out this thesis. It was interesting to study cost estimation concept in early phases of projects and to look into how governments employ and perform cost estimation in early phases. Moreover, it was also examined on how the quality assurance of cost estimation is carried out before budget sanction. Throughout this project report the overview of the governance frameworks for four selected case studies, namely Iran, Australia, Germany, and South Africa are investigated. In order to address the proposed research questions, the selected case studies were compared with the Norwegian appraisal model. In addition, the review on different relevant literature is carried out to find related information and theory base, which is essential in addressing the research questions. History and deep political aspect of governance frameworks for selected case studies are out of scope of this thesis report, and hence have not been discussed.

The significance of this master thesis topic has an explicit impact on understanding the differences in the way of achieving effective and efficient cost estimation in early phase of a project. It is essential for frims' management to realize the best cost estimation practice and its link to governance framework in order to accomplish the program purpose or the project objectives with regard to difficulties and changes that may possibly occur throughout the life cycle of the project. Therefore, this master thesis report is addressed to individuals who are seeking the realization of the different cost estimations in early phase of project, while pointing out the way it gets quality assured in the governance framework of public projects.

I would like to express my deep appreciation and gratitude to Professor Nils Olsson by providing his guidance and supervision throughout this master thesis, and I am thankful for his enthusiastic advice and support he offered to me in order to complete this master thesis report.

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SUMMARY:

This master project investigates public project governance frameworks with respect to cost estimation and user involvement aspects. The objective of this thesis is to understand the differences between governance frameworks for selected case studies and to compare them with the Norwegian appraisal model. The reason for this study is, first, to understand the differences and commonalities for cost estimation and user involvement in the early phase of public projects, and, second, to understand the effect of a framework on the project, which requires understanding of inner functions of the framework.

This master thesis comprises six chapters; each of them discusses the different parts of the topic that are required to fulfill the objective. Chapter one is an introductory part and highlights the background of the topic followed by the problem formulation and research objective as well as limitation and report structure employed in this thesis. In Chapter two, the relevant methodology that has been used in this report is explained. The methods for literature search and data collection as well as approaches that have been used to address the research questions and conclusion are also part of this chapter.

Chapter three is about the basic concepts and literature review. This chapter is divided into two parts and presents the skeleton of appropriate literature and concepts required for this thesis. Part One briefly describes the base concepts and perspectives about them (i.e. project, project management, life cycle of project, flexibility, uncertainty, and project models). Second Part looks upon more relevant concept for this thesis such as user involvement, governance, corporate governance, and cost estimation; moreover, it includes a brief description of cost estimation models, and describes different perspectives and findings that are relevant to address research questions of this study.

Chapters four and five focus on the results obtained for each individual case study through modeling them with respect to the base model (Norway), followed by analyzing and discussing these results in order to address the research questions precisely. The discussion part reach to different statement for each research question, the finding indicates that, achieving reliable early cost estimation in projects require, first the understanding of the corporate governance followed by effective implementation of available legislations with respect to functions for supporting the framework. Correspondingly, it provides the findings about the distinction in procedures and control mechanisms of estimation among all the cases explained by the methods and approaches each case has towards the controlling mechanism. Consensus that can be seen among the case studies is that reliable cost estimate is the main objective; however, there is a significant distinction in approaches and priorities, especially regarding the first steps. The last research question could be addressed by looking upon the role and type of user involvement in

the early phases. While the mechanisms for involvement are similar, the approaches differ, i.e. there is a distinction with regard to priorities in sequencing the mechanisms, which, again, refers to the diversity of functions and means that framework finds suitable for its operation.

In Chapter six, the conclusion is drawn based on the foregoing chapters. The purpose and the intention of this master thesis could be achieved by comparing the selected case studies (Iran, Germany, Australia, South Africa) with the selected base mode, i.e. Norwegian appraisal model for public investment. This thesis concluded that introducing more legislations for improving cost estimation reliability is not an appropriate approach. This report rather strongly suggests that revising the available legislation and its efficient employment should be the first priority. In addition, to reduce the estimation bias in early phase, this report suggests the application of real time information through building information modeling (BIM) in the governance frameworks. This approach could significantly help to improve the estimation in early phase. Moreover it also looks suitable to control the multifaceted nature of governance and the biases in the estimation.

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LIST OF ABBREVIATION

AASQ	African association of quantity surveyors, South Africa
APM BOK	Association of Project Management Book
BCA	Benefit Cost Analysis
BKI	The construction cost information center of the German Chambers of Architects", Germany
BS 6079	British Standard for Project management. Principles and guidelines for the management of projects.
CEA	Cost effectiveness analysis
COE	Chief Executice Officer
DIN	Germany's standardization organization,
DPTI	Department of Planning, Transport and Infrastructure, Australia
FCFA	Financial cash flow analysis
HBR	Harvard Business Review
HOAI	fees for architects and engineers regulation, Germany
IER	International economic review,
IJPM	International Journal of Project Management
JCEM	Journal of Construction Engineering and Management,
JCME	Journal of Construction Management Economics
JESTP	Journal of Economic Surveys and Transport Policy
JME	Journal of Management in Engineering,
MINCOMBUD	ministers committee on the budget, South Africa
MoD	Ministry of Defense-UK
MPO	Management and planning organization, Iran

NRCS	National Regulator for compulsory specification. South Africa
OECD	Organization for Economic Cooperation and Development
PMJ	Project Management Journal,
SABS	South African Bureau of Standard
SANAS	South African National Accreditation system.
SANS	South African national standards
WBS	Work Breakdown Structure

CHAPTER 1 - INTRODUCTION

In today's world, economic strength and development are favorable for any society and authorities of different nations across the globe. The span of development and economic strength does not limit to specific regions or nations. All governments and authorities are seeking better and more stable economic situation, more sustainable development and range of service in the society. This also can be seen as intention of the authorities in creating values from investments and projects. The values can contribute to different development aspect of the society, for instance, public infrastructure (roads, railways, education, hospital, IT, etc.). However, one of the aspects of this stability and development is tied with the investments in public sector and the question how the benefit of such investments can be maximized. This initiates the interest for looking upon the projects and governance models in projects, which can help to understand how the decision making process is carried out and how each different element works together to successfully accomplish the project in order to achieve the purpose of such investment on national scale. The importance of such investments has been addressed to in different researches. For instance, Simon and Tudela state that public investment is one of the most primary and basic element in countries economy development (Simon, 1976; Tudela, Akiki, Cisternas, & Tudela, 2006). Also, Yuzhou and Bin state that considerable problem arises when it comes to choosing project in public investment among investment appraisals (Yuzhou & Bin, 2010). Dixit demonstrates the nature of such investment effects that are indeterminate or challenging to measure and results, which may be very durable (Dixit, 1996). Thus, investment options in any one year will be narrowed by continuing obligations, anticipated level and estimated demand of resources in future (nation, 2009). Such huge investment projects need precise insight of various aspects and procedures for evaluating the viability and effectiveness (OECD, 2014). Probable results of feasibility and cost-effectiveness are normally tied by a partly or even exclusively undeterminable upcoming time, surrounding with ambiguity and numerous types of risk (Unit, 2012). However, present investment markets get bigger within a more and more irregular and enormously interlinked worldwide network; investment plans are tightly open to uncertainties about costs, completion phase and the degree to which the main objectives of the project can ultimately be accomplished. Hence, it is emphasized that making and implementing macroeconomic guidelines is accountability and responsibility of governments (Brealey, Cooper, & Habib, 1997).

In this regard, governments and authorities in different countries across the globe focus on the whole efficiency of investment models, but the whole efficiency of the model cannot be achieved except through the efficiency of each individual element of the system and the balance between them. Therefore, the focus on different parts of governance models to improve their efficiency and to connect them together could result in better decision-making process and outputs; infrastructure and investments in

infrastructure are essential and critical elements of the policy for many governments (Ubbels & NijKamp, 1998).

Governance models consist of series of stage or processes which need to be followed in order to make a concept acceptable by authorities and to implement it through projects. Governance model is a series of activities or processes which need to make an input to desired output. However, during this process the aim is to convert or to make the raw idea or immature idea to more clear and mature concept with defined purpose and goal which can be implemented. Among the different elements which together form the governance model, the economical efficiency of such model is the main concern of many governments and authorities. Due to the type of investment and decisions made by the governments, it is concerned to the society and economic welfare of their nation. In this regard, considerable attention or focus is put to cost estimate practice in early phases of project. It is quite interesting for authorities and decision makers to have a clear and highly reliable estimate of the cost in early phases of project before budget sanction, which is difficult since it contains uncertainty. Carr emphasizes the cost estimation relevance to decision making by stating that accurate reflection of reality is what an estimate must be and ought to demonstrate only the level of detail which is relevant to decisions (Carr, 1989). Furthermore, Ogunlana and Thorpe found out that the capability of model to accurately estimate cost is the function of correlation between factors that create uncertainty in task and task environment (Ogunlana & Thorpe, 1991). They have concluded that one of the main obstacles in developing the precise correlation between project-associated factors and estimate accuracy is the right evaluation of estimating accuracy. Later, -Hicks emphasized that, with no precise cost estimate, nothing of a miracle can be done to avoid a loss, irrespective of management skill, economic strength or expertise (Hicks, 1992). -Ubbels and NijKamp demand for necessity of better understanding of cost estimation in public projects since it has a significant impact on governmental decision-making process (Ubbels & NijKamp, 1998). Akintoye and Akintola indicate that the importance of cost estimate accuracy to all participants involved in the project is a common view; additionaly, they discuss the factors that impact the cost estimate (Akintoye & Akintola, 2000). Flyvbjerg, Holm and Buhl try to describe the grounds of cost overrun in projects (Flyvbjerg, Holm, & Buhl, 2004). They establish the relation between the implementation length and cost escalation of projects. As discussed above, the economic aspect of such investment is always the question for researchers and authorities.

On the other hand, there are opinions regarding the user involvement in projects. Most of the researchers have consensus about that user involvement has significant role in achieving project success. Nevertheless, there are different perspectives regarding how and when this involvement will benefit the project. Some researchers support the view that the more user involvement in early phases of project will

lead to better success in feasibility studies, cost estimation, and hence will lead to achievement of more reliable project estimation. For instance, Doll points out the importance of user involvement as management guidance and support in implementation and development of information system in the organization (W. J. Doll, 1985). He argues that top management support can have a vital role in enhancing the management of information system function. Geddes also emphasizes the importance of user involvement in achieving success in projects (Geddes, 1990). Many further researchers address this aspect of the project: Some of them indicate that close client interaction results in better performance (T. Allen & Allen, 1986; Thomas J Allen, 1977; Thomas J. Allen, Tushman, & Lee, 1979; Tushman, 1979). Likewise, user involvement may degrade uncertainty by giving inventors more precise illustration of user requirements (Ives & Olson, 1984), and escalate inter-unit conformity (Lind & Zmud, 1991) as well as cause more successful implementation (Mankin, Bikson, & Gutek, 1985) and decision-making output. Many of these works draw conclusion that a continuous flow of client information is highly helpful, and indicate that additional user involvement is equally beneficial to users and investors. However, in the literature, there are contrasts in the way "more user involvement" is conceived. For instance, Kanter suggests that turning out more innovation and creativity is strongly tied with more resource and human involvement, more complexity, more perspectives and more interactions and authority across the corporation (Kanter, 2000). This denotes that further comprehensive contact with a likely user and interfaces with many potential customers ought to be equally beneficial. Other researchers point out that market characteristics are the key in affecting level of user relationships (Hippel, 1988, 1989). Pfeffer and Salancik indicate that further source of uncertainty is the result of various connection with clients (J. Pfeffer & G.R. Salancik, 1978).

Therefore, the importance of decision-making in public investments is not only confined to one aspect but is rather multi-dimensional. Thus, it is obvious that government and authorities keep on seeking ways to improve the efficiency of the governance models and appraisal methods in different aspects, (i.e. economical, environmental, social, political, etc.) Even though, different aspects of appraisal methods are important, most of authorities, who are involved in decision-making of such investments, put significant attention to economical aspect of such investments since it has both positive and negative impact on macro and micro level economy as well as society welfare. In order to minimize these concerns, governments and authorities implement various practices to control the economic aspect of investment projects. These practices help to increase the efficiency and effectiveness of appraisal models for public investments, and, hence, improve sustainability of such decisions.

1.1 PROBLEM FORMULATION

Almost all countries have had a heritage or still have unsuccessful public projects. In addition to denying potential advantages and welfares that could have emerged from these projects, the unsatisfactory reputation and background in carrying out public project has created doubt in relation to the ability of the governments and authorities to develop public investment. Considerable studies have been assigned to public investments.Aschauer indicates that the fall in productivity can be described with significant role of public investment (Aschauer, 1989, 1998). Furthermore, Lynde, Richmond and Sanjeev Gupta point out that, in production process, the public investment and its services are among the vital parts, and that the regression in productivity by 40% is described by a reduction in the public funds-labor ratio (Lynde & Richmond, 1993; Sanjeev Gupta, 2011). Over time, the appraisals were examined because they were heaped with procedural and econometric difficulties (Gramlich, 1994). Therefore, the allotment of rare economic capitals to challenging policy objectives is an intrinsic venture of investment in public division. Allocative decision will essentially comprise making preferences between different tactics to the accomplishment of a particular policy objective and the ranking of priorities (Unit, 2012). The public concern is typically not the similar as investors' interests in the private sector, where the financial side of the project so often is superior to other characteristics. The public concerns are often very multifaceted, comprising different stakeholders with distinctive requirements and demands (Benčina, 2011). Moreover, it is claimed that investments in public division have to take place if and only if their return surpasses the opportunity cost of existing projects, where the expenses consist of shifted private capital and reduced consumption (Zerbe, 2013). Expansion around the world is enlarging mutually with influences such as environmental deprivation, and economic crisis, etc. For instance, the transport sector is amongst the leading providers of emissions. So, to make the problem smaller, policy makers have to make trade-offs between shrinking the emissions and the expense of decline (Kok, Annema, & van Wee, 2011; Yuzhou & Bin, 2010). Or building logistic parks is among those large scale projects that aim more efficiency improvement in modern logistic market (Yuzhou & Bin, 2010). Focus on such issues from the public and diverse stakeholders weights additional pressure on governments and related organizations to endow with more precise and promoting evident policy with regard to the project appraisal selection in governance structure (C. N. H. Doll & Balaban, 2013). If appropriately developed and fit in place, it can turn into a beneficial way of inflating responsiveness amongst policy and decision-makers who in general have a tendency to follow developmental objectives at the cost of the environment. This will also lead to enhancement of public investment appraisal. Planning appropriate infrastructure is favorably prioritized, whereas the environmental affairs are regarded to be of less significance (C. N. H. Doll & Balaban, 2013). New investment effect will

remarkably rely on the level, which capital spending points at relieving holdups or bottlenecks in the present network (Sanjeev Gupta, 2011). In addition, Bom and Ligthart have investigated on public sector investment output elasticity, the percentage variation in output for any percent variation in entire inputs, using meta regression analysis (Bom & Ligthart, 2014). Therefore, capital spending or funding choices contend with the means that funds elevated in economic market are connected in effective actions to get the business or project's general objective; Götze states in other words that the amount of investment that is required is directly proportional to the resources which have to be invested (GöTze Uwe, 2008).

Based on the above argument, it is crucial for authorities to have a precise overview of the financial resources that need to be invested in project since it is one of the important aspects of public investment decision-making process. To overcome such issues discussed highlighted in the above discussion and to control the financial aspect of public projects as well as the effects on both macro and micro level of economy and/or society, governments started to implement the cost estimation practice in early phases of the projects. There are different cost estimation methods that governments follow in order to have a ground to put their decision on. Even though the estimation in the early phase of project contains considerable uncertainty, it plays a significant role in decision-making process for choice of public investment from economic and socio-economic perspectives. It is quite interesting to look upon different practices in cost estimation in early phase of project and to compare them for different countries. Therefore, this report looks upon four countries, Germany, Iran, South Africa and Australia for their cost estimation practices in early phase of project before budget sanction. In order to address the mentioned objective for four selected case studies, this report selects the Norwegian appraisal model and cost estimation process, QA1[1] and QA2[1], as reference. Selected case studies have been modeled based on the Norwegian appraisal method, which makes the comparison and addressing the research questions more convenient.

1.2 RESEARCH PURPOSE

The aim of this report is to present and to compare the governance models of public investment project in the early phase with focus on cost estimation and user involvement aspect of such models for selected case studies, Germany, Iran, South Africa and Australia, in comparing with Norwegian governance model as reference. The intention for writing this report is to find out differences and commonalities for cost estimation and user involvement in early phase of public projects for selected case studies with respect to reference model as well as better understanding of frameworks differences and their effects on projects through comparison and modeling of the project life cycle and governance framework. The reason for modeling is, first, to make the systematic comparison more convenient. Second, to make all

[1] *Quality Assurance gate ways*

the selected case studies have the same project model as the reference model, and third, to better understand the connection between different phases and methods of user involvement as well as the effect of governance framework in early phase throughout cost estimation process. Therefore, to achieve both objective and goal, this report aims to address the following research questions:

- How is reliability achieved in cost estimate through early phase of public projects?
- How is cost estimation carried out in each selected country in early phase of the public project (the procedure or model)? How the cost estimate is controlled?
- How is user involvement in the cost estimation procedure in early phase of public project in each selected country?

In order to have a comprehensive cost estimate standard in early phases of public projects, it is essential to carry out such studies like this project work since the result of such comparison can contribute to better understanding of differences between cost estimation practices, and better understanding of relation and effect of governance framework on this aspect of project in different countries, which is essential for contributing to the process of developing comprehensive cost estimate practice in early phases of public project investment. Therefore, the research questions will be addressed to in discussion chapter of this report based on the information gathered and extracted from reliable and valid resources in order to fulfill the purpose of this report.

1.3 LIMITATIONS

Some of the limitations in this report is the inappropriate access to the cost estimation techniques for the selected case studies. The access to the exact procedure of cost estimation could be fulfilled; however, the effect of cost estimation on the decision-making output could not be verified precisely. Additionally, most of the documents and standards in cost estimate were not freely available for public access. For instance, in the German case study, the standards which are used for cost estimation are not freely available for public access, the same applies to the Iranian case study. Therefore, other methods such as interview with former government employees and discussion with supervisors were one of the sources to gather the required information. Another limitation is that the majority of literature investigates and discusses the factors affecting the cost estimation process and performance of cost estimation models; Only few articles look into the differences between the cost estimation model in different countries.

This project work is mainly based on literature study but also contains some information collected through interviews. Selecting specific government organizations or infrastructure sectors was in order to address the research question and to be able to understand the comparison of different cost estimation

models. Focusing on specific organizations for selected case studies in public investment limited the achievement of general cost estimation model. In addition, the time factor was another limitation in this project work, so that the introduction of all literature related to the topic in the report was not possible. Lack of more interview with former employees of different government organizations, which could help to achieve more general model and more detail information regarding the procedure and relation that might affect accuracy level of cost estimation output in decision-making.

1.4 STRUCTURE OF REPORT

This master project report is devided into six main parts: 1) Introduction, 2) Methodology, 3) literature study and basic concepts, 4) Result, 5) Discussion, and 6) Conclusion. In chapter 2, the methodology tracked and employed for gathering information in order to address the research questions of this master project work is explained. Further, in chapter 3, literature studies and basic concepts such as definition of project management, project life cycles, and project modelare briefly introduced. Moreover, different perspectives on user involvement, governance, project governance and cost estimation in projects have been explained in order to address the research questions.Chapters 4 and 5 summarize all results from literature, case studies and interviews regarding the cost estimation that have been gathered for each selected country and presented separately. The following chapter, chapter 6, addresses the research questions by utilizing and implementing the concepts and information presented in both chapters 3 and 5. Finally, chapter 7 draws conclusion and presents the main message and founding of this master project work as well as the relevancy of those findings to the report objectives. Figure 1.1 (below) demonstrates the structure of this master thesis report.

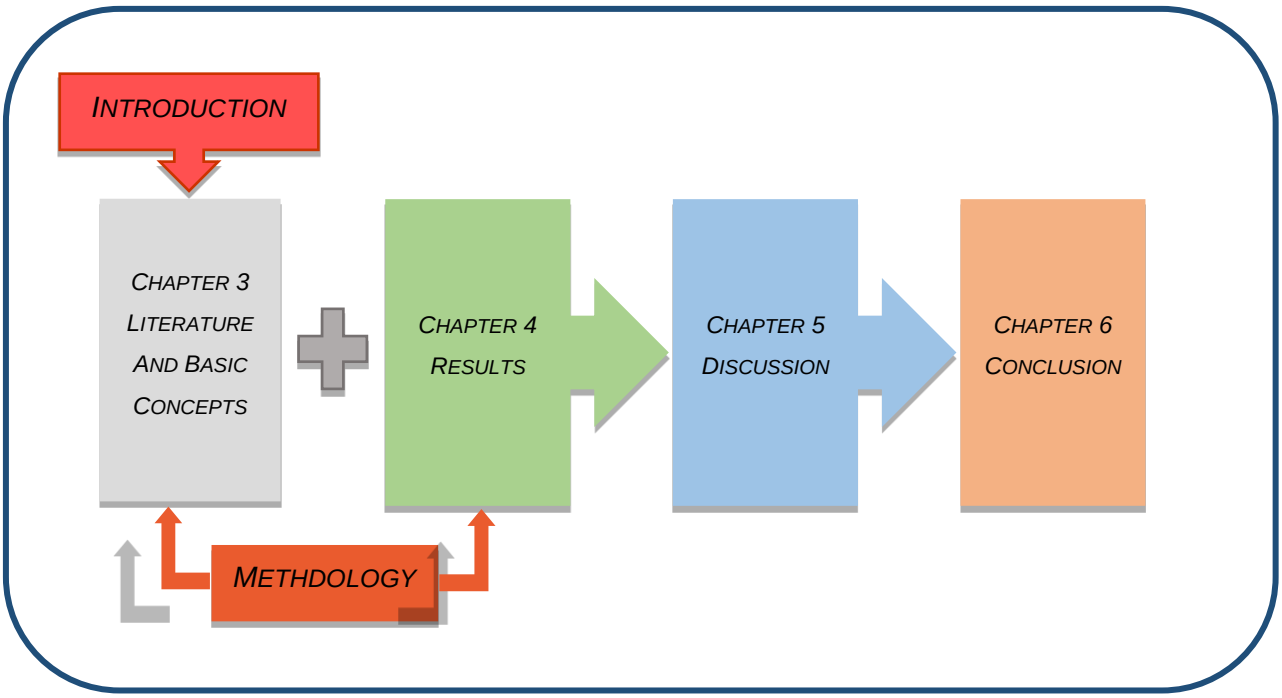

Figure 1.1- Master thesis report structure

CHAPTER 2 - METHODOLOGY

This chapter intends to discuss the methods utilized for this project work and what is relevant to it to employ in addressing the research questions in chapter 1, which is pointed with respect to the cost estimation in public projects. In addition, it presents the different methods and approaches in finding sources of information for the study of cost estimation practice in early phases of public project.

