



# **The Management of Construction Processes in Developing Countries: A Case Study of the Ethiopian Roads Authority**

Solomon S. Desta

A Thesis Submitted for the Degree of Doctor of Philosophy

Department of Construction Economics and Management  
University of Cape Town

April, 2015

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The Management of the Construction Processes in Developing Countries: A Case Study of  
Ethiopian Roads Authority

To Tefera Sertse Desta (DVM) (1960-2001 Ethiopian Calendar)  
Brother extraordinaire!

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**ABSTRACT**

**Title:** *The Management of the Construction Processes in Developing Countries: A Case Study of the Ethiopian Roads Authority.*

The delivery of construction projects in Ethiopia is accused of non-optimum performance. With this poor performance of the delivery of projects as the instigator, this study set major objectives of exploring the current practices of the management of the construction processes in Ethiopia and investigating the major drawbacks of the practices as seen in the context of ‘accepted practices’ and theoretical principles.

As part of the approaches to achieve these objectives, the study first developed a conceptual framework for improved project performance. It identified the processes executed in project delivery, the resources used in executing these processes and the governance/management system through which the processes and resources are brought together and managed; contextualized to the peculiar conditions under which the projects are implemented, as the basic pillars of construction project management. Then, the study used the concepts and principles associated with these basic pillars and ‘accepted practices’ in the management of the construction processes both to inform the data collection and analysis and serve as reference against which the Ethiopian practices are compared.

The study adopted post-positivist inclined case study research methodology whereby the Ethiopian Roads Authority’s (ERA’s) project delivery approaches are taken as case in point. It employed data collected from documents and through interviews. Using content analysis technique, the study explored and evaluated ERA’s project delivery processes and their management. It also explored and analyzed the major challenges experienced by ERA in its project deliveries.

The study found out that the phases and core processes ERA employs in its project delivery are comparable to ‘accepted practices’. However, there are key deviations from the best practices recommended in the literature in the execution and management of these processes. The major ones are: 1) ERA employs extra-fragmented approach to project delivery; 2) ERA’s project delivery approaches and processes are not adequately tailored to the specific characteristics and peculiarities of its projects and its environment 3) the Authority’s project quality assurance measures are weak and its performance monitoring and evaluation approaches are self serving; 4) externally, the volatile environment, the poor supply chain, unconsolidated knowledge base and negligent and slack practices in the industry, over which ERA has little control, are key factors that affect the Authority’s project delivery.

Therefore, a key implication of the findings is the need for adaptation of the project delivery approaches to the project peculiarities and contexts they are implemented under. Related with this, in comparison with its counterparts in developed countries, the context (the environment) under which ERA’s projects are implemented generally presents more stringent constraints and challenges thereby making adaptations to these peculiar challenges even more critical.

Solomon Sertse Desta  
Addis Ababa  
April 2015

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Solomon Sertse Desta

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**ABBREVIATIONS**

AfDB	African Development Bank
AM	Asset Management (ERA's Deputy Director General)
APL	Adaptable Program Loan (World Bank)
ASQ	American Society for Quality
ATC	Australian Transport Council
BaTCoDA	Building and Transport Construction Design Authority
BPR	Business Process Reengineering
CAC	Contract Award Committee
CESA	Consulting Engineers South Africa
CIDB	Construction Industry Development Board (South Africa)
CII	Construction Industry Institute
CM	Construction Management
CoST	Construction Sector Transparency
CSFs	Critical Success Factors
CSIR	Council for Scientific and Industrial Research (South Africa)
DAAD	German Academic Exchange Service (German)
DAC	Development Assistant Committee (OECD)
DB	Design-Build
DBB	Design-Bid-Build
DDG	Deputy Director General (ERA)
EBCA	Ethiopian Building Construction Authority
EO	Engineering Operations (ERA's Deputy Director General)
EOI	Expression of Interest
EPC	Engineering, Procurement and Construction
EPD	Engineering Procurement Directorate (ERA)
ERA	Ethiopian Roads Authority
ERCC	Ethiopian Roads Construction Corporation
ETB	Ethiopian Birr
ETCA	Ethiopian Transport Construction Authority

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EVA	Earned Value Analysis
FHWA	Federal Highway Authority (United States of America)
FIDIC	International Federation of Consulting Engineers (French)
GDP	Gross Domestic Product
GTP	Growth and Transformation Plan
HERQA	Higher Education Relevance and Quality Agency
HRFM	Human Resources and Finance Management (ERA's Deputy Director General)
ICOM	Input, Control, Output and Mechanism
IDA	International Development Association (World Bank)
IDEF	Integrated DEFnition
IMF	International Monetary Fund
KPI	Key Performance Indicators
MoFED	Ministry of Finance and Economic Development
MDGs	Millennium Development Goals
MoC	Ministry of Construction
MoUDC	Ministry of Urban Development and Construction
MoWUD	Ministry of Works and Urban Development
OECD	Organization for Economic Cooperation and Development
OGC	Office of Government Commerce (United Kingdom)
PASDEP	Plan for Accelerated and Sustainable Development to End Poverty
PMBOK	Project Management Body of Knowledge
PMI	Project Management Institute
PPA	Public Procurement Authority
PPD	Planning and Programming Directorate (ERA)
PRINCE	Projects IN Controlled Environment
QBS	Quality-Based Selection
QCBS	Quality and Cost-Based Selection
RFP	Request for Proposal
ROW	Right-of-Way
RSDP	Road Sector Development Programme
SMEC	Snowy Mountains Engineering Corporation

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TCDE	Transport Construction Design Enterprise
ToR	Terms of Reference
TRB	Transport Research Board
UNDP	United Nations Development Programme
UNECA	United Nations Economic Commission for Africa
UNOPS	United Nations Office for Project Services
URRAP	Universal Rural Road Access Programme
WB	World Bank

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## **1 BACKGROUND AND RESEARCH PROBLEM**

### **1.1 Construction in general**

The construction industry is an important part of any economy. Infrastructures delivered by the construction industry and its key allies affect economic growth. Construction, which has the responsibility of creating, defining and maintaining the built environment within which most other social and economic activities take place (Morton, 2002; Cain, 2003) is one of the most important ways in which societies create new values (Winch, 2002). The industry provides society with delivery mechanisms for many aspects of economic, social, political, environmental needs making its products essential to mankind's physical and social day-to day activities.

Moreover, the industry provides significant amounts of fixed investment, contributes considerably to national output and is a major source of employment, directly and indirectly through its multiplier effect (Walker and Flanagan, 1991). In this regard, in most countries, construction constitutes more than half of capital investment, contributes up to 10% of GDP and accounts for almost 28% of all industrial employment (Winch, 2002; CSIR, 2003). In addition, due to its multiplier effect, construction contributes towards employment in other industrial sectors. For example, according to the SECTUER Study quoted in COM (1997), in the European Community, one job created in the construction industry will be associated with two further jobs in other sectors.

In fast developing countries, the contribution of construction to the economy is believed to be higher than the global average (Winch, 2002). For such nations, mainly due to its multiplier effect and being interlinked with various other industries and sectors, construction is claimed to be the best tool, probably next to agriculture in most developing nations, to apply conventional Keynesian economic theory<sup>1</sup> (Hillebrandt, 1974; Ball, 1998) in triggering/controlling economic development.

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<sup>1</sup> The theory, as opposed to free market economic theory, argues that private sector decisions sometimes lead to inefficiencies in macroeconomic outcomes and therefore advocates active policy response by the public sector. Under conventional "Keynesian" economic theory, when the economy is in a recess, the government would increase spending to stimulate economic activity, and when there is a boom, government would reduce its spending (Morton, 2002).

Though multifold its socio-economical contributions and its significance in affecting the livelihood of many, generally, the delivery process of construction is accused for its inefficiency and ineffectiveness. Studies in various countries show that, compared to other industries, construction is known for non-optimal performance (Latham, 1994; Love and Mohamed, 1995; Egan, 1998) These studies concluded that the fragmented nature of the industry, the sequential delivery mechanisms often employed, the often uncooperative and sometimes adversarial supply chain relationships, the industry's inability (slowness) to adopt new technologies and management styles are said to have inhibited the industry from optimal performance.

Various attempts have been made to combat construction's inefficiencies and ineffectiveness. For example, different delivery mechanisms such as the design-build, construction management have been adopted as means of counteracting the problems of the sequential design-bid-build delivery system; partnering form of supply chain relationships have been recommended and implemented as a means of reducing the adversarial relations between the parties involved in construction delivery. Nevertheless, though each of these strategies has attempted to address the challenges in the industry, they have not taken a holistic process improvement approach (Love and Li, 1998) and the success they brought is not consistent.

In this light, researchers in construction (for example Koskella, 1992) argue that as it is, construction lacks a full utilization of the construction team, bringing the skills of all the participants to bear on deliverable value to the client through integrated project processes. Many (Graham and Smithers, 1996; Love, 1996; Koskella, 2000) note that there are many wasteful activities during the design and construction process with many processes consuming time and effort without adding equivalent value. In this regard, for example, Mohamed and Tucker's (1996) investigation showed that, in a construction site, 25 percent time savings is possible in a typical construction activity without any additional resource.

The major malaise of construction works are associated both with the structure (including the temporary nature of projects) of the industry and the processes (as manifested by the inefficient execution of the various processes associated with the delivery). To remove these inefficiencies,

construction is advised to look into and optimize both its structure and the processes (both the conversion and flow processes) it uses in delivering output. To this end, construction is advised to re-engineer its processes and change the way it does business (Koskella, 2000).

## **1.2 Construction in Ethiopia**

### **1.2.1 History of the industry**

Mankind's endeavor in construction works can be dated back to time immemorial. The ability to build things has transcended from the most ancient human skills of the primary ages. During the primary ages, when focus was largely on fulfilling human's basic needs and building major figurative and monumental structures, the construction works had been largely related to talents of human beings on how to construct shelters and monuments.

In Ethiopia as well, construction works can be traced at least to the Shabaite era (circa 10<sup>th</sup> century BC) during which time the legendary queen built her palaces- espoused ruins of which are still standing at the foot hills of the modern day Axum town. Since then, in addition to shelter constructions, ranges of primarily palaces and monuments such as the Axum Obelisks, the Lalibela Rock Hewn Churches, the Gondar Palaces, the Harar Walls had been carved and erected in a widely spaced geographical locations and chronological times.

'Modern' construction, however, had only started during the reign of Emperor Menelik II (1866-1913). Though there had been various construction works before him (ERA, 2001), sustainable construction works, especially infrastructure works such as the Addis Ababa – Asmara road, Addis Ababa-Djibouti Railway, were implemented during his reign.

In terms of administrative (regulatory) setups for the construction industry, however, Haileselassie's era (1930-1974) takes much of the credit. During Haileselassie's reign, the first ministry with a mandate to regulate the public construction sector, Ministry of Public Works (Order No 38. of 1964) was established. Other authorities, including the Imperial Highway Authority (1951), were established as government divisions to promote progress and

developments in the sector. However, during those days, most of the administrative and project works had been done by foreign professionals and firms as there were not citizens and local firms capable of handling such works.

Since the establishment of the industry in modern format back then, various readjustments and proclamations have been made to adjust the authorities and institutions to the needs and ideologies of the governments in power as well as the perceived demands of the sector itself. In this regard, after reviewing various literature sources available on the topic, Wubishet (2004) categorized the history of Ethiopian construction industry into six distinct periods. As discussed below, each of these periods have major distinct characteristics that separate them from the other

The first period (pre 1968), which Wubishet (2004) termed ‘Foreign Companies Dominate Construction Industry’ is characterized by domination of foreign firms and personnel in both the administration of public offices and execution of projects. During this period, in addition to establishing regulatory bodies such as the Ministry of Public Works, there were many schools, offices, healthcare centres, etc. construction projects implemented by none-domesticated companies. Cognizant of the fact that the bulk part of the works in the industry is being executed by foreigners and none-domesticated companies, the Imperial government was working towards improving the capacity of the domestic construction sector which gave birth to the second period.

The second period (1968-1982) is characterized by efforts by the then Imperial government (until its overthrow in 1974<sup>2</sup>) to establish and enhance the capacity of domestic firms and personnel in the sector. During that period, the government facilitated and helped finance the establishment of domestic construction sector firms. The firms were also awarded with construction projects. This initiative of the government, as argued by Wubishet (*ibid*), helped small scale domestic companies to emerge and take root. In that period, parallel to the private sector capacity building, the public sector was also building its capacity and force account (in house) construction works by the government was also increasingly adopted. However, the

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<sup>2</sup> Wubishet (2004) argues for his incorporation of the six years of the succeeding regime (1974-1982) into this period based on the fact that, though the succeeding government was not conducive to private sector, it only declared for the abolishment of the private businesses later on.

capacity building initiative was not a success as expected as the firms couldn't sustain their financial obligation due to tight competition<sup>3</sup>, low-balling and shortage of construction materials and fuel (World Bank, 1984). In addition, the overthrow of the Imperial government and its replacement by the Derg regime that advocates for state controlled command economy meant the private sector capacity building was short lived. This change of regime and ideology by the state also created the basis for the subsequent period.

The third period (1982-1987) is typically characterized by, as it is often the case with command economy structure, parastatal dominated construction industry. Following its taking over of power and consolidation of same, the Derg regime confiscated private businesses and properties and brought them under state control in 1982. This forced the local construction firms to be state owned and international companies which opened a domestic branch to leave the country. During this period, Ministry of Construction, which administers construction sector authorities and enterprises, including the Ethiopian Transport Construction Authority (ETCA) and Ethiopian Building Construction Authority (EBCA) was the major administrator as well as implementer of construction related initiatives.

The fourth period (1987-1997) is triggered by a combination of ideological change by the government from the command economy to mixed economy in 1987 and from lessons learned of the failures of single entities becoming employers, consultant as well as contractors of public construction works in the previous period. The approach of amalgamating all the functions of construction works into a single entity lacked a proper check-and-balance system and is liable to cover-ups, thereby leading to a reduced return on investment, was criticized by international financiers of infrastructure projects (TCDE, 1994). The subsequent period, which is meant to cater for these deficiencies and aligned with the policies of the mixed economy, is known for separation of the designing and supervising entities from constructing ones. Therefore, following the announcement of the mixed economy approach, the then Ministry of Construction gave way for the separation of the design and contract administration works from the construction activities. This is done through the establishment of the Building and Transport Construction

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<sup>3</sup> Berhane (1999), without providing the relative figures, notes that the domestic firms used to execute projects at a substantially lower price than international firms.

Design Authority (BaTCoDA) through Proclamation No. 327 of 1987. The approach was recognition of the need for the separation of the design of construction projects and the monitoring and evaluation of performances during their subsequent construction phase from the actual construction activities. The period, therefore, favored the design-bid-build approach and paved the way for the fragmentation of construction project delivery systems as well as for establishment of various private consulting firms.

The fifth period (1991-2001) is triggered by a return to a market-based economy and decentralization of authority. The period, which is instigated by the overthrow of the Derg regime in 1991, allowed for participation of both national and international private companies in publically funded project bidding, minimized the award of public projects to state owned firms without competition, and focused on slow privatization of state owned companies. The period also focused on the decentralization of power between federal and regional authorities and bureaus. In the latter half of this period, the mandate of construction sector regulation and capacity building was given to the Ministry of Works and Urban Development, which was formed by joining the MoC and BaTCoDA through Proclamation 4/1995.

The sixth period (2001 – to date), in terms of regulation and governance, is fundamentally about re-adjustment of governance structure and state organs. Different proclamations such as Proclamation 256/2001, Proclamation 471/2005 and Proclamation 691/2010 were promulgated and enacted to re-adjust the major parties responsible for, among others, construction sector works. In this regard, Proclamation 256/2001 established and mandated Ministry of Infrastructure for infrastructure works. The major infrastructure development organs of the state such as the Ethiopian Roads Authority, the Ethiopian Electric Power Corporation, Civil Aviation Authority and the Road Fund Office were made accountable to this ministry. While the first five years of this period were characterized by integration of infrastructure related public offices under one umbrella, the subsequent setups rather concentrated on alignments. In this regard, Proclamation 471/2005 re-created the Ministry of Works and Urban Development and made the Ethiopian Roads Authority, the Office of the Road Fund, the Federal Urban Planning Institute and Rented House Agency accountable to it. Proclamation 691/2010 assigned different sectors of infrastructure development to different organs. For example, Ministry of Transport is made

accountable for transport related infrastructure entities such as the Ethiopian Roads Authority, the Ministry of Water and Energy for water resources and energy related entities, the Ministry of Urban Development and Construction, for urban and housing related entities.

In the above section, the major issues discussed in terms of the history of the Ethiopian construction industry are the construction and regulatory reforms of the public sector. This is because, while the private sector is an important part of the industry, the state is a major client of the construction industry and has a significant influence in shaping the procedures and processes the industry adopts. In this regard, for example, the major delivery mechanisms adopted and the standards produced are almost entirely pioneered and developed by the different organs of the public sector. The public sector adjustments and performance have had almost exclusive implication in shaping today's industry.

### **1.2.2 Recent developments and trends in the industry**

In parallel to the regulation and governance adjustments, the last two periods have seen significant increase in construction works and outputs. At a general economy level, in the past few years, Ethiopia's economy has expanded well. According to African Development Bank Group's Country Strategy Paper (2011), from 2006-2010, the Ethiopian economy registered an average growth of 11%, putting it among the fastest growing economy in Africa. Parallel to this strong economic performance, construction works in Ethiopia has grown strongly, with 11% growth in Gross Value Added. The public sector initiatives such as Road Sector Development Programmes (RSDPs), the Power Sector Development Programmes (Power SDPs), the Water Resources Development Programmes, the Integrated Urban Housing Development Programmes, the University Capacity Building Programmes, along with other (public and private) commercial, industrial and residential housing building units have increased construction's output. In this regard, for example, in sixteen years from the launch of RSDPs (since July 1997), Ethiopia has increased its road density from 24 Km/1000Km<sup>2</sup> to 78.2Km/1000Km<sup>2</sup> also improving the total roads networks in good condition from 22% to 70% (ERA, 2013).

However, despite the recent improved performances, Ethiopia's infrastructure is among the lowest even when compared to Sub-Saharan Africa. In this regard, for comparison purpose, based on a 2010 data, the African Development Bank's Infrastructure Index puts Ethiopia at 52 out of the 53 African states (AfDB, 2011). Therefore, given the infrastructure backlog and the geo-demographic situation of the country, Ethiopia's need to meet its infrastructure demands is still considerable.

Given the backlog of infrastructure needed on the one hand and enhanced by the performances of the past few years of the Country's emerging economic development and aspiration to satisfy the Millennium Development Goals (MDG's)<sup>4</sup> on the other, the Ethiopian construction industry can be predicted to keep expanding. In this context, for example, the government's five year Growth and Transformation Plan (GTP)<sup>5</sup> (2010- 2015) gives emphasis for infrastructure development in the country's vision to transform itself from agriculture to manufacturing led economy. In the transport sector, for example, parallel to the existing road and airport construction programmes, Ethiopia has launched a large Railway Sector Development Programme (RwSDP) and Universal Rural Road Access Programme (URRAP) with the objectives of constructing nearly five thousand kilometers of railway and seventy thousand kilometers of all weather road respectively. The GTP sets a target of 2000Km of Railway and a road density of 123.7Km/1000Km<sup>2</sup> by 2015.

Nonetheless, despite its relative increase in output in the past few years, the construction industry in Ethiopia has drawbacks and faces challenges. The competitiveness of the construction industry as whole when measured on its ability of delivering projects successfully on a consistent basis, on its ability of sustainably shaping the built environment, on its ability of coping with various challenges it faces, on its ability of building the capacities of its key participants, on its ability of satisfying the customer's and the general community's interests is argued to be poor

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<sup>4</sup> The UN flagged MDGs have eight multifaceted but interrelated goals of ending poverty and hunger, eliminating gender disparity, achieving universal primary education, reducing child mortality, improving maternal health, combating HIV/AIDS, malaria and other diseases, ensuring environmental sustainability and harnessing a global partnership for development. Each goal is further broken down into specific targets, most of which is to be achieved by 2015.

<sup>5</sup> The GTP is the currently existing (2010-2014/5) economic policy of the government. It supersedes its predecessor, Plan for Accelerated and Sustained Development to End Poverty (PASDEP) (2005/6-2009/10). The broad-based GTP bases itself on seven stated 'pillars', one of which is enhancing expansion and quality of infrastructure development.

(SMEC, 1999; MoWUD, 2001). In this light, in terms of domestic capacity building, for example, in the sixteen years of the RSDP period (1997-2013), 92 (25%) works contracts were awarded to foreign contractors with the local firms taking 278 (75%). However, the figures are considerably skewed in terms of the scope of the project with 54% of the contract amounts going to the foreign firms (ERA, 2013). Particularly, nearly all road projects financed by international financiers were awarded to foreign firms due to the espoused reason that the local construction firms lack the capacity and capability to satisfy the qualification criteria set by the financiers.

In addition, projects delivered significantly fail under the conventional project success criteria of on time, within budget and to the required performance delivery (ERA, 2009). For example, out of the twenty four rehabilitation and trunk road upgrading projects completed up to 2009 under the RSDP, only seven were completed within budget. The remaining seventeen were completed, on average, 165% over budget.

While low capacity and capability of local firms is cited as the major reason for the award of projects to international firms, particularly those financed by international financiers, various reasons can be cited for the poor performance of projects - which does not show significant difference between international and local firms. Generally, the challenges posed by environment such as the poor performance of the whole supply chain and inflations<sup>6</sup> in the general economy can be cited as a major problem. However, the industry by itself harbors deficiencies that affect its performance. In this regard, a study by SMEC, as presented in Wubishet (2004) characterized the Ethiopian construction industry as composed of firms with an inadequate capital base, specifically to construction contractors, old and limited numbers of equipment and low levels of utilization, deficiencies in human resources with regard to technical, managerial, financial and entrepreneurial skills. However, while the study by SMEC highlights that the resource deficiencies of the local firms, it cannot fully explain the failure of projects implemented by international firms. In addition, to resource deficiencies (capacity, capability and competency wise), ERA's assessment of the major problems of the RSDP, for example, indicates process and

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<sup>6</sup> According to the Central Statistics Agency's Consumer Price Index, the average price index for house rent, construction material, water, fuel and power - aggregated together (based on December 2006 base index =100) for the years running July 2007- June 2008, July 2008- June 2009, July 2009- June 2010, respectively has been 112, 136.6 and 159.1

system based problems contributing significantly to the poor performances. In this regard, for example, the Authority blames the Design-Bid-Build delivery system as one major cause of the problem, which perhaps also gives the reason for a major inclination towards Design-Build approach by the Authority.

In addition, the industry's inability to embrace professionalism has also been highlighted as a major problem. Related to this, Wubishet (2004) found out that although there are some construction management process guidelines<sup>78</sup> drafted by different parties and were supposed to be used in the industry, 70% of a seventy nine sample size survey group he studied either did not know their existence or wrongly identified them. This haphazard construction management practice indicates that, in terms of the practice of the management of projects, there is no consistent project planning, coordinated execution and monitoring systems developed (or at least consistently adopted) to guide the creation, development and implementation of projects.

### 1.3 Problem formulation

The construction industry is undoubtedly a national asset whose development ought to reflect the development and transformation of a wider society. Moreover, a nation's economic growth is affected by the physical infrastructure that is delivered by the construction industry and its key participants. Therefore, it is imperative that the construction industry needs to improve its capability and delivery system to meet social and economic objectives. Besides, as large amounts of resources are required/or involved in infrastructure delivery, it is important to

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<sup>7</sup> As example, such 'guidelines' include the Ethiopian Roads Authority's construction management system (CMS) drafted in 1983, the Ministry of Works and Urban Development's construction projects development process management system (CPDPMS) drafted in 1995 and the Ministry of Infrastructure's procedures for carrying out building construction projects (PCP) compiled in 2004. Notwithstanding their low applicability rate and the fact that none of them have been ratified as formal project management procedures of public projects yet, the documents appear to lack in comprehensiveness to successfully guide the management of construction processes. For example, the PCP resembles a procurement directive as it primarily concentrates on procurement procedures and requirement setting rather than project processes. The CMS, though it is obsolete for today's construction technology and management principles, is a good road sector activity designations and resource deployment reference. However, its principal focus on activity execution and concentration only on construction phase of road projects means it overlooks process flow optimizations and its importance. It also overlooks the importance of the early phases of project delivery. The CPDPMS presents the major processes in construction project deliveries without reference to their interactions and how they affect each other (and the overall project delivery).

<sup>8</sup> Internationally financed projects generally follow the guidelines of the financing agency.

investigate whether the systems put in place and the processes adopted are effective in achieving the set objectives. In this regard, as highlighted earlier, the Ethiopian construction industry is said to harbor many inefficiencies and ineffectiveness in its delivery system and processes (SMEC, 1999; MoWUD, 2001; ERA, 2009). These inefficiencies result in a significant impact on the country's already constrained resources, as it means, among others, allocation of extra resources needed to implement the projects, a necessity to maintain infrastructure before their due period and not delivering the intended purpose the projects are incepted for.

One of the causes of the inefficiencies is the lack of a consistent system that identifies the major construction processes and presented 'better practice' on how they are effected (Wubishet, 2004). As highlighted earlier, many projects are not planned, executed and monitored according to the generally accepted (internationally) guidelines of such practices in modern construction management. There are various reasons for this including a lack of trained personnel, non appreciation of the importance of proper planning and monitoring schemes to improve performance- primarily driven by the impetus to dwell on actual physical works and the lack of appropriate guidelines in the management of the various processes.

Nevertheless, improving the performance of the industry through effective and efficient systems and processes is important, not least because the industry has a bottom line effect on the country's economy and the society as a whole but also it is of importance for the industry's (sector firms') survival in the wake of the fierce international competition it is facing. In line with this, this dissertation research work has embarked with an objective to model the construction management processes systems as practiced within the Ethiopian construction industry.

In its approach, the study takes 'improved performance' of projects on a consistent basis as its major target. To achieve the consistently improved performance, the study identifies project processes and their execution, the inputs (resources) for the execution of the processes, the management of the processes and the resources (and the interfaces between them) along with stakeholder (participant) management and the contexts (the general socio - economic environment) of the projects as the four key issues.

#### **1.4 Research question**

In relation to the above highlighted focus area, the study addresses the following research questions:

- What are the construction project management processes the Ethiopian construction industry, implicitly or explicitly, uses as part of its project delivery? Related to this, to what extent are these processes different from ‘accepted practices’?
- What potential inefficiencies are harboured in the processes and their management? To what extent are these non optimal performances influenced by the general environment the industry is related to via the supply chain?

#### **1.5 Aim and objectives of the research**

The aim of the study is to develop a construction process management model that gauges the current practice of the management of the construction processes in Ethiopia and look into the practice to identify key drawbacks that are needed to be removed for the industry to successfully deliver projects on a consistent basis. With this as a major aim, the study has been embarked to address the following specific objectives:

- Develop a conceptual framework that serves as a basis for improved performance in the delivery of construction projects;
- Explore the current practices of the management of the construction processes in Ethiopia and investigate the major drawbacks of the system as seen in the context of Critical Success Factors and Key Performance Indicators for construction projects (from literature), with a major objective of looking for possible ways of improving the Ethiopian system;
- Cross analyze these practices against ‘accepted practices’ and theoretical principles in the area to suggest improvements that are tailored to the potential challenges and peculiarities of the Ethiopian construction environment.

## 1.6 Limitations of the study

The major limitation encountered is lack of construction management process systems that have been in consistent use in the sector. One consequence of the above limitation is that, the study concentrated only on the construction project processes management practices of only one, although prominent in the industry, public entity which is thought to follow relatively consistent processes and management approaches. The practice analyzed and critiqued is limited to the management of the construction project processes as practiced by the Ethiopian Roads Authority (ERA). Therefore, the work can only reliably be applied to the management of construction project processes in the road sector.

Despite ‘resources’ forming one of the pillars of the conceptual framework in chapter two, the study did not address the resource related issues of competence, capability, trait, behavior, etc. for improved project performance. This is because the study concentrated to look into the management of the processes from the client’s perspective. However, the client of the projects for the study, ERA, executes most of its product-oriented processes and some of its project management processes (PMI, 2008) through outsourcing to an external resource base. Consequently, studying the traits of the resources and their effect on project performance would demand looking to into the practices and challenges of the resource base. Given the time and resource constraint, however, the study has delimited studying the practices and challenges of the resource base to be beyond its scope.

The lack of consolidated construction project processes management systems in the sector creates challenges in identifying the strong traits and drawbacks of the system as project deliveries are handled inconsistently. This is indeed one of reasons that tailored the study to comparing the local practices with the literature identified international ‘best practices’ so that such practices (along with theories in the area) can be used as a reference. It is argued that a context tailored critical investigation into the current practices and challenges in the Ethiopian industry and comparisons of the practices with ‘international best practices’ and theoretical principles will help to identify the gaps in the Ethiopian practices and forward possible suggestions for improvement.

In addition, the absence of prior researches in the area in the Ethiopian context and lack/problem of readymade data (and difficulty to explicate data) as can be found in developed nations' industries are limitations compelled the study, at times, to rely on secondary data/ study. It also forced the study to concentrate on broader contexts such as presenting overall project life cycle (so as to create the overall framework first) rather than address specific issues in detail.

## **1.7 Structure of the thesis**

The general outline of this thesis report is as follows:

### **Chapter one: Introduction**

This chapter has introduced the core issues to be addressed in the thesis. It gives a broad background to the subject matter, presents the problem statement and propositions, articulates the objectives and justifications for the study, and puts forward the scope and delimitations of the study.

### **Chapter two: Conceptual framework**

This chapter presents the conceptual framework of the research. It demonstrates the wider appreciation of the topic under study and the conceptualization of same as applied to construction project management. Based on four pillars of processes, resources, governance (management) and context, the chapter establishes a conceptual framework for improved project performance that guides the subsequent chapters of the study.

### **Chapter three: Literature review (detailed and contextual)**

This chapter, while intricately related to chapter two, will present the context (the construction processes and their management as practiced in the 'international' construction industries) of the

study. It develops the conceptualizations in chapter two into analysis and understandings of the concepts, principles as well as best practices associated with the major issues of the management of construction processes. It presents the literature foundation for the research instrument as well as the ‘best practices’ reference base for the analysis and interpretation chapter.

#### **Chapter four: Methodology**

The chapter systematically formulates the research paradigms, methodologies and techniques employed for the study. It provides a description of the methodologies and approaches employed. Within this framework, the chapter stereotypes the cases selected, the data sources used and the data analysis techniques employed.

#### **Chapter five: Analysis and interpretation**

The chapter analyses and interprets the data collected and compares the findings with comparable ‘international accepted practices’ and theoretical justifications. It presents descriptions of the construction project management processes and their management as practiced by the targeted subject. Categorized under the pillars of conceptual framework established, the chapter also presents analysis and critique of the practices as compared with theories and international practices.

#### **Chapter six: Conclusion and recommendations**

The chapter, in light of presenting the conclusion to the study, presents the major findings of the study. It revisits the research questions and objectives and relates them to the findings of the research. The chapter also briefly discusses the implication of the study for body of knowledge in project management in general and project management in developing nations in particular. It also presents recommendations for future study.