This chapter emphasizes the main methodological questions of this project summarized in the present report. As this master thesis project studies the cost estimation model commonalities and efficiencies rather than statistical perspective of cost estimation (i.e. cost overrun, factors affecting cost overrun, etc.), it is apparent that the foremost method that suits to be applied in this project work is a literature review. This research type helps to get a framework of theories, ideas, and concepts, which are lined up with understanding of cost estimation, cost estimation techniques and its components that can be applied in project cost estimation. In addition, snowball technique for finding relevant resource has been used for gathering more relevant information. However, there is also a necessity to supplement it using modeling techniques, to acquire required comprehension and outline of cost estimation procedure in the early phase of public projects in selected case studies. In order to fulfill the objective of this report, which is mentioned in the previous chapter, the following research methods will be applied:

- Literature Study and interview,
- Data collection (case review and discussion),
- Data Analysis,
- Discussion.

Therefore, the design of this master thesis project can be described by the following main steps:

1. The selection of case studies was established based on previous project report, "*Public Investment Appraisal Efficiencies Models and Commonalities",* which investigated the governance framework for decision-making process and quality assurance of the public project in early phase in the selected case studies. After having met the project supervisor, the idea of background diversity in selection case studies was due to the fact that the continent and government structure diversity would give a better result in the comparison of quality assurance system in early phases of project. Moreover, it can contribute to enhancing the comprehensive quality assurance regime in public projects with respect to understanding the differences in quality assurance regime and decision-making process.

2. This master thesis report will go through different resources for theoretical views, as it is essential to set up lucidity of the theoretical structure related to selected case studies, including the cost estimation principle and its components, project models, as well as their backgrounds. The resources (journals, articles, books, etc.) for gathering the required information have been selected with respect to their scientific approval and validity. Also, concerned attention is put to the quality of the selected resources. Hereby, the first platform for starting research for required information was Oria, the NTNU library platform, and Google scholar. Through these two platforms, the access to considerable databases such as SCOPUS (Elsevier) and Web of Science (ISI), ABI/INFORM, JSTOR, PROQUEST, etc. was possible. Followed by high quality journals such as IJPM, JCME, JCEM, JME, IER, PMJ, HBR, JESTP, etc. and useful hints from project supervisor, Professor Nils Olsson, are used for searching the related key words (cost estimation, cost estimation model, user involvement in the project). The review of cost estimation literature and models covers concepts, frameworks, and strategies, which are necessary to address the research questions in the discussion.
3. After reviewing the cost estimation literature and defining the basic concepts required for this study, the information gathering for selected case studies started. The first and the most reliable source of gathering information regarding the cost estimation practice in public project were official government websites and reports related to the public projects. However, for all selected cases there was no detailed and precise transparency in cost estimation process, rather it was possible to model the outline of process for all countries. Moreover, in two cases, Iran and Germany, there was a need to interview former employees of government ministries or organizations in the selected sector to obtain the required information. Regarding the Iranian case study, this was due to the lack of availability of precise public information regarding the cost estimation process. In the German case study, the availability of the cost estimate procedure in German language made the interview more convenient in gathering the required information. The sample of phone interview questions is presented in the APPENDIX-I. Despite these two cases, the required information for other two selected case studies could be obtained from official government websites and scientifically approved articles.

4. 4. Norwegian appraisal model selected as the base model for comparing the selected case studies. This is due to clarity of the Norwegian appraisal model both in cost estimation and user involvement in early phases of project. Since this model consist of two QA, and the structure and contribution of them are clearly present. In addition, the credibility of this model

has been verified through several studies. For instance, several authors find it more credible to consider this model as a base model for comparison (Christensen, 2011; Knut Samset, 2005; Odeck, Welde, & Volden, 2015; Olsson, Austeng, Samset, & Lædre, 2004). Therefore, the selected case studies have been modeled based on the reference model in order to make comparison more convenient. Several justification such as administrative diversity, quality assurance, and user involvement as well as approach diversity in cost estimation practice could be identified from the model comparison of selected case studies. The structure followed for this research is showed in the Figure 2.1

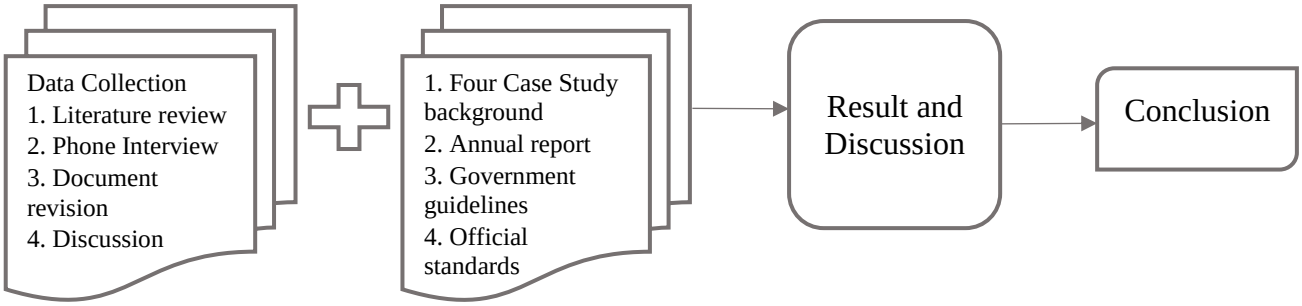

Figure 2.1 - Research structure

CHAPTER 3 – LITERATURE AND BASIC CONCEPTS

This section demonstrates and describes the necessary literature and basic concepts required to address the stated research questions in chapter 1. Therefore, this chapter is partitioned into some sections that are related to the objective of this master thesis. The described concepts in this chapter aid to link the contribution of project management concept, user involvement and governance concept to the cost estimation practice in early phases of project.

Therefore, a brief introduction of the concept of project management, effectiveness and efficiency build the starting point of this section. Further, the literature review on governance, cost estimation and its components as well as user involvement in the project will provide satisfactory ground for discussing the obtained results in discussion part of this report.

3.1 PROJECT AND PROJECT MANAGEMENT

3.1.1 PROJECT

Based on the available literature, there are various verified sources that define the word "Project" differently. The uncited source Wikipedia describes the root of the word Project from Latin word '*Projectum*' derived from the verb '*Proicere*', which means before an action.Kerzner insists that understanding project is essential requirement for understanding project management (Kerzner, 2013). He defines project as series of activities and task that are multifunctional and characterized by start and end dates, and have funding limit and specific objective to be completed within certain specification as well as utilize human and non human resources (Kerzner, 2013). Levine's definition of the project is also based on the same characteristics as Kerzner's. Project is a temporary endeavor undertaken to create a unique product, service, or result (Pinto, 2013; PMI, 2008). On the other hand, Tayntor defines project by a set of adjectives such as *unique*, *finite*, *multiple*, and *specific* that makes a distinction between project and other activities (Tayntor, 2010). In addition, Newell and Grashina define the project by comparing it with production activities based on the project's time restrain, unique product, and service (Newell & Grashina, 2003). Moreover, Lewis bases his definition of project on the quote from *Dr. J.M Juran*[2]*:,A project is a problem scheduled for solution',* and describes the project as problem solving technique, which deals with both negative and positive problems (Lewis, 2011). Roberts also, states that the project is the management vehicle in providing something that directs the benefits recognition (Roberts, 2012).

[2] Reformer in Quality, Quality Management and Management theory.

Samset defines project as a focused undertaking where the primary objective is to produce a number of agreed outputs within a specified time frame (Samset, 2010).

The above discussion clearly indicates that the majority of textbooks and scholar articles has consensus about the three main restraints of a project: *cost, time, and scope*. The above argumentation evidently demonstrates the necessity of iron triangle concept, which describes the mutual relation between these three project restraints. The Figure 3.1 (below), demonstrates this iron triangle concept. Lewis argues that, due to the interrelation as well as mutual relation of these three constraints with respect to each other, it is challenging to assign arbitrary values to them (Lewis, 2011). The way of achieving quality in project is also lying in balancing these restraints (PMI, 2008).

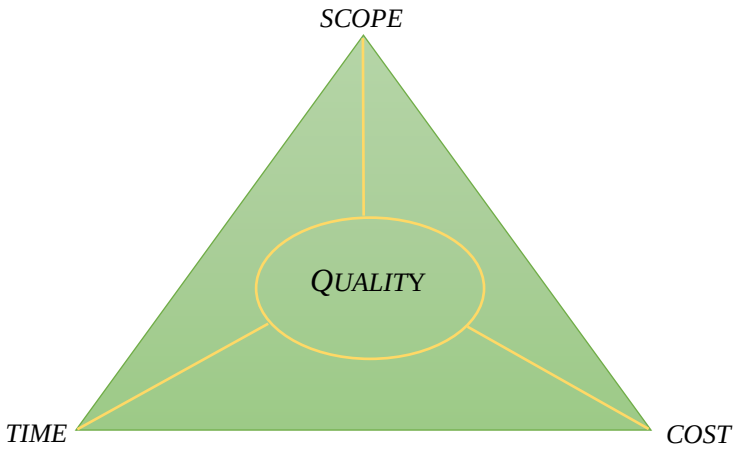

Figure 3.1- Iron triangle (Lewis, 2011; Pinto, 2013; PMI, 2008; Turner, 2014)

3.1.2 PROJECT MANAGEMENT

The most referred to definition of the term "project management" (PM) is the one given by PMBook, which is the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements. (PMI, 2008). In line with PMBook definition, Lewis adds another angel to it and states that mentioning PMBook processes is not sufficient to address the essence of PM (Lewis, 2011). He rather believes that PM comprises dealing with political issues in terms of negotiation for scarce resource and achieving required level performance from team members (Lewis, 2011). However, there are many diverse perspectives on the definition of project management in literature studies. For instance, Smith defines the project management as a means to leads all the factors that are essential to achieve the objective as well as those that will hamper the development (Smith, 2002). In line with this concept, Levine describes and distinguishes PM as other routine management by different way of management, measurement and control systems included in the tasks (Levine, 2002). Moreover, Thomsett states that

a person who can put together the definitions and control elements and operate them efficiently is a project manager (Thomsett, 2009). On the other hand, Wysocki describes PM in terms of client involvement, sponsor's needs, and business value (Wysocki, 2013). He argues that PM is an organized common-sense approach with use of appropriate client involvement to meet the sponsors' needs and to provide expected incremental business value (Wysocki, 2013).

3.1.3 PROJECT LIFECYCLE AND PROJECT MODEL

The most acceptable approach to describe the concept of project life cycle is the one given by PMBook. It defines the project cycle as a collection of generally sequential and sometimes overlapping project phases (PMI, 2008). It refers to the stages of project's development (Pinto, 2013), whereby, based on the sector and project complexity, the sum of phases varies. In line with the same concept, Heldman states that progressing of the project's collective phases in concert is known as project lifecycle (Heldman, 2004). Lester slso describes this concept in terms of control system and decision stages, as a result of which the project position is assessed and can be reviewed (Lester, 2006). Life cycles are significant because they present the logic that governs a project (Pinto, 2013).

PMBook describes that any project can be structured based on the following life cycles structure, regardless of its size and complexity level as shown in **Error! Reference source not found.**.

- **Starting the project**	- **Carrying out the project work, and**
- **Organizing and preparing**	- **Closing the project**

Table 3.1 - Life cycle structure characteristics (PMI, 2008)

PMBook also suggests that the mapped life cycle structure based on the above comprehensive attributes should also demonstrate the characteristics showed in Figure 3.2 (below).

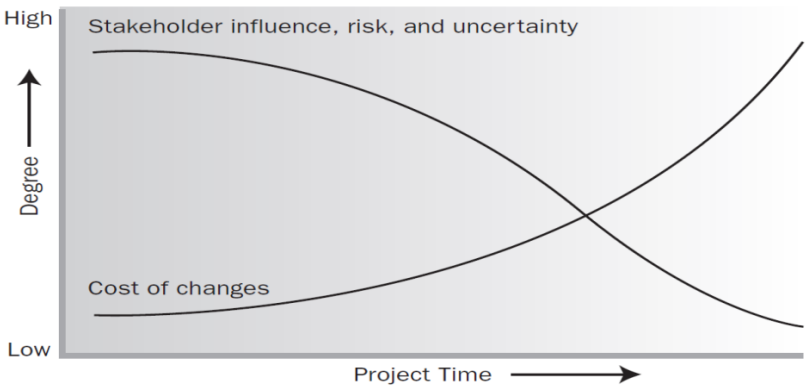

Figure 3.2- Impact of variables on project (PMI, 2008)

Based on the given discussion and the comprehensive characteristics of project life cycle described in PMBook, the project life cycles can have different levels and number of sub activities according to project characteristics (size, complexity level, industry type, public or private, etc.). Therefore, different models can be designed to map the life cycle. In this regard, the most typical project model is presented by Pinto (Pinto, 2013), based on PMI (PMI, 2008), where life cycle is presented based on the four individual phases shown in the Figure 3.3 (below).

Figure 3.3- Project life cycle (Pinto, 2013)

The description of activities given by Pinto in each phase can be briefly described as follows (Pinto, 2013):

- *Conceptualization:* Development of initial goal and technical specification for a project,
- *Planning:* Developing detailed specifications, schematics, schedules, and other plans for project,
- *Execution:* Actual work of the project is performed,
- *Termination:* Delivering completed project to client and resources reallocated.

However, there are other ways of mapping projects, for instance, Lester presents three different project life cycle based on BS 6079, MoD, as well as APM, and argues that each organization ought to develop its own life cycle structure to meet its specific need (Lester, 2006). The sample model presented by him is shown in the Figure 3.4 (below).

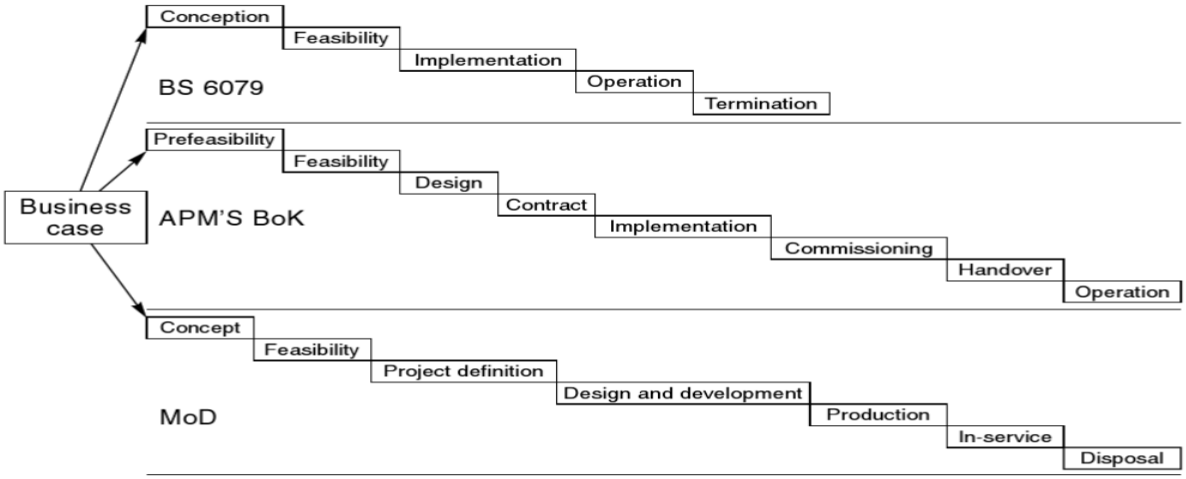

Figure 3.4 - Different Project life cycle (Lester, 2006)

Lester suggests that the term life cycle should be replaced by program life cycle since it spans over full program of the deliverable (Lester, 2006). He suggests that project life cycle includes those activities which form a project in program. On the other hand, Samset defines the project life cycle, as shown in Figure 3.5 (below), based on three perspectives (contractor, users, and commissioners) available within the project (Samset, 2010). He suggests that the project can be formulated in the following three phases, namely *front-end phase*, where the final decision in relation to fund allocation will be made, *implementation phase*, at which project outputs are produced, and *operational phase*, where the outputs of project are accomplished.

Figure 3.5 - Project Life cycle (Samset, 2010)

Based on the above argumentation, all presented models satisfy the comprehensive characteristics that are pointed out by PMBook for project life cycle mentioned earlier. The number of sub-activities in each phase can vary depending on the project characteristics (size, complexity, project goal, project purpose), and more important, the organization requirements of the project, which is emphasized by Lester (Lester, 2006), as well as the type of the project (technical, IT, R&D, etc.). Hereby, this master thesis selects the model presented by Samset (Samset, 2010). Since this project work is focused on cost estimation in the early phases in public project (i.e. before budget decision-making), and as Norwegian appraisal model is similar to the selected model, and the clarity of user perspectives in each phase as well as well as documented studies related to the model. Therefore, the project model by Samset, shown in figure 6 (Samset, 2010) can be regarded as the most suitable one for this study. The significant relation of selected project model to this study is the front-end phase, as Samset describes this phase being related to activities before allocation of fund to the project, which in other word can be referred to as before budgeting.

As mentioned earlier, the activities in each phase can vary depending on the project type. However, in this paper the project model presented by Samset, which is the base for Norwegian appraisal model, has been expanded and modified based on the model presented by Klakegg (Klakegg, 2010). It is shown in the Figure 3.6 (below). This model has been chosen as reference in modeling the selected case studies. As shown in the figure, the Klakegg project model has totally six activities, which can be fit into the model for project life cycle presented by Samset . The decision gates (DG) are presented in the model at

the end of different activities and phases in project. These decision gates are referred to in different names such as *gate review*, *stage gate*, *phase exits*, or *kill points* (Heldman, 2004; PMI, 2008).

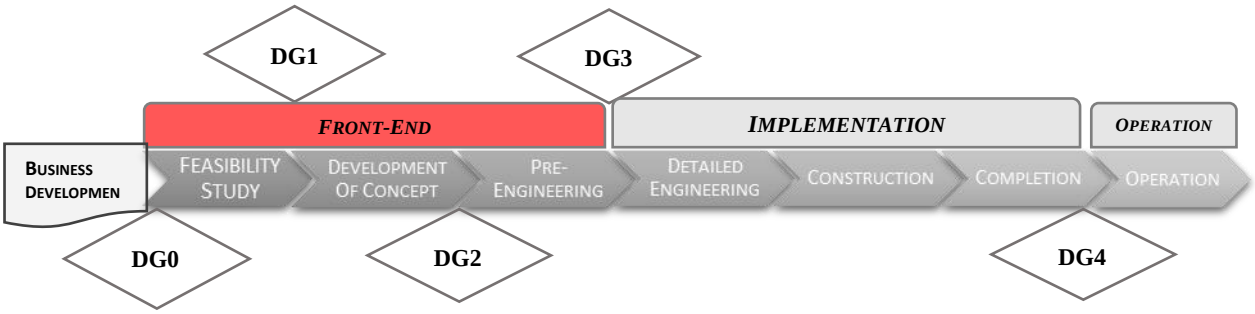

Figure 3.6 - Project Model and life cycle (Klakegg, 2010; Samset, 2010)

The focus in this paper lies on *Front-End* of the project and the activities associated with this phase of the project regarding the cost estimation practice, which fits best for the purpose of this study. Therefore, the implementation and operation phases of project life cycle are excluded from study, only the phase marked in red and its associated activities are taken into account for this study. Figure 7 illustrates selected phase and its activities as well as the reference model for comparison of relevant case studies.

3.1.4 UNCERTAINTY, COST, FLEXIBILITY, AND STAFFING THRPOUGH PROJECT LIFE CYCLE

There are many factors which have an impact on the project throughout its life cycle, but only certain categories of these factors (cost, flexibility, staffing, and uncertainty) are vital for taking into consideration in the beginning of any project. For instance, Figure 3.7 (below) explains the effect of cost and staffing levels throughout the project lifecycle. As illustrated in this figure, the costs and the level of staffing vary significantly: they increase from early phases in project up to the middle of implementation, which is directly proportional to the required level and number of activities needed to be performed. Later on, the cost and staffing level decreases as the project reaches the closure phase.

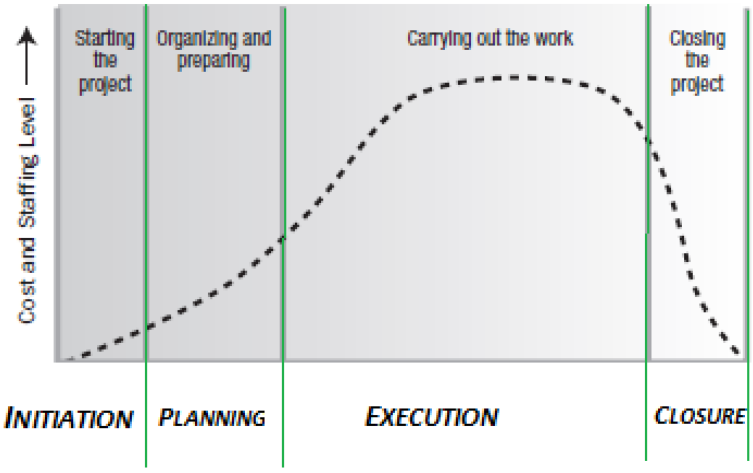

Figure 3.7- Staffing and cost behavior in project life cycle (PMI, 2008)

Moreover, the uncertainty and flexibility in the projects have to be considered, as shown in Figure 3.8 (below): While the uncertainty significantly drops throughout project life cycle as more information is available, the opinion on flexibility also cannot continuously be the same. It depends, first, on perspectives which appear to be related to the incentives faced by the stakeholders and ,second, the value and the benefit the stakeholders get from changes and late locking in project as well as the cost for those who have to adopt (Olsson & Norges teknisk-naturvitenskapelige universitet Institutt for bygg, 2006). Figure 3.9 (below) demonstrates the relation of flexibility and cost in project.

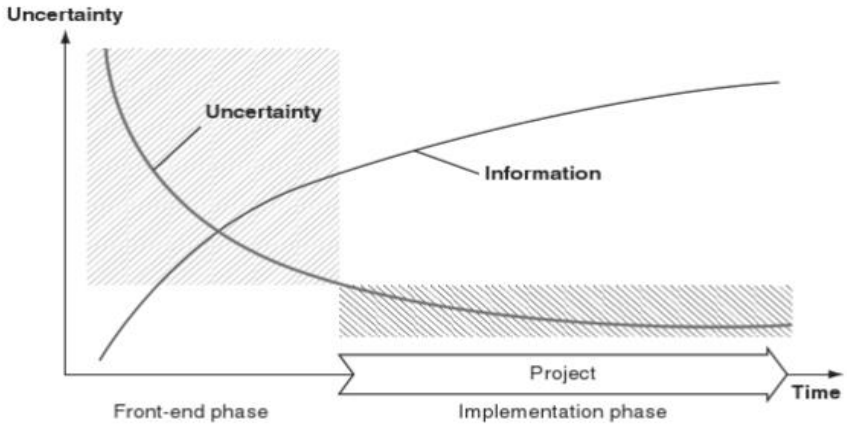

Figure 3.8 - Uncertainty thoughout project life cycle (Samset, 2010)

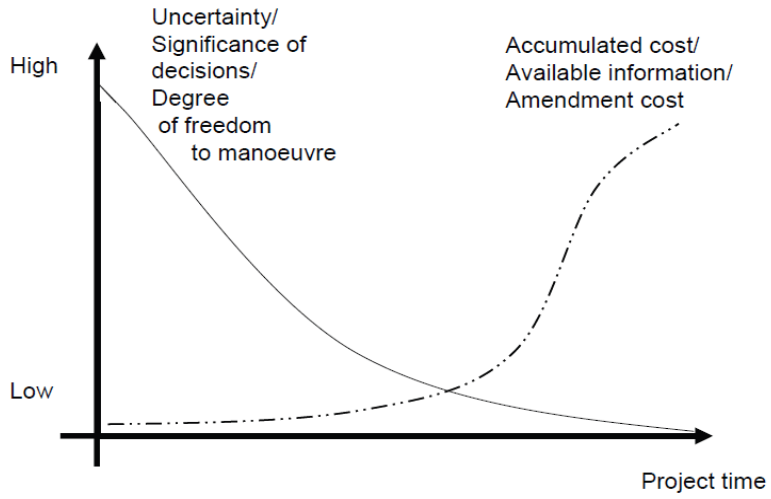

Figure 3.9 - Flexibility throughout project (Olsson & Norges teknisk-naturvitenskapelige universitet Institutt for bygg, 2006)

3.2 USER INVOLVEMENT

Recently, the enthusiasm of companies and academic attention have grown regarding the idea and effect of customer involvement (Lundkvist & Yakhlef, 2004). For instance, Foxall, Gales and Mansour-Cole describe user involvement as a way to strengthen the feedback loop between production and

consumption in management vocabulary (Foxall, 1989; Gales & Mansour-Cole, 1995). In line with this topic, Hippel and Rothwell point out the relevancy of user involvement and product conceptualization (Hippel, 1988; Rothwell, 1976). Nambisan also discusses the ideas extraction from user's mind (Nambisan, 2002). He argues that affluence and repetition of user contribution is seriously limited by structured inquiry mechanisms. Additionally, Wayland and Cole believe that concerns that work against consecutive and significance exchange with firms are logistical and economical (Wayland & Cole, 1997). Furthermore, Nambisan points out choice, location, and incentive as challenges that corporations encounter in entailing their users in a cost-effective way in the proper frame for obtaining knowledge and ideas of customer (Nambisan, 2002). In the event of these strains, Ali, Rahmat and Hassan found out that conceptualizing and putting into practice customer involvement is challenging (Ali, Rahmat, & Hassan, 2008). Kaulio additionally states that tacit realization of the customers without having reasonable infrastructure is not easy, even when organizations do well in pulling together large amounts of customer information (Kaulio, 1997). Following this, Leonard-Barton believes that understanding users' latent needs can be more suitable and appropriate rather in their own ordinary settings than in artificial settings (Leonard-Barton, 1995). He found out that linear and inofficial data is more beneficial than cross-sectional and formal data provided by structural inquiry tools (Leonard-Barton, 1995). Gales, Mansour-Cole and von Hippel clarify that rich social interplays and methods of communication as the information-processing method are essential for transferring implicit and tricky part of knowledge and information, which they believe to dominate in the literature on user involvement (Gales & Mansour-Cole, 1995; von Hippel, 1994). According to Lundkvist and Yakhlef, an information processing aspect of the user involvement leans towards diminishing users as conveyor of information, and it is merely matter of transferring that information from user to where it is needed (Lundkvist & Yakhlef, 2004). Williamson describes the user involvement as opportunity cost and actual financial costs that are linked with the time and energy involved in the development of any extrinsic relation (Oliver E. Williamson, 1981). Moreover, Simon states that the data quantity that human beings are able to process is limited by cognitive confines (Simon, 1976). In line with this, Allen and Tyre note that required quantity of user involvement ought to alter regarding the background is similar to the normative premise of the data processing structure and is founded on the supposition that, at the individual project-level, exchange of information is a key factor of user involvement (Thomas J Allen, 1977; Tyre, 1989). Moreover, von Hippel also found out that different forms of user involvement values are directly proportional to the task interdependence, information situation and foreseeability of project (von Hippel, 1990). Therefore, work division ought to make an attempt to diminish ambiguity from any source by collecting and processing further information (Galbraith, 1977). Gales and Mansour-Cole also state that uncertainty reduction and unique information are function of interaction with a significant set of potential users (Gales & Mansour-

Cole, 1995). In addition to this, Williamson states that it is the more required monitoring that causes the cost of multiple relationships to be high (Oliver E. Williamson, 1981). Harrison found out that organizational capacity of the other contributors and the anticipated level of political and technical challenges that might arise are the two factors in considering the contribution of any actor in project (Harrison, 2011).

As perceived from above discussion, Lundkvist and Yakhlef point out that adhesive and implicit information and perceptions cannot be separated from the social context in which they are generated (Lundkvist & Yakhlef, 2004). They argue that sending and receiving is not the only function of language, but communication and interaction to a great range involved in the creation of knowledge and information. This point of view regarding the role of language in overall, but also specifically the communication and exchange of views as a way of knowledge transfer and co-creation, has been highlighted by several researchers such as Davenport and Prusak (Davenport & Prusak, 1998), cited by Lundkvist and Yakhlef, von Krogh, Ichijo and Nonaka (Lundkvist & Yakhlef, 2004; von Krogh, Ichijo, & Nonaka, 2000). Likewise the language enhances our realization of how interaction, discussion and debate set up knowledge and meaning, Lundkvist and Yakhlef believe that communication and interaction is yet viewed as predominantly cognitive, coped with typical manipulation, withhold such queries as why users would be keen to reveal their perception, and take up to find a solution for a firm's problem (Lundkvist & Yakhlef, 2004). Nambisan views it from social point of view and states that user involvement affords contributors with an attached and recognition feeling quality (Nambisan, 2002). Mills emphasizes that users' motivation might originate from their impression that their effective contribution is essential to assure quality of outcome or service (Mills, 1986). On the other hand, the benefit of early user involvement in projects is pointed out by several researchers (Lingguang Song, Yasser MOhamed, & Abourizk, 2009). They suggest that early involvement of users in projects leads to better cost and performance management, improved collaboration, and better knowledge of development and performance measurement. Damodaran describes the user involvement level in three categories, namely *informative, consultative,* and *participative* (Damodaran, 1996). Furthermore, Wood argues that implicit knowledge of user comprises difficulties in understanding user requirements (Wood, 1997). Additionally, the difficulties between users and developers are considered, leading to the conclusion that ideally, all stakeholders should be motivated and users should be educated about the entire design process (Wilson, Bekker, Johnson, & Johnson, 1997). Following this, Grudin discusses the necessity of user involvement in understanding user requirements (Grudin, 1991). He found out that certain aspects of the interface and user involvement are undervalued in decision making in these organizations and that interface quality is readily compromised. Keil and Carmel demonstrate the link between the successful

project to customer and users involvement (Keil & Carmel, 1995). Chatzoglou and Macaulay also show that the user and documentation are inversely proportional to the number of iteration needed for the completion of the process (Chatzoglou & Macaulay, 1996). In this regard, Blackburn, Scudder and Wassenhove point out that improved productivity and faster cycle times depend on the level of time and effort investment in the early stages of project (Blackburn, Scudder, & Wassenhove, 2000). This reveals some initial evidence to the effect that an understanding of the user's world can lead to more innovations (Good, 1992). Kujala discusses the relation and the effect of user involvement's usefulness on system success and user satisfaction (Kujala, 2003). He concludes that even though the result of user involvement is positive, it is complicated. He argues that the main effect comes through intermediate factors such as better user requirements.

However, there are contradicting ideas with regard to user involvement as well. For instance, some authors argue that high user participation and even user orientation correlate negatively with the evaluated team effectiveness and quality of team interaction (Heinbokel, Sonnentag, Frese, Stolte, & Brodbeck, 1996). Moreover, it is demonstrated that participative approach to user involvement may have negative effect on the project (Wilson, Bekker, Johnson, & Johnson, 1996). The researchers emphasize that this negative impact is due to the communication difficulties between users and developers, and they conclude that users need to be educated regarding the actual meaning of the design. The authors argue that, when users are participating in the project, problem arises when users demand changes in a late stage of development or designers must resolve conflicts between user groups. In the event of this justification, Hawk and Santos found out that user involvement in the form of participation is a costly process that requires time and effort on the part of users as well as developers (Hawk & Santos, 1991).

The above discussion illustrates that, to sustain identical performance level, more and different types of information should be processed by managers in highly uncertain projects compared to those of low uncertainty (Tushman & Katz, 1980). Thus, early involvement of users appears appropriate, based on the condition that user involvement methods are developed further and the roles of users and designers are carefully considered (Kujala, 2003). However, the prevention of ill-effect on user through implementation and consequently through normal operation is the main consideration of the emphasis on user involvement (Damodaran, 1996). Throughout this paper, the definition of user involvement given by Tyre is used, which states the following:

> *User involvement is a communication process that facilitates exchange of information between developers and potential users about user needs and potential solution to problems* (Tyre, 1989).

3.2.1 FORMS AND MODEL OF USER INVOLVEMENT

There are different types how users can participate in the project. Damodaran describes three types of user involvement in the project, namely *Informative, Consultative, and Participative* (Damodaran, 1996). Figure 3.10 illustrates these different types and the key characteristics of these categories suggested by Damodaran. In addition to the presented forms of user involvement, an information processing model proposed by Gales and Mansour-Cole should be taken into consideration (Gales & Mansour-Cole, 1995). It is shown in Figure 3.11 (below). The authors argue that the model illustrates the logic for user involvement is performance progress base, and fundamental to the information point of view is the relationship dependent between uncertainty, information processing, and performance. Additionally, they state that given level of performance can be maintained if the information process increases as the uncertainty in the project does since the similar level of user involvement will not aid all the projects in the same way.

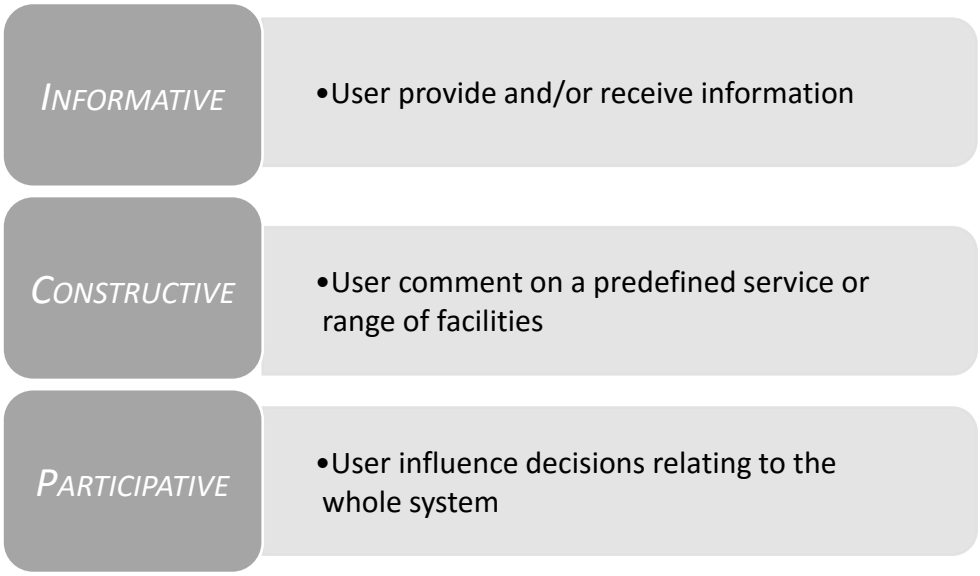

Figure 3.10 Forms of user involvement(Damodaran, 1996)

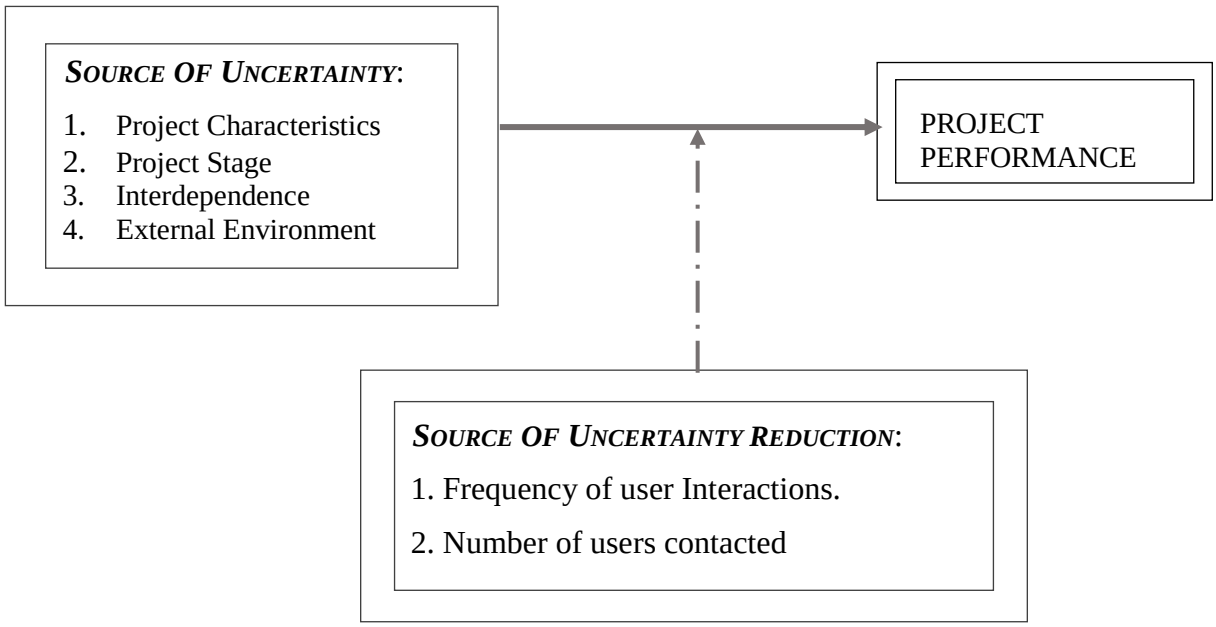

Figure 3.11 - User Involvement, an information processing model (Gales & Mansour-Cole, 1995)

However, as mentioned before, user involvement methods should be developed further, and the roles of users and designers must be carefully clarified (Kujala, 2003). Based on the proposed information processing model for user involvement by Gales and Mansour-Cole as shown in Figure 3.11 (above), it is necessary to have the infrastructure for user involvement in decision-making process which appears to be essential for both user involvement and application of information processing model. In order to establish such an infrastructure, among the diverse mechanisms of user involvement in decision-making process, Damodaran suggests six most common mechanisms, which are the following (Damodaran, 1996):

- Membership of steering/advisory committees,
- Memebership of design teams,
- Membership of problem solving groups,
- Consultation with individuals or groups,
- Prototypes/Simulations,
- Quality assurance procedures.

Moreover, as shown in **Error! Reference source not found.** (below), Damodaran points out the pros and cons of user representative involvement (Damodaran, 1996). He argues that user represntatives have the most challenging and demanding role in the project development. Therefore, the following characteristics are desireable for user represtatives in order to be involved in decision-making process:

- High level of interpersonal skills,
- Ability to preserve in difficult circumstances,
- Basic understanding of technical skills involved,
- Strong sense of mission.

PRO ATTRIBUTES	CONTRA ATTRIBUTES
- Involvement on exciting, leading edge development, - Offers a challenging, demanding, and potentially very poweful position, - Provides opportunities to influence the nature of the user on the whole organization, - Involves contact throughout whole organizational hierarchy, - Provides opportunities for learning a wide array of new skills and a broad knowledge base, - Provides considerable career advancement prospects, - Bridges the traditional barrier between users and specialist.	- Lack of clarity in the roles, - Occupies a 'no-man lands', between users and designers can be a lonely position to occupy, - Lack of understanding of the role on others part at all levels in the organization, - Expected to be knowledgeable in widely differing areas of experties, - Lack of power and authority, - Lack of support from line management and other users, - Can suffer from 'hostage syndrome', i.e. identification with the organization rather than 'championing' the users' interests, - Annual reports are likely to be written by project managers.

Table 3.2 - Pros and cons characteristics of user representatives involvement (Damodaran, 1996)

3.3 GOVERNANCE

The word 'Governance' holds a broad range of altered senses and meanings, and is employed in multiple notations referring to various prospect of social life (Turke, 2008). Business dictionary defines the governance as the establishment of policies, and continuous monitoring of their proper implementation by the members of the governing body of an organization (Dictionary). Furthermore, Bevir describes the governance as the process of governing (Bevir, 2012). He points out that governance is what government does to its citizens, and the same applies to the corporate and its employees (Bevir, 2012). He argues that there is a difference between government and governance. He further explains this distinction by referring to the government as the political institutions, and emphasizing that the ruling process, wherever it occurs, is referred to as governance (Bevir, 2012). Moreover, Hufty looks upon

governance concept from social aspect and describes it as the process of interaction and decision making among the actors involved in a collective problem that leads to the creation, reinforcement or production of social norms and institutions (Hufty, 2011). In addition, World bank defines governance as the means, wherein power is employed in the management of a country's economic and social resources for development (World). In line with this concept, Klakegg, Williams and Magnussen state that governance refers to the development of a structure or a system which cannot be imposed exteriorly, but is the consequence of the collaboration of a range of governing and each other guiding actors (Klakegg, Williams, & Magnussen, 2009). Accordingly, Rhodes describes governance as alteration in the context of government, relating to a novel governing process; or the novel way, which the social community is governed by (Rhodes, 1997). Additionally, Peters and Pierre describe governance as the application of public bodies and systems to develop the guidelines and plans that residents need (Peters & Pierre, 1998). Müller states that governance is the 'conduct of conduct', which is formed by self-regulating correlation among the forces within a society (Müller, 2009). He believes that governance theory is referred to two component, actors, who act in the system with their significances and individual point of view, and Institutions, which form the content in which actors behavior take place (Müller, 2009). Additionally, Stoker describes governance as generation of situations for ordered direction and collective action (Stoker, 1998). In alignment with this concept, Klakegg defines governance as the application of authorization frames, institutions and mutual aid to allot resources and proportionate or control activity in society or the economy (Klakegg et al., 2009). The author argues that the intention of institutional approach is to spot the diverse governance style that will help to entitle harmony of significant actors in society. Jessop explains governance as a complex craft of administering multifold agencies, institutions, and systems, which are both operationally independent from each other and structurally tied through diverse forms of reciprocal mutual dependency (Jessop, 1997). Hence, Kemp, Parto and Gibson look upon governance as the decision-making process in which authorities make decisions conforming to the rules (Kemp, Parto, & Gibson, 2005). The authors describe it as the way of taking actions throughout different forms of interplay or interaction. Cadbury also perceives governance as the holistic process and describes it with respect to its goal and function (Cadbury, 2002). According to his point of view, stakeholders' consensus to the degree that is feasible should be the goal, and generating sustainable success the main function.

The points of view mentioned above indicate that governance has diverse meaning, and one can grasp this concept in different approaches. Its progression to supremacy, root from the obstacles of classified coordination by firms or the state (Lessard & Miller, 2001). Klakegg points out that governance has multifaceted essence (Klakegg, 2010). He explains his point of view through modeling the governance

as shown in Figure 3.12 (below), and argues that the hierarchical nature of governance is visible within the organization levels definitions. He points out that the number of actors and links among them are the indication of its network nature, and emphasizes the importance of this network hub and its sub-nets since there might be different sub-nets (Klakegg, 2010).