## 2 CONCEPTUAL FRAMEWORK

### 2.1 Introduction

Theories give guiding concepts and principles that underpin a given study. Howsoever they may be developed - from top-down when a scientific-oriented theory is applied in practice and used as a conceptual framework in devising tools, methods, etc. and from bottom-up when new methods and approaches are used in an *ad hoc* manner in practice without explicit conceptualization and theoretical foundation but the scientific clarifications and conceptualizations are followed - ultimately theories are foundations over which practices are based on. Such theories may be explicitly articulated or implicitly accepted. In this regard, Heim and Compton (1992) quoted in Koskela (2000:21) note that '[f]oundations for a field of knowledge provide the basic principles, or theories of that field. Foundations consist of fundamental truths, rules, laws, doctrines, or motivating forces on which other, more specific operating principles can be based.' Karl Marx, quoted in Morrison and van der Werf (2012:399), is espoused to have put the relationship between theory and practice in simple, yet elegant, terms as 'practice without theory is blind, theory without practice is sterile'

Therefore, given the importance of a theoretical framework through which scientific explanations can be made, the following section establishes the conceptualization of construction project management this study adopted. The first part of the chapter provides, in a brief summary, the major management theories that could be utilized in project management theories. The chapter also presents a thorough discussion of the major contemporary construction project management conceptualizations identified in the literature. The chapter then establishes both the theoretical and conceptual frameworks for the study. The existing management theories highlighted in this chapter and conceptual framework established, although at a general level, are used as a basis of concept and principles in the discussion of the practices of the management of the construction processes.

## 2.2 The mainstream management theories

The management discipline and theories of management and organization has been evolving over the years. Primarily driven by the need to increase organizational efficiency and effectiveness, over the years, there has been many organization and management theories that once compelled Koontz (1961) to describe it as a ‘management theory jungle’. In fact, the views on how to improve performance and profitability are so diverse and many in number that there does not appear to be any convergence on ‘a theory of management’.

Presenting the historical developments and analysis of the mainstream management theories is beyond the scope of this study. However, by way of summary, Table 2.1 below presents the major developments in historical context (the first three) and some of contemporary management theories which are of particular relevance to construction project management and its conceptualization in this study. It is worth noting at this point, however, that the summary, very brief by itself, only presents the major management theoretical backgrounds and major theories the subsequent theoretical and conceptual framework of the study bases itself. Accordingly thus, the presentation is neither exhaustive nor meant to analyze theories of management as such.

In general, the classical management approaches principally concentrate on establishing a management setup that can optimize production without giving significant attention to the people who are executing operations. The behavioral approach, on the other hand, focuses on explicating motivation and commitment from the people who execute tasks without major emphasis on the structure within which they operate. The socio-technical approach attempts to combine the above two ‘structure focused’ and ‘people focused’ approaches respectively and cultivate on their combined strengths to counterbalance the drawbacks of each.

From modern management theories, with the objective being picking selected theories in the general management area that could be used in formulating the conceptual framework, the study selected a few of the theories that are of major relevance in the management of projects. In this context, systems theory, along with contingency, complexity and institutional theories, serve as a basis of establishing the project processes management systems, establishing boundaries and

interactions between entities and with the environment. They also help to establish a management approach that is contingent on the particular contexts the system is established for. Transaction cost economics, agency theory and resource-based view, combined, will help identify and establish the optimum delivery scheme for projects and the organization of projects. Management science gives the basic concepts and principles that underpin the various scheduling techniques, optimization techniques, performance analysis techniques, etc. used in construction project management endeavor. In section 2.4 below, these theories are discussed further and stereotyped on how they serve as the basis of the theoretical frameworks of the study and in developing the conceptual framework of the study.

Table 2: 1 Relevant management theories used in the study’s conceptual framework

Category	Theory	Key concepts and principles	Major drawbacks	Relation to the conceptual framework
Classical theory	Principles of management	Worker-Task-Motion relationship	<ul style="list-style-type: none"> <li>Inward looking, ignore interaction of organization with environment;</li> <li>Too mechanistic: Setup focused without much attention to the human aspect. ‘Organization without people’</li> </ul>	<ul style="list-style-type: none"> <li>Historical context;</li> <li>Give basic principles of division of labor, hierarchy and framing organizational structure</li> </ul>
	Administrative management	Hierarchy and motivation		
	Principles of bureaucracy	Hierarchy (Bureaucracy)		
Behavioral Theory	Theories of motivation, building leadership	<p>Employee empowerment and participation</p> <p>Intrinsic values, feelings, norms and productivity</p>	<ul style="list-style-type: none"> <li>Inward looking, ignore interaction of organization with environment;</li> <li>Too organic. Concentrate too much on the human aspect. ‘People without organization’</li> </ul>	<ul style="list-style-type: none"> <li>Historical context;</li> <li>Give basic principles of motivation team building, leadership, etc.</li> </ul>
	Socio-Technical Theory	Technological layout (processes) and social needs (workers)	<ul style="list-style-type: none"> <li>Inward looking, ignore interaction of organization with environment</li> </ul>	<ul style="list-style-type: none"> <li>Historical context;</li> <li>Combine the principles of the above two</li> </ul>
Contemporary management theories	Systems theory	Holistic approach to organization and its interaction with its environment; The whole may not be equated to the sum of the parts	<ul style="list-style-type: none"> <li>Too general, fits everything;</li> <li>Not operationalized</li> </ul>	<ul style="list-style-type: none"> <li>Presents the framework through which the dynamics of organizations (projects) within inside and with their environment can be formulated.</li> </ul>
	Contingency theory	Organizing and managing is contingent on nature of work (business) and environment	<ul style="list-style-type: none"> <li>Too general, fits everything;</li> <li>Not operationalized</li> </ul>	<ul style="list-style-type: none"> <li>The conceptual framework formulated and the management process model so developed should be contingent on the contextual factors that affects same;</li> </ul>
	Complexity theory	Systems are complex and dynamic. Organizational and management decisions are bound to be made in an ‘uncertain’ circumstances	<ul style="list-style-type: none"> <li>Too general;</li> <li>Difficult to operationalize</li> </ul>	<ul style="list-style-type: none"> <li>Models and the management approach adopted should be tailored to ‘manage and organize within the unmanageable and unorganizable’.</li> </ul>

Contemporary management theories						
Neoinstitutionalism (Organizational)		Organization behavior is influenced by regulative, normative and cognitive structures and behaviors	<ul style="list-style-type: none"> <li>Too general;</li> <li>Needs multiple level of analysis</li> </ul>	<ul style="list-style-type: none"> <li>Helps establish how the organization's (firm's or project's) performance is influenced by the meta norms and values of the environment they are embedded in.</li> </ul>		
Transaction Economics	Cost	Organizing should optimize transaction cost	<ul style="list-style-type: none"> <li>Neglects production system;</li> <li>Efficiency maximizing, not efficiency seeking</li> </ul>	<ul style="list-style-type: none"> <li>Helps in establishing the hierarchy-market dichotomy in construction project delivery;</li> <li>Used in optimizing transactions in construction project delivery systems</li> </ul>		
Resource-Based View		Competitive advantage of firm based on competence and organization	<ul style="list-style-type: none"> <li>Under-grades effect of opportunism</li> </ul>	<ul style="list-style-type: none"> <li>The framework establishes the principles of optimizing the assets, capabilities, competencies, organizational processes, firm attributes, information and knowledge of the project (or the performing organization) in order to gain competitive advantage in the production(construction) process</li> </ul>		
Agency theory		Agent performs wishes of principal (Contracting)	<ul style="list-style-type: none"> <li>Similar to TCE</li> </ul>	<ul style="list-style-type: none"> <li>Since most construction works are performed via outsourcing, the principles of agency theory can be used in establishing principal-agent relationships</li> </ul>		
Management science		Quantitative and simulation backup for decision making	<ul style="list-style-type: none"> <li>Only a tool</li> </ul>	<ul style="list-style-type: none"> <li>Many tools, such as network analysis methods, optimization techniques, queuing theories, transportation model, etc. are used in construction project management.</li> </ul>		

## **2.3 The theory of construction project management**

### **2.3.1 Background**

Although the human race has been engaged in building of structures since the Primary Ages, accounts of the management of the construction endeavors are very rare. When it comes to early construction structures, what was written tends to be about the charismatic nature of the structures involved while giving only scant attention on how the implementation of these structures had been organized and managed. Walker (2007) suggested that this lack of documentations about the approaches of the techniques and processes of management and organization adopted is revealing that construction project work accounts paid little attention to the organization and management of the skills and resources available.

Nonetheless, the proper management of construction projects is important in delivering the right value for the project. In this regard, Walker (2007:1) states that ‘there is little point in the construction industry in developing the special skills of its members if no one is going to amalgamate them in the best manner’ to meet the project’s objective. Particularly in today’s environment where the construction industry is required to improve its competency and deliver projects to ever increasing complexities and uncertainties and under ever more tightening demands, the need for organization and management skills to properly organize, mobilize and manage the resources and processes is essential.

Indeed, construction has attempted to cope with the increasing uncertainties and complexities and tightening demands. For example, it has developed and adopted various delivery methods meant to improve performance (Kwaku, 2001). It has adopted various management facilitating tools and techniques such as project network analysis, earned value analysis, sensitivity analysis, risk analysis, cost estimating techniques and expert systems. Nonetheless, despite the sophisticated use of the various techniques and delivery methods, construction projects are still falling short when seen under the project success criteria adopted (Egan, 1998).

Against this backdrop of inefficiencies and ineffectiveness within the industry, construction project management has been demanded to look construction project management as a holistic approach to management rather than concentrating on specific tools and techniques. Related with this and in the general project management context, Yeo (1993:112) argues that project management, in general, has concentrated on the hard system approach by ‘... emphasizing quantitative techniques in project planning, scheduling and control’. Similarly, Morris (1997: preface) observes that ‘[project management] is widely misperceived as a collection of planning and control techniques rather than as a rich and complex management process.’ It has been suggested (Walker 2007) that the engineering background of many project managers instinctively guides them to adopt numerical approach to project problems even though such problems do not lend themselves to such approaches.

Furthermore, even many of the currently used bodies of knowledge of project management are accused of not embracing holistic approach to project management (Koskela & Howell, 2002; Morris, 2003). For example, PMI’s Guide to Project Management Body of Knowledge - PMBOK (PMI, 2004), with the major attention given to managing integration, scope, time, cost, quality, human resource, communications, risk and procurement, is accused of being execution oriented without enough attention to the ‘other’ project-product life cycle issues. In this regard, Morris (2005) argues that the PMBOK, for example, is silent in various front-end issues such as strategy and business objective setting and alignment, technology management, requirement management, value management; people and organization issues such as- governance, leadership, supply chain partnering, etc, which, in addition to the issues addressed in the PMBOK, are also seen as crucial for successful delivery of projects (Latham, 1994; Egan, 1998; Miller & Lessard 2000; Morris 2005). Indeed some (for example Morris, 2003) argue that perhaps it is this execution oriented approach to project management by the project management professional associations that rendered project management intellectually uninteresting to be recommended as a major strategy of alleviating the challenges in construction project delivery processes.

### 2.3.2 The need for a theory of construction project management

The major functions of a theory are (1) its use in explaining the nature of a phenomenon and its causal relationship within or with other constructs the phenomena interacts with, (2) its function in predicting future other possible implications and (3) whereas description of nature, explanation of relationships, etc. is the general goal of natural science, a theory in construction project management is also expected to provide a prescription for action (Koskela, 2000). Thus, for production oriented ‘disciplines’ like construction management, besides providing bases for explanation of incidents and forecasting possible implications, a theory would serve as a basis of formulating optimized delivery mechanisms by providing basis for:

- i. Development of tools, techniques, methods, standard practices, etc. that serve in defining, analysing, planning, controlling, execution of project works (Kochikar & Narendran, 1994);
- ii. Communication by providing a common conceptual framework through which the cooperation of people is facilitated (Heim & Compton, 1992) to the common cause of successful project delivery;
- iii. Learning: A theory is generally a condensed piece of knowledge. When it is unravelled and explained, it would empower people to understand (and perform) things. Further, a theory can also serve in pinpointing further progress and understanding (phenomena or other theories) (Fenves, 1996). In this regard thus, a theory would serve the construction project management ‘discipline’ by proving a framework for improvements and learning as well as project deliveries by providing a basis over which deviations can be explained about and hence rectified;
- iv. Transfer of knowledge and practices can be facilitated by abstracting the theory from the given setting of practice and contextually applying it to the target conditions (Lillrank, 1995).

In light of the significance of a conceptual framework of project management, while some argue that there cannot be a theory of project management (Morris, 2002), in recent times, there have been consistent calls and debates about theories of project management (Barnes 2002; Koskela & Howell, 2002; Koskela & Ballard, 2006; Winch, 2006).

### 2.3.3 The trends in construction project conceptualizations

In the general project management context, Söderlund (2003:183) notes that, ‘[p]roject management has long been considered as an academic field for planning – oriented techniques and, in many respects, and application of engineering science and optimisation theory...Project management has, however, in the last decade received wider interests from other disciplines.’ Continuing this line, Söderlund (*ibid*) notes that currently there are two theoretical traditions in project management research. The first tradition has its roots in the engineering science and applied mathematics and is primarily interested in the planning techniques and methods of project management. The second tradition, with the intellectual roots in the social sciences, is more concerned in the organizational and behavioural aspects of project management.

Koskella and Howell (2002a) argue that at the moment there is no explicit theory underlying project management but contend that there is an implicit one over which various practices are based. Koskella and Howell (*ibid*) uncover the implicit theory underlying project management from Project Management Body of Knowledge (PMBOK) guide. They argue that the implicit theory underlying project management as per PMBOK comprises of the theory of project and the theory of management. In the theory of project dimension, project management is viewed as managing work where the work is first decomposed in to smaller activities and then it goes to a production process whereby inputs are transformed to outputs. Koskela and Howell (2002b) explain that the implicit theory of management is based on management-as-planning, the dispatching model and the thermostat model<sup>9</sup>. Nonetheless, (Koskela & Howell, 2002a) argue that this implicit theory is flawed and go on to call for an explicit theory of project management. Others (cf. Koskela & Ballard, 2006) also called for a frontier regarding the understanding of project management.

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<sup>9</sup> In management-as-planning, the major functions of management at the operations level is mainly about the creation, revision and implementation of plans. The dispatching model assumes that planned tasks can be executed by dispatching tasks to executors. The thermostat model is a model of management control that presupposes existence of standard of performance and measurability of performance and uses them to find out possible variance between the standard and the measured value which in turn is used to correct performance of processes.

In regards to construction project management in particular, with different views on how to conceptualize construction project management (Koskela, 2000; Moore, 2002; Walker, 2007; Winch, 2010) and the debate still ongoing (Koskela & Ballard, 2006; Winch, 2006), the theory of construction project management is a work in progress.

#### **2.3.4 Construction project management paradigms**

As discussed in the above section, like general project management, construction project management used to be considered as the application of some tools, methods and administration of contracts in running projects and was taken tantamount to administering the execution phase of projects without sufficient attention to other phases. Against this back drop many (Morris, 1997; Walker, 2007; Winch, 2010) argue that [construction] project management should be perceived as a complex approach to management that takes a holistic approach in order to successfully define and achieve the project's objectives. Such an approach would demand the extensive use of both the hard and soft systems competencies that Söderlund (2003) notes to be influenced by the two different intellectual roots. In this regard, Blockley & Godfrey (2000:87) state that 'all hard systems are understood and managed through soft systems'. Hence all hard systems should be viewed to be embedded in soft ones and dealt with accordingly.

Daniel (1990:80) states that the soft system approach is concerned with human behaviour in organization and garnering effective and motivated performance from them and demands different skills in application to the hard system approach. He notes that 'a basic intellect, an ability to see more than one point of view, to think logically, to advocate and to communicate becomes more important than applying scientific methods, searching for some elusive truth and reducing all problems to rigorous mathematics.'

Along this line, many in the [construction] project management area (Morris, 1997; Bennett, 2000; Koskela, 2000; Moore, 2002; Walker, 2007; Winch, 2010) conceptualized and approached construction project management in a context that uses the mechanistic hard system approach within design and organizations of the organic soft system approach. In addition, they have taken a holistic view of projects that spans from pre-project conception to the product it delivers.

### **2.3.5 Contemporary conceptualization of construction project management**

In recent times, there have been developments to conceptualize construction project management as the use of the mathematical models and tools for optimization within the context of organizing and managing approaches. The approaches strive to facilitate the optimization of construction works on the one hand and the modelling and dovetailing of tools, optimization techniques, organizing techniques, etc. to improve production processes on the other. In broader terms, the approaches taken in conceptualization of construction projects [and their management] can be categorized those organization-focused and those production/process-focused. The following section addresses the basics of these approaches.

#### **2.3.5.1 Organization (structure) focused construction project management**

The organization-focused construction project management theories predominately view construction project management in organization context. They stipulate that, while giving due attention to the production processes, the theory of construction management should be geared towards creating an organization and management system that optimizes on both the production and management processes. In this regard, Winch (2002) argues that project management is essentially the processing of information and hence the organization and management of projects should be geared towards facilitating the context under which information is processed. In this regard, by comparing with the flow of water in a river, he argues that, the processing of information, which is equivalent to the flow of water, cannot be managed directly. Therefore, he argues, management should concentrate in shaping the context-the organizational setting (the river) - under which the important item –the information (the water) can be processed.

Similarly, Walker (2007) takes the stand that the most important element of project management is an organizational issue. For him, organizational issues incorporate ‘the way people are organized and managed in the project management process’ (Walker, 2007:3). He asserts that organization and management are intrinsically interlinked concepts and argues that, given the diverse nature of construction project contributors, particular attention is needed for the organization. Therefore, unlike the conventional hard system approach to construction project

management that equates construction management to a collection of planning and controlling techniques and tools, he argues that the organizational issues of the project and its objective should be given more focus stating that ‘the use of techniques and tools, however sophisticated, will be of no avail if they are applied within inappropriate organization seeking to achieve misguided objectives’ (*ibid*:3).

The organization-focused construction project management theory bases itself on open system theory (Ackoff, 1971) in tandem with transaction cost economics (Williamson, 1975), uncertainty theory (Galbraith, 1977), contingency theory (Lawrence & Lorsch, 1967) and complexity theory (Flood, 1999) in conceptualizing the organization and management of construction projects. The theorists (Winch, 2002; Walker, 2007 for example) use systems theory to provide a framework in understanding the processes, along with their interrelationships, that have to be undertaken to complete the project and the interaction of the project with its environment and transaction cost economics to explain why the entities that undertake the project endeavour are formed and the particular format they are structured in. The roles of complexity and uncertainty theories come on the contention that there could be a deficiency of information to make a wholly informed decision at a given time. Uncertainty could arise due to complexity-the condition that the information is, in principle, available but couldn’t be called for use for various reasons or predictability- the condition that the past could not be a reliable guide to the future. Therefore, the setting up and maintaining of the right context (organization) under which information, material and energy (effort) is readily processed for optimized decision making and execution is important in construction project management. Contingency theory helps in aligning the organization setup and its integrations with the task (or business) to be performed, the factors affecting it and the environment it is performed in.

Against this backdrop, Walker (2007) presents a model of construction processes that underpin organization structures for construction projects and that ‘provides an approach to analyzing and designing project management structures’ (*ibid*: 159). The model involves synthesizing and deciding upon intrinsically interwoven aspects of the environmental forces (Scott, 2003) of political, legal, institutional, sociological, technological and economic issues. It highlights that these forces influence processes and decisions through the importation of information, material

and energy. Therefore, designing of the processes and the making of decisions have to be based on the information, material and energy that come from the environmental forces. However, as it is argued by the strategic contingency theorists, decisions and processes could also, in reverse; affect environmental forces hence should be considered in circles of cause and effect (feedback loops) than linear view. Winch's (2002) tectonic approach to construction project management, on the other hand, views information processing overarching issue and presents how same should be approached over 'five first order project processes' (Winch, 2002:10) of defining the project mission; mobilizing the resource base; riding the project life cycle; leading the project coalition and maintaining the resource base.

In terms of application, the organization-focused construction management theories comment that the application of the approaches should be contextualized to the environmental context they are implemented. Environmental contexts include the national business system, the construction business system, the particular project and its surrounding.

#### **2.3.5.2 Production [process] focused construction project management**

The production-focused conceptualization of construction project management predominately views construction project management as the optimization of the production processes. In this regard, the lean construction approach is the most common approach that emphasizes the need to concentrate on the production process.

In construction context, lean model was probably first developed by Lauri Koskela in his doctoral thesis (Koskela, 2000) as the transformation/flow/value model and was elaborated through subsequent publications (eg Koskela and Ballard, 2003; 2006). The model is constructed from analysis of the existing fragmented theories of production in manufacturing and is argued by the developer(s) that it can also be applied to construction. The transformation/flow/value model identifies the production process based on the transformation concept, the flow concept and the value generation concept. The theory is fundamentally a synthesis of these concepts into a unified theory.

The transformation concept models production as a process that transforms inputs into output. The model does not concentrate on the technical aspect of the transformation itself, rather on the inputs, the outputs and the ratio of output to input (Koskela, 2000). Therefore, in the model, the actual transformation act is left as a 'black box'. As its major principles, the approach concentrates in detailed planning and controlling of processes through decomposition of processes into sub-processes that would result into a series of tasks. The approach then bases itself on the argument that the cost of production can be minimized by minimizing the cost of executing tasks and by implication concentrates on optimizing the execution of tasks. It argues that the effect of environmental (including other tasks in the process) influence on optimization of task execution can be catered for by applying buffers. The transformation approach has resulted in many practical advantages such as in development of sophisticated production technologies, management tools and techniques such as product standardizations, work breakdown structure, material requirement planning. However, it has also been accused of inducing 'significant disadvantages such as the rising costs of work-in-progress created by the buffers, the risk of sub-optimization at the system level and inflexibility in response to changing market demands' (Winch, 2006:165).

The flow concept bases itself on the transformation concept's inability to distinguish and capitalize on processes and operations. The distinction notes that materials actually typically spend little time in being transformed rather waiting to be transformed, being inspected, being moved, etc. hence the requirement for optimizing the flow of production processes. In this regard, the flow concept argues that focusing on reducing the time taken in moving items and processes through the manufacturing system as a whole can help obtain greater economy than solely focusing on the efficiencies of particular sub-processes. Thus the founding principles of the flow concept are eliminating (or at least reducing) the none-value adding phenomenon in production. It propounds that the key to this reduction is to reduce lead time and variability in the execution of particular a sub-process rather than to increase its efficiency (Koskela, 2003). The flow concept has attracted much attention in practiced in Just in Time (JIT) and lean production approaches. Koskela (2000) comments that the flow is the basis for various developments such as continuous improvement, time based competition, process/task re-engineering, supply chain

management, agile manufacturing as well to various theories such as the theory of constraint and queuing theory.

The value concept also takes its rationale from the argued draw backs of the transformation concept for not giving attention to value generation. Like the process-operation dichotomy in the evolution of the flow concept, the value concept stresses the differentiation of selling and marketing<sup>10</sup>. The value concept argues that, flows and transformations of materials are only of value if the resulting product is satisfactory those who are expected to purchase/use it. Thus the definition and condensation of customer requirements into specifications that dictate production definition and measurement of value of the product and ascertaining its satisfaction of the customer's requirement are central to the value concept.

In its application in construction project management, the TFV conceptual framework considers projects as 'temporary production systems' (Koskela & Ballard, 2006:158) and argues that the framework can be used as a 'theory of project'. Regarding the management of projects, Ballard *et al.* (2002) and Koskela & Ballard (2006) argue the 'theory of management' consists of particular theories of planning, execution and control. Ballard and his co-authors (*ibid*) present approaches like management-as-planning and management-as-organizing as the basis of 'theory of planning', classical communication theory and language action perspective as 'theory of execution' and the thermostat model and scientific experimental model as 'the theory of control'. The proponents of lean construction argue that construction project management can be conceptualized as an amalgamation of the 'theory of project' and the 'theory of management'. In this regard, Bertelsen & Koskela (2002) present a three part project management model that links the transformation, flow and value generation concepts through contract management, process management and value management.

In terms of application in construction, the TFV framework supports a variety of different tools and techniques such as last planner (Ballard & Howell, 1998), dependency structure matrix and quality function deployment (Koskela, 2000), supply chain management (Vrijhoef *et al.*, 2001),

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<sup>10</sup> Selling concentrates on the needs of the seller by focusing on converting product to cash. Marketing, on the other hand, concentrates on the needs to the customer through various means associated with the product and its creation, delivery and consumption.

contracts (Bertelsen & Koskela, 2002) that can be used in applying the principles to the management of construction projects (Ballard *et al.*, 2002).

### **2.3.5.3 Comparison of the approaches**

The organization-focused construction project management conceptualizations predominately view construction project management in setting up the organizational framework through which projects are incepted, planned and executed. In this regard, for example, Winch (2002) takes the view the, the most important item in decision making, the information, by itself is not manageable hence we should concentrate on the context, the organization, to manage it. The tectonic approach argues that organizations should be continually adjusted and shaped to the demands of processes and information processing. Therefore, the project organization should be continually adjusted to optimally suite the information processing in dealing project mission; mobilizing the resource base; riding the project life cycle; leading the project coalition and maintaining the resource base processes.

Similarly, Walker (2007) argues that the most important element of project management is an organizational issue where organization issues, defined as ‘the way people are organized and managed in the project management process’ (Walker, 2007:3), are the most important items project managers should concentrate on. He takes the view that the organization and management approach adopted makes the bases over which resources are mobilized, tools and techniques are applied and processes are executed.

While it has taken some management and complexity theories for the management and organization of projects, the TFV approach predominantly concentrates on the production aspects of construction. It hypothesizes that since the major task of construction is production, the theory that underpins construction management should explicitly make production its core. Highlighting this issue, Koskela and Ballard (2006:157/58) state that ‘[a] construction project, as a temporary organization, is characterized by physical production – it is a materials processing system too. Materials processing is the core element of a substantial share of organizations in construction; it simply cannot be abstracted away when discussing project management in

construction.’ In support of this argument, the approach makes the ‘theory of projects’ along with the ‘theory of management’ a core element of the conceptualization of construction project management.

It appears that the major difference in the above two conceptualizations of construction project management comes from the perspectives the proponents see the construct itself. For the organization-focused theorists, the production processes lie within the realms of the resource based managers and hence are not within responsibilities of project managers. In this light, Winch (2006:167) states that ‘[t]he task of the project management function is to coordinate these transformations [the production] so that they move into the flow of the project life cycle.’ On the other hand, the TFV model theorists take the view that the theory of project management should entail both the theory of projects (production), by whomsoever they are executed, and the theory of management.

In this regard, this study takes the view that the conceptualization of construction project management should encompass both the production and coordination aspects of projects. The cost of construction is the cost of production and the cost associated with the governance of that production. I.e., it entails both production and transaction costs. Therefore, optimizing construction works should entail optimizing on both production and transaction costs. Indeed, in this regard, Williamson (1981:552) explicitly states that ‘transaction cost economizing needs to be located within a larger economizing framework and the relevant trade-offs need to be recognized’. In the light of this thus, a theory of construction project management should strive to provide the concepts and principles that could be used as a framework to describe, explain, and prescribe for both production and its governance/coordination.

Economizing on the overall project would entail economizing on both the production and the governance (management) processes. Conversely, leaving out the production aspect would only end up in optimizing projects on only one aspect of the overall economization. Particularly in construction works where often the production aspect takes a considerable proportion of the overall project inputs, leaving it would deny the client from significant optimization leverages. As a corollary to this, construction project managers should strive to optimize on both the

production and coordination aspects of the project endeavor in order to deliver the optimum value to the client. Consequently, as often is the case in practice, construction project managers would be expected to have working knowledge and competencies in both the techniques (for example PMI's application area knowledge) and coordination aspects of project endeavors.

## **2.4 The frameworks of this study**

### **2.4.1 Theoretical framework**

Section 2.2 above presented a very brief summary of the main stream management theories that can be adopted in conceptualizing construction project management. Among the main stream theories, the section highlighted systems theory, contingency theory, complexity theory, institutional theory (and transaction cost economics), agency theory as well as resource-based view of the firm as existing theories over which construction project management could be framed. This section addresses these theories in brief and stereotypes how they serve as the theoretical framework of the study as well as the conceptualization of the framework for the study.

A system is defined by Ackoff (1971: 662) as 'a set of interrelated elements. [...] Each of a system's elements is connected to every other element, directly or indirectly. Furthermore no subset of elements is unrelated to any subset.' Systems theory, therefore, states that parts of a system, their interdependencies and their influence on the performance of the whole system can be better understood, analyzed and improved by looking to the whole aspect of the system and its interaction with its 'environment'<sup>11</sup>. System's theory argues that, unlike the reductionism approach, the whole should not just be taken as the sum of the parts and, particularly in management, through synergy, the whole should be devised to be more than that sum of the parts (Flood, 1999).

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<sup>11</sup> A system's environment is defined as a set of elements and their relative properties, which are not part of the system but a change in any can produce a change in the state of the system (Ackoff, 1971).

In terms of application to management thus, systems theory is concerned with both the system itself-the organization- and its environment. The system's approach to management therefore, in addition to the organization itself, looks into the set of forces and conditions that operate beyond an organization's boundaries but affect a manager's ability to acquire and utilize resources their by improve productivity and market.

In this regard thus, the system approach is of interest to management because it offers a framework to apply the various schools of thoughts and theories of management with less rigidity and more recognition of the dynamics of organizations within inside or with their environment. Therefore, the approach does not out rightly conflict with the other management theories but rather presents a general framework over which they need to be applied and places them in context. The search for better organization structure that facilitates efficiency and effectiveness, effective way of executing a task and its interdependency with other tasks, the importance of human behavior within an organization, etc as has been the focus of the other theories remain important but are more easily understood and made relevant by the understanding of the interactions of the various parts and activities of the organization and the environment within which it operates.

Related with systems, complexity theory, is defined by McMillan (2004) as the study of the dynamics of complex adaptive system which are non-linear, have self-organizing attributes and emergent properties. Complexity theory, thus, deals with complex systems. Senge (1994) classified complexity as detailed complexity and dynamic complexity. Detailed complexity arises when there are many variables that affect a system and its behavior to hold in a mind and appreciate the system and its behavior as a whole. Dynamic complexity, on the other hand, arises under three circumstances of: (1) where short-term and long-term effects of variables of a system are different (2) where effects on a small scale (local effect) are different from a wider scale or (3) effects of variables over time of interrelatedness are subtle and the result of actions is not obvious.

Flood (1999) believes that recognizing that the world is complex and the acceptance that we will always face uncertainty in our decision making help change the way we approach management

and organization. He asserts that such conscious recognition will enable us operate in the paradoxes of:

- ‘We will not struggle to manage over things – we will manage within the unmanageable.
- We will not battle to organize the totality – we will organize within the unorganizable.
- We will not simply know things – but we will know of the unknowable’ (*ibid*: 3).

Furthermore, Flood (*ibid*) believes that better understanding and application of systems thinking and complexity theory would help us ‘learn within the unknowable’, which, as he asserts, should be the goal of learning and transforming organization.

Directly related with system and complexity theories is contingency theory that states that there is no one best way to organize and manage. The theory argues that the organizational structures and the control systems that managers choose should be contingent on the nature of the work to be executed (or nature of business) and the characteristics of the external environment in which the organization operates (Lawrence & Losch, 1967). It argues that an organization’s better performance results from fitting the characteristics of the organizations such as its structure leadership style, strategic decision making process etc. to the contingencies that reflect the situation of the organizations and its environment.

In terms of organization practices and norms, along with other theories such as the open system theory, institutional theory ‘considers the processes by which structures, including schemas, rules, norms, and routines, become established as authoritative guidelines for social behavior. It inquires into how these elements are created, diffused, adopted, and adapted over space and time; and how they fall into decline and disuse (Scott, 2005:409). Institutional theory, which has a skeptical view of the rational-actor model of organization that sees organizations as the manifestations of preferences of individual rational actors, puts institutions at super individual levels and argues that both the formation and existence of institutions cannot be wholly explained as aggregations of individuals’ attributes and motives. In this regard, institutional organization theorists note that organizations are less instrumentally rational and are influenced by taken-for-granted beliefs and widely circulating rules that serve as a template to organize.

There are variations of new institutionalism (as opposed to old institutionalism- see Scott 2005 for example) such as the new institutional economics (Coase, 1984), the positive theory of institutions (in politics) (Shepsle, 1986) and the new institutionalism in organizational theory (DiMaggio and Powell, 1991). In this regard, neoinstitutionalism in organization emphasizes the normative environment in which organizations are embedded. It is a perspective which focuses on the way in which organizations, in their behavior, tend to conform to the institutional rules and norms which are dominant in the organizational environment and hence emphasizing the context dependency of organizations. In all societies, each organization has its own distinctive organizational rules, norms and conventions which are subordinate to the meta norms and rules of the larger society within which they are embedded in.

Related with this, the new institutionalism in economics (particularly transaction cost economics (TCE)) compares the market-hierarchy mode of delivery for services or goods and presents basis for setting up governance structure for organizations. The basic principle behind the approach is that, in order to economize on the total cost of a good or service, both production and transaction costs must be taken into account (Winch, 2001). However, TCE takes production cost as given and concentrates on reduction of transaction costs. The TCE framework, as presented by Williamson (1979), consists of the following three distinct elements of:

- i. Contingency factors: are the critical factors that characterize transaction (Williamson, 1979) and include uncertainty, frequency and asset specificity;
- ii. Behavioral factors: the factors that characterize the possible responses of managers to the contingency factors. They include bounded rationality, learning and opportunism respectively;
- iii. Context: The environmental context the transaction is conducted

According to Williamson (1975), the major difficulty in handling transaction process arises when the above elements- particularly elements of the critical and behavioral factors materialize in tandem. However, if one of them can be removed from the processes, the devising of a mechanism to handle the others would get easier. In this regard, Winch (2001: 800) explains ‘remove uncertainty, and complete contracts can be written in advance to negate opportunistic

behavior arising from asset specificity; remove asset specificity, and negotiations to handle unforeseen events can take place when they occur.’

In terms of application, the major use of the transaction cost economics is in making choices and setting the boundaries between vertical governance (hierarchies) and horizontal governance (markets) as well as in optimizing the performance of both modes through reduction of the transaction governance cost. In this regard, Griesinger (1990) argues that transaction cost approach can be applied at three levels:

1. Along the boundaries of the firm: in the processes involved in determining which activities could be governed internally and which should be outsourced contractually. I.e., in making the buy or make decision that defines the ‘efficient boundaries’ of the firm;
2. On the overall structure of an enterprise and the relationship of its operating parts: in distinguishing between various corporate forms as functional, holding company multidivisional, conglomerate designs;
3. The internal organization of resources: in matching the governance structure of firms/organizations to the demands of the task and the resource executing it.

The resource-based view of the firms states that a firm would gain a sustained competitive advantage – an advantage gained by implementing a value creating strategy that neither can be implemented by any current or future competitors nor can the competitors duplicate the benefits of the firm’s strategy, mainly as a result of its heterogeneous and immobile resources. In his definition, Barney (1991) explicitly declares that sustainability of competitive advantage does not depend on duration or period of time. Rather, it depends on ‘possibility of competitive duplication’ (Barney, 1991: 102). The firm resources- defined by Barney (1991) as resources<sup>12</sup> that enable the firm to conceive and implement strategies that improve its efficiencies and effectiveness.

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<sup>12</sup> A firm’s resources may include assets, capabilities, competencies, organizational processes, firm attributes, information and knowledge controlled by the firm (Barney, 1991).

However, not all firm resources are sources of sustained competitive advantage. For a firm resource to be source of sustained competitive advantage, it has to have the four attributes of valuability, rarity, imperfect imitability and unsubstitutability (Barney, 1991). Therefore, with respect to governance and organization, unlike the TCE which argues for governance to be devised to minimize transaction costs (Williamson, 1975), the RBV calls for governance to be structured so as to provide better sustained competitive advantage.

As noted above, the conceptualization of construction project management has fundamentally two dimensions: The production component and the management component. In addition, in distinction from firms, [construction] projects are temporary organizations, often formed in coalitions of teams coming from different ‘parent organizations’ of particularly client, consultant and contractor. Therefore, the conceptualization of construction project needs to be contingent on these basic realities.

In this regard, therefore, given that projects can also be perceived as systems, systems theory can help explore the interdependency of project parts such as processes, resources and management approaches adopted as well as their interactions with their environment. As noted in section 2.3 above, the environment presents both the stimuli for projects and the resources as well as constraints by which project are bounded. Systems theory helps identify these crucial factors and channel them towards the success of the project. Parallel with this, projects are complex systems that are usually affected by different peculiar factors such as stakeholders, environmental forces, etc. Therefore the concepts and principles associated with complexity theory in tandem with contingency theory will help devise a management system that can be used to manage within the complexity and tailor the approach to the peculiarities of the project.

In addition to being complex, projects are implemented in a given environment which may impose institutionalized sets of norms, values and conventions. They are also implemented by organizations which are influenced by these norms and values. Therefore, the concepts and principles of institutionalism and associated institutional analysis will help identify potential impacts of institutions on project performances. In addition, as also argued in chapter three, the principles of transaction cost economics will help determine whether a project can better be

delivered in house or through the market as well as identify the best delivery mechanism and organization system that reduces transaction costs associated with the delivery. The resource-based view of the firm, as opposed to TCE which concentrates on optimizing on transaction cost, will provide bases for optimizing production cost through competitive resources and hence thereby completing on the optimization of both the production and transaction of project delivery.

Therefore, the conceptualization of [construction] project management can be based on the synthesis and amalgamation of the various concepts and principles associated with these theories. The following section, along with Figure 2.1 below presents the conceptual framework of this study starting from the ontological assumption down to the practices it focuses on. The framework is fundamentally based on the concepts and principles of both the general management theories and the contemporary construction project management theories discussed above. The issues addressed above such as the systems concepts, the theories of transaction cost economics, the contingency theories, resource-based views, etc. as well as contemporary construction project management conceptualizations of life-cycle emphasis, the embedding of hard system based tools, methods, techniques, etc. within a properly devised soft system, though may not be explicitly discussed here, are taken as a basis of the conceptualization.

Nevertheless, while the conceptualization of the construction project management the study developed is based on the amalgamation of the concepts and principles on the above theories, the study by itself, which focuses on the contextual (environment based) analysis of the practices of the management of the construction processes in the Ethiopian construction industry, is predominantly based on institutional analysis. Hollingsworth (2000) notes that there are multiple levels of institutional analysis. The first level is the analysis of institutions characterized by the norms, habits, rules, values and conventions of the general environment within which organizations are embedded in and are influenced by. The second level is the analysis of institutional arrangements which are involved in the coordination of various economic actors. They include such arrangements like markets, states, corporate hierarchies, networks, associations, communities, etc. The third level of analysis is that of institutional sectors such as construction sector, financial sector, etc. The fourth level is the analysis of organizations and the

effect of institutions on the setup and performance of organizations. The fifth level of analysis deals with the performance and output of the various institutional components.

This study looks into practices and performance of the Ethiopian Roads Authority (see Chapter Four) in delivering its projects. To achieve this, the study analyzed both the organization and to an extent its environment and their effect on the performance of the Authority in project delivery. In this light therefore, institutional analysis presents a general and broad framework under which the study was conducted.

### **2.4.2 Conceptual framework**

This section presents the conceptualization of construction project management, which is also the conceptual framework of the study, based on the general management theories and on synthesis of the construction project management paradigms discussed above. The section systematically develops the conceptual framework starting from the ontological assumptions through the concepts and principles adopted and to the applications in practice.

#### **i. Metaphysical stance**

Metaphysics is a branch of philosophy that deals with the fundamental nature of reality. Aristotle used the term ‘the first philosophy’, which later became to be known as metaphysics to refer to the fundamental proposition – the proposition that does not need to be proven by the use of other proposition but that can be used to justify other proposition. Metaphysics is concerned with unravelling what exists in reality and with the basic levels of references that this reality can be understood and explained (Rescher, 1996). The major task of metaphysics is thus to provide a fundamental and credible account of reality at the ‘broadest, most synoptic and most comprehensive level’ (Rescher, 1996:8). In this context, therefore, on its part, this study takes the process<sup>13</sup> ontological stand point which presupposes that the world consists of flow and change and the idea that phenomenon are artifacts of time and space. Consequently, the study

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<sup>13</sup> At a broader context, there are two metaphysical views on what constitutes basic level of reality. One, substance metaphysics, propounds that there are substances or things in the world, while the other, process metaphysics, asserts that there are only processes.

argues that the management of the construction processes should be contingent on the factors that affect it and be adaptable to situations as they are encountered. It does not presume that a universally fitting process management model can be devised for all situations; rather it submits that the process management models should be adapted to the situation.

ii. The conceptual framework

Performance is the goal of project management. Therefore, the conceptualization of project management should have [improved] performance as its synchronized output. In this light, as argued in the above sections, tailored for [improved] performance, the basic conceptualization of a production system (construction being production) should entail the optimal combination of production and management processes (the things that have to be executed), the inputs (resources needed to optimally execute the processes) and the management and governance system (the system through which the processes and the resources are combined and facilitated to produce).

This conceptualization takes the view that the theory of construction management should entail and address both the organizational and production issues. Nonetheless, this study is about the construction management processes. Consequently, it focuses on the management processes rather than the production/conversion processes. In this light, in its conceptualization of the framework for the study, it takes the management processes themselves, the organization system through which these processes are managed and the context (environmental situation) the processes and the organization system is implemented as the underpinning blocks.

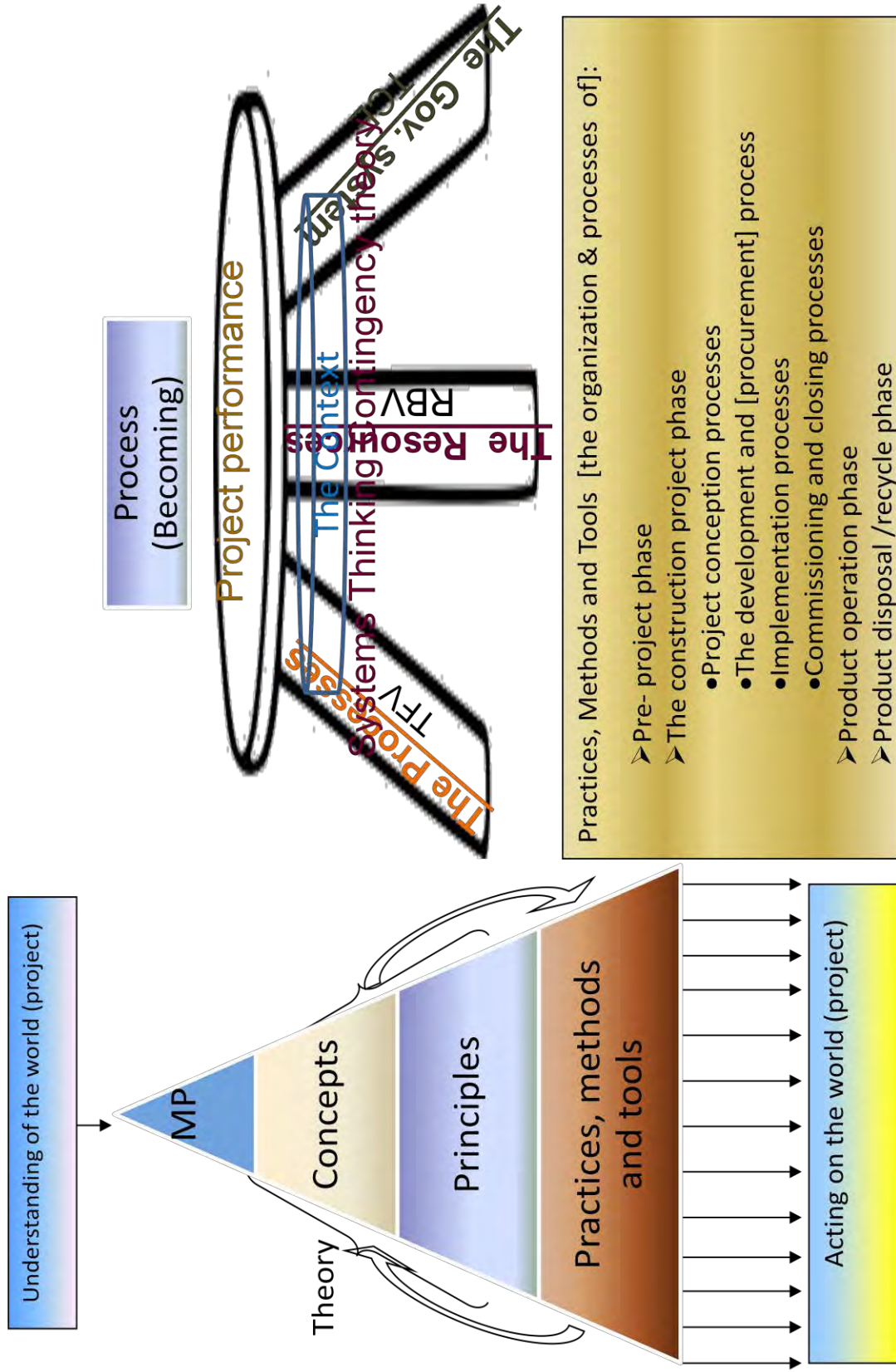


Figure 2: 1 The conceptual framework of the study

The processes, the constructs to be managed for improved performance of projects, make the basic block of the framework. The effective management of the processes, however, demands devising of a system (the governance and management structure) through which the management is effected and deployment of resources to effect them. In addition, as projects are open systems that interact with their environment, the processes themselves, the deployment of resources and the structure through which they are managed is influenced by the environmental forces they are subjected to (and vice-versa). Therefore, adaptation of the processes, the structure and the management system to the context under which they are effected is important for performance. In this light thus, at a basic level, the study takes that the trilogies of the processes, the resources, and management and governance system as the basic blocks that underpin and influence the management of the processes. Nevertheless, these basic blocks, and indeed concept of performance itself, should be adapted and contextualize to respond to the context under which the project is implemented.

a. The processes

A construction project is completed as a result of a combination of many events and interactions, planned or unplanned, over the life cycle of the project with changing participants and processes in a constantly changing environment (Sanvido *et al.*, 1992). Generally, construction processes can be divided into two: project management processes and product-oriented processes (PMI, 2004). The project management processes are processes planned and executed for initiating, planning, executing, monitoring & controlling and closure of projects (PMI, 2004). The product-oriented processes, on the other hand, are processes that specify and create the project's product. Such processes are typically defined by the project life cycle and vary by application area<sup>14</sup>. In construction projects thus, interwoven project management and product-oriented processes are executed to deliver the project's objective.

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<sup>14</sup>The processes associated with scope, time, resource, risk, etc. management generally fall under project management processes category. The product-oriented processes generally are categorized by the phases of a project and are mainly focused towards production/conversion process. The conversion processes in conception and feasibility study, design and development, construction, and project closure are typically product-oriented processes and are typically beyond the scope of this study.

During realization, a project passes through different phases aggregately called project life cycle. As the projects pass through these phases, different project management processes, as they may be adaptable to the phase and the context, have to be consciously planned, executed and controlled in an integrated manner. The TFV model developed by Koskela (2000) and the subsequently elaborated theories of lean construction can be used to further model and conceptualize the construction processes.

b. The resources (the resource base)

Good project management in construction must vigorously pursue the efficient utilization of resources deployed both for the coordination/management and the execution of the processes/operations. Mobilizing the resource base through setting up the project coalition, motivating it to optimally perform and managing the various supply chain involved is crucially important for the project to deliver its set objectives (Winch, 2010). Therefore, where as the major resource base in construction management may not directly fall under the project manager (in most cases of outsourced works), having a competent and capable resource base and mobilization of same to efficiently execute processes is crucially important for the success of the project. Indeed, studies show that (see subsequent chapters for CSFs) the availability and synchronized performance of the resource base is one of the major Critical Success Factors (CSFs) in construction projects.

The inputs to construction works- information/knowledge, material or effort/energy come from the myriads of the physical, human and institutional resources that have to be channelled into the project. The performance of projects is a function of the competencies, capacities and capabilities of these resources, which by themselves are significantly dependent on the characteristics of the general supply chain. The resource-based view (RBV) of the firm conceptualizes a firm's existence based on its competence and hence can also be used as a foundation in exploring the resource component of the model.

Optimum performance in construction projects demands optimizing on both the production and transaction processes. Optimizing on the production side of projects is fundamentally associated

with optimizing on the application area (product-oriented) processes and the resources mobilized for execution of these processes. As noted above, however, this thesis deals with the management processes as viewed from the client's point of view. In this light, the resource component of the conceptualization is only looked from the project coordination/management perspective. I.e., the resource component of the product-oriented processes, though critical for the successes of projects, is beyond the scope of this study and hence will not be elaborated more in the subsequent sections.

In addition, related with the resource base (for the client) is the concept of stakeholders. While the major resource bases for the client/project (its project management team, the contractors, the consultants) are its major stakeholders, there could be other stakeholders that affect the projects performance. These 'other' stakeholders, which are generally external to the project, should be considered within the environment context and their appropriate management should be devised in the management and governance system.

c. Governance and management system

The governance and management of the construction management processes is often associated with the devising of an appropriate governance structure and the management of the processes, the resources, and the interaction of the system with the environment it is operating in. An organization structure links tasks to be performed, the technology and layout to be adopted for performing the task and human components through formal and semi-formal means to ensure the accomplishment of project objectives. Appropriately designed organizational structure, thus, helps achieving a coordinated effort through the structuring of tasks, authority, work flow and amalgamation of the resources to be employed in effecting of the work processes.

Therefore, the governance and management system presents the framework through which the project management processes are planned, executed and controlled. In other words, the system presents the framework through which the processes are structured and governed; resources are solicited, allocated, mobilized and managed; and the environmental interactions are monitored and ameliorated.

In the general management field, there are many concepts and principles that can be applied in the devising and implementation of the governance and management systems for construction projects. As summarized in Table 2.1 above, for example, while the principles of transaction cost economics can be used in devising governance structures for construction projects, other theories such as ‘behavioral theories’ can be used in establishing a management systems that suites to the given challenge.

d. Context (environment)

The performance of construction works is contingent on the contexts under which they are effected. Contextual and environment forces of political, legal, institutional, sociological, technological, and economic (Scott, 2003) affect performance. In this regard, citing the lack of contextual/environment effects of project works in the project management literature, Engwall (2003) notes that studies that link the project to its environment are rare. Nonetheless, Engwall (*ibid*: 790) argues that since a project adopts many of its features in interactions with its environment, it ‘needs to be conceptualized as a history-dependent and organizationally-embedded unit of analysis.’ Particularly in construction, where most production takes place at the place of final use, the characteristics of the project setup and the project performance is hugely affected by the capability and performance of the firms forming the coalition, the industry and the general business context (Winch, 2010) the project is working in and the constraining and/or enhancing forces these contextual factors generate. In this light thus, the construction management system to be adopted as well as the governance structure to be designed should be contingent on the contexts and environment the project is implemented. Arguing along this line Walker (2007) emphasizes that construction projects should be conceptualized in an open system model that interact with their environment through the intrinsically interwoven aspects of the environmental forces of political, legal, institutional, sociological, technological and economic issues.

In regards to management, contingency theory states that a management system devised should be contingent on the factors that affect performance. Related with this, system thinking is an

approach that tries to look into a given system as an interrelated part that should be considered as a whole (and not as the sum of the parts) and, in the case of an open system like a project, it should also be considered in terms of its interaction with its environment. Therefore, among others, the founding blocks of these theories can be used in tailoring construction projects and their management under the context they are implemented.

i. Application in practice

Ranges of methods, tools and techniques are available in the management of the construction processes and the development of a governance framework for same. Such tools and techniques as work breakdown structure, organization breakdown structure, scheduling techniques, resource optimization algorithms, sensitivity analysis techniques, configuration management tools, quality function deployment can be optimally used to systematically and contextually develop and integrate the processes as well as devise the structures through which the processes are governed.

With respect to the application cycle over which the study concentrates, as highlighted above, construction projects pass through different phases throughout their life cycle. In this regard, while the product life cycle of a given construction project stretches from pre-project phases that may lead to inception of construction works through the product management phase to the ultimate disposal of the project's product, this study concentrates only on the project life cycle phases. Therefore, although reference will be made to pre-project phase as well as operation phase processes, the management of the processes discussed in this work will be only those processes within the project life cycle.

## 2.5 Conclusion

The main purpose of this chapter was to develop the theoretical and conceptual framework for the study. Consequently, the chapter highlighted existing general management theories that can be used in the development of the framework. While also presenting a summary of the historical management theories, the section identified systems theory, contingency theory, complexity theory, neoinstitutionalism along with transaction cost economics, resource-based view of the

firm, agency theory and management science as the contemporary theories relevant for the study. The section also discussed trends in construction project management theories and currently existing schools of thoughts of construction project management theories. In this regard, it identified organization focused and production (process) focused conceptualizations as the two dominant construction project management conceptualizations while also comparing and contrasting the two approaches.

Using the principles and concepts in the management theories and project management paradigms, the chapter then developed a conceptual framework for the study. The framework developed, which has improved performance as its main out, argues that the processes needed to be executed, the capability of the resources that execute these processes and the management and organization structure that brings the processes and resources together and manages them, as adapted contingent on the environmental factors it faces, is the best conceptualization of construction process management. The subsequent chapter presents the major approaches and practices in the management of the construction processes.

### **3 THE CONTEXT – MANAGING THE CONSTRUCTION PROCESSES**

#### **3.1 Introduction**

In addressing issues associated with the management of the construction processes that are meant to help improve performance in project endeavors, it is essential to present the criteria against which project performance is assessed in the first place. The management processes should be tailored to the performance measurement criteria adopted.

Therefore, with the major focus of the chapter itself being exploring international ‘best practices’ in the management of the construction processes, the chapter starts with the exploration of project success criteria often adopted in analyzing projects and the measurement approaches used. Then, the chapter contextualizes (in terms of international practices) three of the major pillars<sup>15</sup> of the conceptual framework established in the previous chapter. In this regard, first the chapter discusses common phases of construction projects along with project management processes as tailored to the different phases. Next to that, the chapter presents the management and governance structures in common use in construction project deliveries. Finally, the chapter addresses the need for contextualizing both the processes and the management and governance structures to the environmental context the project is implemented in.

#### **3.2 The project performance criteria and critical factors that affect performance**

##### **3.2.1 Common project success/performance criteria**

In a project environment, ‘success’ is interpreted differently by different stakeholders of the project. For example, as highlighted by Freeman and Beale (1992), a client may rate a project as success when it is finished within budget and scheduled time while a designing

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<sup>15</sup> The fourth component, the resource, in construction project context -where works are often delivered through the market, is provided by the resource base. The study, however, looks construction from the client's perspective and given that the management of the resources is generally left for the resource base (mainly the contractors and the consultants), it lies beyond the scope of the study.

consultant may rate it so when it incorporates best innovative artifacts. Still the community the project is implemented at may call it a success when it is safe, creates opportunity and is environmental friendly. Highlighting the difficulty, a while ago, Pinto and Slevin (1988:67) noted that '[t]here are few topics in the field of project management that are frequently discussed and yet so rarely agreed upon as the notion of project success.'

In general, as it is, the problems with project success measurement are triple fold. First, lists of success or failure factors vary in previous studies and there appears to be no universally agreed criteria from which specifics can be drawn. Secondly, as mentioned by De Wit (1988) and Pinto and Slevin (1988) a while ago, it is still not clear how to measure project success since project stakeholders perceive project success or failure differently. The third reason, as also remarked by De Wit (1988), is that for each project stakeholder, the objectives and their priorities are set differently throughout the project life cycle and at different levels in the management hierarchy. I.e., project success criteria and the associated measurement are variable both along the project life cycle (span) and corporate hierarchy (depth).

Therefore, with various dimensions considered, there are no consolidated project success criteria (or Key Performance Indicators (KPIs) as of yet. Indeed, given the 'unique' nature of projects (PMI, 2008), probably there could only be general level of criteria that can be universally adopted but needs to be tailored to the specifics of the project. The diverse characterizations of success indicate that defining success criteria for a project needs to be carefully established contingent on both the specific project and stakeholder dimensions. Project success criteria addressed in the literature range, in terms of span, as wide as from the effectiveness of the business plan of the project in the first place to the ability of the facility delivered fulfilling the business plan it is incepted for (product life span coverage) to the more narrow evaluation of identified criteria within project life cycle phase. Similarly, in terms of depth, the criteria adopted range from the high

(corporate or even economic cooperation) level such as the OECD's criteria<sup>16</sup> to a lower (say project management) level of criteria.

Conventionally, however, success in project works have been measured based on the trilogies of on time, within budget and to the set standard delivery (Belassi and Tukel, 1996; Walker, 1995; 1996; Hatush and Skitmore, 1997). It is argued that the three factors need to be properly optimized in planning and, given such optimized planning, no significant gain in one can be achieved without compromising on the other(s) (El-Rayes and Kandil, 2005).

Through time, the project success criteria have been evolving. In this regard, within the confines of projects, Chan *et al.* (2002) reviewed project success criteria from eight journals during the 1990-2000 periods and came up with the following overlapping success criteria used by various researchers. The criteria include time, budget (financial), quality and technical performance; health and safety, profitability, completion, aesthetics and functionality, productivity (efficiency) achievements; satisfaction of (client (customer), contractor, project manager (team)); dispute resolution satisfaction (conflict management, absence of conflict, claim, etc.); educational, social, professional aspects achieved and environmental sustainability.

Nonetheless, as noted above, key performance indicators (KPIs) are context dependent which are significantly influenced by stakeholder's needs and objectives of the project. In this light therefore, while the literature identified KPIs and their ranking can be taken as starting points, they need critical adaptation to particular conditions.

### **3.2.2 The monitoring and measurement of performance criteria**

Once stipulated, tracking and measuring of performance in projects is important both for the success of the project and future learning. Monitoring and measurement of

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<sup>16</sup> The Development Assistance Committee (DAC) of the Organization for Economic Co-operation and Development (OECD, 2002) uses five criteria for measuring project success: relevance, efficiency, effectiveness, impact, and sustainability.

performance gives feedback for improving performances and modeling and predicting project targets. Besides, feedback serves as a learning tool (for current and future project and endeavors). Evaluations also help to make operations and results transparent - aimed at improving both performances and accountability (Grizzle, 2002).

Chan and Chan (2004) compiled Key Performance Indicators (KPI) for construction projects from exploration of literature and proposed a methodology for measuring each KPI. They identified construction time, speed of construction, time variation, unit cost, percentage net variation over final product, net present value, accident rate and environmental impact as KPIs for which they proposed an objective way of measuring performances. On the other hand, they identified quality, functionality and satisfaction of end users, clients, design teams and construction teams as KPIs which can only be quantified by using subjective measurement criteria.

With respect to evaluation, particularly time and cost performance of projects, the most commonly used way of evaluation are direct deviation analysis and the Earned Value Analysis (EVA) technique. The direct deviation analysis compares performance against actual through direct comparison of the two. EVA, on the other hand, is a technique that helps evaluate project current status and forecast possible implications. It uses cost and time variances and indices in evaluation and forecasting.

The EVA approach generally presents financial performance that expresses both cost and time in terms of the financial progresses made. However, as highlighted above, for measurement and evaluation of project performance to be comprehensive and effective there is a need to combine financial and non-financial; hard and soft performances and hence target and process system of measurements that could capture such performances. The use of balanced scorecard is argued to present such a tool that can help evaluate both soft and hard performance targets (Kaplan and Norton, 1993).

In terms of physical progress evaluation of performance, which is often presented in detailed forms, physical progresses measured in physical measurement units are

employed. Such a detailed measurement presents detailed performance of the various criteria such as scope, quality, time, cost, risk, health and safety issues, resource performance.

### **3.2.3 Factors that influence project success**

Parallel with setting achievable and measurable success criteria (and monitoring and evaluating the set criteria), it is important to identify and act upon the major factors that influence success (or on the contrary may lead to failure). The identification of such key factors that significantly influence success will enable optimized allocation of resources and effort. These major factors that determine the success or failure of a given endeavor are normally termed as Critical Success Factors (CSFs). In the context of project management, critical success factors are defined by Savindo *et al.* (1992) as the factors that predict the success of projects.

Wubishet (2004) studied the development of critical success factors over the years and his summary shows developments from early factors of technical issues to holistic approach and quality at entry (to implementation) in later years. Similarly, Chan *et al.* (2004), after exploration of the critical success factor studies published in seven journal sources, compiled a list of critical success factors identified by researchers and presented a ‘conceptual framework’ of these success factors and their inter and intra-relations. They grouped the factors into project-related factors, project procedures, project management actions, human-related factors and external environment.

As presented by Chan *et al.* (2004), the project-related factors refer to the characteristics of the projects. The attributes include the project type and nature, its complexity, its scope and size, etc. The factors fundamentally dictate the resource demand and the methodology to be adopted which in turn dictates the relative performance on the individual activities and overall project.

The procurement-related factors are related to the governance structure and the delivery methods adopted (Savindo *et al.*, 1992) along with the tendering and pricing methods used. These factors determine the optimum governance structure to be adopted and the mechanisms through which the governance structure is implemented.

Project management factors include various project management attributes such as communication, leadership, motivation, feedback capabilities, control mechanisms, troubleshooting, coordination effectiveness, decision making effectiveness, monitoring, project organization, plan and schedule followed, safety and quality assurance program, and the overall managerial actions. These factors lie, among others, under the various attributes such as supply chain management, risk management, time management, etc. and are core requirements in the management of construction processes (e.g. PMI, 2008).

Project participant related factors are attributes of the client and the major project participants such as designers, project management personnel, contractors etc. The client factors include the expectation, ability and experience of client, nature and size of client organization, client's emphasis on cost, time and quality, and client contribution to the project. For the project management personnel, it includes project team leaders' experience and skills, project team leaders' commitment on time, cost and quality, project team leaders' involvement, project team leaders' adaptability and working relationship, and the last one is support of the project team leaders' parent companies. These factors span the issues of selecting the right supplier/partner/employer in procurement through to motivation and leadership capability in explicating stakeholder commitment in process management.

The environmental/context factors refer to the general and construction business contexts within which the project is implemented. The attributes used to measure this factor are economic environment, social environment, political environment, physical environment, industrial relation environment, level of technology advanced, level of sophistication of construction industry and supply chains, etc. Contextualization of endeavours and the factors that dictate it are importance for success. In this context thus, a construction

project's success is significantly dependent on the geophysical-technological-social-economical-political environmental context under which the project is implemented.