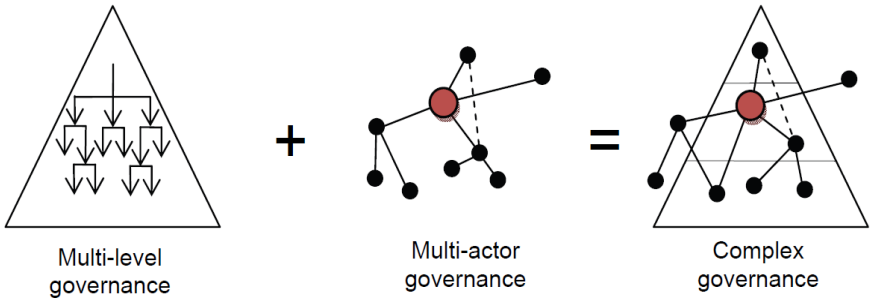

Figure 3.12 - Governance model (Klakegg, 2010)

Therefore, this report selects the definition for governance given by OECD, which states the following:

> *It refers to the formal and informal arrangements that determine how public decisions are made and how public actions are carried out, from the perspective of maintaining a country's constitutional values in the face of changing problems, actors and environments* (OECD., 2005).

The reason for selecting this definition in this study is its comprehensive nature and specifically the mentioning of*public actions*, which is related to the selected topic and objective of the report.

3.4 CORPORATE GOVERNANCE

The word 'corporate governance' follows a different concept than governance. In the following, a brief overview of this concept from different perspectives is given. Shailer describes corporate governance as procedures and affairs, by which organizations are administered and navigated (Shailer, 2004). O'Sullivan defines corporate governance as an arrangement, which forms such topics as who carries out decisions related to capital spending organization, what kind of capital spending is performed, and how revenues are distributed from capital spending (O'Sullivan, 2000). Detomasi describes corporate governance as a result of social, political and economic reflection (Detomasi, 2006). He emphasizes that corporate governance is nation specific, i.e. in his point of view, corporate governance structures and frameworks are diverse from one nation to another with respect to aim, frame, and utility. Furthermore, Jacoby describes it as rules and acts, in which directors or executives are kept accountable to whomever has a legal or lawful share in the organization (Jacoby, 2005). Therefore, the quality of corporate governance influences the price for organizations to access capital for growth and the

confidence with which those that provide capital directly or indirectly can participate and share in their value-creation on fair and equitable terms (OECD., 2015) (P10). Hence, Biesenthal and Wilden describe corporate governance as controlling and exercising authority in organization by means of set of rules, relationships, process and system (Biesenthal & Wilden, 2014). Council presents corporate governance as the way of impacting how institutional objectives are established and attained (Council, 2010). Likewise, some authors promote self-regulation in larger settings, without defining and assessing each action of institutional actor (Clegg, Pitsis, Rura-Polley, & Marosszeky, 2002). On the other hand, Müller defines corporate governance as governance within the corporate governance framework, i.e. value system, responsibilities, processes, and policies that allow projects to achieve organizational objectives and foster implementation, which is the best interests of all the stakeholders, internal and external, and the cooperation itself (Müller, 2009). This study selects the definition of corporate governance given by OECD, which is as follows:

> *Corporate governance involves a set of relationships between a company's management, its board, its shareholders and other stakeholders, it also provides the structure through which, the objectives of the company are set, and the means of attaining those objectives and monitoring performance are determined* (OECD., 2015).

The reason for selecting this definition is that it covers the aspects of organizational actors' relations to each other, and also describes the necessary framework for achieving organization's objectives.

The governance concept comprises some theories in order to make the concept clearer and to better understand the relations and linkages within this concept. These theories have been studied by various scholars(Coase, 1937; Davis, Schoorman, & Donaldson, 1997; L. Donaldson & Davis, 1991; T. Donaldson & Preston, 1995; Eisenhardt, 1989; Freeman, 2010; Jensen & Meckling, 1976; Kooiman, 1993; Mitnick, 1973; Müller, 2009; North, 1990; J. Pfeffer & G.R. Salancik, 1978; Ross, 1973). In this regard, Müller has described four theories as the governance theories, which are (Müller, 2009):

- Shareholder Theory,
- Stakeholder Theory,
- Transaction Cost Economics,
- Agency Theory.

In addition to these four theories, Pfeffer and Salancik proposes the theory called 'Resource dependence theory' (J. Pfeffer & G.R. Salancik, 1978), and further authors discuss the corporate members connections, which are referred to as 'Stewardship theory' (Davis et al., 1997; L. Donaldson & Davis, 1991). The detailed discussion of these theories is out of scope of this paper. However, a brief presentation of each theory in **Error! Reference source not found.** (below) can help to understand the

governance theory clearer and to address the research questions more convenient, since the governance and corporate governance can significantly help to understand the differences between the selected case studies' cost estimation frameworks.

THEORY	SUMMARY	AUTHORS
Agency Theory	This theory sees an organization as a correlation of groups or individuals in institution or firm. Players are viewed as reasonable logical economic players that behave and function in a self-seeking way. It deals with the possibility of contradiction of interests, which arise between stakeholders and managers of the organization. Cost and control orientation is the base for the governance frame. It might benefit interim or temporary outcomes.	(Mitnick, 1973; Müller, 2009; Ross, 1973)
Shareholder Theory	Maximizing return on investment of the shareholders is the main intention and assumption. This entails the organizational frame to ensure that managerial measures and functions are anytime in the best interest of the stakeholders.	(Freeman, 2010; Jensen & Meckling, 1976; Müller, 2009)
Stakeholder Theory	It considers and covers broader social responsibility of companies or corporations. It takes into consideration the interests of different stakeholders and develops corporate objectives by balancing the interests' contradiction. Hence, shareholders have a priority position in this theory.	(T. Donaldson & Preston, 1995; Freeman, 2010; Müller, 2009)
Transaction Cost Economics	Converting input to desired output through an individual transaction is the main attention. It means that institutes or corporations adjust or conform their governance frame to attain the lowermost feasible transactions costs. It presumes multifaceted affiliation among buyer and seller. Selecting specific transactions is also subject to the behavioral factors.	(Coase, 1937; Müller, 2009; Oliver E Williamson, 1979; Oliver E. Williamson, 1981)

Resource Dependency Theory	It says that in order to achieve organization's objectives, resources of corporate, both internal and external, can be ranked, obtained or developed, accelerated by directors of the organization.	(J. Pfeffer & G.R. Salancik, 1978)
Stewardship Theory	It describes connection and links between organizational members, wherein particular goals do not stimulate the managers, but more are agents or administrators those, whose incentives are arranged in line with the purposes of their principals. According to this theory, faith is the core for governance frame in order to develop the long-term corporation's efficiency.	(J. Pfeffer & G.R. Salancik, 1978)

Table 3.3 - Governance Theories: Summary

3.5 QUALITY ASSURANCE

According to American society for quality (ASQ), quality assurance (QA) is the planned and systematic activities implemented in a way that requirements for a good product or service are fulfilled (Quality). Accordingly, several authors describe it as a procedure to ensure sufficient quality in the project development process, to manage and resolve concerns that might evolve throughout the project (Christensen, 2011; Samset, Berg, & Klakegg, 2006). Correspondingly, O'Leary, as cited by Shiferaw (Shiferaw, 2013), explains it as procedure to assist joint decision-making by delivering an independent point of view of the project's conforming with primary agreements and development alongside a plan. Therefore, Shiferaw concludes that it is a framework arrangement to ensure that entire correct, proper and relevant questions have been raised in order to originate significant questions and develop their answers in the process (Shiferaw, 2013). Hence, Garland characterizes QA process as information dependent (Garland, 2009). In this regard, Miller and Lessard point out that qualification through QA system requires any project initiatives to answer concerns such as customers and opposite parties' value, distributing generated value appropriately, different options, estimation of market, finance source, and risks associated to project (Miller & Lessard, 2007). In the same context, the Office of Government Commerce points out that QA ensures successful development of projects to the later step through assessment of projects at significant decision points in their life-cycle (Office of Government Commerce, 2007).

3.6 COST ESTIMATION

A cost estimate is the means intended to predict the overall expected costs (Uher, 1996). Estimates are always uncertain; uncertainty is baked into the very definition of this word (Armour, 2014). Business dictionary defines cost estimation as an approximation of the probable cost of a product, program, or project that are computed on the basis of the available information (Dictionary). Looking upon different literature studies helps to understand the meaning of the terms 'cost' and 'cost estimation'. Manegold describes cost as a general term that jointly relates to the various goals or objective (Manegold, 2009). He explains the term 'optimization' as obtaining the best or no less than a practically good between the similar other plans. Later on, he discusses that cost estimation relates to the assignment of foreseeing or expecting the cost of a provided query execution plan (QEP) a priori, i.e. with no concrete assessment of it (Manegold, 2009). It is a prediction that is based on the information known at a given point in time (PMI, 2008). It facilitates a realistic budget reference for the project and helps to find required project resources (Pinto, 2013). On the other hand, Carr describes cost estimation as a means to provide some information in decision-making process (Carr, 1989). He discusses that, to perform a project, producing a statement of the approximate quantity resource is essential. He calls this approximate statement as an estimate, whose aim is to supply information to decision-making process (Carr, 1989). Another researchers also indicate that the aim of estimating is to create prediction (Azman, Abdul-Samad, & Ismail, 2013). They believe that there should be a referral point to evaluate the assessing performance. Furthermore, there have been researches that look upon the factors that affect development of cost estimation during the early phases of projects. For instance, Hicks states that pitfalls in cost estimation are caused by the absence of identification of the extent and complication of the task and the necessary actions to the successful solution of the problem (Hicks, 1992). Accordingly, Doloi argues that cost overrun is a old obstacle within most projects (Doloi, 2011). He found out that project inception stage, political and legislative factors play considerable roles in the business case development. According to his point of view, compliance and environmental matters are realized to be vital in affecting cost performance in projects (Doloi, 2011). In this regard, Azman together with further authors points out that the appearance of overestimation stems from government directive instruction, which can challenge the logic of accurate estimate (Azman et al., 2013). They argue that the cost estimate preciseness may progress if adequate design information, appropriate cost planning and enhancing usage of old data cost exist. They believe that steady development for pre-design projects particularly in cost-estimation directs to additional value of the government's money. On the other hand, Ogunlana and Thorpe suggest that cost estimating precision is recognized to progress with the project progress (Ogunlana & Thorpe, 1991). They found

out that project type, size, geographical location, market conditions influence the precision attained in cost estimating. In line with this, Akintoye and Akintola studied the factors that influence project practice (Akintoye & Akintola, 2000). They found out that there are seven categories, which are the main contributors in cost estimate practice, namely project complexity followed by technological requirements, project information, project team requirement, contract requirement, project duration, and market requirement. Another authors investigated on uncertainty as containing interference and variability (Bennett, Ormerod, & Management, 1984). They described interference as external factor, which influences the project and interrupts effort on certain tasks. Venkataraman and Pinto describe the reason for low initial cost estimation as a consequence of underestimating the extent and complication of the task to be carried out (Venkataraman & Pinto, 2010). Magnussen's and Olsson's studies demonstrate that introduction of quality assurance regimes leads to systematical decrease in difference of the proposed cost estimation in the public projects (Magnussen & Olsson, 2006). Thus, one reason for the lack of accuracy in early design stage is caused by the lack of information from designers (Azman et al., 2013).

Moreover, Bertisen and Davis studied the bias and error in capital cost of project (Bertisen & Davis, 2008). They found out that both bias and error are contained in the capital project cost, and they argue that the bias is intentional due to the competency in market for financing the projects. In addition, Bock and Trück studied the indirect cost estimation practice (Bock & Trück, 2011). Their finding is that the particular and independent decision-making processes comprised in these tasks are described by qualitative data and information that is ambiguous and makes it hard to quantify and organize. Following that, Skitmore and Wilcock investigated on estimating processes in construction projects (Skitmore & Wilcock, 1994). They pointed out that not sufficient is realized about factors comprised in cost estimating in practice. Hence, Armour describes estimation as ranges of uncertainty (Armour, 2014). He argues that the range, to which demands and necessities are uncertain, is about the identical range, to which an estimate is uncertain. Furthermore, he emphasizes the capability to entirely outline the necessities and demands up-front, however, he suggests that in most cases we probably should not try it (Armour, 2014). Ubbels and NijKamp found out in their study that the inflation effect was evidently huge in investigated projects (Ubbels & NijKamp, 1998). They discuss that changes in projects are one of the main reasons for imprecise cost estimation. Flyvbjerg and other researchers have done most of the contribution regarding the cost estimation in projects (Flyvbjerg et al., 2004). They tried to describe the reasons for project cost overrun. The researchers found out that the duration of implementation phase is directly proportional to the cost increase. Additionally, they argue that considerable risk of cost increase can be the consequence or result of lagging and long implementation time. They highlight that risk of cost

increase for all projects can be high regardless of their size and type. In the same context, Jørgensen and Wallace studied the link between managerial flexibility and cost estimation in projects (Jørgensen & Wallace, 2000). They found out that project manager flexibility throughout the project life cycle, in practice, plays a considerable role in improving the cost estimation accuracy. They concluded that the lack of considering managerial flexibility results in pessimistic estimation (Jørgensen & Wallace, 2000). Mastilak also investigated on the effect when, the classification of costs into cost pools affects the precision of individuals' understanding of correlation among costs (Mastilak, 2011). He found out that the cost pool classification affects the accuracy of judgments about cost. He explained that cost pool directs the user attention more towards relations within pool and not those that cross cost pool (Mastilak, 2011). Finally, he concluded that the cost pool classification results in over-looking across relation of pools and is a plausible cause for cost estimation imprecision (Mastilak, 2011).

The above discussion indicates that the literature on cost estimation is mostly focused on the factors affecting cost estimation practice and the reasons causing cost escalation in the projects. Hence, in order to overcome such obstacles and minimize the effect of such factors in cost estimation, there is a need to identify the suitable cost estimation model that can minimize such effects on cost estimation practice.

3.6.1 COST ESTIMATION MODELS

As mentioned in the previous section, the need for identifying suitable cost estimation model is evident. In this regard, Liu and Napier have studied the accuracy of the risk-based cost estimating for a water infrastructure project (Liu & Napier, 2010). They argue that, the risk-based estimating (RBE) is capable to prevail over the two main cost overrun factors, namely strategic misrepresentation and optimistic bias. They found out that those projects that apply RBE have better estimation accuracy compared to those that applied traditional method. Moreover, regarding the budget, RBE-based projects are under the budget, while the traditional estimation has led to overrun of the budget. Finally, the researchers highlighted that outside view/collective experience, attention focusing and probabilistic, bottom-up modeling are the three key performance drivers for RBE method (Liu & Napier, 2010). On the other hand, Hyari presents a conceptual cost estimation (CCE) model (Hyari, 2015). The researcher argues that the data sensitivity of CCE model is due to the fact that it is based on artificial neural network (ANN) technique. However, the findings of the study indicate that the model is able to provide the reliable cost estimation in the early phase of the projects. Hyari suggests that the aims of such model are facilitating capital spending decision making at the conceptual stage, budget ascertaining, and predicting the likely cost. Similarly, Uher studied the probabilistic cost estimating model (Uher, 1996). He argues that probabilistic method, hence, presents the idea of risk management into cost estimating, and points the

estimator to evolving the highly effective and satisfactory degree of risk in cost estimate. In addition, Rad describes the estimation models that are usually followed in projects (Rad, 2002). The brief description of some models is summarized in **Error! Reference source not found.** (**Error! Reference source not found.**).

MODEL NAME	DESCRIPTION
Parametric Model	Uses historical data as the basis of the model's predictive features. It calculates the dependent variable of the cost and duration based on one or more independent variables. The utility of this model is dramatic if the parametric of the model is used to develop several estimates for alternate configurations of the same potential project (Rad, 2002).
Analogous Estimating	Refers to the estimating process, where there is a significant similarity between the proposed project and those projects contained in the historical database. It tends to be less complex, easier to use and exacter than parametric model. It is typically used for early estimates that are called order of magnitude, conceptual, or ballpark estimates. These techniques are used to estimate project costs by comparing the proposed project with similar project, for which historical information is available (Rad, 2002).
Ratio Estimating	The premise of this technique is that there is a linear relationship between the cost and duration of the project, and one or more of the basic feature of the proposed project. The basic features in this process are related to either physical attributes or performance characteristics (Rad, 2002).
Range Estimating	It is to provide not just one estimate for the cost of an element, but rather to define the range of possible values for the cost of a specific element. It utilizes the same statistical fundamentals in estimating total project cost based on probabilistic elemental cost (Rad, 2002).
Expert Judgement	Includes consulting one or more experts to validate the estimate of the proposed project against the experience and understanding of the experts, who will consider the details of project complexities and characteristics in tempering the estimate or occurring with it (Rad, 2002).
Feasibility Estimate	It can be developed after preliminary project design work is completed. It is suitable when the published information on material costs is widely available (Venkataraman & Pinto, 2010).
Definitive Estimate	It can be developed when most of the design work is completed. At this stage, there is a very clear understanding of the scope and capabilities of project (Venkataraman & Pinto, 2010).

Ballpark Estimates	Also referred to as 'order of magnitude'. It is used when there is no sufficient information or time available to develop more accurate or detailed estimates. It is suitable for initial rough-cut estimates of resources needed for a project (Venkataraman & Pinto, 2010).

Table 3.4 - Cost estimation models (Rad; Venkataraman & Pinto, 2010)

In addition to the above models' description, there are guidelines and standards that can also be followed in order to have precise cost estimate in early phase of the project. For instance, as shown in Figure 3.13 (below), the cost estimated practice developed by United States government accountability office. The purpose of this practice is to achieve the credible cost estimate for managing capital program cost. It also initiates the development of the comprehensive practice for cost estimation in early phase of the project. Additionally, as discussed in previous sections, there are evidences and obstacles in achieving such objectives.

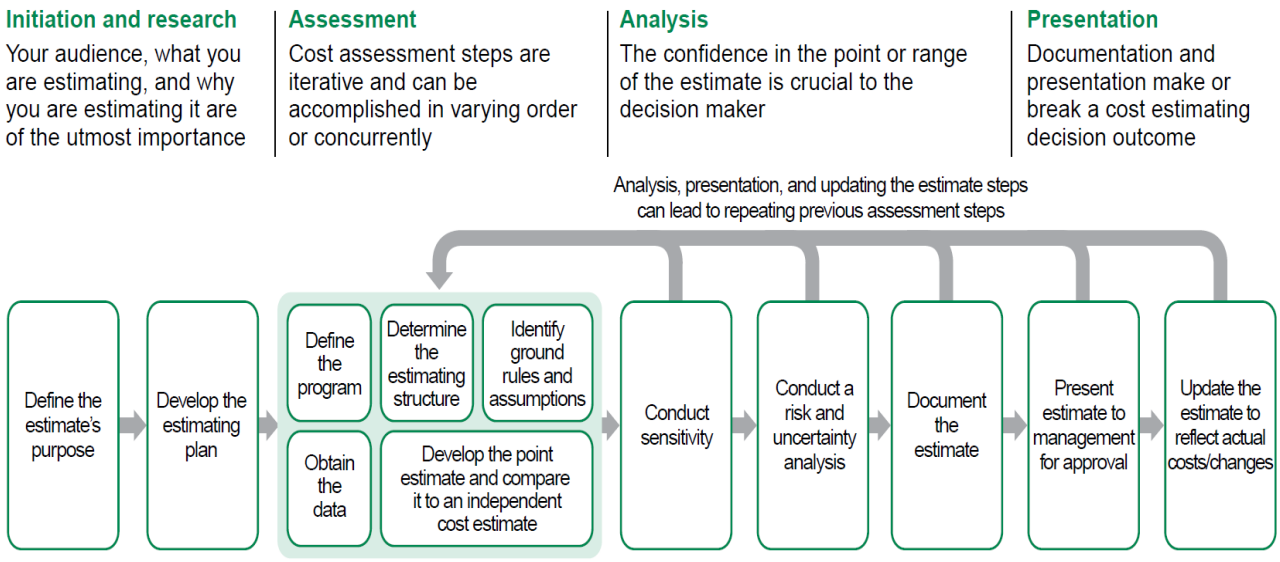

Figure 3.13 - High quality cost estimation practice (Office, 2009)

Moreover, there is a need for cost estimation classification. It acts as a reference point to understand the accuracy of each estimation model and its degree of accuracy. In this regard, the authority for total cost management (AACE) has developed international cost estimation classification standard, which is used as benchmark. The aim of such classification is to develop comprehensive cost estimation classification with respect to accuracy range, maturity level, application and methodology that is required to achieve the mentioned objectives. The developed AACE classification is shown in the **Error! Reference source not found.** (**Error! Reference source not found.**).

	Primary Characteristics	*Secondary characteristics*		
Estimate Class	**Maturity Level Of Project Definition Deliverables** Expressed As % Complete Definition	**End Usage** Typical Purpose Of Estimate	**Methodology** Typical Estimating Method	**Expected Accuracy Range** Typical Variation In Low And High Range
Class 5	0% to 2%	Concept screening	Capacity factored, parametric models, judgment, or analogy	L: -20% to -50% H: +30% to +100%
Class 4	1% to 15%	Study or feasibility	Equipment factored or parametric models	L: -15% to -30% H: +20% to +50%
Class 3	10% to 40%	Budget authorization or control	Semi-detailed unit costs with assembly level line items	L: -10% to -20% H: +10% to +30%
Cost estimation varies	30% to 75%	Control or bid/tender	Detailed unit cost with forced detailed take-off	L: -5% to -15% H: +5% to +20%
Class 1	65% to 100%	Check estimate or bid/tender	Detailed unit cost with detailed take-off	L: -3% to -10% H: +3% to +15%

Table 3.5 - AACE Cost estimate classification (International, 2011)

CHAPTER 4 – RESULTS

In the previous section required literature in order to model the selected case studies for comparison with the reference model, Norwegian appraisal model, is described. In this chapter the proposed models for each selected case studies are shown with respect to choice of project and relevant ministry. Correspondingly, main intention in each model is to look upon cost estimation and quality assurance in front-end of the project.