However, the major drawbacks of the various works so far in identifying CSFs is that either they do not present the success criteria contexts under which the identified success factors may work (for example Cook-Davis, 2002) or do not have a common indicator of success so that comparison can be made between the findings (Chan *et al.*, 2002; Chan *et al.*, 2004). Indeed, in this regard, there are some arguments (for example, Nguyen *et al.*, 2004) that state that given the intricately interrelatedness of the various success criteria themselves, attempts to map CSFs with the individual success criteria would result in rigidity and non optimum output. However, it can be argued that, given the various and non converging perceptions to what amounts to a project success, it is imperative that the factors and their relative importance in determining success, even though they are interrelated to each other, are also bound to be variable. Therefore, having a project success factor which does not correlate to what success it brings is bound to create a gap in application and a loss of focus as it does not lend itself to prioritization<sup>17</sup>.

In addition, like the success criteria themselves, the relative importance and implication of the various success factors is bound to be dependent on such factors like project type and complexity and the environment the project is implemented. Hence, like success itself, critical success factors are context dependent. In this regard, for example, given that most critical success factors identified in the literature are not done in the general business environment this research is conducted, the identified critical success factors, and the relative importance, may need contextualizing.

Therefore, given this challenge of context dependency and the relative immaturity of construction management practices in the Ethiopian construction industry, this research

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<sup>17</sup> Chua *et al.* (1999) tried to map the CSFs they identified from literature against project success criteria of on budget completion, within schedule completion and to the require quality performance using analytical hierarchical process approach. They found out that, adequacy of plan and specification and constructability consistently scored the first two ranks of the seventeen CSFs on all the three success criteria by all categories of respondents that include consultants, contractors, clients, and project management

adopts a general categorization of factors that dictate project success. Arguing along this line for their study of CSFs in the Vietnamese construction industry, Nguyen *et al.* (2004) state that in industries where the body of knowledge of project management is not mature, the more complicated the dissection the CSFs to smaller level, the less likely that the success factors and the lesson learned will be adopted for future projects.

In the light of this thus, this study addresses the success factors in the four major categories<sup>18</sup> of project processes and their management, the capacity, competence and commitment of the resources allocated to the project, governance structure and their organization along with stakeholder (participant) management and the environmental contexts the projects are implemented. In this regard, at a general level, the above discussed Chan *et al.* (2004) critical success (or failure) factors for projects can be related to these four categories that this study takes as the basic blocks of successful project management.

The project-related factors dictate both the project processes and the resources needed for their efficient execution. The procurement-related factors are factors that can be taken within the context of both the project governance adopted and the project management processes. The project management related factors are mostly resource and project governance and management related issues. Project participant related issues are mostly stakeholders' management issues which are addressed under governance and management. The environmental factors are directly related to context.

### **3.3 Construction processes and life span**

#### **3.3.1 Construction product [project] life span**

Starting from the identification and management of the opportunities or threats in the performing organization that could lead to a need for a construction solution, construction projects and the products they deliver thereof pass through different but interdependent

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<sup>18</sup> Although the resource component, for scope limitation reason, is not covered in detail.

phases<sup>19</sup> with various stakeholders of different (and variable) interests involved. The life span of a constructed asset can be classified as pre-project, project life span, operation life span and disposal phases (Kagioglou *et al.*, 2000; Wideman, 2004; Turner, 2009). As schematically captured in Figure 3.1 below, the stages that incorporate pre-project, project and post project endeavors are referred to as product life span (cycle) while those at the project stage are named as project life cycle. The following section addresses the major features of each phase:

i. The pre-project phase

Projects are not an end by themselves; they are a means to an end. The end for which a project is started to achieve is the project's business plan(s) (OGC, 2009). Hence, the success of the project is measured both against its ability to deliver the business plan it is incepted for- and as it may be modified along the way (Morris, 2005), and the performances (of the project processes) during the project life span (Ika, 2009). Often a project's business plan is initiated by environmental stimuli to the client company (Walker, 2007). The external stimulus to the client company provides the motivation for the company to respond to the stimulus. The degree to which the company responds to the stimuli depends on the extent of motivation which in turn depends on the level of incentives (opportunities) or threat the environment is providing/posing. The link between environmental stimuli and company reaction is addressed in strategic management. In this light, therefore, projects can be seen as vehicles to achieve deliberate or emergent (Mintzberg & Waters, 1985) strategic plans. Along this line, Turner (2009) and Morris and Jamieson (2005) give a cascading link between corporate strategy through portfolio and program strategies that lead to project strategy and finally to execution strategy<sup>20</sup>.

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<sup>19</sup> The PMBOK guide (PMI, 2008:18) defines a phase as a division 'within a project where extra control is needed to effectively manage the completion of a major deliverable'.

<sup>20</sup> The PMBOK guide (PMI, 2008:8-9) defines a portfolio as a 'collection of projects or programs and other work [which may not necessarily be interrelated] that are grouped together to facilitate effective management of that work to meet strategic business objectives. It also defines a program as 'a group of related projects managed in a coordinated way to obtain benefits and control not available from managing them individually.'

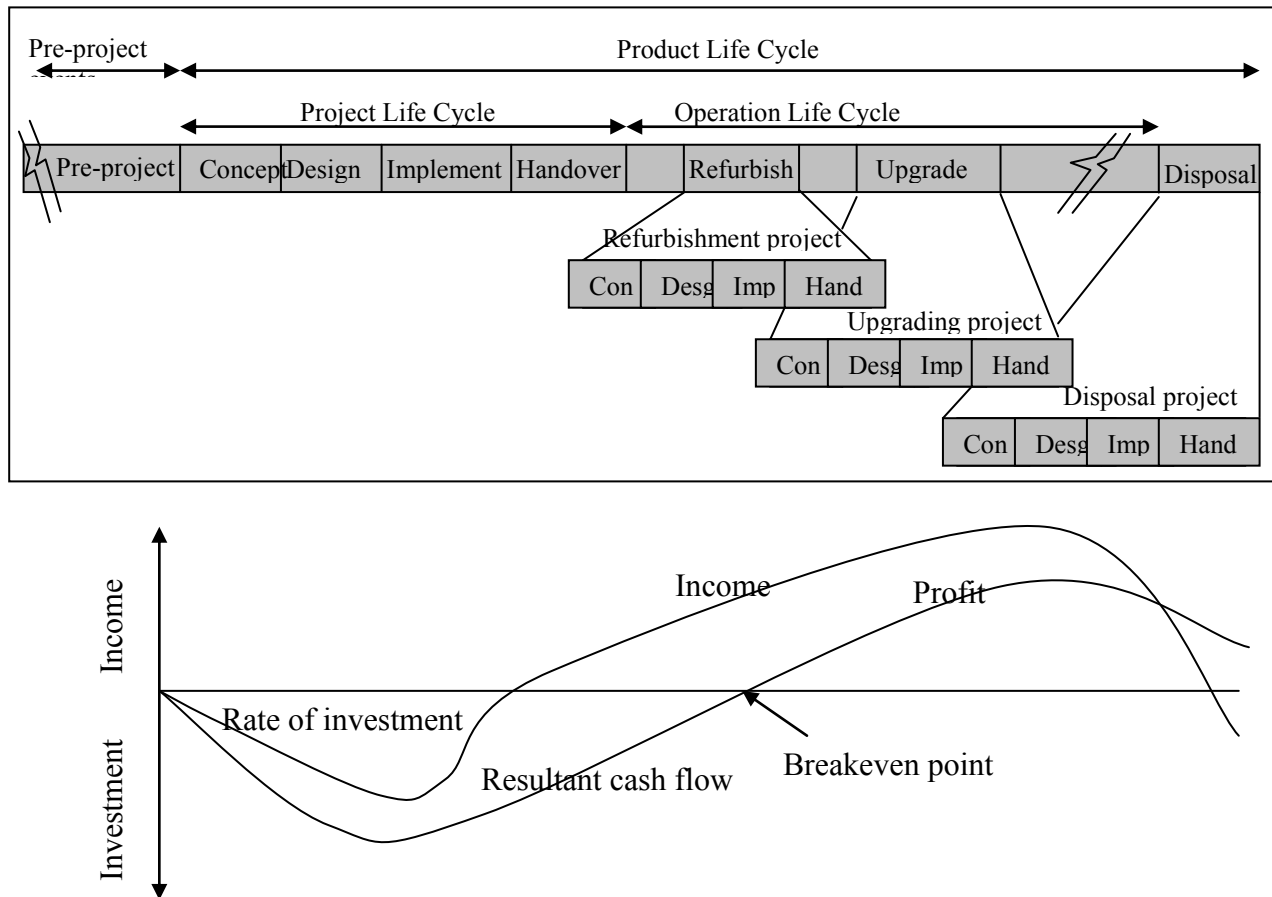


Figure 3: 1 Product life cycle Vs project life cycle (adapted from Kerzner, 1990)

In this light thus, the pre-project (also pre-portfolio or pre-program) events are crucial in determining whether an investing company has to start a project at all and, if it has to, determining the scale of the project. The start point of project processes can be argued to be the recognition of the client organization that there is a threat or opportunity that needs responding to (Walker, 2007). The response, however, could either end up to be a need for a constructed asset or otherwise. The response could lead to construction asset when the analysis of the stimuli and other factors (such as relative challenges of possible courses of action) reveal that a constructed asset is the best way of responding to same. In this light, therefore, the pre-project phase provides the *raison d'être* of the projects.

The analysis of the opportunities and threats within the client company's environment and trading them with the company's strengths and weaknesses to come up with the

appropriate way of taking advantage of the opportunities or defusing the potential threats is often taken to be the core scope of strategy management (Barney, 1991). In context of this study, however, while acknowledging and emphasizing the importance of the pre-project phase, given that this study focuses on the management of the construction processes, a detailed look into pre-project processes would lie beyond its scope.

ii. The project life span

Once pre-project events trigger the commencement of a project, a project may formally be started. Patel and Morris (1999:52) defined a project life cycle [span] as ‘[t]he sequence of phases through which the project will evolve [and] will significantly affect how the project is structured.’ If fast racking (overlapping of phases) is not envisaged, the change in phases are usually marked with evaluation and approval of the deliverables of previous phases and permission to commence subsequent phases. These points of phase transitions are termed ‘gates’ (Patel and Morris, 1999; Cooper *et al.*, 2004). Gates could also be associated with a considerable change in organizational setup such as in transition from design setup to construction setup.

The project life span by itself is often divided into different phases. The number of phases associated with a project life span and the nomenclature given to them has not consolidated yet and could depend on project delivery mechanism adopted and the major stakeholders involved in the project. In this light, while phases adopted in projects financed by the Multilateral Banks and UN agencies (Youke, 1988<sup>21</sup>) can be argued to be different to cope with the bureaucracy and negotiation involved, there are variations of phases by researchers and writers on the subject as well (Morris, 1998a; Wideman, 2004; Walker, 2007; Turner, 2009). In broader terms, incorporating the functions and processes the various classifications provide and corresponding to the life span of living things,

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21 Youke (1988) synthesized phases of World Bank sponsored projects and presented them as pre-identification, identification, preparation, approval, mobilization, implementation and operation. Here, the operation phase is meant for evaluation of the project’s deliverable and measuring results against expectations and hence does not mean the operation of the product or service delivered *per se*.

project life span phases can be categorized into conception (germination), feasibility (incubation), development (growth), procurement and implementation (maturity) and commissioning and closing out (metamorphosis) (Turner, 2009).

The conception of a project is intricately related to the pre-project phase. This phase helps to recognize the need for a project solution and, to an extent, the scope of the project. The feasibility study phase involves conducting explorations with the objective of arriving at possible ways of acquiring the business plan's objective, or if so the study indicates, abandoning the project. At the stage, different alternatives are explored and compared to arrive at the project that best fits to the business plan and constraints. The development phase is the stage where the objectives of the project are interpreted into design and planning artifacts in the form of drawings, specifications, construction plan, etc. The stage may also involve development and testing of a prototype. Procurement and implementation phase, as is often the case in construction where the construction works are outsourced, involves the procurements of services, works and goods from qualified suppliers<sup>22</sup>. Along with mobilization of resources, this phase involves all the processes and activities that interprets the planning and designing outputs and changes them into physical structure which is used to achieve the business plan the project is incepted for. Commissioning and closing phase involves a formal handover of the products delivered after commissioning. It also involves the handover of the associated documents of knowledge learned and maintenance/running documents as well as closure of contracts.

As projects move from one phase to the other over the project life cycles, they manifest various common characteristics such as 1) the ability of stakeholders to influence the final characteristics of the project's product and the potential to add value (without a considerable or even none proportional cost) decreases; 2) the uncertainty about that project and hence the risk of failing to achieve objectives decreases while information about the project grows. These characteristics of project life cycles dictate that, given that major decisions that consume resources are committed at the early phases of the life cycle

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<sup>22</sup> Depending on the delivery strategy the performing company may adopt, the development and feasibility study phases could also be outsourced and hence procurement of services for same may be needed.

and the cost of change is significantly higher as the project moves forward, making a thorough front-end assessment and informed decision is crucial for the success of the project. Nonetheless, despite the importance of thorough front-end assessment, the literatures criticize that, often, the early phases are not given enough attention (Morris, 1998a).

iii. The operation life span

The success of the whole package of the project is measured, in addition to the success of the project processes, on the ability of the product delivered fulfilling the purpose it is incepted for. For that though, the product delivered and the business purpose it serves need appropriate operations management schemes which intern may demand various adjustments of the facility delivered via the project. The management of the facility within its operation span is sometimes termed facility management (Winch, 2002). From maintenance and adjustments of the facility point of view, the major phases of the facility management include:

- A maintenance (refurbishment) phase: The product delivered may need to be looked after continuously and maintained for it to efficiently deliver its purpose. The maintenance of the product may vary from routine maintenance to extensive maintenance. The refurbishment endeavor, by itself can be categorized as a project, particularly if it is of an extensive maintenance type;
- An upgrading (expansion) phase: At some point in the product's life cycle, it may be necessary (for economic reasons or otherwise) to upgrade the product. The upgrading work itself is a project;
- A disposal phase: In some cases, a facility may be needed to be disposed for finishing its life span or other purposes. The disposing work itself, particularly of such facilities like urban buildings, waste treatment plants, nuclear plants, etc, demands an organized and coordinated effort that can be approached as a disposal project. The stage also involves recycling of some useful components which may serve similar or other purposes.

Generally, transitions from one phase to another involve handoffs of some concrete deliverables. Normally, deliverables from one phase are reviewed for completeness and accuracy and approved before work starts in the next phase unless fast tracking<sup>23</sup> is thought to be necessary.

The success of the project and the business plan it is incepted for, therefore, demands proper management of the various and intricately interwoven processes in each stage and the inter-phases. In this wake, it is advised to employ product life cycle costing approaches where cost/benefits (or project/product success criteria in general) are evaluated over the product life cycle rather than the project life cycle alone. Nonetheless, the scope of this study lies only within the project life cycle. Therefore, it focuses on the management of the processes within the project life span only.

### **3.3.2 Construction processes**

Halpin and Riggs (1992: 2) defined a construction process as ‘a unique collection of work tasks related to each other through a technological structure and sequence’. A construction project is completed via execution of a combination of intricately interwoven processes. In this regard thus, a construction work is a processes-based endeavor.

Construction can be viewed as a combination of conversion processes and flow processes<sup>24</sup> (Koskela, 1992). The processes in construction work, the conversion and flow processes, can be divided into project management processes and product-oriented processes (PMI, 2008). The project management processes are the processes that facilitate the effective flow of projects. It is generally accepted that the effective application of these processes would enhance the chance of success in projects (PMI,

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<sup>23</sup> Under fast tracking circumstances, phases may merge and hence issues can be dealt with in a concurrent manner providing opportunities to take concurrency advantages , among others, rendered by concurrent engineering.

<sup>24</sup> During the conversion process, various inputs are converted into outputs with added value. The flow process, however, does not actually add value by itself but could be a requirement for the conversion processes to be effected

2008; OGC, 2009). The product-oriented processes, on the other hand, are processes that specify and create the project's product. Such processes are typically defined by the project life cycle and are often application area specific.

While project management processes are applicable to most project, product-oriented processes can only be defined and addressed specific to the application area they are applied too. Therefore, while this study may address some of the product-oriented processes (see for example Appendix 5.4), it mainly concentrates on project management processes<sup>25</sup>. Often, processes are depicted in the form of a model. The following section addresses the commonly adopted construction management process modeling techniques often adopted by researchers in the area.

### **3.3.2.1 Construction management process modelling**

A model is an abstract representation of reality without much of the details of the reality. In this regard, the purpose of a model is to reduce complexity of a phenomenon modeled by eliminating the details that does not influence the construct's behavior under consideration. The most important aspect of a model of a process is that, it has to depict the required aspect of the process and represent it correctly. In its simple form, the model of a process should be easy to understand, easy to change, and easy to correct and above all should represent the process correctly (Abeyasinghe & Urand, 1999).

Construction process models normally depict the activities that would be executed during the construction process and normally include the information, participants and resources associated with the activities (Zhong *et al.*, 1994). Associated with the classification of construction processes themselves as product-oriented and management processes,

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<sup>25</sup> The major *de facto* accepted standards for project management, the PMBOK and PRINCE, attempt to enlist the commonly accepted project management processes. In the PMBOK guide (PMI, 2008), the project management processes are associated with each other by their performance for an integrated purpose of initiating, planning, executing, monitoring & controlling and closure of projects. PRINCE2 gives seven processes of starting up a project, initiating a project directing a project, managing a stage boundary, managing a product delivery, controlling a stage and closing a project as the main project management processes (OGC, 2009)

construction process modeling can be argued to be divided into construction product-oriented process modeling and construction management process modeling. Although no distinctively formulated as product-oriented or project management process modeling, there are many process models that tried to depict construction processes. They include the RIBA (Royal Institute of British Architects) Plan of Work; The BPF (British Property Federation) model; Savindo (1990); Zhonge *et al.* (1994); Kagioglou *et al.* (2000) and Karhu (2001).

In a broader sense, there are two approaches taken by the construction process modelers<sup>26</sup>. The first approach drives its root from the engineering system modeling and is often presented in Integrated DEFinition (IDEF) family<sup>27</sup>. There are a few construction process models developed by using the IDEF0 approach. Savindo (1990) used the IDEF0 technique to develop an ‘integrated building process model’. Karhu *et al.* (1997) developed ‘construction process model’ using the IDEF0 technique. Similarly, Zhonge *et al.* (1994) and Savindo & Norton (1994) used the same technique to develop a model for building design processes while Karhu (2001) combined the IDEF0 technique with other techniques such as scheduling and ‘work flow’ technique to develop a generic model for construction processes.

In general, IDEF0 method of modeling is flexible enough to accommodate many different processes at a detailed level. Indeed while this capacity could make the approach a

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<sup>26</sup> Related to this, it is worth noting that schedules prepared using network diagrams and bar charts, although not particularly used for modeling purposes, can also be taken to be models of processes (Karhu, 2001).

<sup>27</sup> The Integrated DEFinition (IDEF) modeling technique includes family of modeling approaches used for various purposes. The IDEF0 is used to model ‘functions’, the IDEF1 ‘information’, IDEF2 ‘simulation’, IDEF3 for process description’, etc (Hunt, 1996). IDEF0 is the approach used for construction process modeling. The IDEF0 modeling uses a box and an arrow system that represents an activity (function) and a flow respectively. A flow can be an input, a control, an output or a mechanism (ICOM) depending where it enters the activity. Input enters the box from the left, control from the top, and mechanism from the bottom. Output leaves the box on the right. Therefore, the role of the flow determines whether it becomes an input, output, control, or mechanism of an activity. The IDEF0 diagrams are generally presented hierarchical; with diagrams at lower levels representing more detailed activities than those at the higher levels.

preferred option for researchers, when it comes to practitioners however, the method has been found to be difficult to understand and transcend (Berg von Linde, 2000).

The second approach to construction process modeling is more of a management tool which tries to depict the flow of information and material between different actors. For example, the RIBA plan of work divides construction works into four phases of preparation, design, construction and use and presents tasks to be undertaken in each phase along with the responsibilities of the major parties such as the architect, quantity surveyor, and contractors. Particularly developed to a process protocol for the UK construction industry is also Kagioglou *et al.*'s (2000) generic design and construction process protocol<sup>28</sup>. It uses a 'map' of activities and responsibilities on a two dimensional Cartesian coordinate system. Construction activities, divided into four phases of pre-project, pre-construction, construction and post-construction are presented on a horizontal axis, while responsible parties, represented by management functions, are presented on a vertical axis.

### 3.4 Setting the governance structure of construction projects

The construction industry takes various inputs from other industries such as machineries from automotive and manufacturing industry, training and trained personnel from service industry and various materials from different industries such as the petroleum and steel industries. Nevertheless, these 'upstream' transactions from where construction takes inputs, while important, are not the principal focus of this study. The governance issues addressed herein focus in what would be called a 'downstream' transaction that involves decisions on whether to perform an activity (ranging from a single activity to whole project) internally or to outsource it and how they should be structured. The following sections address the major issues associated in the construction industry's practices of setting out its project governance structure.

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<sup>28</sup> Winch and Carr (2001: 519) defined a protocol as process maps that ought to happen in an organization, in contrast to a true map of processes which they defined as what actually happens in organization.

### 3.4.1 The market-hierarchy decision

Economically, the decision to buy or make - the market-hierarchy dichotomy- can partially be explained using transaction cost economics<sup>29</sup> (Williamson, 1975). When the costs of transaction are high, a client for a given construction project would prefer to integrate the execution of the work (or part of it) within its hierarchy. Such an approach, also termed 'force account delivery' could be made economically attractive for the client when some characteristics of the project lend to a higher opportunism by the market. On the contrary, when the transaction cost of in-house delivery is high, such as due to lack of competence, the market may give the better economic advantage.

In general, however, the nature of construction works/projects favors market transaction than hierarchy. In this regard, the construction industry is espoused to have a number of characteristics which sets it as 'unique' from most other industries (Ganesan, 2000). Such characteristics as 1) save for minor pre-fabricated items, the place of production being place of use and hence subjected to seasonal fluctuation of work; 2) mainly prescribed production (as opposed to speculative) where demand and main feature of product often been specified by client (Morton, 2002; Ganesan, 2000; Briscoe, 1989); 3) the outputs being generally large, heavy, durable, expensive, heterogeneous and immobile in addition to being required over a wide geographical area and to some extent complex (Ganesan, 2000) are main features of construction which sets it aside.

With respect to market-hierarchy decision, researchers (Eccles, 1981; Gonzalez-Diaz *et al.*, 2000) argue that the majority of the characteristics of the construction industry and

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<sup>29</sup> The transaction cost economics argues that markets and firms are alternative instruments for completing a set of objectives and purports to make the decision between the market-hierarchy dichotomy based on transaction costs. It bases its analysis on three pillars of contingency factors (uncertainty, asset specificity and frequency) that characterize transaction, behavioral factors (bounded rationality, learning and opportunism) that characterize the possible response of decision makers to the contingency factors; and context that defines the environmental context the transaction is conducted. Transaction cost economics only concentrates in transaction costs, leaving aside production costs, and hence may have to be amalgamated with other conceptualizations (such as the resource/competence view of the firm ((Conner, 1991; Kogut & Zander, 1992; Connor & Prahalad, 1996)) to be used in construction projects (Bridge and Tisdell, 2004).

projects such as the job volatility, the often big size nature of project (with respect to company sizes), the onsite production and associated geographical dispersion of projects, the uniqueness (non customization) of projects that are often produced to the stated requirement of clients-hence adding complexity and need for special trades, seasonal fluctuation of works favor the market option. Particularly from the client side, the limited number of chances being engaged in construction works, the complexity of construction works, the fact that client's core business may not be in construction and hence may not possess the capability and competency in effecting construction works (which also leads to information skewedness and subsequently to opportunism (Williamson, 1975)) etc., would make the market option more favorable.

Consequently, often, construction delivers its outputs through market transaction. However, while there are a few studies that show why general contractors subcontract works (Eccels, 1981; Buckely and Enderwick, 1989; Gonzalez-Diaz, 2000; Winch, 1989; Masten *et al.*, 1991; Pietroforte, 1997; Walker and Wing; 1999; Lai, 2000), there are no studies this researcher encountered that investigate why clients in the industry do their work through contracting. However, it can be argued that, at a general level, the incentives for the general contractor to sublet (due to the above cited features of construction works) can also be taken as the reasons for a client to outsource.

### **3.4.2 Construction governance and contracting strategies**

In addition to skewing the buy-make decision towards the buy option, the above characteristics of construction projects means, the delivery processes of construction projects involve big asset specific investments and are characterized by information asymmetry as well as high level of uncertainties. These characteristics, as argued by Williamson (1975), make the construction delivery processes liable to *ex-post* (after contract) opportunism. Under such conditions, when outsourcing is the preferred strategy of delivery, the trilateral and bilateral governance structure (Williamson, 1979), along

with neoclassical and relational contracting<sup>30,31</sup> (Macneil, 1974; 1978) respectively are the recommended governance and contracting options.

In general, in terms of practices in the construction industry, most often, construction deliveries use a trilateral governance structure (client-contractor-consultant for example in the conventional design- bid- build approach) and use a third party for dispute resolution. In addition, mostly a neo classical contracting approach, with appropriate adaptations implanted in it, are used in contracting.

Related with this, although there are recent calls for partnering forms of delivery for construction projects (see below), which leans towards the bilateral – relational contracting form of the Williamson framework, such a delivery hasn't consolidated yet even for recurring types of projects. One major reason for this, it can be argued, could be the public sector's preference for procurement and contracting procedure. In this regard, for predominately socio-political reasons such as wealth distribution, fairness, accountability, public sector procurement procedures often do not lend themselves for bilateral - relational contracting, even when economic considerations indicate otherwise as in recurring type projects. This, along with the fact that the state (public sector) is a major client of the industry (Ball, 1998) and government policies, interests and directions have a significant impact on the industry and the industry is often shaped by the need of the public sector (Flanagan *et al.*, 1998), trilateral governance structure along with

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<sup>30</sup> Based on how flexibility is planned into economic relations and what legal responses are present to such planning; how conflict between specific planning and needs to adapt to subsequent change in circumstances are treated; how contractual relations are preserved when conflicts arise and how economic activities are terminated when they are no longer needed, Macneil (1978) categorized contract laws as classical, neoclassical and relational contract laws on his discreteness (transactional)-relational contract law continuum.

<sup>31</sup> Using Macneil's (1978) categorization of contract laws and the critical characteristics of transaction in terms of frequency of transaction, asset specificity and uncertainty involved in the transaction, Williamson (1979) developed a framework for governance of contractual relations. He recommends market governance with classical contracting for non asset-specific investments of either recurrent or occasional nature. For occasional transactions of asset specific or mixed type of investments, he proposes trilateral governance using neo-classical contracting. If investment is of mixed type and entails reduced uncertainty and is of recurrent type, bilateral governance with relational contracting is recommended whereas if investment is of asset-specific and entails increased uncertainty, unilateral governance with relational contracting is the better option.

neoclassical contracting<sup>32</sup> are the dominant form of governance and contracting in the construction industry. Nevertheless, although the tri-lateral governance has been the most dominant form of governance in the delivery of construction projects, throughout history, the industry has been employing various forms of deliveries. The section below addresses the most common forms of delivery mechanisms construction employs and some recent ‘innovative’ approaches to counteract the drawbacks the often used delivery mechanisms are said to harbor.

### 3.4.3 Construction project delivery approaches

Throughout history, there have been various arrangements for the governance and administration of the delivery of construction projects. With each of the delivery processes having their relative advantage over the other, currently, with their different variations, the major forms of project delivery methods practiced can be classified as design-bid-build, design-build, construction management and the different variations of the public private project delivery systems (Kochar and Sanvido, 1998; Kwaku, 2001; Dell’Isola, 2002; Molenaar, 2004; Hughes *et al.*, 2007; Murdoch and Hughes, 2008). Table 3.1 below provides a summary of the major characteristics of each approach along with their major advantages and drawbacks.

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<sup>32</sup> Most construction contracts use standard conditions of contracts, with adaptations to the particular condition in provisions for particular applications and also incorporate provisions to deal with change in condition of contracts that helps in ‘flexible planning’. Most of them (for example those based on the FIDIC general conditions) also give provisions to cater for the ‘gaps that may be created in seeking flexibility’ with such provisions as substantial (as opposed to absolute) completion/performance, reasonable expectation/forecasting, third party (engineer) involvement in evaluation of performance and changes (and their effect), alternative dispute resolution, etc. According to Macneil (1978) these are major characteristics of neoclassical contracting.

**Table 3: 1 Delivery methods and selected innovative contracting in construction**

Type	Major characteristics	Major advantages	Major disadvantages/drawbacks
Design-Bid-Build <sup>33</sup>	<ul style="list-style-type: none"> <li>➤ Client enters contractual relationship with both consultant (for design and supervision) and contractor (for works);</li> <li>➤ Except in minor cases of fast-tracking, the design, bidding and construction processes are conducted sequentially;</li> <li>➤ Known for fragmentation of entities (parties) and processes</li> </ul>	<p>The major advantages stem from the sequential delivery that entails detailed scope definition at commencement of construction.</p> <ul style="list-style-type: none"> <li>➤ Design output in a set of substantially completed documents facilitates transmitting the owner's wishes to the constructor;</li> <li>➤ Enables client and the constructor to gauge the risks involved and cater for same before committing for the implementation/construction phase.</li> </ul>	<ul style="list-style-type: none"> <li>➤ Except in fast tracking, which may demand bidding without substantially completed design documents, the process is sequential and takes longer time;</li> <li>➤ Due to the fundamentally fragmented nature of this approach, where there is an artificial separation of design and construction; there is weak overall management and coordination;</li> <li>➤ Due to the inherent nature of construction works where the various factors that affect production cannot be completely anticipated, the certainty and predictability the approach is argued to provide may be lost or even abused (say through <i>ex-post</i> contract opportunism by one party).</li> </ul>
Design-Build	<ul style="list-style-type: none"> <li>➤ The client enters a contractual arrangement for both the design and construction of the project with one firm;</li> <li>➤ While the responsibility of quality assurance lies entirely on the design-build firm, the client may appoint a separate consultant to monitor and control quality of the works as well as evaluate performance;</li> <li>➤ Variations include (Murdoch and Hughes, 2008)                             <ul style="list-style-type: none"> <li>➤ Performance - based contracting: the extreme type of DB classification where the client only states the performance required of the facility to be developed;</li> <li>➤ Package deal: is the term used in arranging a single firm to oversee the Engineering, Procurement and Construction (EPC) of complex projects;</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>➤ A single point of responsibility for design and construction and coordination of processes means, from client's perspective, problems associated with accountability and deflection of problems to the other party, often experienced in DBB approach, are reduced. Also the potentials for claims and disputes are reduced;</li> <li>➤ Enables save time of delivery both due to avoidance of the double bidding processes (for design and later for construction in the DBB) and creating opportunity for concurrency of processes due to the single point of responsibility;</li> <li>➤ Is better suited for concurrent engineering and value engineering concepts as various options of achieving the objective can be explored better with the design and</li> </ul>	<ul style="list-style-type: none"> <li>➤ The checks and balances between the designer (supervisor), contractor and client available in the DBB approach may not exist, which may lead to tradeoff decisions to be always made to the DB firms favor. The lack of control of processes by the client may also lead to cover ups and opportunism;</li> <li>➤ While, once agreed, changes could be implemented relatively expediently, the tracking of changes and incorporation of same into the project works so that it responds to the client's potentially changing needs (or due other change circumstances) are difficult;</li> <li>➤ While the burden of design process follow-up and design qualification and double procurement (for contractor and design consultant) needed for DBB is removed from the client, the burden of selecting appropriately qualified design-build firm is more difficult;</li> <li>➤ Whereas studies show that DB incurs less cost (Hale <i>et</i></li> </ul>

<sup>33</sup>Gray and Hughes (2001) note that complexity of construction projects has led to the demarcation of the different phases and the fragmentation of the different disciplines that manage and execute these phases as well as the adoption of the sequential execution of the different phases. In this regard, Gidado (1996) notes that construction faces complexities both due to uncertainties in execution of processes (dynamic complexity) and interdependent (detailed complexity) processes and issues.