4.1 IRAN:

The selected ministry in the case of Iran is ministry of energy. The short summary of ministry structure is shown in the APPENDIX-II. The ministry is organized with respect to the diverse policies, duties and governance structure with respect to sub-department and division's objective and duty domain. It is multi-faceted organization, in other words, it is multi-industry management. The ministry is comprises of four key industries of Iran, which are, renewable energy, wastewater, Water, and power industry. The structure implies necessity and importance of resource management in different projects executions. The ministry comprise of three main level, as shown in the APPENDIX-II. The top most level consist of five deputy ministries and is in charge of defining corporate governance and making overall policy and administrative norms , followed by second level, consisting four sub headquarters, which their main duty is to monitor, plan, and assess their specialized subsidiary companies to ensure the implementation and achieving macro level policy of the ministry. The third level of ministry is called operational level, where the project executions and operations are carried out. In other words, this level three is the executive arm or executive branch of ministry. It comprises fifteen sub-divisions, and institutions, which have totally 326 offices that are working under these sub-divisions or institutes. All of these sub-divisions and institutes are possess high technical proficiency in operative level.

In the case of Iran, the required information is collected through phone interview with former employees of ministry of energy and MPO. As indicated by interviewees, each ministry has pre-defined limits for budget spending, which is delegated to CEO of regional offices, with no need for approval from higher levels or sub headquarters in the respective ministry. Likewise, to some extent the budget can be allocated by sub headquarter of ministry also, but if the project requires budget more than pre-defined limit then the project appraisal need to be assessed first, in province governor office and then presented to government cabinet minister and parliament infrastructure development committee for budget allocation. However, the interviewees indicated that, the process of cost estimation in front-end of project for each ministry is purely depend on the size and complexity of project. However, till some

point all the ministries follow the same procedure i.e. using price lists issued by MPO, and then it starts deviating (i.e. controlling mechanism) based on the nature and characteristics of the projects, except in the case of ministry of oil and gas, which has almost completely different framework for project appraisal and early cost estimation in projects.

For the cost estimation in public projects, regardless the size of project, there are clear directives from the cabinet minister regarding the macro policy and frameworks that need to be implemented and followed. In addition to these macro policies, there are micro and clear instruction available regarding cost estimation of project with respect to project types from the organization called, Management and Planning organization (MPO). This organization is branch of the presidential administration and has an office in each state, which some of its duties are mentioned briefly in the Table 4.1 (below).

Table 4.1 - Iran's MPO duties and responsibilities Source: Phone interview and (organization)

- Design budgeting system and preparation of annual budgets. - Notification of the approved budget and resource allocation. - Description of the operations, including quantitative quality goals standards and prices of services and projects. - Designing Intelligent system for budget and financial management of country - Design of decentralization program for ministries and government agencies. - Design and development of administration and decision-making systems.	- Review and comment on the draft legislation and executive decisions within the framework of, the general policies of the country, existing laws, long-term, medium-term and public resources. - Determine the roles and duties of governmental and non-governmental sector in the form of documents and legislation. - Approving government macro-structure design and structure of executive agencies. - Design and implementation of HR management process.

As mentioned in the above table, operations description including quantitative quality goals standards and prices of services and projects is which comprises set of detail directives and instructions for cost estimation in the projects. Moreover, notification of approved budget and resource allocation, not in all cases, but to some extent MPO acts on behalf of the government for resource allocation approval. However, it is notable that the authority of MPO will vary with respect to the project size, complexity, and budget. For the process of early cost estimation in the projects, MPO publish the updated price list every year for different infrastructure projects except Oil and Gas projects. These price lists and standards comprises of prices for different operations, equipment, and all other details required and essential for

cost estimation. According to cabinet minister and ministries directives all the projects, which government is included, the cost estimation should be based on MPO's standard and guidelines. The price lists can be reviewed few time during the year and updated with respect economic situation of country. These price lists compilations are based on the report from different government ministries and economic situation as well as, market's inflation rate.

As indicated from interviewees, the early cost estimation in the projects officially starts when ministry, approves the first project appraisal after DG1, as shown in the Figure 4.1 (below). However, one of the interviewee emphasized that, in the cases where, the execution of project does not need the official approval from sub-headquarters or there is very less uncertainty about the project, then cost estimation will be done and attached along with the initial proposal. Nevertheless, in the case when the sub-headquarter approval is needed the procedure is a bit different. Here, the first cost estimation is done internally through expert team consists of financial, technical, and market professionals. This estimate is based on the available data from the similar previous projects and price list issued by MPO. Later this estimation will be reviewed through consulting company, the type of consulting company (native/foreign), number, and selection procedure is purely depending on the project size, complexity, and technological requirements, which set of instructions and directives are communicated through ministry for these purposes. After the cost estimation is reviewed by consultants and corrections made through meetings, then the final cost estimation document is ready to be send for final approval and budget sanction, DG2, where again the independent cost estimation review will be done throughout the DG2 to ensure that everything is in order. However, in the case of mega projects, which is out of authority of sub-headquarter for decision regarding the budget, the proposal should be pre assessed by a committee through province governor office, which is called as 215 committee. This committee consists of MPO representative, province governor representative and their expert financial and technical team. After the first approval, DG1, the cost estimation carried both with participants from ministry's sub-division representative team and consulting companies and the prepared cost estimation will be peer reviewed and after approval then it will be forwarded to cabinet minister and parliament civil and infrastructure committee for final approval, where documents will be peer reviewed before sanctioning the budget.

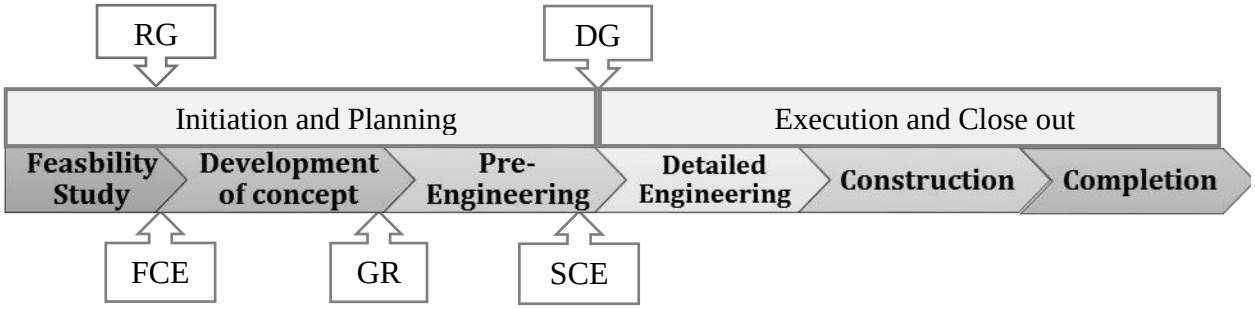

Figure 4.1 - Iran cost estimation procedure.(Note: GR= Gate Review, DG= Decision gate/review, FCE= First cost estimatie, SCE= Second cost estimate)

In conclusion, the process of cost estimation in case of Iran is both internally and externally. It depends on the project size, and complexity that whether pure internal estimation is enough or external estimation is needed as well. However, the first estimation in early phase is purely based on the MPO price list, similar previous projects, and expert judgment. This also illustrates considerable bureaucracy level in cost estimation process.

4.2 AUSTRALIA:

In this case the selected industry is road and railway construction. As the literature and government reports shows, in Australia estimating is performed by a broad domain of staff who agree with practices that are generally recognized, but not systematically well detailed(Department of Infrastructure & Government, 2008). The method of estimating differs among clients and is not indicated in a verified industry standard. Government agencies along with public and private corporations need consistency and accuracy in the project cost estimation to attain their goals. The industry sectors are generally split up in two sector namely, engineering, and building infrastruct (Department of Infrastructure & Government, 2008). In building sector, the estimating purpose is achieved through the Quantity Surveying profession which is in line with the Australian Institute of Quantity Surveyors' standard. Therefore, investors realize the project cost estimation(Department of Infrastructure & Government, 2008). Training and education of an individual in the building sector is one of the duty of the educational institutions servicing the building sector. On the other hand, it indicates from government report that, engineering infrastructure division is more dissimilar than building division since it covers extensive types of projects (e.g. rail, power water, road, etc.). Therefore, this background diversity evidently implies the requirement of heavy skills in technical knowledge in estimating infrastructure projects' cost(Department of Infrastructure & Government, 2008).

In order to understand the early cost estimation in the case of Australia, first, there is need to realize the project phases in federal infrastructures. In this regard, DPTI of Australia suggests a model for federal

infrastructure project phases, as shown in the Figure 4.2 (below), which a best practice cost estimation should possess.

Figure 4.2 - Federal infrastructure project phases obtained from (Department of Infrastructure & Government, 2008)

The tasks that contains in each phase is briefly explained as follow:

- *Project identification:* it requires appraisal of broad alternatives (e.g. rail, road, travel demand, etc.) it should consider how well the broad alternatives meet network and corridor objectives and identifies a preferred alternative for inclusion on the National Land Transport Plan and progressive Project Scoping(Department of Infrastructure & Government, 2008).
- *Project Scoping:* entails the investigation of specific options that achieve the preferred alternative. For each of the specific options, a Business Case is required investigating BCA, financial analysis, triple bottom line reporting and budgets/timing. A preferred option will be the result of the Business Case(Department of Infrastructure & Government, 2008).
- *Project Development:* entails detail planning and design of the preferred option. A Delivery Strategy requires revised BCA, detailed project budgets / timing and a procurement method(Department of Infrastructure & Government, 2008).
- *Project Delivery:* Project Delivery requires construction and commissioning of the preferred option following a procurement process. Progress reporting and progress claims are required from the proponent at regular intervals(Department of Infrastructure & Government, 2008).
    - According to the above discussion and federal infrastructure model presented by DPTI, the proposed model for Australian early cost estimation in project is shown in Figure 4.3 (below). However, details for both of cost estimation model and general process as well as required federal infrastructure procedure is attached in the APPENDIX- III

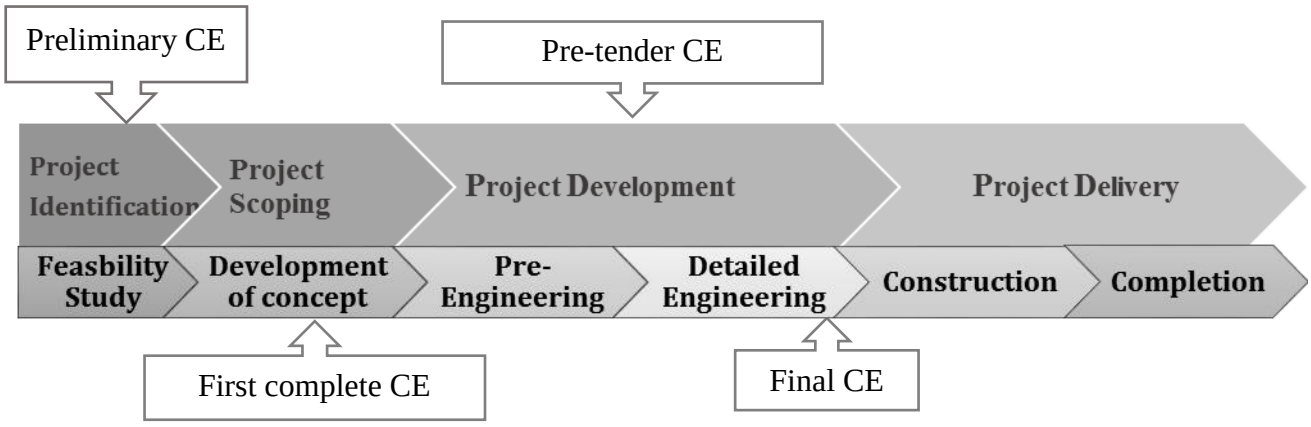

Figure 4.3 - Australian cost estimation in early phase sources: (Department of Infrastructure & Government, 2008; Finance, 2014)

However, before proceeding to explanation of cost estimation process, shown in the Figure 4.3 (above), the recent guideline on the cost estimation for road and rail construction by DPTI suggests the recommended levels of estimation in projects and their purpose. The brief explanation of recommended levels are summarized in the Table 4.2 (below).

Table 4.2 - Estimate levels and Purpose, Australia Case, source:(Department of Planning, 2015)

Level 1- *Strategic Cost Estimate*	For providing initial strategic level advice of an initiative being considered, not intended to be used to seek project funding.
Level 2 *Preliminary Options Estimate*	Used in considering the range of options that deliver the objectives of the initiative. Not intended to be used to seek project funding.
Level 3 *Preliminary Concept Estimate*	Used in identifying options to progress to a more refined level of planning (i.e. preferred options), While not recommended, funding is sometimes sought based on this level of estimate
Level 4 *Concept Estimate*	For use in the Outline Business Case – assists with comparison of options; Funding may be sought using this level of estimate.
Level 5 *Preliminary Design Estimate*	For use in the Full Business Case – focuses estimating effort on the preferred project option and qualifies project justification. Ideally funding is sought using this level of estimate.
Level 6 *Detailed Estimate*	Used for technical refinement. Based on the detailed design allowing a high level of detail and certainty within the estimate.

	Typically funding will have been granted before proceeding to this level of estimate
Level 7 *Pre-tender*	Final construction estimate (market price estimate), used for comparison with tendered rates.

In addition to the above recommended level of estimate, the DPTI guide line presents two models for estimation namely project option estimate that are generated for each alternative project option being considered for providing necessary information to evaluate cost of project in contrast to its benefit and *formal estimate,* which are essential at definite times in life-cycle of project and are established on the uppermost realistic project alternatives estimate at that point (Department of Planning, 2015). In addition the DPTI guideline, suggests four estimation method, where a brief description are given below in the Table 4.3 (below).

Table 4.3 - Estimating methods suggested by DPTI, obtained from (Department of Planning, 2015)

Global Estimate (Benchmark rates)	It refer to an rough or low order technique of estimating, including the usage of 'all in' or 'global' composite prices.
Unit Rate estimate (Based on historic rates)	It computes the price for each component of the project through multiplying the amount of work by historical unit rates. Sum of the elemental costs is the project cost.
First Principles Estimate	It is the calculation of project-specific costs based on a detailed study of the resources required to accomplish each activity in WBS
Hybrid Estimate (Unit rate/First principles)	It is mix of some features of the unit rate method and some of first principles method.

The Australian cost estimation model is based on the WBS. As illustrated in the figure, the first cost estimate, which is preliminary, is carried out during the feasibility study same as project identification, here in this estimation, just evaluations of initiatives are carried out with the global benchmark technique, no detail calculation is required, and it is normally based on the previous similar comparable projects. This estimation is followed by quick assessment of feasible preliminary options, where range of options that are potential to achieve objective of the initiatives are identified, before entering the phase of concept development. As per estimates at these early levels are every so often associated with more conceptual information with very restricted or less relevant info about actual project scope, timing, risks, range etc. it is believed that there is a potential for project variable, hence, the estimates are expressed as a cost

range(Department of Planning, 2015). The DPTI's report indicates that, normally estimate level one and two are applied in this level. In this regard, after approving and selecting the appraisal then the concept development or project scoping phase starts, here in this phase the aim is looks upon the most potenital options that can facilitate achieving the selected appraisal, and for each option separate business case should be prepared for investigation. Later each business case should go through cost estimation and investigated with respect to BCA, budget, time, financial assessment. This capital estimate is the first cost estimate in the early phases of project. The DPTI guideline emphasize that, this level of estimate should comprise with sufficient investigation, design of main elements, and it should be place on purpose of the project(Department of Planning, 2015). Moreover, The outcome of this estimate is considered as part of the full business case during the federal infrastructure process (Department of Planning, 2015). The estimate in this level is prepared usually with respect to unit rate and first principle technique. The outcome of project scoping phase is further taken to the next level, project development phase, where a detail planning and design of preferred option is carried out. Here the cost estimate comprises two part. The first estimate is done with respect to the outline business case assists with comparison of options, funding decision, and project justification, these can be achieved with either first principal estimate method or combination of first principle and unit rates method(Department of Planning, 2015). Later this estimation followed by preliminary design estimate where the funding decision-making is carried out for the project. It should be note that, there are predefined templates provided by DPTI of Australia for this purpose. Each template is used for certain cost estimation level by corresponding organization's staff member. However, there are instructions regarding filling out the templates based on the project characteristics. In addition, the price escalation calculation should be done and included in formal estimate throughout the process.

According to above explanation, throughout the process the estimation is followed certain steps to reach to the final step for presentation to federal infrastructure for approval. The most important part after the estimate have been made ready, before submission for decision-making process as emphasized by DPTI guideline, is peer review or estimate reality checker, where a senior and well experienced staff member in the corresponding organization review the estimate to make sure that everything is in the place before submission for evaluation(Department of Planning, 2015). Additionally, the project program and its cash flow.

In light of above explanation, based on the guideline by DPTI of the Australia, the cost estimate should consists the following components as shown in the Figure 4.4 (below).

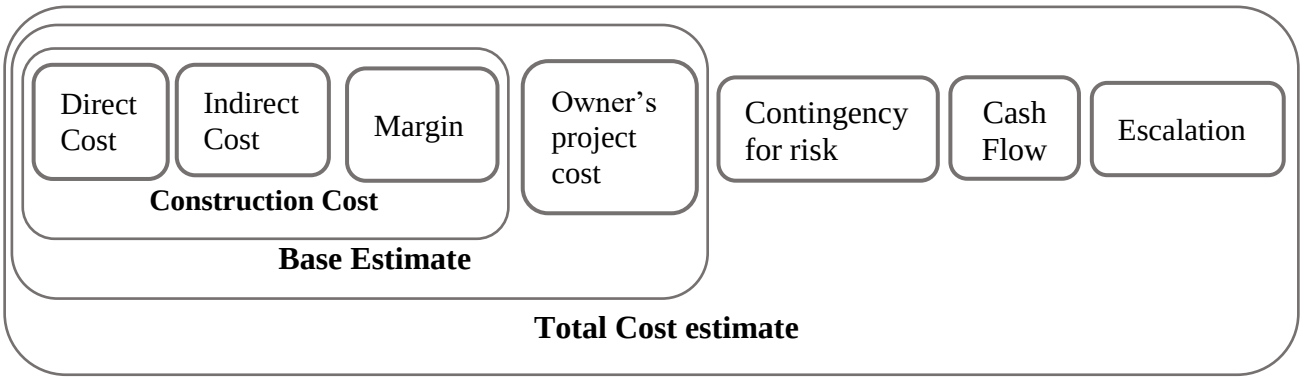

Figure 4.4 - Cost estimate Components in case of Australia, source: (Department of Infrastructure & Government, 2008; Department of Planning, 2015)

4.3 GERMANY:

In the case of Germany, as the federal structured country, the responsibility structure is tiered vertically (Gühnemann, April, 2013). The report by Gühnemann indicates that, federal level holds the general responsibilities, and the state level act as a execution branch or arm of federal government in the state by use of their administrative part(Gühnemann, April, 2013). However, the federal level maintains the right and power to monitor and send out directives and guideline to the states and also financial monitoring in the investment decisions(CENTRE, 2004; Gühnemann, April, 2013). The infrastructure planning in Germany is in the form of master plan, where the development projects from different state will be formed into one document called as infrastructure master plan, which need to be approved by parliament(CENTRE, 2004; Gühneman, 2006).

Looking upon the cost estimation system in Germany, Dursun Onur suggests cost identification in construction industries can be categorized based on the availability of information to the estimator (Onur, 2014). The suggested classification of cost realization is presented in the Table 4.4 (below).

Table 4.4 - Category of Cost Identification basd on the DIN 276-1. Source:(Onur, 2014)

Budget	Identification of costs on the basis of demand planning
Preliminary Estimate	Identification of costs based on the basis of preliminary planning
Approximate Estimate	Identification of costs base on the design planning
Final Estimate	Identification of costs based on the preparation for execution
Statement of Final Costs	Identification of the final costs.

As indicated from interview with one of the design and construction company in Germany, cost estimation is assigned to the specialized consulting engineers and architects bureaus who possess requested expertise. the interviewee also emphasized that local public construction projects are subject to decision-making process at the relevant governmental level. Big federal projects (e.g. construction of highways) are topics to be discussed by the Federal Ministry of Transport and Digital Infrastructure;

smaller projects such as local road constructions, local pipeline constructions, etc. are discussed at the level of certain relevant states, districts, communities, municipalities' authorities. The short overview of the Germany government administration level is shown in the Figure 4.5 (below).

In this regard in Germany, regulations on fees for architects, engineers are given by (HOAI). In this regard, HOAI forwards the architects to Standard DIN 276-1, the standard for construction industry. The principles and definitions can be used as basis in infrastructure construction as well, for cost planning through particular project phases. In addition, HOAI suggests architects' fess based on the cost of structure. The DIN standards give specific details on the cost items that need to be calculated. The brief category of cost item in DIN standards is shown in the Figure 4.6 (below).

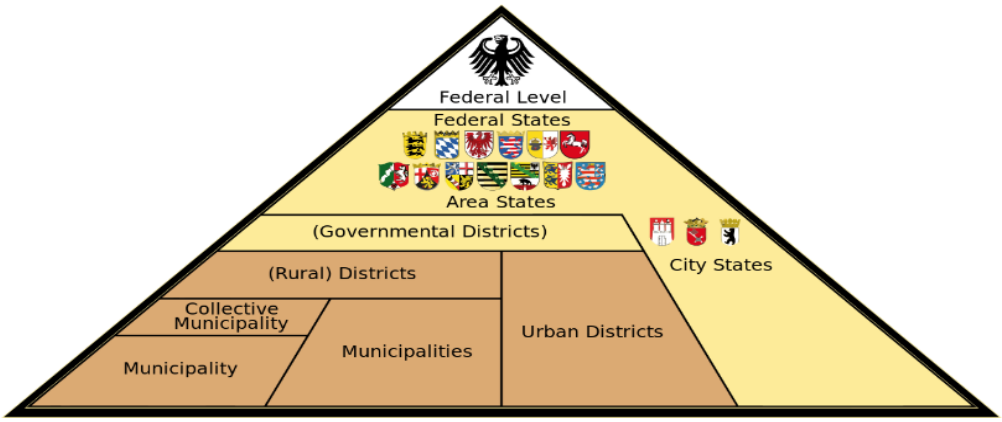

Figure 4.5 - German government administration structure source:(Wikipedia)

Cost estimation can be based on the data provided by (BKI), the service facility center for architects and construction cost data base, as well, which is also according to DIN 276. The interviewee indicated that, normally the first rough cost estimation is based on the data of BKI, brief estimation just for feasibility analysis, carried out with respect to the desired construction property (school, hospital, office etc.), required standard (high/medium/low), and historical data from similar previous projects, it is more like a bench marking in most of the cases with previous similar works. Here the minimum anticipation from architects is to estimate the rough cost of structure, as shown in the Figure 4.6(below) with respect to DIN 276 or BKI, individually in the total costs (i.e. all seven column in Figure 4.6). Based on this information, it is possible for the estimator to calculate the cost key values. After project enters preliminary estimates, the total costs should be specified with respect to the first level costs groups as a minimum of individual cost classification. Through approximate estimates, which is performed at planning and design integration phase, the total costs should be calculated as a minimum to the second level of cost category, as shown in the Figure 4.6, through costs units.

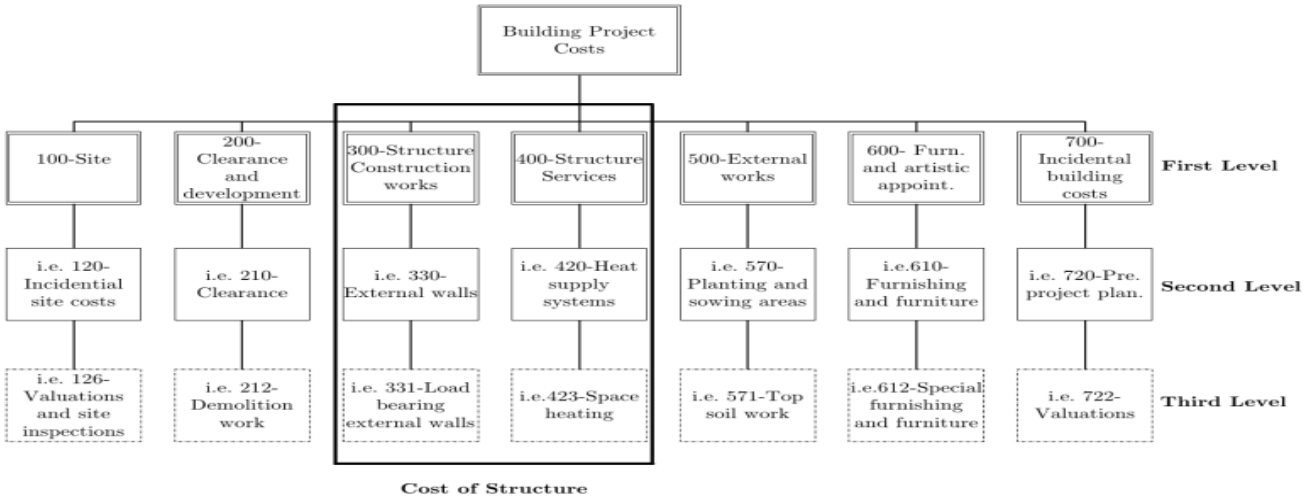

Figure 4.6 - DIN-276 Categories for cost estimation source:(Onur, 2014)

Hereby, the cost categories follow the DIN 276 norm are included, but other cost groups that are not included in DIN 276 (cost of property, outdoor facilities, etc.) and are not standardized need separate estimation. Therefore, the estimation of these non-standardized costs takes place when the total cost of the project is estimated. The ministry is the decision-making authority for the final decision about project budget. Here the ministry, usually perform peer review either internally or through external auditor , but the base for decision-making will be DIN 276 standard and required quality, scope and economic feasibility. Sometimes some changes regarding quality, features, or configuration are done in order to lower the construction costs. At this stage of the project no architect plans are needed. Once the concrete final decision about the project was made, the first cost estimation has to be proved by architect planning (at least as so called approval planning is requested, but it is better to have a so called execution planning in order to be aware of all construction materials needed for the completion of the project). This allows to prove the rough cost estimation and to increase certainty as well as a precision of the cost estimation. These meetings will be held by ministry or corresponding local or state authority with architect's company in order to clarify the questions and ambiguity in the project cost estimation. Furthermore, based on these meetings and estimation, every single element and component as well as each part of the construction plan receives a concrete cost key value. Also the non-standardized and other cost groups (which are not explicitly included in DIN 276) get approved / updated cost values. It should be noted that, the cost estimation review from first cost estimate till third cost estimate is done internally by the architect's team. Only final estimate is reviewed by ministry or higher authorities. The cost estimation according to BKI data is an accepted and acknowledged method for public projects since BKI possesses a huge data pool. The proposed model for German case with taking into account the cost category identification is shown in the Figure 4.7 (below)

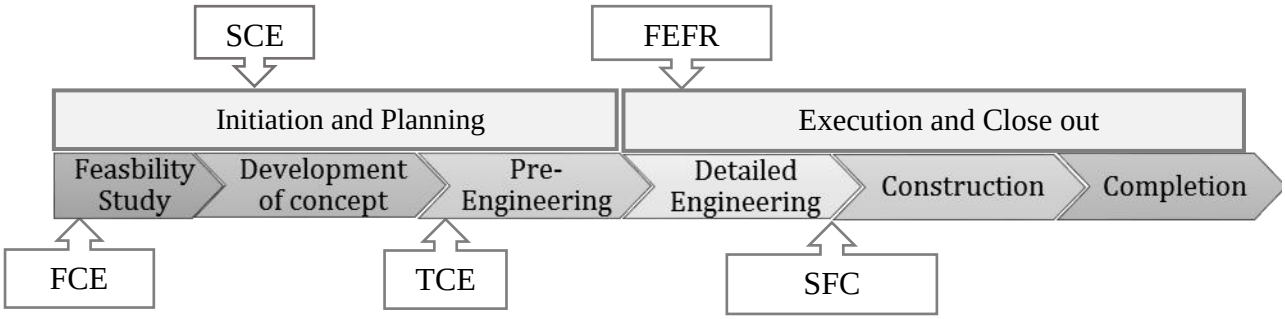

Figure 4.7 - Germany cost estimation model

Note: FCE = First cost estimation, SCE= Second cost estimation, TCE = Third cost estimation, FE = Final estimate and final review, SFC = Statement of final cost

4.4 SOUTH AFRICA:

In the case of South Africa, the cost estimation approval of project is done by National Treasury Department in case of medium size project, which is responsible for coordinating macroeconomic policy and promoting the national fiscal policy framework. In addition, the duty of National Treasury Department also is to coordinates intergovernmental financial relations, manage the budget preparations process and exercise control over the implementation of the annual national budget, including any adjustments budgets(Department). The budget for infrastructure project or public projects are prepared through a framework called as, 'Medium-Term Expenditure' (MTE). It seems to be more generally employed as the general term containing different parts of public finance management. The MTE framework, is holistic plan or master infrastructure plan that need to be prepared as part of the budget of government and present to parliament for approval. The governmental department and institutions should propose their required budget for public project implementation through this framework for three years, but yearly update is allowed as well. In this regard, the ministry of National Treasury publishes a guideline to all departments for submission of their proposal for preparing the master plan. The guideline contains the necessary information regarding the required information in the proposal and steps that need to be followed for proposal approval in MTE framework(Treasury, 2016). However, this guide line is the holistic view of the proposal approval process with respect to how it should be and what need to be included, but not detail cost estimation. The government official websites and reports indicate that, the process of cost estimation of projects in South Africa is basically with reference to standard guidelines and practices that issued by institutions from processing a pool of data and information of previous private and public projects as well as national standards. In this regard, the construction sector has been selected for further analysis. Correspondingly, these institutes are not completely but partly governmental or get support from government. For instance, African association of quantity surveyors (AAQS), this association comprises different African countries, which issues the required practices regarding the

construction, management, and engineering projects. Also, South African Bureau of Standard (SABS), which was founded due to the standard act, and is a legal body in providing range of services to South African industries like, providing latest standard to the industries, quality assurance services, maintaining South African national standards (SANS) and other relevant services(SABS). There are some more institutes, whose providing, standardization, quality assurance, and accreditation such as, NRCS, SANAS.

According to MTE guideline, the nature, complexity and size of project is the key element in determining the depth of information required, also, it is suggested that multiple small projects with same output can be grouped and presented as a single infrastructure project(Treasury, 2016). One of the most common method used in South African construction industry is elemental cost estimating technique that is used during design development process in the projects(AASQ, 2013). According to AASQ guideline, elements are defined as major features, common to most of the construction project, which perform a given function regardless of the design, specification, construction method and materials used(AASQ, 2013). Accordingly, the AASQ guideline suggests a set of principle when defining and choosing the elements for preparing the cost estimation as summarized in the Table 4.5 (below). For each element the unit rate should be applied, however, the rate should be inclusive of material, labor, plant, contingency allowance, design fee if any, and any special requirement that is essential in project for the considered component.

Table 4.5 - Principal for element selection in cost estimation. Source :(AASQ, 2013)

1- Each element should have a significant influence on the cost of a building and a high frequency of occurrence(AASQ, 2013)
2- There should be consistency and simplicity in the definitions of elements. One of the primary purposes of a standard list of elements and components is to enable cost analyses to be made of completed projects(AASQ, 2013).
3- Wherever possible an element should be capable of measurement(AASQ, 2013).
4- Elements should apply to any construction type(AASQ, 2013).
5- Elements separate elements from related external works and services(AASQ, 2013).
6- Elements should as far as is reasonable and practical relate to other international elemental classifications such as the UNIFORMAT II (USA) and those of the Canadian Institute of Quantity Surveyors (CIQS) and the Royal Institute of Chartered Surveyors (RICS-UK)(AASQ, 2013).

However, before elemental selection, during the feasibility study the first estimate is usually based on the similar previous project and expenditure data on similar previous projects from national treasury database(Treasury, 2015). When the feasible option selected and business case has been developed for that alternative, then the process of elemental cost estimating starts. First, as mentioned the elements will be selected based on the suggested principle by(AASQ, 2013). After the element selection is over and unit rates are added to the items and the cost of each element with respect to the required quantity is specified then the sum of the cost leads to the final cost estimation document. However, as mentioned in the MTE guideline, the care should be taken for the project proposal, since it should be verified with different financial analysis tools such as, CBA, CEA, FCFA(Treasury, 2016). Additionally, in the MTE guideline also recommended that, the proposal should have been peer reviewed. In case of lacking internal peer review capacity, the department can subcontract this task to external verified source (i.e. consulting company)and the report from the external source regarding the review of cost estimate should be attached to the appraisal, and the same should be applied to appraisal activity based on the institution capacity(Treasury, 2016). However, based on the government directives, the entire construction plan in the country should comply with the 'National building regulations and building standards ACT'. The control over the process is done through reporting, which acts as performance indicator system. The final decision on the cost estimation in case of large projects is held by the ministers committee on the budget (MINCOMBUD), however, the corresponding committee decision is partly based on the report and recommendation from National treasury and Medium Term Expenditure (MTE) committee(Treasury, 2016). If the budget require for project work does not exceed the master strategic plan's budget, then the process of decision-making will be delegated to ministries. It should be noted that, the risk assessment and sensitivity analysis report should be attached if the decision for budgeting need to be taken by MINCOMBUD. These will back the cost estimation up during assessment and also the estimator(Treasury, 2015, 2016). Therefore, it is set of frameworks that need to be followed in the case of South Africa; the proposed model is shown in the Figure 4.8 (below).

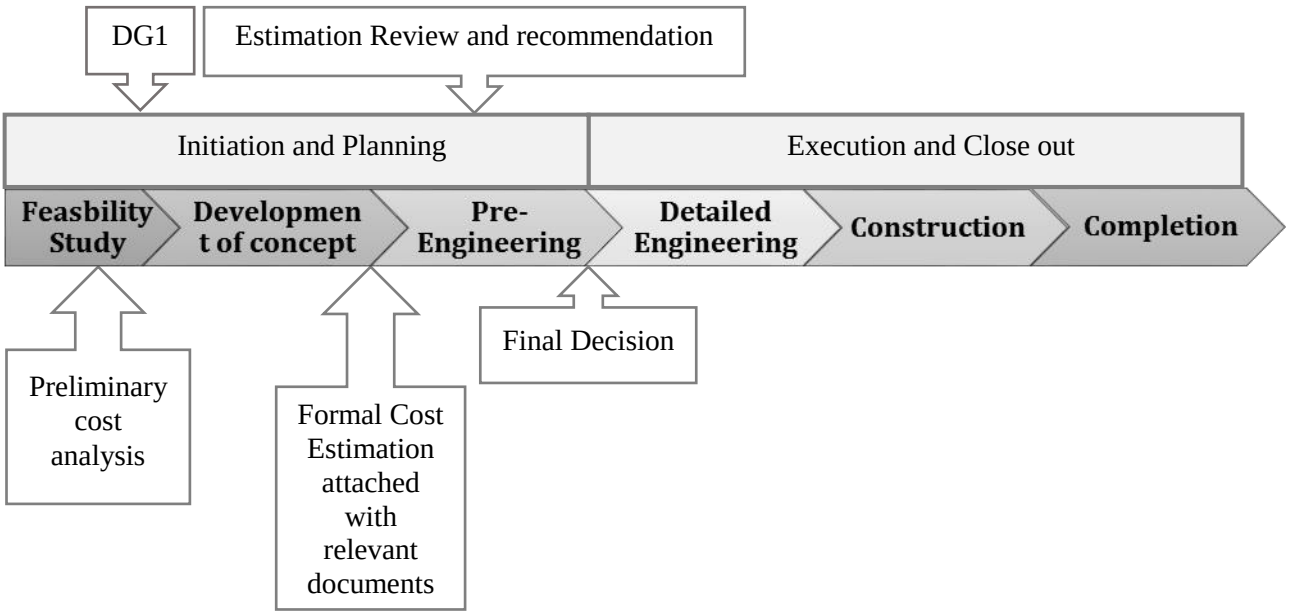

Figure 4.8 - South African Cost Model for cost estimation
Note: DG= Decision Gate

4.5 NORWAY:

Appraisal model in Norway is called differently with respect to scope and purpose of studies carried out by different scholars. For instance, Magnussen and Olsson referred to it as, Quality at-entry regime(Magnussen & Olsson, 2006), Odeck et al. called it as, Norwegian quality assurance regime (Odeck et al., 2015), or Samset et al. called it as, Norwegian Front-end governance of investment projects (Samset et al., 2006). In spite of all these but the concept and explanation of all these scholars regarding the function of Norwegian appraisal model for public project are aligned together. As stated by Magnussen and Olsson The incentive for looking into better mechanism to control and manage the public projects in Norway was based on realization of not achieving the predefined requirement and large cost overrun in public projects(Magnussen & Olsson, 2006). Also, Also, Odeck et al. pointed out the same reason for initiating the government order for implementing the Quality Assurance (QA) regime for public projects(Odeck et al., 2015). In this regard, Samset et al. pointed out that, the objective of the Norwegian Appraisal model was to ensure quality and consistency of analysis and decisions, rather to implement the new rules for decision making(Samset et al., 2006). They emphasized that, the intention of Quality-at-Entry regime is to ensure the right early choice of concept, which in their point of view is the key step to assure the start of right project and avoid of unviable project(Samset et al., 2006). The Norwegian appraisal model, as shown in the Figure 4.9 (below), consists of two gateways namely 'QA1' and 'QA2'. According to the regulation by Norwegian government and ministry of finance, all the project that require budget over 500 million NOK (60 million euro) are subjected to go through quality assurance

regime. As described by Samset et al. the aim of QA1 is to assure the rationality of choice of concept with respect to political process since, choice of concept is a political one(Samset et al., 2006). In addition, they explain the purpose of QA2 as, a mean to deliver an independent review of decision documents before parliament budget approval to the responsible ministry(Samset et al., 2006). They argue that, in the QA2 the strategic management is in the focus and the consistency of documents with respect to QA1. But, the output should be reliable in such a way that can be employed as base for control mechanism though the implementation phase(Samset et al., 2006).

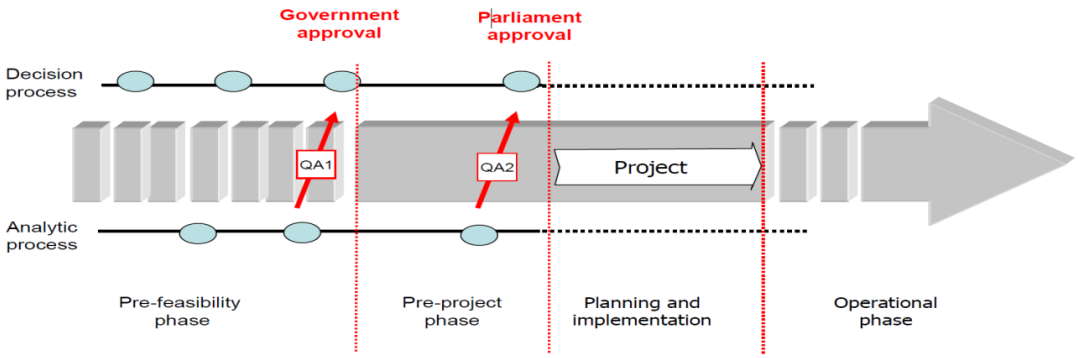

Figure 4.9 - Norwegian Quality-at-Entry regime for major public investment projects source:(Samset et al., 2006)

In this regard, Magnussen and Olsson described the opportunity and process of cost estimation in QA process. They suggested that, the cost estimate in the early phase of the project offers the opportunity to realize how three stakeholders (project organization, external consultant, and parliament) perceived the project(Magnussen & Olsson, 2006). According to Magnussen and Olsson the required budget for the project is prepared by project organization before the quality assurance take place(Magnussen & Olsson, 2006). The cost estimation is usually starts after the QA1, where the choice of concept for the project is approved by cabinet minister. Later, after the approval in QA1, this estimate is done by the project organization and is usually based on the previous similar projects and the internal data base available to the project organization. However, the accuracy of the cost estimation is based on the precision of historical data and standards that need to be followed for design and implementation. After preparation of cost estimation by project organization, an independent external consultant will review the project documents including cost estimate documents. Here, the external consultant will usually carry out separate uncertainty management and review the cost estimation and write a recommendation for budget estimation before it submitted to the parliament for final decision-making. The budget usually is subjected to the 50% probability that the project would finish within the proposed cost (Magnussen & Olsson, 2006). In addition, both provided uncertainty analysis from project organization and consultant

give the basis for the project owner to decide upon representing the estimate include in national budget or individually to the parliament as shown in the Figure 4.10 (below)(Magnussen & Olsson, 2006).

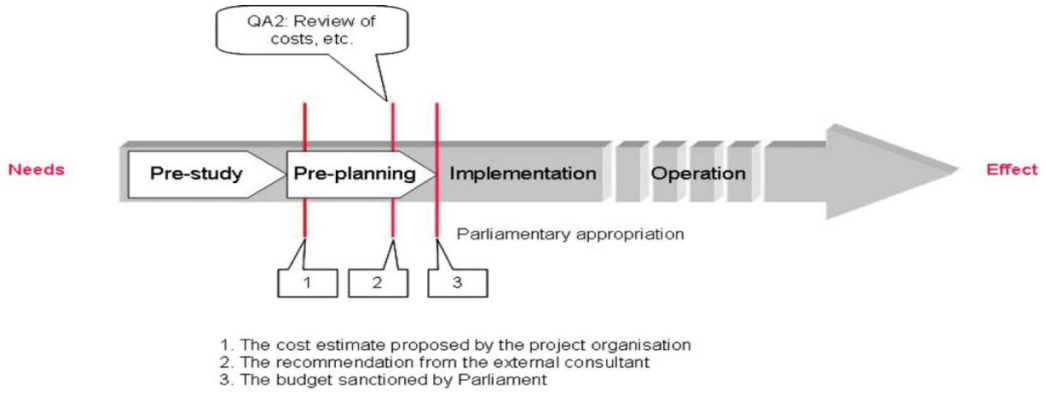

Figure 4.10 - Cost estimation in QA process – Norway Case, Source:(Magnussen & Olsson, 2006)

Correspondingly, It indicates that, the most common method for cost estimation in Norwegian public projects is stochastic uncertainty analysis, which is based on the estimation technique called judgmental forecasting and it facilitate the aim of predicting future factor that may influence project cost. Also, it is assumed that the uncertainty is normally distributed (Magnussen & Olsson, 2006). The model for the Norwegian appraisal model, which is selected as base model, is presented in Figure 4.11 (below).

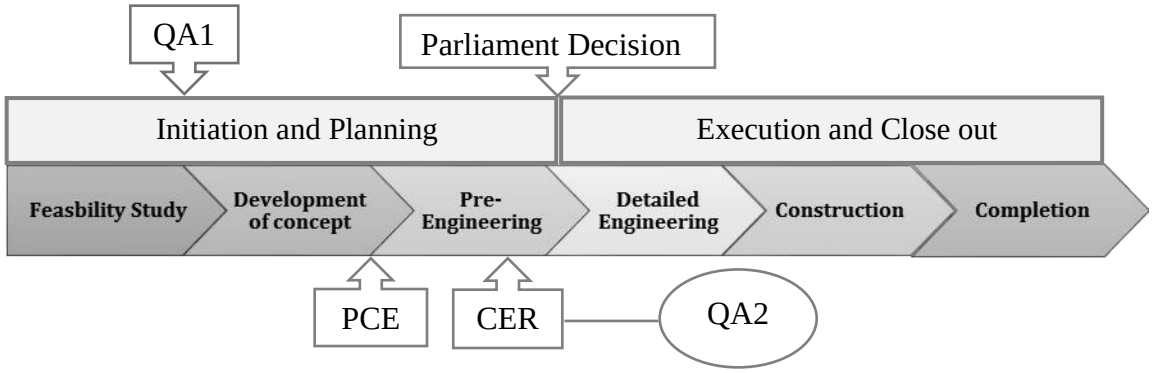

Figure 4.11 - Norwegian Appraisal model for comparison the case studies. Obtained from: (Magnussen & Olsson, 2006; Samset, 2010)

Note: PCE= Proposed Cost estimation, CER = Cost estimation review.,

CHAPTER 5 – DISCUSSION

The results of the investigation on the four selected case studies' profiles for cost estimation framework in public project are summarized in Table 5.1 (below). The table illustrates how cost estimation framework is carried out in each selected case study. There are differences in the implementation and the way of auditing the process, but from holistic perspective, all case studies have commonalities in the framework regarding the estimation base, auditor type, coordination place of process, sponsoring firm/organization, and process possessor.