	<ul style="list-style-type: none"> <li>➤ Bridging (develop and construct) design - build contracting: refers to the arrangement where the client prepares the preliminary designs (often for procurement purpose). If the clients team who prepared the design are assimilated to the DB firm, the approach is termed novation;</li> <li>➤ Turnkey: is the arrangement where the firm contracted to design and implement the project also finances the project.</li> </ul>	<p>constructing firm working as a unit i.e. no fragmentation)<sup>34</sup>.</p>	<p><i>al. (2009)</i> for example), it only offers cost advantage in less risky projects and in a market where competitive offers can be solicited;</p>
<p>Construction Management</p>	<ul style="list-style-type: none"> <li>➤ Is an arrangement where the client employs a construction project management consultant to provide leadership and perform administration and management for the project;</li> <li>➤ Variations include:                             <ul style="list-style-type: none"> <li>➤ CM-at-agency: The CM firm is responsible for project and site management but does not involve in actual construction work. Contracts for the works is between the client and the contractor (or designer);</li> <li>➤ CM-at-risk: Client enters a contractual arrangement for the management and coordination of the construction processes with a given firm, who in turn, enters a contractual agreement with trade contractors for the actual execution of the works;</li> <li>➤ Management contracting: similar to CM-at-risk but, in management contracting, risks are shared between client and trade contractors even if trade contractors are ‘contracted’ with the CM firm.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>➤ It counteracts the drawbacks of DBB (e.g. fragmentations) and DB (e.g. loss of control and difficulty to accommodate change (Minchin and Ellis (2005));</li> <li>➤ The CM process allows a systematic approach to project management. The CM firm can contribute in design phase to enhance value engineering and life cycle analysis. The firm manages the inter phases and coordinates different stakeholders. The CM firm’s management and economics competencies complements both the designer’s design skills and the contractor’s construction skills to procure optimal design and construction;</li> <li>➤ Specialty contractors for the trades they specialize in is argued to result in them performing tasks at a lesser cost. However, loss in potential economy of scale, distinct mobilization-demobilization, need for more coordination effort, may offset such gains;</li> <li>➤ The use of trade contracting facilitates the phasing of design and construction and provides a potential for fast tracking.</li> </ul>	<ul style="list-style-type: none"> <li>➤ The CM firm adds an ‘additional’ overhead over general contracting method. Such cost could be offset by the gains from the competency of the firm in construction methods, construction management and construction economics and the coordination and bridging between design and construction the approach offers. The approach is advised for big and complex projects and programmes where the complexity and magnitude of the project dictates the involvement of multiple parties, ‘multi prime projects’(Tider and Cox,1983), and the need for coordination of the parties and the inter-phases becomes crucial;</li> <li>➤ In CM-at agency, the CM firm does not have direct contractual relation with the trade contractors that could reduce the perceived authority and power. The CM firm may also have limited liability for performance which may not foster sustained commitment;</li> <li>➤ Difficulty to organize, coordinate and control several prime contractors on the phase of fast-tracking contracts. In addition, difficulty of defining who is responsible for what in the overlapping trades.</li> </ul>

<sup>34</sup> Hale *et al.* (2009) compiled various empirical researches conducted to explore the relative performances of DB as compared to the DBB. The findings consistently indicate that the DB gives both cost and time advantage.

Public Private Partnership	<p>➤ A cooperative venture between the public and private sectors meant to deliver project using the private sector's finances through the appropriate allocation of resources, risks and rewards;</p> <p>➤ Tries to cater for the relative drawbacks of both 'pure' free market delivery and 'publicly delivered' services. The public sector is more suited in drawing attention to public interest by being inclined to social responsibility and environmental awareness (UNDP, 1998). This and its openness for scrutiny suites it for 'policy management, regulation ensuring equity, preventing discrimination or exploitation, ensuring continuity and stability of services and ensuring social cohesion' (Osborne &amp; Gaebler, 1992: 24). The private sector, on the other hand, is creative and dynamic in performing a better economic tasks, innovating and replicating successful experiences (or abandoning wasteful and obsolete endeavours), adopting to situations, etc. and hence brings better knowledge of technology, management efficiency, entrepreneurial spirit, etc. (UNDP, 1998).</p>	<p>➤ Better risk management: The public and private parties concentrate on issues that they are better suited to perform. Risk allocation is done on the basis of which party is better suited to manage the risk better (Li <i>et al.</i>, 2005; Shen <i>et al.</i>, 2006);</p> <p>➤ Given the general longevity of the relationship and its inherent intention to allocate risk to the party that is better suited to it, the probabilities of opportunist behavior decreases, hence permitting for mutual beneficial relationships for the parties (Erridge and Greer, 2002; Zhang, 2004).</p>	<p>➤ Perhaps the major drawback of the approach from developing countries point of view could be, despite all the drawbacks of derived externality and inefficient bureaucracy, the better capability and competence for most initiatives could still lie within the public sector;</p> <p>➤ Another problematic area could also be that the procedures of the public sector as well as the pertaining laws may not be currently able to accommodate a long term and trust based relationship.</p>
Other Innovative contracting <sup>35</sup>	<p>➤ Serial tendering: the approach of obtaining tender for a sequence of similar projects.</p> <p>➤ Prime contracting: the arrangement will be made for the design, construction and maintenance responsibility of a facility.</p>	<p>➤ The certainty of long term work will enable bidders to optimize on their resources and reduce profit margins for risks associated with lack of work.</p> <p>➤ With payments tied to performance and innovation and the contractor knowing of the long term commitment, the contractor would be able to devise a life cycle optimization mechanism thorough innovation of methods, bulk purchasing, better supply chain management, etc.;</p>	<p>➤ May not be suitable in change (such as inflation) prone environment;</p> <p>➤ May not be suitable in public procurement where wealth distribution is of an essence.</p> <p>➤ May be difficult in change prone environment.</p>

<sup>35</sup> Although not technically delivery approaches, these are innovative contracting approaches which could be explored in developing countries.

<p>▶ Performance-based maintenance contracting;                  ▶ Warranty-type performance-based contract the contractor guarantees the integrity of the constructed product.</p>	<p>▶ Unlike method based maintenance contracts, performance based maintenance defines an end outcome (performance) required of the asset and lets the contractor choose the best way of achieving the stated performance hence encourages contractor innovation and improves quality. This arrangement creates improve opportunities for value engineering and efficiencies;                  ▶ Contractors focus on preventive (as opposed to reactive) maintenance;                  ▶ Can give a platform for capacity building of small sized contractors.</p>	<p>▶ Performance criteria have to be clearly stated and measurement mechanism have to be clear but sometimes it may be difficult to quantify some attributes;                  ▶ The contractor may not focus on the overall asset management of the product, particularly near the end of the contract period;                  ▶ The legal system of a given country may entail a clause that render long contracts unenforceable;                  ▶ The securing of the warranty may be difficult for small firms as their bonding capability may be below.</p>
<p>▶ Lane contracting<sup>36</sup>: a system of contracting on highways, railways or runways (or with adjustments, other facilities) works where a contractor will be required to pay compensation if the particular stretch of the road (lane) is not opened for traffic within a predefined duration of time;                  ▶ The essence of lane rental is ‘the contractor is renting the right to use the lanes from the public’ (Herbsman 1998: 411) and hence should pay compensation to the public for the delays and inconveniences (as well as fuel costs) incurred by using the road section during rush hours or forcing commuters to detour.</p>	<p>▶ In urban (heavy traffic) roadway rehabilitation, restoration and resurfacing projects, where extended occupation of a lane causes substantial inconvenience to commuters and damages to businesses, lane renting technique it meant to encourage contractors to work off-peak traffic hours and expedite the construction of that portion of the stretch;                  ▶ Lane renting gives focus to a particular stretch of a roadway section over which the work has to be expedited-usually on busiest/most important stretch of the road.</p>	<p>▶ The knowledge of the ‘worth’ of the roads at various times is the most important factor to evaluate whether lane rental approach is optimal or not and to serve as a basis of evaluating bids. While developed countries may have a readymade cost rates of lanes (for example Herbsman (1998) note that most states in the US have), such readymade scheduled rates may not be available for developing nations.</p>

<sup>36</sup> There are at least three variations of lane rental approaches (Srinivasan & Harris, 1991): bonus - rental charge, lane by lane rental and continuous site rental. In the bonus –rental charge approach, the contractor would be given a bonus for finished occupancy of a stretch of a road section before an agreed date while would be required to pay compensations for deadlines missed. In the lane by lane renting method, the contractor will be charged for the duration that a lane will be closed. The rental rates may vary with respect to time of traffic sensitivity thereby encouraging contractor to work off rush hours. The continuous site rental approach is an extension of the rental approach in which the contractor will be charged an agreed fee for each day a lane is occupied by the contractor .

#### **3.4.4 Determination of construction procurement path for project coalition setup**

Construction projects are often implemented using a temporary coalition of firms brought together to implement the project. Given the complexity of construction works over the project life span, typically the various parties working on the project come from multiple firms. In setting up these coalitions then, a client has to select the best possible mechanism that serves the project's interest. The selection of appropriate procurement system that is tailored to the characteristics of the project and its participants is important in not only project governance and hence the associated project transaction cost, but also project productivity. The procurement method adopted therefore affects both organization (governance and contractual) structure and the management of the project processes (Tookey *et al.*, 2001).

In terms of organization, for example, the procurement system adopted will dictate whether the project is design (consultant) led (for example in the traditional design-bid-build system), producer led (in case of contractor in design and build) or project coordinator led (construction management). In terms of the management of the processes, the procurement system significantly affects the coordination and interrelations of processes. As presented in the above section, for example, the design-bid-build often demands sequential processes while the design-build approach lends itself for fast tracking and concurrent engineering. The construction management may facilitate better value management, concurrent engineering and supply chain management.

Given the significance of the procurement method in affecting major characteristics of projects, there is an argument that the correct choice of delivery method will significantly contribute towards the success of a construction project (Bennett and Grice, 1990; Tookey *et al.*, 2001). Indeed, in one of the 'success' criteria- cost, studies show that (contractual, 1982 – cited in Gordon (1994)) the selection of an appropriate delivery and procurement method could reduce a project's cost by an average amount of 5%.

Therefore, a structured and objective procurement system aims to achieve the goal of ensuring the simultaneous selection of an appropriate contractor to deliver the project, the mechanism and

setup of governance, the price to pay<sup>37</sup> and the legal framework under which it is established (Hatush and Skitmore, 1997). The belief is that, these factors can be coordinated so that the procurement path adopted will be reconciled with the constraints and characteristics of the factors that dictate the project's setup, performance, and environment.

In this context, various studies have been conducted to identify procurement routes that assist clients make a better informed and systematic decisions about the project procurement methods they adopt (Skitmore & Marden, 1988; Alzahmi & McCaffer, 2000; Al Khalil, 2002; Chan *et al.*, 2001; Mahdi & Alreshaid, 2005). All the approaches emphasize for the need to incorporate the parameters that affect decision/performance, to appropriately rank these parameters, and to correlate the parameters and the rankings to procurement so that the appropriate procurement path is adopted.

Various researchers have compiled different parameters that are argued to be important factors in procurement decision making process. The parameters can generally be categorized as project characteristics, client characteristics, stakeholder and environmental characteristics. In this regard, expanding on the above general categories, Alzahmi & McCaffer (2000) and Luu *et al.* (2003) give an extended list of the various parameters. Some of the major ones that are also addressed by other researchers (NEDO, 1985; Skitmore and Marsden, 1988; Love *et al.*, 1998) include need for speed of delivery (both design and construction), need for certainty (of time, cost, cash flow, etc.), flexibility in accommodating changes, demand for quality performance (both product and process performance), the nature and complexity of the project and its environment (stakeholders, legal environment, etc.), the risk and responsibility allocation sought, the level of competition, transparency, non discrimination etc. sought, claims & disputes, experience and capacity for a given route of procurement.

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<sup>37</sup> Construction generally uses two modes of payment for services and works: price-based and cost-based modes of payment. Within cost-price based mode continuum, however, there are variations of modes of payments such as lump sum and unit price for price-based and variations of cost plus payments for cost-based. Attributes of the project such as extent of scope definition, complexity of the project, probability of change in scope and condition; the stands of the parties in terms of absorption/transfer of risks, the general economic stability are the major factors that need considering in selecting the appropriate payment mode. In general, when seen from the client's perspective, flexibility to incorporate changes increases as the approaches change from price-based contracting to cost-based ones. Parallel to this, the risk (cost risk) associated with the project work increases as the flexibility of incorporating changes increases (Carty, 1995).

In regards to the relative weights to be allocated to the parameters, researchers attempt to use different approaches. For example, Love *et al.* (1998) used a ‘priority rating’ system where the client rates each parameter on a given scale. Alzahmi and McCaffer (2000) used a multi-faceted weighing approach that uses ‘weighed evaluation’ of procurement routes with respect to the client’s needs through ‘paired’ comparison of each procurement methods.

Different techniques have been employed in selecting the appropriate procurement path. Most methods use a multi-criteria decision analysis approach and attempt to implement a degree of objectivity to subjective areas (Fellows *et al.*, 1983) to arrive at the best procurement path. For example, Skitmore and Marden (1988) used a procurement path decision chart adopted from (NEDO, 1985). Alzahmi & McCaffer (2000) used a combination of alternative technique of value engineering (Parker, 1985) and analytical hierarchy process theory (Saaty, 1994). Chan *et al.* (2001) used the Delphi method ((Linstone and Turoff, 1975) while Alkhalil (2001) and Mahdi & Alreshaid (2005) adopted analytical hierarchy process theory.

Given that the procurement parameters as well as the weighting facts to be applied are mainly contingent on various attributes of the project, the environment the project is implemented, the stakeholders involved and their needs and capability, there cannot be any one possible procurement route that can be recommended for all projects. Therefore, a procurement route has to be determined for a specific project based on the parameters for that project.

Nevertheless, there are some empirical studies that suggest, depending on the major criteria sought for, a possible procurement route that can be used as a starting point (possible in the absence of specific objective comparison). In this regard, for example, Laedre *et al.* (2006), from literature review, concluded that while there are no ‘recommended routes’ to procurement of design services for public construction projects, the competitive approach is the recommended selection processes for construction works procurement. In terms of the delivery approaches and payment methods, their analysis of the literature revealed that the PPP combined with long term revenue, the DB along with the lump sum payment and multiple prime contractors (closely related to CM-at-Risk) with unit price mode of payment are the most recommended procurement

routs. Their study (in Norwegian public construction sector), however, shows that the multiple prime contracting with unit price mode of payment is by far the most dominant route of procuring construction works. Similarly, Konchar and Sanvido (1998) conducted a comparison of delivery methods based on nine factors of unit cost, cost growth, schedule growth, construction speed, delivery speed, intensity, turnover quality, system quality, equipment quality for six categories of construction works in the US. They found out that there are no criteria where the DBB has outperformed the DB and CM-at-Risk approaches.

### 3.4.5 Supplier [contractor] selection

When projects are decided to be delivered through the market, not only do clients have to select the best fitting procurement route, they also have to select the most appropriate supplier(s). Given that one of the key features of construction works and services procurement is that suppliers are selected before products/services, the success of the project and the output delivered thereof will be significantly influenced by the selected supplier. Therefore, the selection of appropriate supplier that is capable of successfully delivering the project is one of the important decisions faced by clients (Holt *et al.*, 1995; Yang and Wang, 2003).

Fundamentally there are two routes in selecting a supplier for a given service, work or good: competition and negotiation<sup>38</sup>. The rationale behind competitive selection is free market competition which argues that genuine competition should achieve best value for money for the client. The negotiated approach, on the other hand, is the better option when the nature of the procured item (e.g, when the procured item is complex and/or unique to identify technical and financial features), the market (e.g. limited suppliers), the situation (e.g. emergency situation), etc. compel that market competition cannot be harnessed.

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<sup>38</sup> The competitive bidding can further be categorized as selected (restrictive bidding often with pre-qualification) and open competitive bidding. The open competitive bidding can be conducted as one -stage or two-stage competitive bedding. In one-stage bidding, which is generally the preferred mode of public procurement (for example, Proclamation No. 649/2009), both technical and financial proposals are submitted together (in one or two envelops) but evaluated in sequence (if two envelope) and no modification of the technical proposal is allowed. In two-stage bidding, often, technical proposal is submitted first (it could also entail submitting both proposals together, in two envelops, but the contractor is allowed to modify the technical proposal during negotiation) for evaluation and financial proposal of only those qualified is solicited.

The competitive selection of suppliers is the preferred approach in public procurement and has been the dominant selection route for many years<sup>39</sup>. Due to problems associated with fairness, integrity, transparency and its lack of fostering competition, the negotiated approach is not normally preferred in public procurement (for example Proclamation 649/2009 of the Federal Democratic Republic of Ethiopia).

Whichever selection approach is adopted, the often used criteria in assessing potential suppliers are eligibility, professional/technical capacity and competency and the remuneration (Merna and Smith, 1990; Moselhi and Martinelli, 1990; Dennis, 1993; Herbert and Biggart, 1993). The first sets of criteria, eligibility, define whether a given potential supplier is eligible (usually for legal and administrative reasons) to supply the required item. The second sets, the capacity and competency, determine the qualification and experience (often for technical reasons) of the potential supplier. The third set of criteria, the remuneration for the service/work provided, are the payments to be made for expenses in producing the work (production cost), in effecting the transactions needed for the production (transaction cost) and mark-ups as contingencies for perceived risk and expected profits.

In negotiated bidding, the client normally selects the supplier that satisfies the eligibility criteria, experience and other general requirements. Then, the client negotiates on the methods to be employed, machineries, plants and facilities and personnel to be deployed as well as the prices for the service/work. In competitive tendering, for contractor selection<sup>40</sup>, often the least

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<sup>39</sup> Normally, in open competitive bidding, confidential bid submission approach where bids are submitted sealed and confidentially is employed. Adopted from FIDIC tendering procedure and to serve as a highlight of the main issues addressed in tendering construction works, a summarized presentation and description of the major procedures, deliverables, the responsibilities of each party as applied to open competitive tendering through pre-qualification is presented in schematic form in Appendix 3.1.

<sup>40</sup> For consultant selection, both the technical qualification result is used in the final evaluation rather than only for qualifying for subsequent phases. For example, the World Bank's (1997) guideline for consultant selection recommends a short-listed (restricted) competition approach for consultant evaluation based on: a) Quality and Cost-Base Selection (QCBS) which takes both the quality of the proposal and the cost for the service in selection of the qualified consulting firm; b) Quality-Based Selection (QBS) where the highest ranking consultant in the evaluation of the technical proposal (one envelop system) is required to submit financial proposal and awarded the contract. The Bank (*ibid*:3) recommends this approach 'for complex or highly specialized assignments or those that invite innovations'; b) the Bank also recommends other methods such as least-cost (similar to the least evaluated bidder for contractors) selection (for standardized and routine services), selection under fixed budget approaches (for simple projects and fixed budget), selection based on consultant's qualification (for 'very small' value of services where preparation and evaluation of proposals cannot be justified).

evaluated bidder approach is adopted. The approach entails, first, tender qualification based on pre-determined sets of criteria and weighting factors. Then, from those tenders that qualify (score above a pre-determine threshold on the qualification evaluation scoreboard meant to guaranty quality and performance), the one that provided the lowest price is recommended for contract award<sup>41</sup>. Therefore, save for eligibility and qualification requirements, bid prices are the sole basis for contractor selection and competition (Hatush and Skitmore, 1998). In the price only competition approach, the client specifies other major project requirements such as construction time and quality and hence price bid becomes the dominant selection criteria.

This approach, which principally concentrates on the price aspect of project, has been accused of inherently inhabiting problems (Ellis and Herbsman, 1991) such as unrealistic time frame setting by clients which ultimately may lead to claims and prolonged construction duration as well as prohibiting both contractors and clients from optimized cost-time tradeoffs. In addition, it is argued that, bidders, when faced with a shortage of work, ‘are more likely to enter low bids simply to stay in business in the short term and in the hope of somehow raising additional income through “claims” or cutting costs to compensate’ (Hatush & Skitmore, 1998:105).

The logical balancing to mitigate these problems is to use a multi-criteria evaluation and selection system that incorporates the major factors that affect the performance of the project. The objective of the approach is to broaden the evaluation criteria so that it takes into account risks associated with non-price data concerning the individual contractors involved. In the light of this, there are some attempts, for example Alsugair (1999), to develop a multi attribute evaluation method. One of the major drawbacks of the multi criteria contractor selection, however, is the difficulties encountered when comparing different criteria measured on different scales. There are some works and proposals to overcome the problem (Holt *et al.*, 1995; Hatush & Skitmore, 1998). Another alternative path taken is the reduction of the criteria to be

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<sup>41</sup> However, at different times and various countries, different modifications to the ‘lowest’ evaluated bid approach itself have been tried. For example, Italy, Portugal, Peru, and South Korea use(d) the so called ‘bid averaging’ approach, where the lowest and highest bids used to be excluded from the bids submitted and the closest to the average of the remaining bids is used to taken as the winner (Herbsman & Ellis, 1992). In some countries, the lowest bid that lies within predefined range of the owners cost estimate (for example 70% in Saudi Arabia (Martinelli, 1986)) used to be the winning bid.

incorporated. In this regard, the most adopted approach is the use of cost (price) and time as evaluation criteria.

The merit for the cost plus time approach (or most notably known as the A+B approach) bases its argument on two interrelated justifications. Firstly, a potential contractor's bid price can be set as construction cost plus an appropriate markup. Construction costs usually depend on construction time hence making bid price a function of time. Therefore, it is advantageous to give potential bidders a tradeoff between the price and the time. Second and related to the first is that since the project's early completion can contribute to the client's return on investment while the project's delay may result in loss of business opportunities or even create social problems for public projects (Shen *et al.*, 1999), contractor's should be allowed to specify the duration within which they can finish the project rather than same is stipulated for them. The logic here is that, a contractor knows his own capacity and commitments and would provide a realistic time framework of when he can complete the project while the client would also be able to get advantage from competing contractors both on price and time. Therefore, in cost plus time evaluation, competitors are required to submit a bid price as well as a construction time to complete the project.

Nonetheless, even in this approach, the client (bid evaluating team) has to covert the criteria into same measurement, usually cost, unit. The common approach to the A+B bidding procedures is that each unit of construction time is assigned a certain monetary value and this unit time value will be added into the bid price to calculate the total combined bid. The conversion of the time value of money into cost demands knowledge of gain/loss on benefits when projects are finished earlier/delayed. Then the winning bidder would be the one with the lowest combined bid amount.

### **3.4.6 Organizing projects [project set up]**

Along with the determination of the procurement routes and the selection of the performing companies, it is essential to devise an organization structure that is tailored to improved performance. In the context of construction projects, Walker (2007:4) defined (project) organization as a 'pattern of interrelationships, authority, and responsibility that is established

between the contributors to achieve the construction client's objective.' The organization structure should be designed to link the tasks to be performed, the approach and technology to be adopted in performing the task and the personnel (or work resource) who perform it, as well the coordination of the people and processes through formal and semi-formal means. The organization structure will help create '[a] mechanism for linking and co-ordinating people and groups together within the framework of roles, power and authority' (Naoum, 2001:77).

Many studies conducted in organization and organizing tend to refer to organization of stable firms as opposed to project organizations (which are temporary coalitions) (Mintzberg 1980; 1981, for example<sup>42</sup>). Consequently, the issues addressed in mainstream organization literature are those that generally affect the characteristics of stable organization (including the individual firms of the construction project coalition), and hence their application in a project coalition may need critical review and adjustment. In this regard, Walker (2007:51) notes that '[t]he issue of the distinction between managing firms and managing inter-firm project management is one

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<sup>42</sup> Mintzberg conducted an insightful and critical research into characteristics of organizations. He notes that there are five major types of organizations which tend to manifest five fundamental components of strategic apex, the operating core, the middle line, technostructure and supporting staff and five basic ways of coordination of direct supervision, standardization of processes, standardization of outputs, standardization of skills and mutual adjustment. When direct supervision is relied up on, mainly aimed to exert control and retain decision making power by the top management, the resulting structure will be the flexible entrepreneurial simple structure. This type of organization is adaptable to simple and dynamic environment and at times of hostile situations.

The technical support staffs pull for standardization of working system as it is their core function in the organization. To the extent that the organization achieves this standardization, the resulting structure will be a machine bureaucratic one. This type of organization generally fits for standardized type of operations such as mass production.

The middle management, on the other hand, strives for more and more autonomy, pulling power from both the top management and operating core-discouraging vertical decentralization. To the extent that conditions favor, the result will be divisional organization.

Similarly, the member of the operating core also pull for more autonomy and strive to limit the interference of administrators-managers and technical analysts thereby promoting both horizontal and vertical decentralization. When conditions permit, the result will be a professional bureaucracy where most of the power is concentrated at the operating core. Professional bureaucracy is generally suitable for stable but complex environment.

Finally, the administrative support staff would exert more influence when collaboration is needed that involves usage of its expertise. Such arrangement would result in adhocracy. Mintzberg (1981) states that there are two kinds of adhocracy: the operating adhocracy and administrative adhocracy are fundamentally distinguished in the separation of the administrating apex and the operating core. In the operating adhocracy, the operating and administrative efforts combine together. Therefore, managers, staffs and operating experts should work together to effect goal. In administrative adhocracy, on the other hand, a distinct separation of the administration from the operation is possible. In this arrangement, the administrative component carries out the planning and design work while the operating core executes the operation. Adhocracy is better suited for dynamic and complex environment as it adapts to the challenges the environment presents. However, Mintzberg (1981:113) states that the arrangement achieves 'its effectiveness [for challenging and innovation seeking conditions] through inefficiency' as the ambiguities, politicking problems, conflicts, and efforts of persuasions to effect decisions that it normally needs makes it inefficient for ordinary operations.

which is not addressed in the mainstream management literature'. In addition, the temporariness of projects is also not properly addressed in mainstream literature that normally deals with organizing firms. In this regard, while the fundamental goal of organizations in general is to preserve themselves and grow, the objective of a project organization, by its nature, is to work itself into extinction. Therefore, the dynamics involved in the two sets of organizations may be different and hence may need distinct consideration.

In this light, a study conducted in the UK's construction industry (Shirazi *et al.*, 1996) on the characteristics of construction project organizations on the dimensions of environment and technology shows that construction project organizations do not comply with the literature stipulation in mainstream management. For example, on the dimensions of environmental stability, while the mainstream management literature (for example Mintzberg, 1980) state that a centralized bureaucracy and standardize approach is the norm in stable environment, Shirazi *et al.* (1996:210) found out that construction project organizations often adopt 'more flexible coordination mechanisms and less rigid work procedures.' In hostility dimension, contrary to the mainstream management literature suggestion, in construction, hostile conditions do not lead to a centralized system. Rather project organizations try to curb the influence of the environment by redrawing their lines and creating buffers. With regards to technology, certainty of technology does not lead to breaking of works to routines and standardization of processes to create a bureaucratic approach. Instead, Shirazi *et al.* (*ibid*: 210) found out that 'mutual adjustments and less formal methods of communication' are the adopted approaches. Shirazi *et al.* (*ibid*) attributed the non-conformity to the theoretical suggestions to the temporary nature of project organizations that is often composed of teams from independent firms. They argue that both the temporariness of the set up and the coalition of independent firms should be taken as additional contingencies in setting up construction project organizations.

In addition, as highlighted in the above sections, the project organization structure that needs to be setup and that evolves is significantly dependent on the project delivery method to be adopted. For example, the number and nature of the firms involved in DDB arrangement is different from that of DB - hence demanding a different type of organization 'fit'.

Given these ‘peculiarities’ thus, in construction project context, the focus of project organization would be the search and adoption of a structure ‘which overlays and comprises a range of firms each of which has a structural orientation which suits its particular contribution to the project (Walker, 2007:51) and that is particularly tailored to the peculiarities and needs of the project. With respect to the adapting to the peculiarities of the project, Walker (2007:235) states that ‘[t]he organization structure for each project should be developed from first principles. Although a range of ‘standard solutions’ may emerge it should not be presupposed that any predetermined solution is correct.’ However, although they need critical adaptation to the specific contingencies of the specific projects, there are general project organization types from which a specific organization structure may be developed. The following section addressed the most common forms of project organizations.

#### **3.4.6.1 Types of project organization structure**

Mainly based on the relative influences the project manager and functional managers have over resources and the project coordination/management approach adopted, Galbraith (1977) classified project organizations structures into three categories of functional, matrix and project organization structures. Later, recognizing that the influences of the project manager over resources vary significantly within the matrix context, Larson and Gobeli (1987) further divided the matrix organization structure into weak, balanced and strong matrix.

The functional arrangement allocates activities and responsibilities on the basis of departmentation. Staff members are grouped by specialty and each employee has one clear superior. When a project is to be organized in this arrangement, the project is divided into segments and is assigned to functional departments/groups. The project will be coordinated by functional managers and upper level management.

Matrix organizational structure is a form of organizational structure that combines the functional and projectized structures. Demands for quality and price may pull an organization toward the functional end, whereas demands for service and speed may pull an organization toward the divisional end. To address those demands, top managers may settle to position the organization

to achieve both characters. Depending on the authorities given to the project manager (coordinator), matrix organizations are often divided into weak, medium (balanced) and strong matrix. Weak matrices maintain many of the characteristics of a functional organization and the project manager role is more that of a coordinator or expeditor than that of a manager. The functional managers have authority over resources and take responsibility over performance. In balanced matrix, the project manager and the functional manager will have equal power over resources. They jointly plan and approve performance. Strong matrix, on the other hand, has many of the characteristics of the projectized organization and can have full-time project managers with bigger authority and full-time project management staff.

Project organization structure is a variation of functional organization that divides the organization activities into self-contained entities, each responsible for marketing, production, finance, personnel etc. Where grouping is arranged around specified products or services, each group has its own specialist functions provided at the operational level.

Chuah *et al.* (1995) and PMI (2008) give the major characteristics of the each approach and the relative advantages and disadvantages each entail. For example, project process integration is the strongest the pure projectized set up while disciplined (competence, knowledge) retention is the highest in the functional organization. Reaction time is the fastest in strong matrix while it also incurs the highest overhead cost.

### **3.5 Environmental context**

The environment at which a project is implemented provides challenges, opportunities, resources, etc. to the project and in terms may take something from the project. The physical, socio-cultural, economical, political, legal environment through which the project is implemented has an impact on the project's performance. Consequently, in addition to the project itself, project management team should look into the set of forces and conditions that operate beyond the project's boundaries but affect the project's (the teams') ability to acquire and utilize resources, maximize on opportunities and defuse challenges.