In order to address the first research question regarding the way of achieving reliability in cost estimation through early phase of projects. The literature review for cost estimation focuses more on the factors affecting and causing cost underestimate such as technical, economic, psychological, and political factors which have been investigated and modeled by Flyvbjerg, Holm and Buhl, while it is believed that overcoming the identified factors can result in sound cost estimation with least error or inaccuracy (Flyvbjerg, Holm, & Buhl, 2002). This ideology is true to a great extent, but the reliability of the cost estimation in early phase of projects does not purely depend on these factors, but these factors need to be carefully taken into consideration, and good control mechanism should be implemented for them to result in enhancement of cost estimation reliability. However, this report addresses its first research question in two perspectives, first, in order to overcome cost estimation inaccuracy and to minimize the effect of the factors on the cost estimation process, there is a need to understand the corporate governance. This statement is based on the understanding of definition of governance given by OECD, as mentioned in the literature, a part of the definition that precisely described the corporate governance as a mean for attaining objectives and monitoring performances. This part of definition justifies the first perspective that deals with how understanding corporate governance can benefit the controlling of factors affecting cost estimation. Further elaboration on this is that, since any firm or organization has objectives and desired level performance to achieve (as the projects do) , there is need for understanding the relation and collaboration between them. Even though there are counter arguments that the projects are independent from organizations, and they should be managed and controlled separately from organizations routines, the mutual connection between corporate governance and project governance is still undeniable. It is not about which one rules or has more effect on the other, but more about how the knowledge transfer between them can benefit both in achieving their objectives. In this context, the appropriate corporate governance can assist the project to achieve its objectives with proper budget to cover and to fulfill its objectives. The traditional and well-known objectives of any project are the so-called 'iron' or 'golden triangle', which deal with balancing of the three most desired attributes of project (cost, time, and scope)

in order to achieve high quality in projects. In this regard, there are various governance theories that their effect can be discussed on the reliability of cost estimation during early phase of projects through balancing the iron triangle. The second perspective is to look upon how the governments and authorities implement these governance theories. This is nothing by the mechanism and practices used to enhance the estimation reliability. For instance, ways to achieve for reliable cost estimation, which results in more value creation, or, required procedure to minimize the waste and complexity and improve the efficiency, effectiveness and accuracy. It does not mean that more mechanisms and regulations lead to more accuracy, but it is the question of efficient and effective implementation, and more important, of utilization of available regulation for enhancing reliability in cost estimation.

As briefly presented in the literature, among the six governance theory, the shareholder theory (Freeman, 2010; Jensen & Meckling, 1976; Müller, 2009) builds the core of all selected case studies' governance frameworks. The results also indicate that the application of stakeholder theory (T. Donaldson & Preston, 1995; Freeman, 2010; Müller, 2009), the transaction cost theory (Coase, 1937; Oliver E Williamson, 1979; Oliver E. Williamson, 1981) as well as the resource dependent theory (Jeffrey Pfeffer & Gerald R. Salancik, 1978) is evident in the framework of case studies for cost estimation in public projects. Thus, these theories are useful in achieving reliable cost estimation in early phases of project. Therefore, all selected case studies have these theories in their framework, but the implementation and the degree of utilization of these theories are related to the government structure of each individual case. The analysis of result helps to validate the above perspectives.

In the case of Iran, as the model demonstrates, the reliability in cost estimation is achieved through more application of stakeholder theory in the early phase of project. The frameworks improve reliability of its cost estimation by following the government instruction and standards, also by using reliable source of information, i.e. experts, consulting companies, and proper documentation of previous projects of similar type as well as up-to-date price lists issued by government organization (MPO). This perspective diversity leads to better results of cost estimation, and at the same time to higher value creation with less possible cost. In the case of Germany, the reliability of cost estimation in early phases is achieved by providing detailed standards and guidelines comparable to those of the Iranian government. However, in Germany, the availability of up-to-date and highly detailed standards is considered as the main pillar for achieving reliability in cost estimation in early phases of the project, which is the evidence for more emphasize on the shareholder theory by creating the maximum value. In addition, the well-detailed guideline for design phases and processes, even the fee required for architects and engineers to finish each design phase (i.e. HOAI) is the indication of resource dependency theory in the framework, i.e. by accelerating internal resource to facilitate the cost estimation preparation by providing robust and detail

standardization. The Australian government tries to improve the reliability of estimate in early phase by providing step-by-step guideline with appropriate level of details and suitable methods that need to be followed to prepare reliable cost estimate. For instance, in the case of road and rail construction, DPTI of Australia issued the manual of estimating, which comprises the necessary and required steps that need to be followed when preparing cost estimation. This manual even comprises the estimation levels required in each project phase and the appropriate methods that are commonly used. This also indicate the intention of the Australian government towards maximizing value creation by providing proper and well-detailed guidelines, and also the application of resource dependency theory by using internal resources to publish precise guidelines and practices in order to have a reliable cost estimation preparation. In the case of South Africa, the results indicate that the reliability is achieved through implementing auditing and reporting systems, and referring to the standards. South African government complies its standard with United States in construction and other cases, while it also puts more emphasis on transaction cost and agency theory for achieving reliability, i.e. more emphasis on adjusting framework to attain least feasible transaction cost as well as cost and control in early stages in order to enhance the value creation. However, referring to Norwegian appraisal model, it can be stated that the Norwegian government enhances the reliability of the estimate through independent external auditing system, which is called as quality assurance regime. This means that consultants review the estimation documents independently and provide the recommendation for further decision-making. This indicates that the Norwegian government also emphasizes on the maximum creation value with less possible cost.

The above discussion indicates that all five selected case studies, including the reference case, use the same governance theories in order to enhance the cost estimation reliability, but the approaches used are diverse, even though the use of standards and guidelines are common to most of them, while the content of guidelines and their application are different. All these regulations and procedures that are implemented by governments help to control the uncertainty level in the projects, which is one of the key points in having enhanced cost estimation in early phases of project. The uncertainty management is the key principal in all five cases' frameworks, and one of the key means to improve cost estimation precision. Additionally, the implementation of the guidelines in the framework and the authorities' diverse approaches to them. For instance, in the case of Iran, the government does not only approve the estimation, which is only based on the price lists issued by MPO, it should rather be internally and externally reviewed (base on project attributes), and the estimation should possess extra calculation and scenarios in case of changes or unexpected event. Although all cases consider the risk and contingency same as Iran does, the approaches are different. These diverse approaches are one of the obstacles in enhancement of cost estimation precision, even within the same framework. To conclude the first

research question, it can be stated that all five case studies, including base model, follow almost the same path for achieving better reliability in cost estimation, but the only difference among them are the approaches and the way of implementing them through cost estimation. Moreover, these approaches difference highlights the necessary functions pointed out by Klakegg in order to implement the governance framework (Klakegg, 2010), which are functions of policy making/strategy development (core function), functions to support operations and asset management, and functions to support planning and execution of projects as well as functions to support decision-making. These four functions support the explanation of the first research question since the idea of different approaches to the same method by different governments can be justified by looking upon these functions, and the idea of understanding governance as well.

In response to the second research question, the guidelines and procedures that are followed in each case in comparison with the base model (Norway) are summarized in Table 5.1 (below), which demonstrates the difference between the case studies and the base model.

In the Iranian case study, the cost estimation is usually first carried out internally, and then external review will be done with respect to the project size and budget. However, the starting place for cost estimation is ministry's sub-division. The cost estimation is based on the standards and regulations given by MPO. Even though the estimation practice is available to organizations, given by MPO, it is not obligatory for organizations to follow it, the way of approaching the estimation practice is up to the organizations' estimators, but deviation from the practice without genuine reason and explanation is not acceptable. The decision-making authorities for budget sanction vary with respect to the project size and the budget requirement; the various decision-making authorities with pre-defined responsibilities demonstrate the decentralized nature of the Iranian framework. In general, the cost estimation process starts at the ministry's sub-division, is then verified internally and externally (if required), and is then proposed to the decision-making authorities. The decision-making authority will review the appraisal and cost estimation as well as recommendations if any available. The decision-making authorities usually have their own system of control, which consists either of experts with required background/verified consulting companies, whose job is to assist government in assessing the appraisal or MPO in case of large or mega projects. However, it should be noted that the consulting companies' or experts' duty is just to review the appraisal documents and to write their recommendation through official report to the authorities or project organization, and they have no influence on the main decision-making process. Moreover, when the project size is big, and the budget required is huge, then the consulting company and the project organization will be invited to the meeting by decision-making authorities to clarify the ambiguities and uncertainties of the authorities in appraisal. In the case of Mega projects or National

scale projects, the decision-making authority is the cabinet minister or the parliament infrastructure development committee. In such cases, the ministry and the corresponding province governor will file the budget together and present it to the cabinet minister and parliament infrastructure development committee. From the point of view about mechanisms for controlling cost estimation, as mentioned earlier the consulting companies, standards, and guidelines from MPO as well as MPO itself. However, the MPO can audit and monitor all projects, but usually it will be involved in monitoring estimation process when the project size is at least large or mega scale. The medium size and small projects are monitored or controlled by consulting companies, which are verified by MPO.

In the case of Australia, the cost estimation is based on transparent and clear guideline that explains what is needed to be done in order to prepare reliable cost estimation, from the start till the final decision by authorities. The process starts in project organization, where the first estimation is strategic, followed by three more levels of estimate (Preliminary options estimate, and preliminary concept estimate) to refine the options, and the first formal estimate of appraisal takes place in the concept estimate level (within project scoping phase). This is the level, where preferred option has been chosen, and the corresponding business case is approved. The estimation base in this case is based on the standards available from the government. However, the first estimate - the strategic cost estimate - is purely based on the previous data of similar projects, and the common technique used here is the benchmarking technique. The decision-making authority varies based on the amount of budget required, ranging from chief executive, minister, and in the case of mega projects cabinet minister. The monitoring instruments in this case are guidelines and standards that have been issued by the government. In addition, the controlling instruments here are both internal assessor and external consultant. However, one of the emphasis of the guideline is that the cost estimation has to be peer reviewed, where an expert senior inside the project organization should review the estimated cost for given work scope, and experts review as well as cash flow of the program should also be presented. What is needed to be done in Australian case to achieve reliable cost estimation is to prepare good and detailed business case for each identified option in order to select the best option and business case as well. The strong point about Australian estimate practice is the available guidelines and precise instruction that what need to be done for preparing flawless estimation. Such instructions help to minimize the bias or drift in the context to a reasonable extent but still the individual bias in perception of contingency and risk cannot be reduced with such instruction.

In the case of Germany, the cost estimation like other cases is based on the guidelines and national standards issued by the governments. What makes the German case distinct from the others is the extensive level of details in standards and guidelines available for estimation. Even for the fees that required for architects and engineers to finish the design and drawing in each phase of the project (i.e.

HOAI). The monitoring is carried out with employing the guideline and national standards, and basically the estimation is based on the DIN-276 and BKI for the construction industry. These standards possess all the required details and fees that need to be taken into consideration for construction projects. However, it should be note that, these standards cannot be fully implement for mega infrastructures detail design but the concept and definitions given in these standards are sufficient to cover the initial cost estimation for decision making of the budget. Also, the cost of land acquisition, and facilities are excluded from these standards. These cost need to be estimated separately. The auditing is done both internally and externally based on the project size and budget. The decision authority for funding the budget varies, it can be local authorities and state, or federal government based on the size and budget of project. The meeting with estimator and ask for justification is also another way of auditing the estimate. The decision authority in some cases ask the estimator to explain why part of the project has specific estimation compare to other parts.

In the case of South Africa, the cost estimation is same as other case studies based on the national and approved standards. The process of cost estimation starts in Departments or Ministry in case of big project. The extensive care should be taken during cost estimation to present the financial viability of the project by presenting cash flow. The monitoring system is implemented by reporting system and the performance measurement system (performance indicator). The reports acts as a monitoring mechanism. The National Treasury guide for estimating budgeting emphasis that, the estimation document have to be peer reviewed, which act as controlling mechanism. This means that before submitting the appraisal for budget decision-making process should be internally reviewed and make sure that everything matches the scope of estimate. Also, it states that, in case of lack of internal capacity, it should be done externally and the report should be attached to the estimation documents. What makes the South African case a bit distinct from the other cases is the monitoring system, which is explained, and decision authority. For large projects or higher budgets, there is committee called as, Minister Committee on Budget (MINCOMBUD) which is combination of ministers and parliament senators and president. This committee base part of his decision on the recommendation report from ministry of National Treasury and another committee called Medium-Term-Expenditure (MTE). The recommendation report from these two are essential for MINCOMBUD to further proceed with the decision making process.

In comparison with the base model, Norway has much more simpler process of cost estimation and cost control compare to the rest of the case studies. In Norwegian appraisal model, the first cost estimate is done internally by the project organization is mostly based on uncertainty analysis, internal database and similar previous projects if any. Later the appraisal model is presented for passing from the quality assurance regime, QA2, which act as a Norwegian monitoring system. Here, the external independent

consultant will review the cost estimate documents and write the recommendation for uncertainty regarding the project and estimate documents as well as, recommending the budget based on individual uncertainty analysis. The auditing mean in the Norwegian has to be external and the type of monitoring should be consultant. This is how the Norwegian QA2 designed and should perform. The authority for decision-making for large projects is only parliament, cabinet minister is in charge of selecting or reviewing the documents for choice of concept, which called as QA1.

In conclusion for the second research question, Norway has much more simpler process than the rest of case studies and specifically lesser number of review compare to the rest of case studies. As shown in the table-11, Germany and Australia has the highest number of reviews, where the cost estimation reviewed by internal and/or external auditor, before budget decision-making followed by Iran and South Africa. The high number of review gates does not necessarily guarantee the reliability of cost estimate but it has direct impact on less bias or at least better uncertainty management. Since, the reliability of cost estimate is not only depend on the uncertainty management but also on the managerial flexibility as mentioned by(Jørgensen & Wallace, 2000), and as mentioned by (Mastilak, 2011) understanding the relationship between the cost pools and the cross relation between them. In addition, the result from all case studies shows that, all five case studies include the base model, use parametric model or analogous estimating for first rough estimation, where historical data and similar previous project data are the base for rough estimation. This shows that all complies with the class 5 methodology that is suggested by AACE (**Error! Reference source not found.**). Later the estimation models develop to range estimating and feasibility estimate as the project progress and uncertainty decreases. This indicates the moving of the cost estimation from class 5 to class 3, which is desired for budget decision-making with -15% to +50% variation. Also, among what (Flyvbjerg et al., 2002) stated as the barriers for underestimation i.e. political, technical, economic and psychologic. The political factor is evident in all the cases, since decision authority of all five case studies are government. Either in budget decision-making or in choice of concept in Norway case or creating infrastructure master plan in all other cases. The comparison also indicates the diverse approaches that governments take in cost estimation process. For instance, the Norwegian model base the estimation on uncertainty management before decision making for budget, where in the case of South Africa the attention is more on the risk management in early phases. In the case of Germany, Iran and Australia, the focus is a bit more on the costs that associated with tasks in the beginning, and risk profile for estimation is added further in the estimation. This verifies the two functions introduced by (Klakegg, 2010) for governance framework, the means to support decision-making and functions to support project planning and execution. The difference lies in prioritizing the

methods and techniques to achieve reliable cost estimation and it is nothing but the difference in administrative culture and governance framework strategies in cost estimation.

The third research question of this study is concerned with means of user involvement in the early phase of the public projects. As indicated by (Damodaran, 1996) the user involvement aim is to reduce the ill effect on user. The reduction of ill effect will result in more sustain performance level, which can be achieved through more information processing by managers in uncertain projects, as found by (Tushman, 1979), and by identifying user requirements as well. Therefore, there is a need for developing methods and further defining roles for both users and developers as (Kujala, 2003) emphasize that. To identify the means of user involvement in early phases of project in each case, the three types of user involvement introduced by (Damodaran, 1996)(**Error! Reference source not found.** P**Error! Bookmark not defined.**)and the information processing model by (Gales & Mansour-Cole, 1995)(Figure 3.11 P23) has taken as base for comparing the four case studies with the base model.

The nature of public projects is in such a way that, its outcome effect on society is wide. Therefore, involving extensive group of users has no benefit except more ambiguity and complexity added to the project. Hence, the government and authorities who makes decisions are considered as users' representative, and provide their requirements through guidelines, standards and legislations. This ensure authorities involvement in the appraisal process by issuing directives and reports from auditors. This decentralized involvement is to enhance the efficiency of decision-making process and planning. However, governments can take different role during the appraisal process. As indicates from the results, all of the case studies, including base model, consider the consulting companies as the common way of user involvement in the project but with different role. In the case of Iran, the user involvement is mostly informative and constructive since, there are available instruction and price list from MPO for carrying out the estimation. However, in especial cases, the cost estimation is carried out with consultant as participative role, where the projects are of mega size and require more advanced method of estimation for project. There are instruction from government that how many consultant should be involved based on the project size and budget. The number of reviewing cost estimation (frequency of user interaction) is usually two times, one after rough estimation and the second one before submitting the appraisal for decision-making process. In the case of Germany, the user involvement before decision-making in the beginning is informative but before submitting the cost estimation documents the user involvement should be constructive since, there is requirement for report from consultant to make sure that the cost estimation complies with national standards. The cost estimate will be reviewed three times, two times in the beginning phases i.e. mostly informative, and one time before submission for decision-making, i.e. constructive. Here also, same as the Iran case the user involvement type can change to participative role

in case of mega projects. In the case of Australia, the user involvement is both of informative and constructive; this is due to the availability of transparent guidelines and procedures for cost estimation. However, again like previous case studies, it can change based on the project size and budget to participative as decision authority does. It should be note that, the first two time before formal submission is informative and constructive respectively but the last review should pure constructive by senior faculty member in organization. In the case of South Africa, the user involvement is most of the time purely constructive and the report should be submitted along with appraisal for decision-making process. It happens very seldom to use informative and participative. Here the estimation process reviewed two times once in the project organization and the other one in the ministry of national treasury. In comparison with base model, the Norwegian model takes constructive user involvement approach, here the consultant write the recommendation with respect to an individual uncertainty analysis and it is only done once before passes QA2 and go for submission to the parliament for budget allocation decision-making. However, it seems that before cost estimate document enters QA2 for review, the project organization involved in informative and constructive approach several time, but there was no solid piece of information regarding this interaction.

To conclude the third research question, it indicates evidently that, all selected cases in this study are indirectly have kind of informative user involvement, i.e. application of legislations, guidelines and standards in preparing the cost estimation documents. Moreover, the need for means and definition of role for users that discussed by(Kujala, 2003) as essential requirement for effective user involvement are completely evident in the all case studies, i.e. involving consultant as the method and the type of involvement (i.e. informative, constructive, and participative) describes the role that user supposed to hold. In addition, use of consultant, standards, and guidelines are the means for reducing uncertainty at least in financial and technical aspects to a reasonable extent and sustaining performance level. This is nothing but using of the preprocessed approved pool of information, which is discussed by (Tushman, 1979). Additionally, the way of involving users in decision-making in all case studies are same as the mechanisms pointed by(Damodaran, 1996). The result shows that, the users are involved in decision-making process through advisory/steering committee, consultation, quality assurance procedure, or membership of problem solving group (participative role) in case of large project, where more information is required. Additionally, the more willingness toward application of informative and constructive type of user involvement compare to participative in one way can be to control the influence of user involvement in decision-making process.-

	IRAN	SOUTH AFRICA	GERMANY	AUSTRALIA	NORWAY
Number of Review	2	2	3	3	1
Mointoring Instrument	Standard, guidelines, Government directives and/or Consultant	Reporting and/or performance indicators	Guideline and National Standards	Guidelines and definitions	Consultant and/or Gate ways
Estimation Base and/or Instrument	Government Standard (official price list issued by MPO)	Government Approved Standard and/or consultant database	National Standard (BKI and DIN)	Internal and historical database of previous projects	Internal & historical refined database
Auditor type (External/Internal)	Selected based on project size and budget. Large project assessed both internally and externally. Medium to small project assessed internally or in special case both internal and external.	Internal and/or External based on the department capacity	Both internal and external	Internal and/or External assessor	External Assessor
User Involvement type	Mostly constructive and/or Informative OR in case of mega projects participative	Mostly constructive,seldom to be informative and participative	Mostly informative and/or constructive OR participative	More informative and constructive- rarely happen to be participative	Constructive
Coordination Place	Ministry's sub division and/or Province governor office committee and/or Parliament infrastructure committee (based on the project size and budget)	Ministry and/or Departments	Basically Ministry, but can be State government	Ministry and/or Departments	Ministry
Sponsoring firm/organization	Ministry and/or Province Governor office	Departments and/or Ministry	Ministry and/or state and/or federal government	Ministry of treasure and finance	Ministry
Commencement of Process	Ministry's sub-division	Departments and/or Ministry	Ministry	Departments and/or Ministry	Ministry
Process holder	Ministry and/or Province governor office	Departments and/or Ministry	Ministry and/or consulting and construction agencies	Based on the project size can be Ministry alone and/or construction and consulting agencies	Ministry (Project Organization)
Decision authority	Ministry and/or Province Governor office. In mega projects Government cabinet minister and infrastructure development committee in parliament	Ministry and/or MINCOMBUD	Local and/or State Government OR parliament in case of mega projects	Depending on budget and project size can be chief executive and/or minister and/or cabinet	Parliament

Table 5.1 - Case Studies Comparison: Summary

CHAPTER 6 – CONCLUSION

In this chapter conclusion of foregoing chapters will be drawn. This master thesis project found differences between public investment models with respect to the cost estimation and user involvement for four selected case studies by comparing them with Norwegian appraisal model. These differences could help in understanding the function of the different governance framework in public projects as well as, administrative cultures with respect to cost estimation and user involvement. In addition this will help in getting better insight over the control mechanisms that have been employed by different government in order to achieve more reliable cost estimation in early phases of public project. In order to attain comprehensive model for cost estimation in public projects, such studies are essential and facilitate to understand the differences more in lucid manner.