Given this environmental interaction, therefore, there is no one best way to organize and manage projects. In this regard, as argued by general management literature, the organizational structures and the control systems that managers choose are contingent on the nature of the work to be executed (or nature of business) and the characteristics of the external environment in which the organization operates (Lawrence & Losch, 1967). An organization's better performance results from fitting the characteristics of the organizations such as its structure leadership style, human resource management, strategic decision-making process to the contingencies that reflect the situation of the organizations. In construction project setups as well, while responding to the peculiar nature of projects, it can be argued that fitting the organization structure and management style to the contingencies the environment provides will have a better chance of resulting in better performances.

In this regard, the international/ national business context, the state and capability of the construction industry, the state and capability of firms that form the project coalition (the client-consultant-contractor) will have a significant impact on the performance of a given project (Winch, 2001). The 'parent' organizations that form the temporary project coalition, by being the major sources of resources, can affect performance of the projects depending on the capability and competence of the resources. Authors in the construction project management (for example Benett, 2000; Walker, 2007) note that, in construction projects the client, consultant, contractor firms, in addition to the project setup itself, would have a significant toll on the organization that evolves and the project performance.

The state of the general business context such as the financial system, the legal system, the state and performance of other industries, through the supply chain and interrelationship with a given project will have an impact on the project's performance. The construction industry through which the project is implemented, as the industry that sets standards and provides resources will also affects performance of projects within the industry. Indeed, success of a given construction industry is generally assessed based on its capability to efficiently and consistently shape the built environment and competitiveness as compared to other industries and other construction industries (Momaya and Selby, 1998).

In this regard, competitiveness of construction industry as whole can be measured on its ability of delivering projects successfully on consistent basis, on its ability of sustainably shaping the built environment it is operating in, on its ability to embrace new and progressive technologies and management styles, on its ability of coping with various challenges it faces, ability of building the capacities of its key participants, its ability of satisfying the customer's and the general community's interests, etc.

As highlighted in chapter one above, the performance of the Ethiopian construction industry is low when measured both in terms of the participation local firms in big projects and the delivery of projects to the trilogies of success criteria of within budget, within schedule and to the required standard delivery. In this light, as discussed in chapter one, the majority of the actual construction works in the industry are executed by international firms as the domestic firms lack the capability. Studies suggest that (SMEC, 1999; ERA, 2005) the local contractors and consultants lack resources, competence and experience to satisfy the screening requirements financiers set to compete in big internationally financed projects. Besides, financial and loaning system and other industries are not well developed to supply construction with what it needs and support the industry. Indeed, given that poor project performance is witnessed over projects executed by both local and international firms (see chapter one), the major contributor to same can be argued to be the low capacity of the industry and the general supply chain under which the firms are operating.

In this light thus, the construction industry in Ethiopia (in terms of capacity, competence, system) and indeed the general supply chain are weak and can be argued to negatively impact on project performance. The inefficient and non-optimum performance of the industry and the supply chain as a whole induce significant inefficiencies in project deliveries. In the wake of this thus, in managing construction, it is necessary to cater for this challenges in the industry and the supply chain.

### **3.6 Conclusion**

The purpose of this chapter was to present the major practices in construction process management and how governance structures are established in the delivery of projects. It was intended to address the major approaches available, their drawbacks and look into their context dependency. In an attempt to do so, the chapter first established construction project success criteria (Key Performance Indicators) often adopted and discussed Critical Success Factors that the literature identify to critically affect the performance of projects. The chapter then went to present the commonly adopted construction project phases and discussed the key processes employed in the delivery of construction projects. It presented the product life-cycle based phases and discussed the key characteristics of each phase.

The chapter also addressed the major practices in establishing the governance structure of construction projects. It presented a summary of the project delivery approaches adopted in construction along with their brief application, advantages and drawbacks. It also presented the procurement paths available for clients in conducting procurement for their projects and the different ‘objective’ selection approaches suggested by the literature. In addition, with focus in public works procurement, the chapter presented approaches often used in selection of suppliers particularly for public works. The chapter also discussed the major forms of project organization structures available and presented their relative advantages and drawbacks. Finally, the chapter discussed the need for contextual adaptations of the construction management processes, organization structure, delivery methods, procurement approaches, etc. identified in the literature to the context and environment projects are implemented under.

The subsequent chapter presents the research methodology employed in the study. It discusses and stereotypes the methodology adopted and presents justifications for selection of the specific approaches for the study.

## 4 RESEARCH METHODOLOGY

### 4.1 Introduction

Research is an organized and systematic way of fact finding missions that is embarked to find answers to questions about a given issue or explore its practice (Tayie, 2005). Research involves critical investigation of the various aspects of the problem under consideration; understanding and formulating guidelines that govern the research procedure; and developing and / or testing theories for the enhancement of the existing situation, state or process. In this light thus, a research concerns with both what the research explores (the issues, the facts and conclusions) and how the facts are acquired and the conclusions are reached (the methodologies) (Fellows and Liu, 2008).

A research methodology is, therefore, a combination of techniques<sup>43</sup> (Easterby-Smith *et al.*, 2001) used to enquire into the issue under investigation and reach conclusion. It deals with the mechanisms how the enquirer goes about finding out the facts about the phenomenon under investigation and makes conclusion. The selection of the appropriate research methodology, method and the operationalization<sup>44</sup> of same would demand a critical research processes design. For the research to provide a quality output, the research endeavour should be guided with systematically designed processes that feed into each other.

A research design is a plan that ‘guides the investigator in the process of collecting, analyzing and interpreting observations. It is a logical model of proof that allows the researcher to draw inferences concerning causal relations among the variables under investigation’ (Nachmias and Nachmias, 1992:77). A research design, therefore, is the logical step that links research’s empirical data to the research question and ultimately to the conclusion (Yin, 2003) by dealing with what question to study, identifying relevant data, devising mechanisms and collecting data and devising mechanisms and analyzing the data to reach conclusion (Philliber *et al.*, 1980). A research design involves a critical review and articulation of the research questions that are

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<sup>43</sup> An individual technique for data collection, analysis, etc. employed in the research processes is called a research method.

<sup>44</sup> Operationalization, in this context, is the process of establishing observable characteristics of a construct.

tailored to the problem statement, the methodical design of the research methodology and philosophical stand adopted, the critical design of the research instrument, collection of the data needed and critical analysis of the data to reach to an informed conclusion.

Therefore, with the research problem drawn in chapter one, the conceptual framework developed in chapter two, the theoretical analysis and conclusions presented in subsequent chapters, this chapter, as part of the research design, presents the research methodologies adopted. The first part of this chapter categorises and discusses research methodologies according to philosophical thoughts and their bearings on the research design and the methodology adopted. Then the chapter stereotypes the specific research methodology adopted for this study and justifies why it was chosen. This is followed by discussions of data collection and data analysis methods employed. Finally, the chapter discusses the rigours applied to assure the quality of the research process and its output.

## 4.2 Research paradigm adopted

Research methodologies and the outputs they produce are guided as well as influenced by the underlying philosophical understanding and thoughts about the nature of the issues explored and ways of exploring it. The ontological<sup>45</sup> view point about reality principally dictates the epistemological relationship between the researcher and the researched. Therefore, before one goes on to discuss about research methodologies, it is necessary to understand the underlying philosophical thinking as it will help clarify research designs and dictates what kind of evidence is required and how it is to be gathered and interpreted. Summarizing from the literature, Easterby-Smith *et al.* (2001) identify three philosophical schools of thought that deal about reality and ways to enquire into it. They are the positivistic, post-positivistic (relativistic), and constructivist schools of thought. Table 4: 1 below depicts the methodological implications of the different epistemologies as compiled from Easterby-Smith *et al.* (2001), Guba (1990) and Cook and Campbell (1979).

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<sup>45</sup> Ontology refers to the assumption we have about the nature of reality. It deals with the human mental models of 'how things really are' and 'how things really work' (Guba 1990:19). Epistemology, on the other hand, refers to the general sets of assumption about the best way of enquiring into the nature of reality/the world. It explores the nature of the relationship between the enquirer and the issue under scrutiny.

**Table 4: 1 Summary of research paradigms and their major characteristics**

<b>Paradigm</b>	<b>Positivism</b>	<b>Post-positivism/Relativism</b>	<b>Constructivism</b>
Ontology (basic assumption)	Realism: Reality is external, objective and is driven by immutable natural laws	Critical realism: A real world driven by natural laws but due to the limitedness of human cognition, imperfect sensory and constrained intellectual mechanism, exploring and perceiving into the true nature of reality is impossible.	Social constructivism: Reality is socially constructed and therefore our understanding of it is subjective, varied across situations and cultures and is conscious ideological.
Epistemology	Objectivism: Enquirer should behave objectively in an effort to explore reality and unravel universal laws that govern causal relationships through non-value laden means.	Modified objectivism: Reasonable objectivity of enquirer by trying to be as neutral as possible and articulating interferences and value laden characterizations.	Subjectivism: Given that reality is a human mind construct, subjective interaction between enquirer and enquired is the best way of constructing it.
Major methodology	Manipulative methodologies that both curb from inquirer bias and meticulous enough to penetrate into the characteristics of the issue under scrutiny.	Critical multiplicity of methodologies (triangulation of multiple data, source, investigators, theories, methods, etc.) to achieve the commitments for critical realism and modified objectivism.	Approaches that properly gauge the hermeneutics and dialects <sup>46</sup> aspects of an enquiry.
Major aim of enquiry	Discovery of the natural laws of nature.	Exposure into and 'estimating' reality through multiple perspectives.	Invention/construction of 'reality'.
Major designs	Experiment/ observation.	Triangulation.	Reflexivity.
Analyses/ interpretation	Verification/ falsification.	Probability.	Sense-making.
Outcomes	Causality.	Correlation.	Understanding.

<sup>46</sup> The hermeneutics aspects of an enquiry deals with as accurately as possible depiction of the particular construct while the dialectics aspect deals with comparing and contrasting of the aspects of the particular construct so that the various constructs are brought to terms and synthesized (Rosen, 1982).

Generally mirroring the above categorization of enquiry, in the construction project management areas, there had been series of debates regarding the paradigms and quality of research approaches adopted. The debates appear to be between those fostering a shift towards constructivist paradigm and qualitative approaches (Seymour & Rooke, 1995; Rooke *et al.*, 1997; Seymour *et al.*, 1997; Seymour *et al.*, 1998) and those favouring methodological multiplism and paradigm diversity that uses the continuum of positivist and constructivist paradigm as appropriate (Runeson, 1997; Raftery *et al.*, 1997; Wing *et al.*, 1997; Harris, 1998).

Those favouring the ‘interpretivism’ approach (the constructivist paradigm) state that construction management principally involves people who, like the researcher, attach meaning to constructs and the issues under scrutiny. Therefore, they argue, instead of the rationalist approach which concentrates in establishing causal relationships and explanations, attention should be shifted towards *verstehen* understanding of meaning and context. In this regard, for example, Rooke *et al.* (1997: 492) note that ‘[i]t is our central contention that *verstehen* understandings rather than causal ones should be the aim of social research and that management studies are primarily a social discipline.’ The ‘interpretivists’ argue that the central focus of construction management study, which is generally meant to improve performances of practitioners and develop normative guides, should be tailored towards explicating the meaning the practitioners attach to it and formulating frameworks that would enhance better acceptance by practitioners and improved performance.

The proponents of the interpretive approach, while they do not categorically reject, for example, the multi-paradigm approach, they, however, fear that such a path would lead to degeneration of rigor as it opens rooms for ‘evading definable standards’. As for the current (mainly rationalistic) approach, they argue that it allows ‘bad researchers to get away with a mechanistic application of formal procedure, because adherence to such procedure is assumed to confer ‘objectivity’ on their findings’ (*ibid*: 493).

The supporters of methodological multiplism and paradigm diversity, on the other hand, argue that uncovering knowledge in construction management as discipline involves studies in various areas such as technology, law, finance, economics, resource management and that calls for

multiple approaches tenable to the needs of the problem at hand (Raftery *et al.*, 1997). Research in such wide fields of studies would benefit from diversity of methodologies that may be associated to the rationalistic or interpretivist approach or even both at the same time. In this regard, Wing *et al.* (1997: 99) argue that '[s]ince construction management is a practical subject, we suggest that the choice of approach should be a pragmatic one: the approach that is likely to generate practical solutions should be adopted.'

Given the multiplicity of the areas researched and the mainly contextual nature of the researches, they argue that, it is difficult to prescribe one research approach or paradigm for all construction management research problems. 'Different approaches serve different functions in the knowledge discovery process. The important issue is that, at each stage, the approach is rigorous in that the issues are defined clearly and the logic of the argument is made explicit along with any assumptions implicit in the approach adopted' (*ibid*:101).

Wing *et al.* (*ibid*) characterize research as a non-trivial endeavor that encompasses richness of meaning and quality of detail, can be replicable/testable/refutable, and can be generalizable. Following this characterization, they argue that qualitative approaches could be better suited for non-triviality and incorporation of as much meaning and quality detail as possible, hence becoming a platform for hypothesis building. Good quantitative approaches could encompass all characterizations and hence can become, in addition to hypothesis building, good tools for hypothesis and theory testing. In this regard, the use of qualitative approaches, which are best in explicating perceptions and meanings, are argued to be a starting position in hypothesis building while the quantitative research could best be suited in testing the validity of the hypothesis so built (Bryman, 1984).

Therefore, for the methodological multiplists, the choice of the methodology and the adoption of a given paradigm is dependent on the nature of the problem at hand, discovery level on knowledge (building or testing), purpose of the research, etc. Nonetheless, whatever the approach adopted, it is important that the problem and associated key concepts are defined clearly and that the methods used as well as the underlying assumptions and limitations are transparent and defensible with respect to the problems, concepts, and conclusions made.

On its part, this study, which inclines towards the post-positivist epistemological school, inclines towards the methodological multiplism approach. It takes the view that the selection of methodology should be contingent on the research problem and other major factors (such as philosophical point of view and experience of the researcher) that affect the rigour of the process and the outcome. Construction project management is a multi-disciplinary endeavour and hence research meant to improve it will have to focus on various issues that deal with human as well as ‘thing’ aspects<sup>47</sup>. In any case, methodological multiplism encompasses interpretivism and hence can be used accordingly when situations justify its usage. Therefore, this research takes the stand that some of the mechanisms to improve rigour in the study is to use approaches like triangulation of data, sources, analysis techniques, etc., which are better associated with multiplism than the dogmatic reliance on interpretivism.

Therefore, epistemologically, the study inclines towards the post-positivist stand point that assumes the existence of reality independent of inquirer but accepts the fallibility of the inquiry and knowledge creation process to accurately depict reality. Accordingly, the study mainly focuses on improving the chance of accurate measurement of facts in the quality assurance section below, it takes such rigors as multiple data source, multiple data collection strategy, comparison with existing literature and previous studies to improve the chance of generalizability of the outcome and its internal logic. In regards to approach, predominately, it takes the qualitative approach. The reason is that, rather than focusing on frequency and statistical generalization, the study, as argued in the research methodology selection below, focuses in explication of data and analyzing and synthesizing same towards a theoretical generalization. In this regard, given the research’s objectives of exploring and analyzing the current practice of the construction management processes (along with the challenges associated with them), the explication of rich data and channelling it towards the possible improvement approaches is the preferred option.

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<sup>47</sup> For example, part of the planning process of construction projects can be researched from the ‘thing’ perspective.

### 4.3 Justification of the methodology used: selection of the research method

One of the basic requirements in selecting appropriate forms of research methodology and method as well as controlling the processes is to ensure that the characteristics reflected on the research output are that of the trait of the phenomenon and not methodological artefacts (Jick, 1979). The purpose of the research (the nature of problem to be solved) has a significant bearing on the methodology that needs to be adopted. For example, such descriptive goals that pose what, who, where, how many, how much questions would generally be best addressed via surveys and archival studies. In this type of research, what is generally sought is exploration and description of incidences and their frequency without major inclination for causal linkage. When the research goal is to look causal linkage asking the how and why questions (explanatory or predictive in nature), the more appropriate methods would be experiment, surveys, histories or case studies. Therefore, clearly defining the research question/problem is an important precursor in research method selection as it underpins the nature of the enquiry. The research's substance (the issue it tries to investigate) and form (what form of investigation it anticipates to embark on – such as descriptive or explanatory) are important issues that need thorough articulation before method selection.

As presented in chapter one, the major objectives of this research are exploring the current practices of the management of construction processes, identifying the major characteristics and peculiar challenges within the industry with the aim of framing approaches that would improve the current practices. These objectives, at a general level, call for descriptive<sup>48</sup> explorations of the characteristics of the practices in the industry and explanatory investigation to establish causal links between processes management (and challenges) and improved performances.

Authors (Stake, 1995; Yin, 2003; Gerring, 2004) note that a case study research can be used for exploratory, descriptive as well as explanatory studies. They (for example Yin, 2003) note that while, generally, case studies are suitable for an explanatory research where 'how' and 'why' issues over which the investigator has little control are investigated and when contemporary

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<sup>48</sup> In terms of form, research can be classified into descriptive, exploratory and explanatory ones. Descriptive studies describe the characteristics of the phenomenon under the study. Exploratory studies explore aspects of the construct under study. Explanatory studies explain causal relations between variables (Yin, 2003).

phenomena with a real life context are sought, they can also be used in exploratory and descriptive studies. Similarly, Stake (1995: 8) noting that often researchers take a case ‘...to know it well ... what it is and what it does’ argues that the first business of a case study is ‘understanding the case itself’.

In this context thus, the most suitable research strategy that combines this research’s objectives of exploring and describing the construction process management approaches in the industry and establishing causal links between issues that are affecting better management of the processes and how they can be mitigated is the case study. In addition, as noted by Yin (2003), one of the major appeals of a case study is its capacity to be tailored to contexts. Therefore, the method will enable to contextualize the construction processes adopted and the challenges experienced to the environment under which they are experienced. The strategy also allows retaining the holistic and meaningful characteristics of real-life events. These traits of a case study, along with proper design of theory formulation, data collection and analysis techniques will make the strategy the better options for the study. In the wake of these relative appeals of the case study and its relevance for the research questions posed, the study adopts a combination of descriptive and explanatory case study to explore, describe and establish a causal relationship of the management processes, the major challenges and possible mechanisms that would lead to improved performance of construction processes.

#### **4.3.1 Case study research design**

A research design should ensure that the evidences collected addresses the research questions asked and is essential that it ensures coherency and rigour. This is necessary because the design establishes the links between the research problem to the findings and conclusions. It provides the mechanisms to explicate the data to test the validity of the problem statement and in order to acquire the relevant data the appropriate question must be asked. The research design significantly affects both the reliability and validity (see below for the meaning) of the research.

Yin (2003) identifies the following five issues to be of particular importance in research design for case studies. They are:

1. The nature of question that the study is embarked to address: Whatever the substance of the study, in terms of form, a case study, while better suited for an explanatory nature of investigation, can also be used in exploratory and descriptive studies. In this light, as presented in chapter one, this study tries to explore the construction management process practices and the major challenges in managing same, tailored to the Ethiopian construction sector, and frame approaches that link the processes to improved performance. Accordingly thus, a case study research approach guided by the appropriate theory and with appropriate design of case selection, establishment of unit of analysis, data collection and analysis techniques is the best approach to the research;
2. The theory (proposition) of the study, in the event that it is articulated and needed, will help direct the research process and delimit the variables that research ought to concentrate on. When properly devised, a theory and/or a proposition (or a hypothesis) would help guide research and help researcher focus the research by stereotyping the investigation and cubing from the temptation to cover ‘everything’ about a phenomenon. Theory development prior to field data collection will help provide a blueprint for the study. The conceptual framework of the study helped guide the design of the research approach, the exploration process as well as the analysis and interpretation of the data;
3. Unit of analysis refers to the unit to which the research applies to and from which data is collected from. The unit of analysis specifies what the case is about. The appropriate delimitation of same is important in case studies. Generally, if the problem statement is properly addressed and the research questions thoroughly and specifically formulated, the identification of the unit of analysis may not be that difficult. For this study, given that the research envisages developing a process model for projects, the most appropriate unit of analysis is a project itself. Accordingly, within the organization selected for the study, the study adopted projects as its unit of analysis;

4. The logic linking the data to the proposition/theory: As noted above, the major purpose of a case study is to generalize against or towards a proposition/theory. Consequently, linking that data to be gathered and the proposition stipulated is important. Pattern matching (Campbell, 1975) is the often suggested technique in linking data with proposition. The study used the conceptual framework developed and the recommended construction process management approaches from the literature as its guide and matched the selected case's processes and approaches to identify similarities or deviation;
5. The criteria for interpreting the findings set the extent of pattern matches to support or contradict a proposition. The study adopted a comparative approach with the selected cases's practices are compared with existing theories and recommended international practices on the issues addressed. This helped to both categorize the selected case's practices along the theories and recommended practices already identified and make comparisons.

#### **4.3.2 Selection of the case**

Case studies are normally conducted by selecting a few best fit cases for the phenomenon under scrutiny. They emphasize detailed contextual analysis of a limited number of events or conditions and their relationships. Yin (2003) notes that critics of the case study method argue that the study of a small number of cases can offer no grounds for establishing reliability or generalizability. The counter argument presented is that, case studies, like experiments, are generalizable to theoretical propositions and not to populations. In this regard, Yin, (2003:8) argues that 'the case study, like experiment, does not represent a "sample", in doing a case study your goal will be to expand and generalize theories (analytical generalization) and not to enumerate frequencies (statistical generalization)'. To facilitate the generalization and ensure the quality of the research, however, it is necessary to select the appropriate number and type of cases.

For a case study work, selection of cases (qualitative sampling) is generally purposive (Kuzel, 1992) and is 'decidedly *theory-driven*' (Miles and Huberman, 1994: 27). In addition, samples (cases) in qualitative study may not be wholly pre-specified as they could be adjusted and evolve

as works progress. In general, however, at least as a starting point, in terms of number of cases, while a single case can be used when suited to the situation (e.g. critical case), often, for replication purposes<sup>49</sup>, multiple case studies are used. In this regard, Eisenhardt (1989) recommends the use of four to ten cases for better external validity. However, Yin (2003) notes that while a larger case number may be needed for theoretical replication, when fit, even two cases may be enough for literal replication. In terms of the best suite cases, the selection fundamentally depends on what the research envisages to achieve. For example, if the research envisages explicating as much information as possible from the case, extreme cases may be the preferred options (Kuzel, 1992).

As briefly highlighted in section 1.2.2, in recent times, Ethiopia has embarked on different sector development programs (road, housing, power, railway) overseen by different institutions. Therefore, processes adopted by the institutions that oversee these programmes such as the regional Housing Development Programme Offices (HDPOs) for the Integrated Housing Development Programme; the Ethiopian Electric Power Corporation (EEPCo) for the Power Sector development Programme; the Ethiopian Railway Corporation (ERC) for the Railway Sector Development Programme can be taken as candidates for the study. However, with the exception of EEPCo, both the HDPOs (which are also regionally divided as opposed to federal institutes) and ERC are relatively young<sup>50</sup> to have well evolved and consolidated processes whose advantages and disadvantages can be streamlined and compared with international practices.

The ERA, on the other hand, has a long history of being the dominant road sector employer in the country. In addition to being in operation for a long time, the ERA has been the biggest construction sector employer, and had many international stakeholders (contractors, consultants, financiers) which demand follow up of standardized processes (e.g. the World Bank). Therefore, the Authority, it can be argued, has to build its capacity to follow the ‘generally accepted practices’ in the management of its processes.

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<sup>49</sup> There are two types of replication (Yin, 2003). Literal replication happens when multiple cases predict similar results while theoretical replication occurs when multiple cases predict contrasting results but for predictable reasons.

<sup>50</sup> Please also refer to Section 1.2.1 how the regulatory and main public employing sectors have been changing.

In this light, therefore, by selecting ERA's project delivery approaches as its focus, the study selected the case which borders the extreme cases when seen in the context of the general Ethiopian construction industry. Projects administered by Ethiopian Roads Authority (ERA) can be thought as 'best case scenario' projects which can be presumed to manifest the various construction management processes presented in the literature. The case selected for the research inclines to the 'best case scenario' in terms of possibility of applying standardized project management processes. Within ERA's projects, however, the study focused on how the Authority handles its overall project management processes and did not pick any specific project. This is particularly because a) the authority follows a fairly standardized approach to its project delivery b) for the project conception phase (planning and programming), the Authority devises and manages its processes in networks and programmes rather than specific project so that making the individual project invisible to be picked.

#### **4.3.3 Method of data collection adopted**

Under the case study research realm, there are different data sources such as documents, archival records, interviews, observations, physical artifacts (Yin, 2003). While each of these can be used as a standalone data source, as much as possible, it is advised (e.g. Yin, 2003) to use multiple data sources that could be used in 'data triangulation' (Patton, 1987). For this particular study, given the nature and scope of study (where observing the whole processes of the project(s) cycle takes significant time and physical artifacts do not offer relevance), the data sources selected are documents (and archives) along with interviews. Documents and archives are used as the major data source with data from interviews used to fill gaps identified from the documents and to triangulate the data gathered through document analysis.

Documents and archives, notwithstanding their drawbacks such as retrievability, reporting bias, biased selectivity and accessibility (Yin, 2003), are important sources of data. Particularly in this particular case where it can be expected projects by ERA to be sanctioned, administered and closed formally, the documents and archives concerning the relevant projects can be argued to be of important data source. Therefore, with the selection of the cases also channelled into the

potential availability of data (Stake, 1995), the available documents relevant to the case were collected and relevant data was retrieved.

Interviews provide an opportunity to interact with informants; hence offer distinct advantage for targeted insightful perspective of informants. Parallel with this, one of the most important issues with respect to interviews is the selection of the informant (Johnson, 1990) as the informant's knowledge of the issue and recall of same has important bearing on the information relayed. For this study, informants were selected (and re-selected as appropriate) from pools of personnel who are thought to have been well informed about the issue under discussion. Such pool includes the Authority's hierarchy in control (involved in) of the processes. Particularly, interviews are conducted with 'owners' of the major processes (see Table 4:2 below).

A semi-structured (focused) interview where the interviewer comes up with probing questions to guide the interviewing process is adopted. The semi-structuring of the interview was needed to guide the interview within the study protocol and to supplement the information gained from the documents and archives. In the interview processes, key probing issues are picked from the document study and the concepts and 'standard practices' addressed in the literature review. The interview thus was intended to confirm/discard or further elaborate on the issues identified from the document studies or fill the gaps between the concepts and practices identified in the literature review but found lacking in the document analysis.

Interviews, especially face-to-face interviews, are said to be susceptible to an interviewer bias (where the interviewer's way of behaving influences the way interviewees respond) and response bias (where by respondents do not give the facts or what they know of the construct for different reasons such as by wishing to impress or reflexivity). Thus, to get the 'correct' image of what one tries to achieve, a researcher should try to combat the above biases. In this study, however, given the position and stature of the interviewee (directors and team leaders who deal with many business people, politicians, international institution representatives as part of their works), biases of wishing to impress or being affected by the interviewer are not taken as a serious problem. However, withholding (not revealing) of information, particularly if that reflects on the performance of the interviewee (and the branch or the Authority), is considered a serious

challenge. To combat these challenge, cross referencing with the findings from document reviews and other interview outputs is conducted.

Table 4:2 below presents the major documents taken as data source, along with the major phases for which they are used. The table also presents the interviews conducted and the major purposes of the interviews.

**Table 4: 2 Summary of major data sources for the study**

Item	Data source	Description
General (Project life cycle and ERA's organization)	ERA's BPR study report [ERA's Project Delivery Process Protocol]	Presents the then (pre-BPR) 'As-Is' processes of project delivery and governance as well as the 'To-Be' project processes and governance. The documents provide the Authority's Process Protocol for project delivery as well as the Authority's prescribed 'Organization Structure' along with staffing requirements and job descriptions. The current ERA organization structure and project delivery approaches are being modified to suite the 'To-Be' prescriptions of the Protocol;
	ERA's Quality Manuals	The Quality Manuals of the Authority (2012) present the Authority's approach to the management of its Project Delivery Processes;
	Other evaluations	External evaluations of selected projects by Construction Sector Transparency Initiative (for different projects) and World Bank (for the Bank Sponsored IPL 2 projects) are used as source documents. In addition, other academic studies (referenced at the sections) in the area are used as sources of data and information;
	Interviews (various)	Interviews conducted with Regional Directors and Planning and Programming Team Leaders.
	RSDP documents and evaluations reports	RSDP documents present the general performance criteria adopted for the sector development by the Authority; The RSDP evaluation reports present the performance of both the RSDP period and the reporting period (often annual) performance of the sector;
Project performance criteria	Project development and procurement documents	Project development and procurement documents present the specific project's performance requirements by defining the scope of the projects, quality requirements and duration of the works contract implementation;
	Service and works contracts	<ul style="list-style-type: none"> <li>➤ The project service contracts specify the performance requirements of the service supplier in terms of scope and quality of service, duration of the service and the service fees;</li> <li>➤ Project implementation contracts present the implementation stage performance criteria by setting the cost of the works contract;</li> </ul>
	Project performance (progress) evaluation reports	The project performance reports present the evaluation of performance and hence are used to check if evaluation is done according to set criteria as well as identify for causes of deviations;
Project performance criteria	Interviews	With Regional Directorates ('owners' of project development and project implementation core processes) to identify the major performance criteria adopted for each phase (and/or corroborate with those identified from the service and works contracts) and check the implementations;
	Road network master plan	With Performance Evaluation Team leader to explicate more data on the contents and rigours of the performance evaluations conducted by the Team;
Planning	Road network master plan	With Internal Audit Directorate and Quality Assurance Directorate to check the restructuring of the governance of the processes and the creation of relevant 'check-and- balance' as stipulated in the Authority's Protocol.
	ERA's current master plan development contract (ToR)	ERA's road network master plan study (2002) <sup>51</sup> is used as the major source of data for the Authority's road network master plan. The processes and governance systems adopted (as reported in the master plan reports) in producing same are used as major data source of the network development process;
		ERA's current contract with Kyong Dong for master plan development is used as a data source how the Authority develops its requirements, selects suppliers and administers the network development process;

<sup>51</sup> A reference is also made to the Ministry of Transport's COWI-GOPA produced transport master plan (2008).