This could be achieved by looking upon the governance frameworks of the selected case studies in comparison to base model and understanding the different function that support each framework in decision making, planning and execution of project, and decision-making. These functions are same as those that have been studied and introduced by '(Klakegg, 2010)', who's pointed that, these functions are essential for implementing the governance frameworks, but this report found them as useful mean to understand the differences between governance framework as well. In addition, the result obtained from these factors emphasis the differences in administrative and policy/strategy making cultures. Also, explicit the means for supporting decision making in the frameworks, which indicates the diversity in approach in achieving the same objective.

Correspondingly, this report could find that, another mean to achieve reliable cost estimation in early phase of the public project depends on the balance between four factors mentioned by (Flyvbjerg et al., 2002 378), political, geographical, and technological as well as psychological, which presents them as four grounds for cost underestimation. This report found that the most contributor among these factors to the cost estimation process in early phase are psychological followed by political since, the other two factors can be controlled and predicted through legislations and standardizations. This is due to the reason that most of the case studies except the base model (Norway) illustrated lack of proper mechanism to control the psychologic effects. In all four selected case studies, it can be seen that, the idea of more legislation and precise regulation is the mean to achieve sound and reliable estimation and control over psychological factor. However, it is not contradictory but this report found that more bureaucracy and legislation does not make sound estimation and does not extensively minimize the psychological biases. This finding is based on the study of the base model, where the framework is much simpler and emphasis for estimation to be based on the uncertainty management, which can be used as a leverage for controlling

optimism bias in the estimation, which can result in control over psychological bias. However, this does not mean that optimism bias should be minimized completely and pessimism bias should be increased for better estimation, but it is a question of balance between two. Lack of enough optimism bias will affect the political factor, since the political side fears to go for investment in the project, and the same applies to pessimism bias.

Moreover, this study found that, more legislations and guidelines does not necessarily result in reliable cost estimation in early phases but the more important aspect is effective employment and application of the available rules and regulations to achieve more efficiency in process as well as reliability in cost estimation rather putting new rules and legislations in place. Also, this report found that, dealing with uncertainty and subjective judgement during early estimation in projects are challenging mission and usually expose to significant level of error in precision. Hence, to avoid such imprecision, real time information and computation can significantly affect the reliability of early cost estimate. This can be achieved by implementing building information modeling (BIM); it is software base system that help in virtual modeling and early estimation in projects. This a new era for many countries to enhance their performance in the early estimation. All in all, the multifaceted nature of the governance frameworks requires the government to keep improve the internal functions of the framework for achieving more reliable output.

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APPENDIX-I

PHONE INTERVIEW QUESTIONS:

1. What are the steps for cost estimation?
2. What is the basis for estimating cost?
3. Where does the cost estimation start?
4. How is the control mechanism over the cost estimation?
5. Who is deciding the cost estimation approval?

APPENDIX-II

IRAN'S MINISTRY OF ENERGY

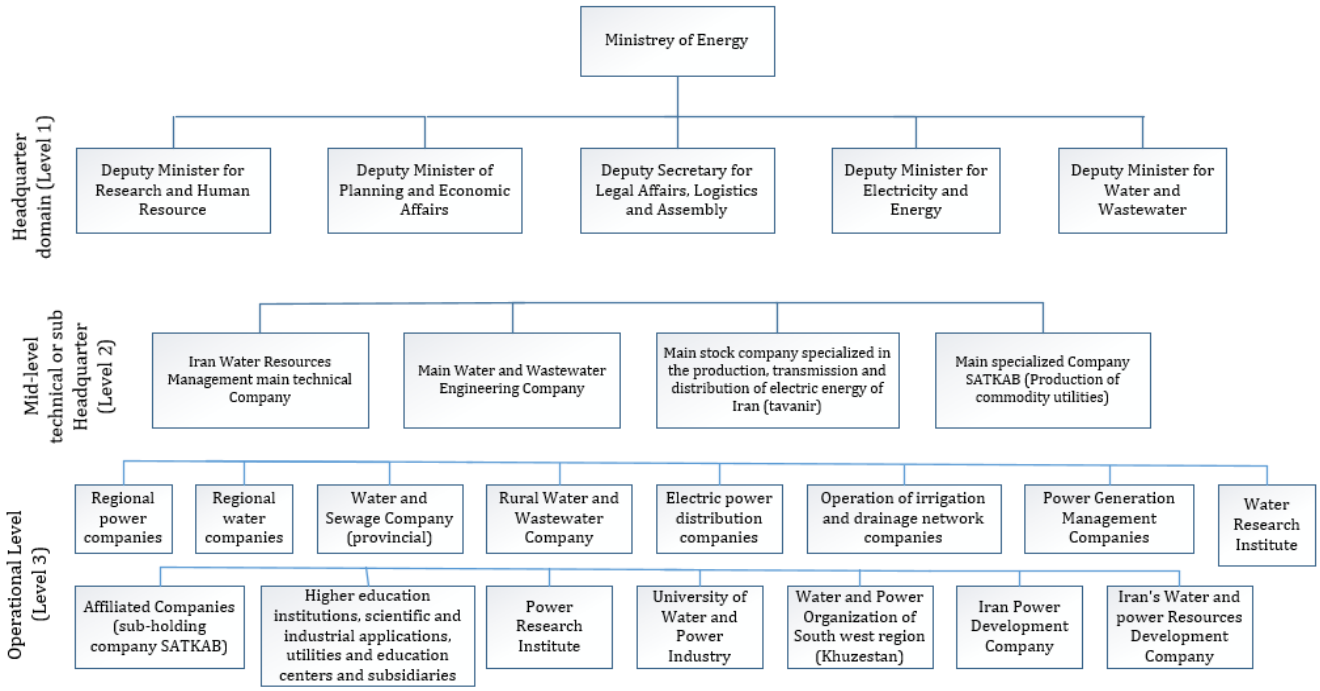

Figure 9.1- Ministry of Energy Structure, Iran Case, Source: (http://moe.gov.ir/)

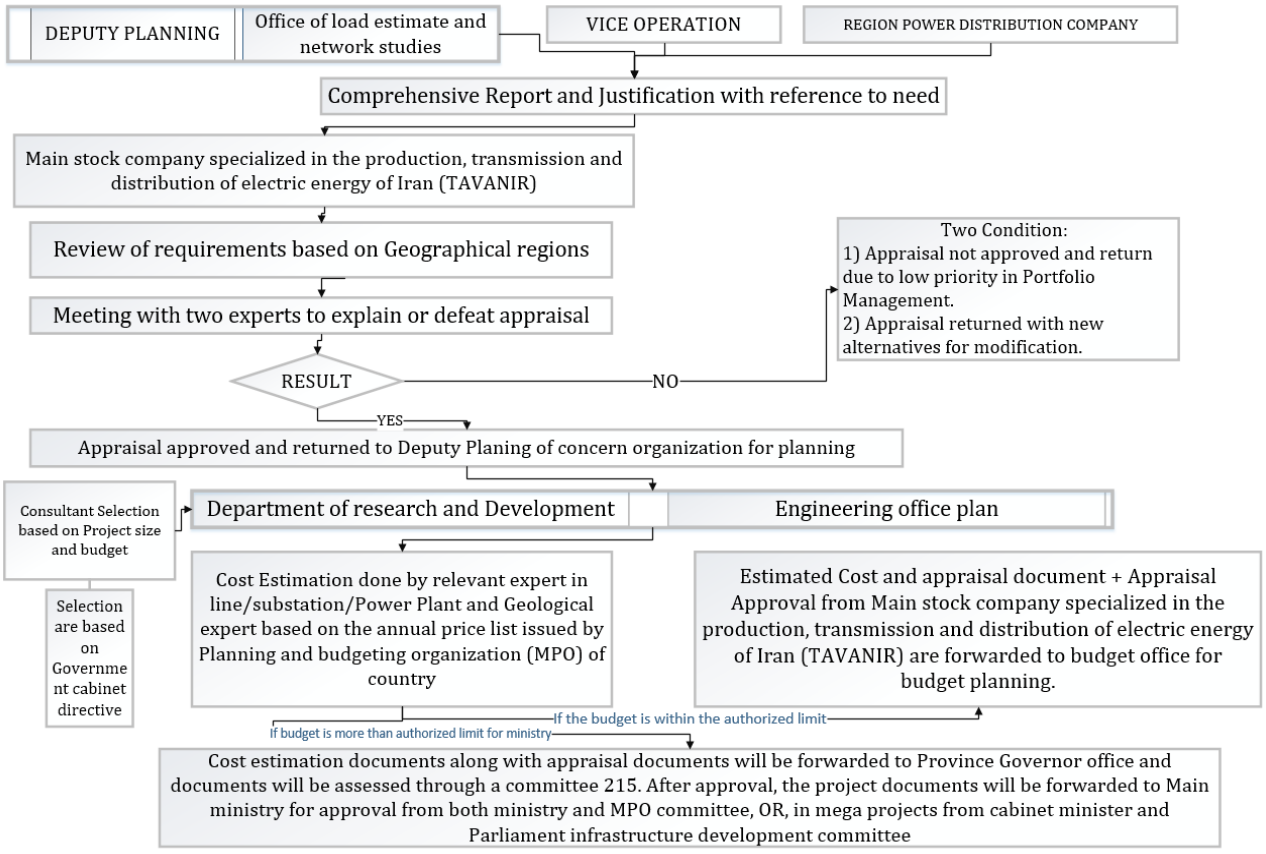

Figure 9.2 - Detail Appraisal and Cost estimation Process, Source> Phone Interview

APPENDIX- III

AUSTRALIA COST ESTIMATION DETAIL

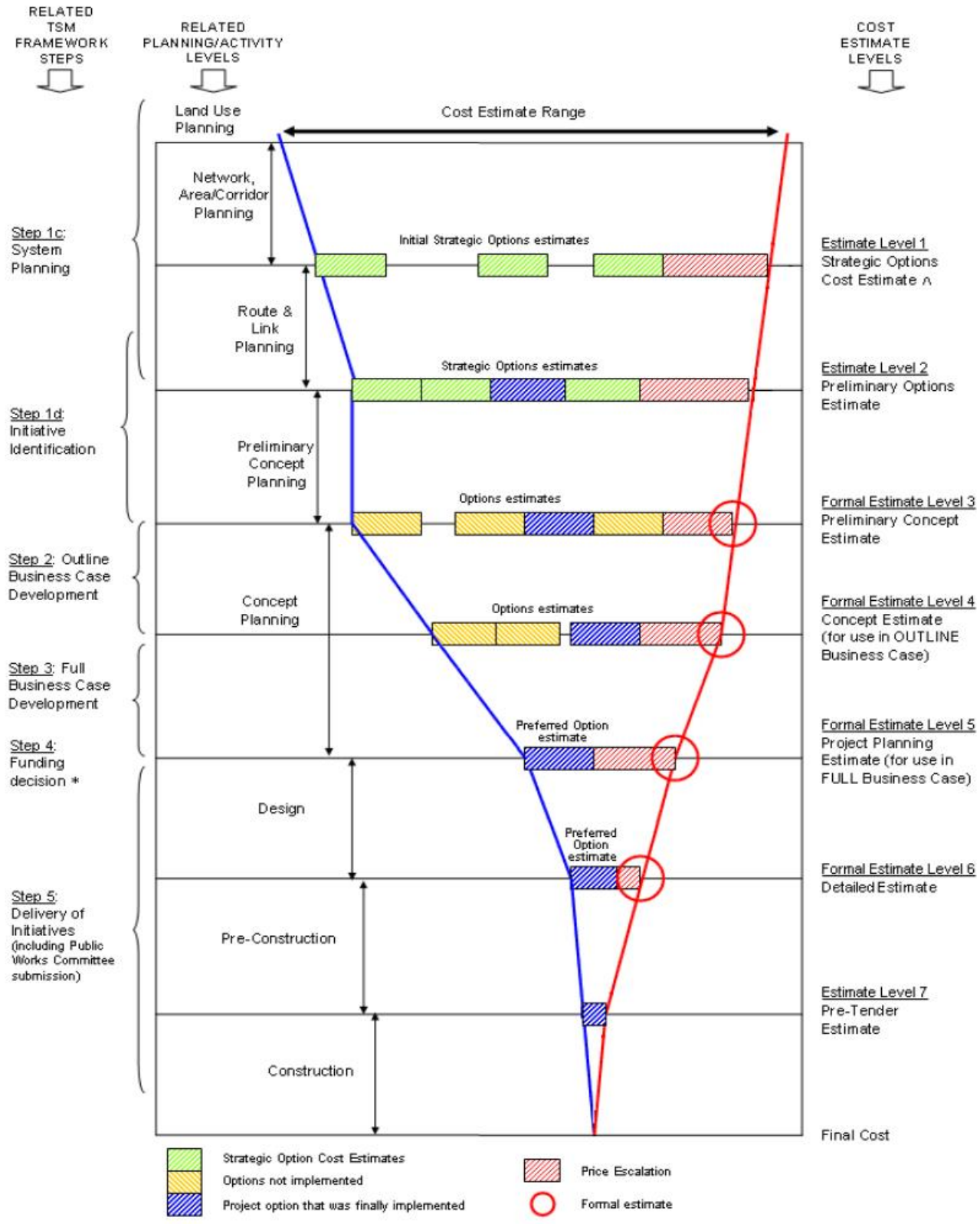

Figure 10.1 - Cost estimate model for road and rails, Source:(Department of Planning, 2015)

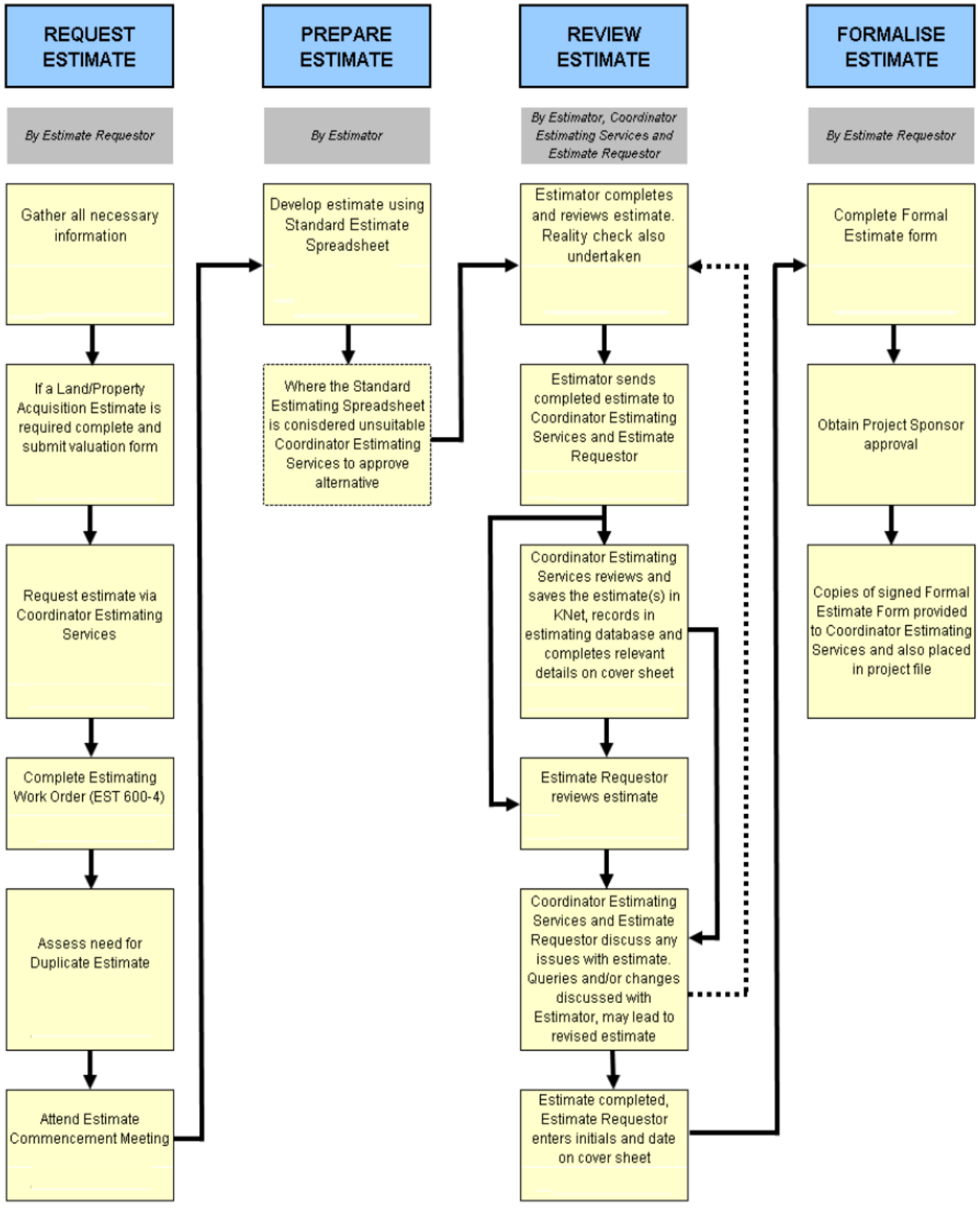

Figure 10.2 - Generic cost estimate process, Source: (Department of Planning, 2015)

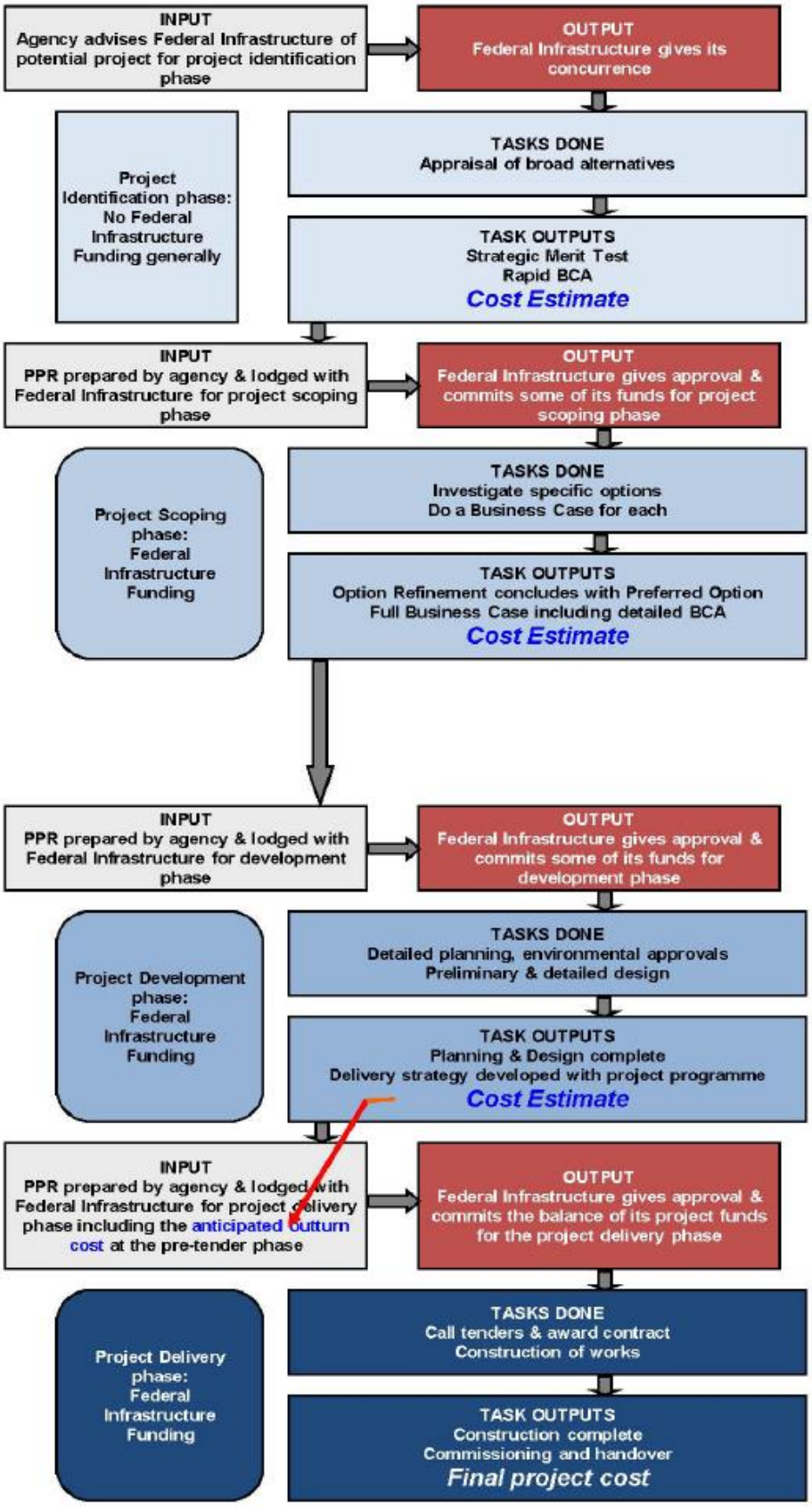

Figure 10.3 - Federal infrastructure process for approval of cost estimation, Source: (Department of Planning, 2015)