	RSDP documents; Annual Investment Plans RSDP evaluations (ERA)	For programming, the ERA sequentially develops time tailored Road Sector Development Programme (RSDP) documents; currently into its fourth generation (RSDP/IV). These documents, along with Annual Investment Plans, are used as the main source of information for programmes. In addition, the Authority's multiple (annual) evaluations of the RSDPs are referred for sector development performance evaluations;
	Interviews	With Planning and Programming Team Leader (multiple times) to: <ul style="list-style-type: none"> <li>➢ Identify (cross check with the identified) the major processes adopted;</li> <li>➢ Identify the major challenges of the processes;</li> </ul>
	Federal procurement laws, regulations and directives	With Budgeting Team Leader to check how projects are budgeted for and implications of project performances.
	ERA's procurement manuals	The federal procurement laws, regulations and directives give the procurement requirements of public procurements;
Project development core process	Design [project development] service contracts	The ERA's procurement manuals present the Authority's procedures and standards for procurement of services and works;
	Project development reports (various)	The contract presents the requirements, including the TOR <sup>52</sup> as well as the rights and obligations of each party, for the project development;
	Design contract progress reports	These reports present the output of the product-oriented processes in the form of inception report, route selection report, design standard selection report, feasibility study report, environmental impact assessment report, material and site investigation report, engineering design report, tender document, consultancy completion report. These documents are reviewed to check compatibility of outputs to requirements (ToR);
	Interviews	Presents the evaluation of the progress of the project development processes as well as the major issues that are faced during the development stage;
		With Procurement Directorate Team Leaders: <ul style="list-style-type: none"> <li>➢ To check compatibility of procurement processes with manuals and directives;</li> <li>➢ Identify major challenges of the process;</li> </ul> With Regional Directors and Team Leaders ('owners' of the project development) to: <ul style="list-style-type: none"> <li>➢ Check compatibility of processes (protocol, requirements in service contract) with actual implementation;</li> <li>➢ Identify major challenges and problems of the project development processes;</li> <li>➢ Identify the Authority's plans and responses to counteract for the identified problems.</li> </ul>
Project implementation core process	Works and (supervision) service contracts	The supervision contracts stipulate the requirements for the contract administration of the works by the supervision consultant. The works contract stipulates the scope and requirements of the works. Multiple contracts based on both the FIDIC and PPA general conditions are reviewed;
	Contract administration manual	Gives the Authority's recommended approach, procedures, and standards for the management of the contracts.
	Project progress reports	Present the status of the project, performance evaluations as compared to planned (contract) values, major issues and challenges faced;
	Interviews	With Regional Directors and Team Leaders ('owners' of project implementation) to: <ul style="list-style-type: none"> <li>➢ Check compatibility of processes (protocol, requirements in contracts) with actual implementation;</li> <li>➢ Identify major challenges and problems of the project development processes;</li> <li>➢ Identify the Authority's approaches and responses to counteract for the identified problems.</li> </ul>

<sup>52</sup> While adapted to individual projects at some sections, the ERA generally uses standardized TOR that is revised occasionally. The Authority's two recent TORs (those used before and after 2012) are used as reference documents.

#### 4.4 Analysis and interpretation techniques

The study used documents and interviews as its main data source. The process of document analysis as a data source generally calls for elements of content analysis and thematic analysis (Bowen, 2009). Content analysis is defined as ‘the process of organizing information into categories related to the central questions of the research’ (Bowen, 2009:32) while thematic analysis can be defined as a form of pattern recognition within the data, with emerging themes becoming the categories for analysis (Fereday & Muir-Cochrane, 2006).

In this study, the analysis used the conceptual framework developed in chapter two and the concepts and ‘international practices’ identified in chapter three as its main theme of categorization of data and analysis. Performance, processes, structure (organization) and context are used as the main theme of categorization that defined the main topics of the analysis section. To curb for the potential problems associated with paradox of categorization<sup>53</sup>, as argued by Bulmer (1979), the concepts that are used in categorization are iteratively modified based on the observations (document analysis and interviews) made and the emerging concepts.

Miles and Huberman (1994) identify two major types of within case analysis and display of qualitative data. They are ‘exploring and describing’ that presents the description of (after exploring) the phenomena under study and ‘explaining and prescribing’ that presents explanations as to why events happen the way they happen and prescribe potential adjustments to the way phenomena are implemented. Parallel with this categorization, this study first presents description of the practices of the management of the construction processes and the challenges in managing them. Then, the study, based on ‘best practices’ and recommendations in the literature, seeks for explanations for the identified ‘poor’ performances and prescriptions to improve them.

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<sup>53</sup> The paradox of categorization is that, ‘observation contaminated by thought yields circular tests; observation uncontaminated by thought yields no tests at all (Scheffler, 1967:13).

**i. Exploration and description of the Authority's practices**

As presented in the research objectives, one of the objectives of the study has been to explore the practice of the management of the construction processes in the Ethiopian construction industry. This objective is narrowed to exploring and description of ERA's processes (the case projects) and their governance as practiced by the Authority. Content analysis of the documents noted above was done to key concepts and practices. The analysis was guided (framed) by the conceptual framework developed in chapter two as well as the project management concepts and practices identified in chapter three. Therefore, the description is displayed in conceptually ordered manner (Miles and Huberman, 1994).

From the document analysis and interviews, the core processes the Authority employs in project delivery are identified. Then, each core process was scrutinized separately for the detailed exploration of the practice by the Authority. Concepts and practices identified from the document analysis, which were further enriched through the interviews, were discussed with key informants for confirmation and in depth exploration of their practice.

IDEF0 modelling technique is employed to map the processes. Hierarchically, ERA's overall project and product management is mapped into 'Infrastructure Delivery and Operation Process'. This overall process is further broken into three core processes and mapped into a lower hierarchy IDEF0. The core processes, in turn, are broken down into sub-processes.

In addition to the process maps, the inputs needed for each sub-process, the control system used by the Authority in executing the processes, the mechanism (refer to section 5.3 for definition) employed in executing the processes and the major outputs of each sub-process are identified from the analysis of the documents and further refined through the interviews conducted. The final process map of the Authority's practices, developed into IDEF0 process map, was presented to selected informants with the aim of soliciting their reactions on whether the map developed properly reflected the Authority's practices. The models were further refined based on the discussions

**ii. Explanation and prescription**

In addition to exploring and describing the management of projects, the study aimed to identify major challenges to performance and prescribe ways of improving same. This needed an explanatory analysis to identify factors that affect performance and make predictions of possible improvements.

The study used the documents (project progress reports, project evaluation (formal evaluation reports after project completion) reports, programme evaluation reports and previous studies) as its main source of data to identify level of performance and as a starting point for possible causes of the identified low level of performance. Then further identification and elaboration on major causes of low level of project performance was conducted through interviews with the Authority's personnel involved in project delivery.

As its starting point, the study used, Key Performance Indicators identified from the literature as success criteria. This is further particularized to ERA's case through the review of the various documents that deal with project performance and interviews. Similarly, Critical Success (Failure) Factors identified in the literature are used as a starting point of factors that affect project performance. These are further modified using the various progress reports and project evaluations that typically highlight the major factors that are affecting performances in the Authority's projects. The critical factors that affected project/product performances were thematically categorized under processes, [resources], governance, and environment/context - the building blocks of the conceptual framework.

The factors identified are then mapped into a causal network while thematically being categorized under the major blocks of the conceptual framework of the study. Causal network diagrams are prepared for each of the three major phases of the project delivery life cycle. The causal network developed is used as a framework of discussion with the interviewee to both identify further major factors that are not incorporated and modify interrelationships. However, only causal relationships between variables are established without concentrating on the degree of relationship (influence) or even indicating whether the relationship is a reinforcing one or a

negating one. In addition, for the sake of brevity, factors were summarized into fewer groups under a theme. The causal network diagrams prepared were presented to key informants for further discussion. The diagrams were further refined based on the discussions.

The prescriptions for possible ways of improving the current performance are predominately done through comparison of the Authority's practices with international 'accepted' practices and theoretical justifications. When possible (and necessary), by taking better practices in developing countries (and international institutions' practices in developing countries), the study tried to make the prescriptions stereotyped to a comparable challenge and conditions the Ethiopian construction industry is facing.

#### **4.5 Measures to ascertain research quality**

One of the key claims of research is that it is more believable than common everyday observations. Indeed one of the major characteristics of knowledge (science) itself is the notion that science is derived from facts. In this regard, Chalmers (1999) notes that the 'facts' science is claimed to be based on are 'the world that can be directly established by a careful, unprejudiced use of the sense' (*ibid*: 1). Science is therefore based from what can be heard, seen, touched, etc. and if the reasoning employed to establish the laws and theories from the facts is sound, the scientific knowledge so established can be argued to be secured and objective ( i.e. the positivist view of knowledge). In this light of science, the major issues of concern will be thus:

1. The nature of facts, which, as discussed above, could be view to exist independent of the scientist who observes it or the construction of the observer. In this regard, the different ontological views would lead to different meaning of what a 'fact' is;
2. The mechanisms how scientists have access to the 'facts'. Observation of 'facts' using the human sense has various fallibilities. Firstly, the object observed through the human sense and the human brain's interpretation of it may not be same - based on various things. For example a scientist's observation of 'facts' is influenced by his/her accepted framework and previous theories in the area. Secondly, there could be gaps and mis-representations in

expressing of ‘facts’ in human language. In addition, the extent of observation itself will be affected by the existing mental model of the observed construct. Therefore, the appropriate characterization of the ‘facts’ using statements and human communication channels is heavily affected by the existing mental framework of the observer;

3. How the laws and theories that constitute knowledge are driven from ‘facts’ once they are obtained. Science grows through induction. However, the formulation of theories and laws from observed facts through induction creates problems [the problem of induction (Popper, 1972)]. Science is about establishing causality, about formulating conditional statements that can be tested. The testing of the conditional statements usually involves deductive theory testing often conducted through falsification (Popper, 1972) or at least progressive improvement of the theory, say through Bayesian<sup>54</sup> approach (Chalmers, 1999).

In this regard thus, knowledge development (science itself) is faced with challenges. On the one hand, it has to devise mechanisms for explicating the ‘facts’ that are the basis of knowledge generation and curb such explication processes from observing artefacts which may not be attributes of the phenomenon under observation. Secondly, it has to develop the knowledge in a manner that is derived from the facts. Chalmers (1999) notes that, throughout history, scientists and philosophers of science have been working to come up with mechanisms that satisfy these requirements. However, such an account that provides a general framework of science and scientific methods has not been found. Indeed, submitting on the issue, Chalmers (*ibid*: 247) states that ‘there is no general account of science and scientific method to be had that applies to all sciences at all historical stages in their development.’ Nevertheless, to at least partially back the claim that science is more believable, scientific methods should provide a more defensible case for establishing what is called ‘knowledge’. In the context of a research, this involves critically examining and testing to assure the rigour of research processes and the inferences made. Therefore, the processes of the literature review, methodology selection, the research instrument and design, analysis technique employed and the interpretation and conclusion made have to be critically examined and empirically or logically constructed.

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<sup>54</sup> The approach tries to improve the probability of a new theory better explaining things than an old theory.

The measures of quality of research are often tied to the epistemological stand point of the research set up. However, generally, the major quality assurance criteria used in providing a defensible knowledge are validity (with variations of construct, internal and external validity), and reliability<sup>55</sup> (Cook and Campbell, 1979; Kidder and Judd, 1986; Seale, 1999). In addition, the processes to be followed to satisfy the quality assurance criteria and the extent of adherence and rigour required are dependent on the epistemological stand point of the research. For example, as noted above, this research inclines to the post-positivist epistemological paradigm that presupposes the existence of reality independent of inquirer but appreciates the fallibility of the inquiry process. In the positivist and post-positivist context, the literature, for example Eisenhardt (1989) and Yin (2003) particularly for case study methods and Miles and Huberman (1994) for the analysis of qualitative studies, provide quality assurance techniques to be employed. Some of the rigours to be applied such as the use of theory to guide process, applying justifications for case selection, application of replication logic and stereotyping of generalization contexts, use of triangulation to data collection and theory building are discussed above. Various researchers (for example Cook and Campbell (1979), Eisenhardt (1989), Denzin and Lincoln (1994), Miles and Huberman (1994) and Yin (2003)) have identified the major rigours to be applied in case study research works of this nature. Table 4.3 below presents summary of the major ones along with how these rigours are implemented in this study.

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<sup>55</sup> Construct validity refers to the establishment of the correct operational measures for the construct being studied, i.e the extent to which the research measures/investigates what it claims to measure/investigate. External validity (generalizability) refers to establishing the domain to which the study's finding can be generalized, i.e., the degree to which one research output can be replicated or generalized to other research setting. Internal validity (also known as logical validity) refers to establishing a causal relationship where certain conditions are shown to lead to other conditions, i.e., the degree to which a researcher draws accurate conclusion. Reliability refers to demonstrating that the operation of the study can be repeated with a similar outcome.

**Table 4: 3 Quality assurances as tailored with the case study research approach**

	<b>Major measure of quality/rigor</b>	<b>The study's approach to comply for the rigour requirement</b>
Construct validity	➤ Data triangulation (both source and collection strategy)	The study tried to triangulate data source (different documents and interviewee) and collection strategy by employing document analysis and interviews as its data sources.
	➤ Review of transcripts and draft by peers, key informants, etc.	The summarized outputs (IDEF0 and causal diagram) were reviewed (and commented upon) by key informants. In addition, the whole document was reviewed by a person who has done a PhD thesis on 'Performances for Public Construction Projects in (Least) Developing Countries: Federal Road & Educational Building Projects in Ethiopia' (with ERA's projects as part of the case study).
Internal validity	➤ Present cases systematically (from research question to conclusion and vice versa)	The links between research objective (and questions), research conceptual framework and analysis output were established.
	➤ Explanation of data analysis (clarification of data analysis procedure)	Clarification is established. Content analysis of documents and interviews guided by conceptual framework established and theories and 'accepted' practices is used.
	➤ Conceptual framework (preferably explicitly derived) to be used as basis of research processes;	The study used the conceptual framework established in chapter two to guide the research processes.
	➤ Theory triangulation (different theoretical lenses and bodies of literature used, either as research framework, or as means to interpret findings)	The study heavily relied on other research and international practices as its part of analysis in both identifying critical success factors of projects and ways of improving them.
External validity	➤ Using different analysis techniques	Content analysis along with thematic analysis was used as the major analysis techniques.
	➤ Theory as a basis of generalization	The study used theories and 'accepted best practices' as its basis of generalization.
	➤ Rationale for case study selection	The rationale for selecting the ERA's project delivery is presented.
	➤ Details on case study context	Details of the ERA's project delivery approaches are presented.
Reliability	➤ Comparison with other literature/study	As much as applicable, comparison with the literature (particularly in the explanatory analysis) is conducted.
	➤ Case study protocol (report of how the entire case study was conducted)	A summarized presentation of how the study is conducted is presented in the above section.
	➤ Case study database (database with all available documents, interview transcripts, archival data, etc.)	Database of the documents analyzed and interviews conducted is maintained and can be accessed upon request.
	➤ Maintain chain of evidence	As much as possible, chain of evidences from research question to the conceptualization to the data analysis and conclusions and recommendations made are established.

#### **4.6 Conclusion**

The purpose of this chapter was to present the research methodology adopted for the study. It was intended to critically establish the preferred research along with the adopted methodology, the data collection mechanism to be adopted, the data sources to be used for the study and analysis techniques adopted as well as present the quality assurance techniques employed for the study.

Accordingly, therefore, it has compared and contrasted the various research paradigms and ontological and epistemological schools of thoughts often manifested in the study of construction management and established its arguments for the post positivism and methodological multiplicity the research inclines to. Then, the chapter critically established case study as the best option for the research problem at hand with documents and interviews argued as the best data collection methods. The chapter then presented data analysis techniques employed both for the descriptive study part that presents description of ERA's project processes and their management and the analytic part that presents explanatory links between factors that may affect ERA's project performance. Finally, the chapter presented the various quality control techniques it employed to assure the rigor demands of the study.

The subsequent chapter presents the discussions of the findings of the study. Congruent to the analysis techniques adopted, each section is presented with first the descriptive part of the study that presents ERA's project processes and its approach to their management which is followed by analysis and comparison of ERA's approaches to recommendations in the literature and other practices.

## 5 ANALYSIS AND DISCUSSION

### 5.1 Introduction

ERA is a project-based organization whose principal business is to oversee the planning and execution of road construction projects and the management of the road asset so built. As defined by Hobday (2000:874) a project-based organization is an organization ‘in which the project is the primary unit for production, organisation, innovation, and competition’. Project-based organizations organize ‘their structures, strategies, and capabilities around the needs of projects, which often cut across conventional industrial and firm boundaries’ (Hobday, 2000:875). In this regard, when it comes to project implementations, most of ERA’s systems, norms and cultures are geared towards management by projects<sup>56</sup>.

As part of the analysis and discussion, the Chapter presents the Authority’s approaches to the management of its project processes. Excluding this introductory section and sections 5.4 and 5.5 that present brief summaries of ERA’s asset management and summary for the Chapter respectively, the Chapter is divided into two major sections. Section 5.2 presents the organization structure, project phases and performance criteria adopted by the Authority. In each sub-sections, first descriptions of the Authority’s practices are presented. Then, based on theories and ‘international practices’, suitability of the Authority’s practices for improved performance are discussed. Section 5.3 presents the Authority’s core project delivery processes and their management. Each core process is further broken down into sub-processes. Under each sub-section, descriptions of ERA’s processes and the governance systems adopted is presented while also key problems of ERA’s practices as compared to ‘international practices’ are identified and discussed. Finally, under each core process, the key factors that affect the performance of each core process are presented.

For the sake of stereotyping, the analysis is framed around the basic pillars used in the conceptualization presented in chapter two. Figure 5.1 below presents schematics of the sub-topics addressed in this chapter.

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<sup>56</sup> In the Authority’s endeavors, projects are the basic units of focus.

**5.0 Analysis and Discussion  
(The management of ERA's project processes)**

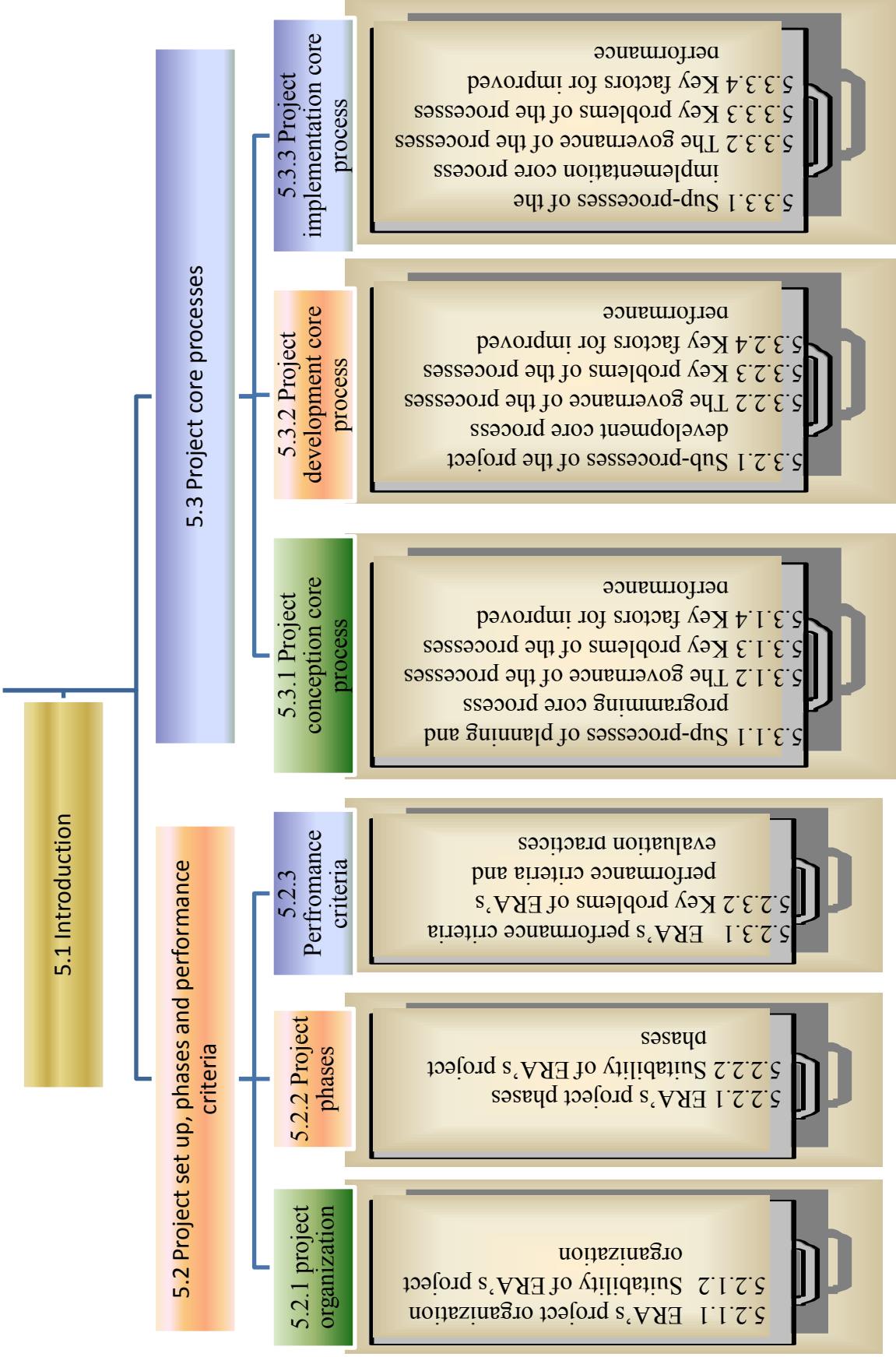


Figure 5: 1 Topic flow for chapter five

## **5.2 ERA's organization structure, project phases and performance criteria**

### **5.2.1 [Project] organization structure**

#### **5.2.1.1 Description of ERA's project structure**

Since its establishment in 1951 as the Imperial Highway Authority, the current Ethiopian Roads Authority (ERA) has undergone through various developments and changes often aligned with the ideological views and strategic setups of the different governments that ruled the country since then. Under the current government, for example, the Authority has been re-established numerous times through Proclamations No. 60/1993, No. 80/1997, and currently, under Regulation 247/2011. Regulation 247/2011, along with Regulation 248/2011, has split the old ERA<sup>57</sup> into two entities.

Regulation 247/2011 has re-arranged and aligned ERA to concentrate on the planning for road network, overseeing of the delivery of road projects and the management of the delivered asset while significantly reducing the Authority's involvement is actually executing the product-oriented processes of road asset delivery. Along with and as a consequence of the re-establishment under the new Regulation, the Authority has undergone internal re-arrangements to create a new organizational structure. In addition to 'supporting' directorates to the Director General, the new structure has four Deputy Director Generals (DDGs) of Planning and ICT, Engineering Operations (EO), Asset Management (AM) and Human Resource and Financial Management (HRFM)<sup>58</sup>.

The two DDGs that are directly linked with the planning, execution and management of the project delivery processes are the Planning and ICT and EO. The Planning and ICT DDG is responsible for the planning, execution and management of the project conception phase (see section 5.2.2 below for project phases) as well as the monitoring and evaluation of project performance while the EO DDG is responsible for project development and implementation

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<sup>57</sup> By making the old ERA's Operation Department its core base, Regulation 248/2011 has created a separate autonomous government development entity - Ethiopian Road Construction Corporation (ERCC).

<sup>58</sup> The Organization Structure of the Authority is attached as Annex 5:1

phases. The AM DDG is responsible for the operation phase of the product life cycle of the built asset. In addition to taking care of the built asset after taking over from the EO DDG, the AM DDG provides feedbacks to the Planning and ICT DDG that will be used in conception of new cycle of projects/programmes. For the project delivery processes, the involvement of the HRFM DDG can be said to be of 'support' level as it provides/manages the human resource and facilities for the delivery processes as well as the services related to finances.

Below the DDG level, the Authority's structure is divided into different directorates. With respect to the project delivery processes, the major directorates involved are:

- The Planning and Programming Directorate (PPD) under the Planning and ICT DDG is responsible for road network (project) planning, sector programming, project budgeting as well as the high level monitoring and evaluation of project/programme performance;
- The Engineering Procurement Directorate (EPD) under the EO DDG is responsible for both services and works procurement processes;
- The five Regional Directorates (North, West, South, East and Central), along with the Design- Build Directorate, all under the EO DDG, are responsible for overseeing project development and implementation processes. Assigned based on geographic demarcations (or delivery mechanism adopted in the case of BD Directorate), a given directorate will be required to oversee the project development and/or project implementation core processes;
- Depending on the need, legal input during procurement or during contract management (such as when claims or disputes arise), the Legal Service Directorate may also get direct involvement in the project delivery processes;
- Internal Audit Directorate gets involved in project delivery as part of auditing both technical and financial performance (although currently it predominantly concentrates on financial audits);
- In addition, in terms of structure, the Quality Assurance, Road Inspection and Safety Management Directorate is mandated to assure the quality of road delivery processes and the products they deliver, inspect the performance and safety of roads. However, in terms of practice, as it is, the directorate is ill-staffed<sup>59</sup> to properly discharge its mandates.

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<sup>59</sup> For example, the Directorate is not staffed with Engineers to conduct any technical audit of project/product performances.

Below the directors, the lower level of the Authority's structure<sup>60</sup> is made up of teams lead by team leaders. In relation to project delivery processes, as will be discussed in the subsequent sections with the respective processes, the Road Network Planning Team, the Budget Management Team and the Monitoring and Evaluation Team under the Planning and Programming Directorate are responsible for network planning (and programming), budget planning and management and project performance and progress monitoring and evaluation respectively. The multiple Engineering Procurement Teams plan and execute procurement of services and works. During the project development and implementation phases, the Design and Implementation Team of the different Regional Directorates and the Design-Build Teams of the Design-Build Directorate manage and monitor the project development and project implementation processes.

#### **5.2.1.2 Suitability of ERA's project structure**

Structure wise, at a corporate level, ERA is set up as a functional organization whose structure is divided functionally as ICT and Planning, Engineering Operations, Asset Management and Human Resource and Financial Management. At project level, the Authority uses a functionally leaning organization structure with the planning and programming of projects handled by the PPD, the procurements for projects (of services and works) handled by the EPD and the contract administration of project development as well as implementation handled by the different Regional (or Design-Build) Directorates. In this regard, as noted in chapter three, although studies that explore better organization structures to manage projects are slack, a study by Larson and Gobeli (1987) found out that the strong (project) matrix and the projectized structures were rated as the most effective in managing projects. However, in ERA's context, given that the

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<sup>60</sup> Along with the structural set up, the Authority's organization structure is associated with manning/staffing requirements of each level of the organization. In addition, as also presented in the 'team charter' and 'jobs description' portions of the Authority's BPR study (ERA, 2009), the structure is accompanied by job descriptions of each position as well as the experience, qualification and attributes needed for the positions. Nevertheless, although this study did not explore the composition, capacity and competency of ERA's existing teams, as observed by the World Bank APL2 projects evaluation team (World Bank, 2012), the Authority struggles to attract /retain competent and experienced personnel as devised in the charter.

Authority manages many projects<sup>61</sup> at a time, the projectized structure could create proliferation of such project structures which may lead to inefficiencies and significant transaction costs.

Further, with the notion of project manager entrenched to mean the manager of the resource base on site (for the implementation phase), the Authority's system does not have a single project manager (or the functions thereto<sup>62</sup>) to effectively plan, organize, lead and control the project from inception through to completion (Love *et al.*, 1998). Nevertheless, particularly given that the Authority 1) uses fragmented approaches to project delivery with most of the issues under a given phase handled at a given directorate; 2) does not have an effective system that facilitates the different resource base professionals (particularly for design) to integrate, cooperate and communicate, a functional structure without assigned project manager to oversee the overall project life cycle<sup>63</sup> may create inefficiency and lack of accountability.

A project manager, in addition to steering the project from its inception to completion, would help bridge the gaps between fragmented parties and sequential processes, acts as a 'single point of responsibility' and becomes hub of communication. The literature (Turner, 2009; PMI, 2008) argue that while operations are normally organized vertically along the structure, projects are better organized (if a projectized organization is not used) horizontally along structures so that they tap into the expertise in the vertical structure on the one hand and bridge the demarcation of the structure and the interfaces on the other. In this context, Morris (1983) argues that managing project inter- phases and integrating the various parties involved in project delivery is one critical success factor that affects project performance. In this light, therefore, it can be argued that a matrix organization that uses a project manager to oversee the whole phase of the project life cycle, with the actual expertise being either in the Authority's functional organization or that of the resource base, is the better option for the Authority. While the functional organization of the Authority will help concentrate (create home for) expertise and avoids the need to duplicate

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<sup>61</sup> For example, the Authority allocated budget for not less than 123 road construction projects (excluding budgets for advance payments) and not less than 35 design projects for the 2013/14 (2006 E C) Fiscal Year.

<sup>62</sup> However, for project implementation phase, the supervising consultant takes many of the attributes of the project manager on site.

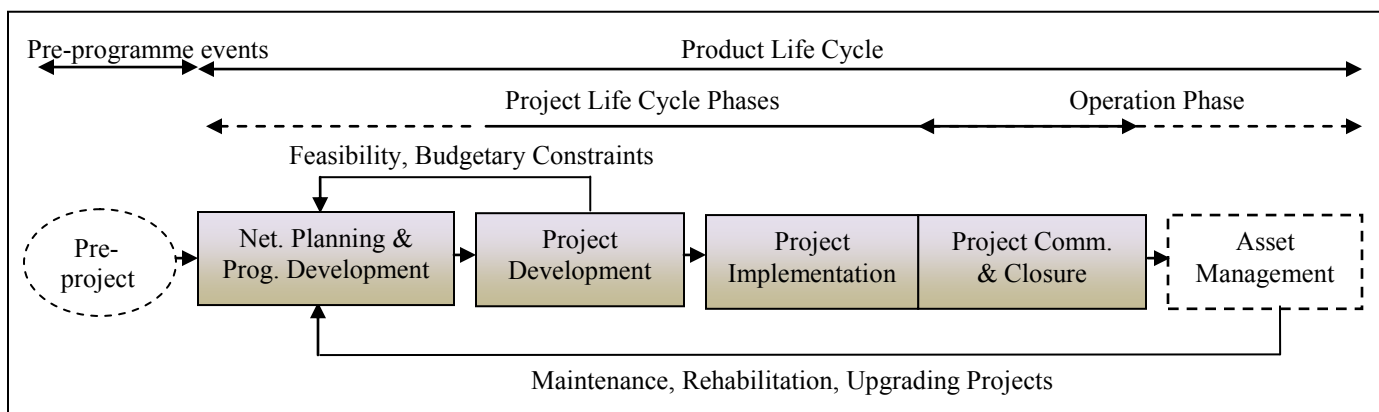
<sup>63</sup> The Authority assigns a 'counterpart (project) engineer' to act as the focal point of a given project. However, as the 'counterpart engineer' is only assigned to oversee the separate faces, and different counterparts could be assigned for the different phases, the system cannot be said to be equivalent to assigning a project manager to oversee the overall project life cycle phases.

structure for the many project the Authority engages in, assigning a project manager to ‘push projects’ horizontally along the structural/organizational boundaries and phases could help improve both performance and accountability.

## 5.2.2 Project/product phases

### 5.2.2.1 ERA’s project phases

As discussed in section 3.3 of chapter three, one of the major features of project phases is that they are generally characterized by different mission, technology, processes involved and these differences create/demand their own particular different characteristics of work, competence and management style (Morris, 1993; Wideman, 2004; PMI, 2008; Turner, 2009). In this light, ERA’s project delivery approach can be characterized by distinct phases. As presented in Figure 5.2 below, ERA’s overall infrastructure delivery and management endeavor can be divided into pre-project phase, the project life cycle phase and the management and operation of the built asset phase. The project life cycle phase can further be divided into four sub-phases of network planning and programme development, project development, project implementation and project commissioning and contract closure<sup>64</sup>.



**Figure 5: 2 ERA’s product life cycle (the DBB delivery approach)**

<sup>64</sup> Nevertheless, while there is a clear demarcation between planning and programming, project development and project implementation phases, there is no such clear demarcation of the implementation and project closure phases. However, the two phases have a different mission (to implement project and to close the contract respectively) and often the project closure phase overlaps with the product operation phase. Therefore, the two can be argued to comprise two different phases with distinct mission and setup.

In general, the Authority's phases resemble the project/product life cycle discussed in section 3.3.1. Nevertheless, there are some key issues that distinguished the Authority's phases from the conventional phases of product/project life cycle presented in the literature:

Firstly, given that the Authority sets road sector development strategies and objectives, its project delivery approaches are subsumed by its network and programme development. One consequence of the Authority's cascading programme to project strategy is that, particularly during the early phases (project conception), the individual project becomes invisible as strategies, objectives, controlling mechanisms, etc., are set for the overall network and programme rather than for the individual project. As a result of this, the conception of the individual project is undertaken under the network planning and programming phase with the individual project, as an entity, only coming to the fore and becoming dominantly visible after individual budget is assigned for it and incorporated into the Authority's annual plan. This is also a strong indication that the project will be picked for project development<sup>65</sup>.

Secondly, in terms of disposal, as often the assets built are kept under rehabilitation/upgrading and are aimed to deliver operation for a long time, the Authority's product life cycle does not include the disposing phase. The following section presents a brief summary of each phase as practiced by the Authority.

#### **i. The pre-programme/project phase**

The country's socio - politico - economic policy priorities and strategies influence the objectives and priorities of the road sector investment. These pre-project factors (environmental stimuli) provide the reasons for the network planning and programme development the Authority embarks upon and at times force the Authority to override its existing plans and programmes<sup>66</sup>.

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<sup>65</sup> Even if a given project is conceived (say through the fact that a given link is incorporated into the national network master plan), due to change in strategy, priority, etc., it may take long (or even get aborted) before it germinates into the project development sub-phase.

<sup>66</sup>Requests from federal government, regional governments', the private investor's or general public's urgent needs (such as, for example, the need to access the sugar factories recently built), the Authority's own assessment of

The Authority's monitoring of the performance of existing network as part of its asset management processes (problems of the existing network); desired objectives for the road network (such as improved accessed, mobility, reduced vehicle operating cost, travel time, accident), the states' priorities, request from local authorities, (see section 5.3.1 below for further detail) both inform and influence the planning and programming phase (and hence thereby the project conception).

## **ii. The project life cycle phases**

Under normal circumstances (where for example other factors do not force the Authority to bypass its network plans and programmes), the projects the Authority implement pass through four major phases:

- i. The project planning and programming phase involves the development of pools of potential projects for implementation and is generally divided into two sub-phases. The network development sub-phase involves developing a long term plan (for example 23 years for the recently in use Sheladia developed network master plan). The programme development sub-phase, on the other hand, involves the development of a medium term sector development programme (the RSDPs) that involves the packaging of the projects selected and prioritized in the previous (planning) sub-phase (and those added) and the development of a road sector development programme tailored to available/expected funding;
- ii. Project development phase, which could be executed sequentially or in parallel with the implementation phase depending on the delivery strategy adopted, involves the development of the project artefacts and compiling it in drawings, specifications, design reports and different parts of contract documents. In the Design-Bid-Build delivery approach, the phase can be divided into three sub-phases of:
  - The design service procurement sub-phase deals with procurement of design service providers for project design. The sub-phase ends with the handing over of the design service contract to the responsible Regional Director;

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urgent needs (particularly through the District Engineering Directorates), etc. may compel the Authority to embark on projects for which it did not consider in its plans/programmes.

- The design sub-phase involves the development of the design artefact. It is normally divided into two stages. The preliminary design stage involves feasibility study to explore the possible benefits and constraints of the project as well as possible ways of acquiring the project's objectives, or if so the study indicates, send back the project to future programming. The stage, which involves Environmental Impact Assessment (EIA), Social Impact Assessment (SIA), economic appraisal along with preliminary design that gives the technical assessment, explores and compares different alternatives to arrive at the project that best fits to the project's objectives and constraints. The detailed design (development) stage develops on the findings of feasibility study and involves detailed analysis and development of the project characteristics. The sub-phase's major output, along with the various reports, is the works contract tender document which is meant to govern the implementation phase of the project;
  - The procurement of supervision consultancy service and works sub-phase involves procurement for supervision consultants and works contractors. The sub-phase takes the output of the design sub-phase and ends at contract signing with the supervision consultant and works contractor and handing over of the document to the responsible Regional Directorate.
- iii. The implementation phase, along with mobilization of resources, involves all the processes and activities that interpret the planning and designing outputs and changes them into physical structure which is used to achieve the objective the project is incepted for. As its current practice, the Authority also conducts a related sub-process of right-of-way obstruction removal under the implementation phase;
- iv. The project commissioning and closure phase involves the commissioning of the project's product under operation through defect liability period<sup>67</sup> and contract closure. The phase formally hands over the product, along with associated documents, to the ERA and closes its contracts with the resource base.

In terms of deliverables and transition between phases, one of the major output of the planning and programming phase, the project development initiation sheet, is handed over to the Engineering Procurement Directorate (EPD). The EPD uses this document as an input to

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<sup>67</sup> The ERA's contract, at times, allows for partial handover of products and hence the commissioning may not always be effected near the completion of the contract.

commence the project development phase through the procurement of design services. The design service contract document, which is executed under the auspice of the EPD, is handed over to the responsible Regional Directorate for the implementation of the service contract. Then, the major output of the feasibility and detailed design sub- phase, the tender document for works, is handed over back to the EPD. The EPD conducts the works procurement, along with procurement for consultancy service for supervision of the project, and hands over the contract documents to the responsible Regional Directorate. The Regional Directorate oversees the implementation phase and hands over the product (road/bridge asset) to the Asset Management DGG.

During the delivery processes, the Authority's projects go through two major 'gate controls'. Firstly, the commissioning of projects for development demands the incorporation of the project into the annual plan by the Authority which, at least implicitly<sup>68</sup>, demands the revision, optimization and prioritization at different levels of the government hierarchy. The second gate review and the associated 'go/no go' decision is undertaken at the transition from feasibility study and preliminary design to the detailed engineering design sub-phase<sup>69</sup>. At this stage, if the feasibility study indicates that the project is not feasible, mainly in terms of the economic appraisal, the project is returned to the pools of projects under the programme for future considerations or scope revisions. Related with this, while reviews are conducted at the development-implementation and project closure-asset management interfaces, the reviews are meant to serve as checks for completeness of requirements (for the development/implementation interface) or conformance to requirements and defect corrections (project closure/asset management interface) rather than serve as gate control point.

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<sup>68</sup>The Government, through the hierarchies of the MoFED and the Council of Ministers, concentrate in optimizing and prioritizing sectors rather than individual projects.

<sup>69</sup> The ERA can only construct projects if their feasibility study indicates that they are economically feasible based on the MoFED established economic rate of return (discount rate) for public investment (currently at 10.23).

### iii. The operation life cycle

ERA considers maintenance (periodic), rehabilitation or upgrading of roads as projects that need to pass through the phases and rigors described for projects as above<sup>70</sup>. That being the case thus, the asset management (operation) phase of the product life cycle involves the managing of the road/bridge asset and the monitoring of its performance. The major tasks that are accomplished under this phase are road asset preservation (such as routine maintenance), road asset operation, and road asset performance feedback. The road asset preservation incorporates the planning and implementation of asset preservation schemes in which the road condition assessment, gap identification and finally determination of treatment and intervention are planned and implemented. The road asset operations works are the activities carried out to oversee the smooth operation of the asset and are carried out in parallel with the rest of the asset management activities. The monitoring performance involves the monitoring of the assets performance and deterioration. The output of the process serves as one input into the inception of maintenance, rehabilitation and/or upgrading<sup>71</sup> of projects.

#### 5.2.2.2 Suitability of ERA's project phases

At a general level, ERA follows a project cycle that is comparable to 'common practices' as presented by the literature (Turner, 2009; Wideman, 2004; Morris, 1993, for example). In this regard, the Authority's project life cycle presented above closely parallels with the one presented in section 3.3.

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<sup>70</sup> Although periodic maintenances may not need detailed design of the development phase.

<sup>71</sup> The ERA classifies projects into construction (new), rehabilitation, upgrading and maintenance projects. Construction (new) projects involve the construction of new asset along routes where there are no such assets before. Rehabilitation projects are projects rebuilt on an existing route with the new project having the same standard as that of the existing one. Upgrading involves the upgrading of the existing road to a new standard. In terms of maintenance, the ERA Specification (2003) classifies maintenance projects as routine and periodic maintenances. Routine maintenance involves light and unscheduled maintenances that demands monitoring of the road asset and maintenance for defects as they are witnessed (or affect performance beyond specified level). Periodic maintenance, on the other hand, involves relatively heavy maintenance that can be periodically planned and executed. While routine maintenances are conducted routinely as part of the asset preservation scheme, the Authority considers periodic maintenances as projects.

In the DBB project delivery approach, the Authority executes project phases in well demarcated sequential order. In addition, the different directorates handle the different phases in a fragmented way with deliverables from one phase handed over to the next phase (and the directorate that handles it) through the ‘over the walls’ type of arrangement.

However, the sequential and fragmented approach to project delivery is argued to affect project performance (for example, Egan, 1998) as it does not encourage the integration, coordination and communication between participants as well as optimization over the whole life cycle. In addition, Love *et al.* (1998) argue that the practice inhibits the scope for creativity and innovation as functional disciplines often operate independently. The sequential and fragmented approach is characterized by a habit of making decisions without considering their impact on other disciplines and the creation of artificial ‘walls’ between disciplines over which the project is thrown once one functional discipline has completed its respective tasks (Evbuomwan and Anumba, 1998).

The frequently presented approach to counteract this problem is the use of concurrent engineering and fostering integration, cooperation and communication between the key parties involved (see section 5.3.2 for more). The principles underpinning concurrent engineering involve the integration of planning, design, and construction processes and maximizing concurrency and collaboration in working practices (Jaafari and Manivong, 1999; Evbuomwan and Anumba, 1998). The need for the integrative and collaborative design of the projects is particularly emphasized for project success (Austin *et al.*, 2007).

However, the ERA’s DBB project delivery approach, although puts latent attempts for integration<sup>72</sup>, does not incorporate a designed mechanism that demands the various professionals regularly communicate and cooperate in an effort to provide a collaborative output. In addition, the approach lacks any clear integration of the planning, design and implementation processes and a devised approach that manages the whole project as a single entity.

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<sup>72</sup> For example, the ERA’s design services ToRs stipulate the design team leader to act as the hub of communication.

### 5.2.3 Project performance criteria

From the literature, the issues and difficulties associated with project success criteria and the measurement of same are presented in section 3.2 of chapter three. As discussed there, with the criteria adopted often dependent on various factors, there are no universally accepted criteria for success. On the other hand, however, both in view of making corrective measures for the specific project at hand and developing knowledge base for future use, it is important to monitor and evaluate project performance as well as identify critical success/failure factors. This section addresses ERA's adopted project and programme performance criteria. The section also discusses the key drawbacks in ERA's project performance criteria and evaluation practices.

#### 5.2.3.1 ERA's performance criteria

As part of its performance monitoring and evaluation approach, the ERA uses a two tier performance criteria that can be divided to programme performance and project performance. At a programme level, with plans within a given time (RSDP periods, or annual)) taken as the control variable against which performances are evaluated, the Authority uses the following performance criteria (ERA, 2013; 2011):

1. Performance evaluation in comparison to the RSDP's plans expressed in terms of physical (eg. length of construction/intervention) and financial accomplishment;
2. Network improvements expressed in terms of riding quality, accessibility (including rural accessibility and access to key corridors), mobility<sup>73</sup>, vehicle operating cost, impact on poverty as well as income distribution<sup>74</sup>;

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<sup>73</sup> Riding quality is often expressed using the International Roughness Index (IRI) and reported as 'good', 'fair' and 'poor' road (World Bank, 2004). Accessibility (say mean distance accessibility –inverse of road density) is expressed as the ratio of a given area to the length of road within that area. Rural Accessibility Index (used as a target of the MDGs) gives the proportion of population that lives within 2kms of all season motorized transport. Mobility refers to the cumulative distance vehicles travel (vehicle kilo meter) during a given period (say one year) and is a measure of both performance of infrastructure and increase in traffic. Mobility index, on the other hand, is often presented as the ratio of travel time by the physical route (speed determined by the condition) between an origin and destination and the travel time by the air distance at desired (design) speed. It is taken as the measure of the efficiency of the road network.

<sup>74</sup> The Authority considers environment and safety (as part of its EIA and SIA assessments) as major criteria in its project development processes (see section 5.3.2), and reports measures taken to cater for same in its programme evaluation (although not in explicit indications of the improvements achieved). Nevertheless, its Master Plan does not incorporate these criteria as its control.

3. Capacity building in terms of domestic construction sector interventions through local contracting (as compared to services and works rendered by international firms), increasing the number of local firms by facilitating the entrance of local contracting and consultancy firms into the road construction sector, training of personnel and providing other services (such as facilitating bulk purchasing, assisting in machinery maintenance centers, etc.

The Authority's programme level performance criteria can generally be argued to be in line with other international performance criteria such as the UNECA's/World Bank's<sup>75</sup> proposed 'Road Sector Performance Indicators for African Countries' (UNECA/WB, 1999). In addition, it can be argued that, in general, the Authority uses the achievement of the objectives the programmes are intended for (see below for programme objectives) as the major performance criteria.

At a project level, analysis of both the Authority's requirements (as stipulated in its contract document) and the subsequent performance/progress evaluation reports indicate that, the Authority uses the conventional time-cost-scope (quality) as its overall project performance evaluation criteria. In terms of monitoring and measurement of the criteria, in general, while cost and time have a consistent unit of measurement, for scope and quality of performance, the Authority adopts process and product-focused performance criteria for the different phases of the project. In this regard, therefore, in addition to the project (phases) cost and time of delivery, the other performance criteria (which can generally be aggregated as quality needs) for each phase are often stipulated in (or can be implied from) the contract document the Authority enters with the delivering resource base. The Authority uses these set criteria (in the contract) to evaluate performance during implementation of the contract. Although amendments to the contract can be initiated if necessary, ERA uses contract values/requirements as the base line against which performance is evaluated.

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<sup>75</sup> The UNECA/WB proposed performance criteria for African countries are accessibility, mobility, safety, environment, equity and programme related issues of programme delivery, programme development and programme performance. For comparison, the OECD (OECD, 1997), uses a more specific and detailed criteria that includes average road user costs, level of satisfaction regarding travel time and its reliability and quality of road-user information, protected road-user risk, unprotected road-user risk, environmental policy/programmes, processes in place for market research and customer feedback, long-term programmes, allocation of resources to road infrastructure, quality management/audit programmes, forecast values of road costs vs actual costs, overhead percentage, value of assets, roughness, state of road bridges, satisfaction with road system.

### 5.2.3.2 Key issues of ERA's performance criteria and evaluation practices

#### i. Suitability of the performance evaluation criteria set

The setting of performance evaluation criteria has two dimensions: the factors that indicate performance (often termed key performance indicators) and the values against which these performance indicators are vetted (for example termed planned value in earned value analysis). Therefore, analysis of suitability of performance evaluation should look into both dimensions.

##### a. Key performance indicators adopted

At the programme level, as noted above, the Authority uses performance indicators that are aligned to both the programme's (network development's) objectives and international practices. Nevertheless, on the Authority's performance evaluation reports, one notable omission, both from the UNECA/WB recommendation and its programme objectives (see for example the objectives of the master plan) has been evaluation on equitable distribution of networks until it was incorporated in the RSDP IV document. In addition, some performance indicators can be more qualified to properly reveal what they are intended for<sup>76</sup>.

For the project level performance indicators, as presented in chapter three, from the literature, recent trends appear to have expanded performance indicators over the conventional 'iron triangle' (Chan and Chan, 2004). In this light therefore, it may be advisable for the Authority to incorporate other factors such as functionality, productivity (efficiency) achievements; satisfaction of project team; dispute resolution satisfaction (conflict management, absence of conflict, claim, etc.); educational, social, professional aspects achieved to its project success criteria. The expansion will give the Authority a focused approaches and lessons for improvement.

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<sup>76</sup> For example, the Authority indicates the number and amount of contracts signed (and delivered) by local firms as performance indicators, presumably to indicate assistances to capacity building of the local industry. However, that indicator can be more qualified to indicate how the contracts have helped the local firms improved their capacity by looking into such issues as knowledge accumulated, resources acquired, systems (such as management system) developed, etc. This is particularly important in view of Birnane's (1999) claim that the local firms take projects as a lower price which may have negative impact on the actual capacity building.

b. Planned values against which performance is compared

At a programme level, ERA sets the planned values for its programmes. The planned values, for example, in terms of physical plan (length of different classes of roads to be built, rehabilitated, upgraded or maintained) and associated financial demands are indicated in the RSDP documents. However, while the programmes are set based on prioritization of demands for projects (see project identification in planning and programming below) and projection of average cost of existing projects for the corresponding class of road on the one hand and an aggregation of budget ceiling established by MoFED and forecasting of potential grants and loans on the other, the optimality of the programmes based on the capacity of the Authority (and the industry in general) is questionable. One manifestation of the potential problem in this regard is that there are revisions of plans (Wubishet, 2004 for RSDP - I) and projects spill over to subsequent programmes<sup>77</sup> (ERA's 2002 network master plan, for example).

For project evaluation, in its current cost-time-quality performance criteria, the Authority uses contract values as base (planned) values. Nevertheless, the use of contract requirements as the basis of evaluating performance has one major drawback. The conventional 'iron triangle' project success criteria is founded on the basic principle that the three variables are optimized during planning and implementation (El-Rayes and Kandil, 2005; Eshtehardian, *et al.*, 2008). As a corollary to the optimum planning of the three competing criteria, unless the conditions under which the optimum planning envisaged changes, any improvement on one criteria, during implementation, can only be achieved via compromise on either or both of the other two (i.e. principle of Pareto optimality)<sup>78</sup>. In this light, therefore, the precursor to the cost-time-scope (quality) as project success criteria is that, the criteria are planned and executed optimally.

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<sup>77</sup> Although implementation problems also contribute to the spill over to subsequent RSDP periods. Also inputs used in computing cost of projects in the programmes is flawed thereby creating significant disparity between planned and actual costs.

<sup>78</sup> Indeed the recently issued Performance Audit Manual, Standards and Implementation by the government (MoFED, 2013) takes performance as a measure of economics (acquiring and protecting the right quantity and quality of resources at the right time, at the lowest possible cost), efficiency (maximizing the output from a given level of resource inputs) and effectiveness (ensuring that the output is produced as planned, and/or achieved the desired results) stating that performance auditing, in essence is '[the government] getting adequate values for the money it spends on various programs, projects and activities' (*ibid* : 4).

When seen in this perspective, the Authority's use of [none-optimized] contract values as performance indicators is flawed. As its current practice, the Authority specifies the duration of projects (Wubishet, 2004:235) argues that the durations set are often unrealistic 'urgency driven, politically imposed, ambitious, and with little prior articulations') and the scope/quality performance requirements (often on method-based contract documents) while the market (deprived of the leverages to optimize on time and methodology (in method-based specification)) determines the third (cost) criteria<sup>79</sup>. In addition, if the market fails<sup>80</sup>, the set of criteria will not be optimum at contract, and hence will not be a true gauge of project performance at execution<sup>81</sup>.

In this light, therefore, the Authority may need to look for another reference as its base (planned value) in its performance evaluation. The obvious reference could be, for the implementation phase, the Authority's cost estimation (assuming that it is done in optimization of the three criteria) at appraisal of the projects. Nevertheless, even in this regard, the estimate at the appraisal is found to be seriously flawed (World Bank, 2012) to effectively serve as the optimum base while project times (contract duration) appear to be determined with no thorough project scheduling. Another option would be to use multi-criteria supplier qualification approaches that would enable the resource base (the market) to optimize on the major performance criteria the employer values.

## **ii. The suitability of the project performance evaluation practiced**

In addition to setting project performance requirements that are key indicators of performance and tailored to the project/programme objectives, one key aspect of project performance measurement and evaluation is to devise a system that accurately and consistently measures the

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<sup>79</sup> The Authority currently uses the 'least evaluated bidder' approach to works supplier selection and hence (aside from the option of cancelling tenders) does not have influence on the optimality of the cost component.

<sup>80</sup> For this purpose, any factor that affects the optimality of the three criteria at bidding such as lack of competition in the market, unethical practices such as collusion, low bidding by suppliers for non-economic reasons (such as lack of work) can be taken as 'market failure'.

<sup>81</sup> A good indication to this is that, when ERA contracts out projects in lots (and requirements such as not to award more than one project in a group of projects tendered together make the least-evaluated bidder not always the successful bidder) with no apparent significant differences in scope of work or other constraints, the cost of the contracts of the different lots could be considerably different (Alaba –Arbaminch –Lots I & II, Hargele-Dolobay Lots I & II and the capacity building projects could be cases in point). However, it cannot be logically argued (as the gain by the Authority for the equal amount of money spent is considerably different) that both contracts performed equally well if they finish within the contract values.

performance indicators set. To achieve a performance indicator that can be used both as a measure of performance of the existing project and an input to the knowledge base for future adjustments, the evaluation endeavor should set clear evaluation criteria, measure the criteria appropriately and analyze and evaluate the performance along establishing accurate causes for deviations, if any (and use same to make corrective actions).

However, when considered in this light, ERA's project evaluation practice seems to have key drawbacks. In this regard, for example, the World Bank (2012) identifies that ERA's APL2 financed projects were both cost underestimated and benefit overestimated. One of the unintended consequence of the these practices, on performance evaluation, is that, given the practice in evaluation that analysis of projects often tend to justify decisions that have already been made than to support the ongoing allocation of resources (Michaelowa and Borrmann, 2006; Martens, 2002<sup>82</sup>), project evaluations suffer validity and reliability issues.

Besides being caught in the politics of project appraisal (Flyvbjerg *et al.*, 2003) and politics of project evaluation (Valdez and Bamberger, 1994), project performance evaluation may also suffer from evaluation bias (Scriven, 1975) when the evaluation is conducted by parties who are, directly or indirectly, accountable for the performance of the project. Related with this, ERA's projects are often evaluated by parties responsible for their performance (supervising consultants, overseeing directorates<sup>83</sup>). In this regard, although ERA has an Internal Audit Service Directorate mandated for auditing of performance, to effectively serve as the check-and-balance point of assuring value for money of the projects implemented by the Authority, the Directorate has two major challenges. Firstly, with the role of internal audit traditionally limited to 'expressing recommendations on financial statements and related issues of legality, regularity and fraud' (MoFED, 2013) and expanded view of performance audit to incorporate economic, efficiency and effectiveness issues only being standardized at the federal level recently (the MoFED only issued such a guideline in 2013), the up to now performance audits conducted by the Directorate are only limited to procedural checkups. Secondly, as noted by the Directorate,

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<sup>82</sup> These studies are for international [development] aids but the logic and findings can be applied for other projects as well.

<sup>83</sup> Both the supervising consultant and the different Regional Directorate have accountability for the performance of the projects they oversee and hence may induce evaluation bias in evaluating performance by themselves.

although its structure shows a staffing requirement that could make it capable of conducting technical audits, in reality, it struggles to attract technical personnel to discharge its mandate<sup>84</sup>. In this regard, although the Directorate could counteract the drawbacks associated with resources by conducting assessment of performance by external parties (for example, the World Bank audits the performance of the projects it finances) it is not doing same.

In another dimension, in ERA's case, the evaluation and reporting of project performance practices do not appear to indicate the links between project performance/objectives to programme objectives. However, it is importance to cascadingly link the project-programme objectives (Turner, 2007) as well as the evaluation of the achievements of same. In this regard, for example, project performance reporting of projects earmarked for capacity building purposes (the programme objective) need to monitor and evaluate the capacity building achievements of the firms. However, analysis of the project performance reports indicates no such attempts. In addition, probably curbed by the contracts (see section 5.2.3 below), the project level evaluations appear to concentrate only in reporting without major emphasis on analyzing, forecasting and suggesting ways of catering for deviations.

#### **5.2.4 Summary**

ERA's project organization structures, project phases as well as performance criteria adopted have some peculiar characteristics which are influenced by the particular situation the Authority functions under and influence its performance. Table 5:1 below presents summary of the major findings of ERA's practices in terms of project organization, project phases and project performance criteria. The Table also presents the major drawbacks of ERA's approaches.

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<sup>84</sup>A possible option to this challenge could be to periodically evaluate projects by parties external to project coalition of the consultant-contractor-client. The approach could help to objectively spot problems as well as suggest possible solution. Related with this, the World Bank (IDA's) loan to the ERA under its Transport Sector Project in Support of RSDP4 (scheduled for a revised implementation from Jan 2013 – April 2019) includes a support for 'modernization of the Authority' that incorporates a component for 'Technical Audits and Quality Management' meant to improve its auditing and quality management practices.

Table 5: 1 Summary of ERA's approaches to project organization and phases

Item	ERA's practice	Advantages of the approach	Drawbacks of the approach	Potential best approach
Organization	Projects fundamentally organized and managed functionally.	Avoids proliferation of projectized organizations given the number of projects the Authority engages in.	No single point of responsibility for overall project performance; No single entity to manage inter-phases and different parties evolved.	Matrix organization with a single project manager to stir projects from inception to completion and coordinate between functional departments and resource base.
Project phases	In the DBB approach, distinct phases of network planning and programme development, project development, project implementation and project/contract closure.	As in the general case of DDB, the approach gives an opportunity for gate reviews and scope adjustments/verification before committing big resources.	The sequential delivery, when compounded with fragmented project team with no single responsible person to oversee processes and bridge phases and structural boundaries may lead to inefficiencies.	Using a dedicated project manager (or the function there to) may help reduce the drawbacks associated with the approach.
Project performance	Two tier (programme and project level) evaluation; Programme performance criteria set for each RSDP; Project performance criteria set in contracts; Performance mainly evaluated by parties responsible for performance.	Given the Authority's mandate of planning, implementing and managing roads in the country, the programme level planning helps prioritize and strategize at programme level; Potential for clear and cascading link between programme and project level objectives and performance criteria.	Non-optimized project performance criteria; Performance evaluation self-congratulating.	Devising optimized performance criteria; Using an impartial body to assess project performance.

### 5.3 The project processes and their management

As presented in section 5.2.2 above, the Authority’s project phases can be divided as project planning and programming, project development, project implementation and project commissioning and contract closure. Parallel with the phases, and by merging project implementation and project commissioning and contract closure phases because there is no clear process demarcation (although clear phase demarcation –in terms of time and scope of work can be established), the core processes executed by the Authority can be categorized as project planning and programming core processes, project development core processes and project implementation core processes.

These processes, along with the sub-processes, are presented in IDEF0 model formats in the subsequent sections. As discussed in section 3.3.2.2, the IDEF0 technique is one of the process modeling techniques used in construction. By way of summary (refer to Savindo (1990) for detailed description), as schematically presented in Figure 5.3 below, the IDEF0 architecture has five major components of function, input, control, mechanism and output.

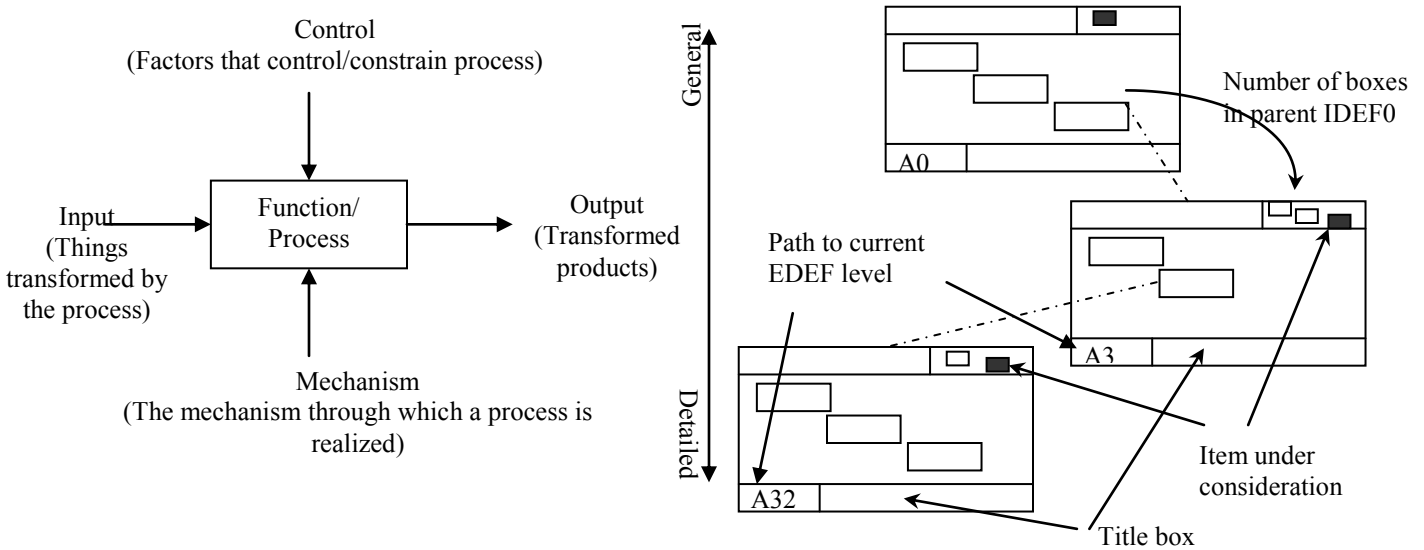


Figure 5: 3 IDEF0 architecture and hierarchy depiction (Adopted from Sanvido (1990))

- A function, represented by the box, indicates an activity, a process, an action, an operation or a transformation that is going to happen under the model;

- An input, represented by the arrow that enters the box at the left, depicts the entity (usually resources such as materials, information/knowledge etc.) that is transformed by the function;
- An output, represented by the arrow that leaves the box at the right, represents results/products created by the function;
- A control, represented by the arrow that enters the box at the top, represents controls or constraints that controls or influences the conversion from input to output by the function. Typically, controls are not influenced by the function;
- A mechanism, represented by the arrow that enters the box from the bottom, represents entities such as work resources (person (natural or legal) and/or machine) that actually execute the function.

Modeled on IDEF0 format, Figure 5.4 presents the first level core processes of infrastructure delivery and operation management as practiced by ERA. As noted in section 3.3.2.2, one of the major drawbacks of the IDEF0 modeling approach, particularly if over detailed, is the difficulty to understand and transcend (Berg von Linde, 2000). To counteract this drawback, in the process model developed here, a general level is used that simplified the model by aggregating the various components of the IDEF0 components. Accordingly, inputs are simply left as resources while only main (and summarized) mechanisms, controls and outputs are depicted. In addition, the IDEF0 modeling runs hierarchically from general to detail in a systematic manner whereby each of the core processes are further elaborated in the subsequent sub-sections designated for each of them.

By way of explaining the model in Figure 5.4, the Authority's overall product life cycle processes are congregated into 'road infrastructure delivery and management' process that aggregates both the project delivery and product operation processes. The project delivery main process is broken down into network and programme development, project development and project implementation core processes. In the model, the operation processes are aggregated into asset management core processes.

At a general level, the Authority's infrastructure delivery and subsequent product management is controlled by the mandate bestowed on the Authority. The major output of this high level process is the strategy the Authority adopts in delivering its responsibilities. Various stakeholders, such as the legislators of the Country, the various executive organs such as Ministry of Transport, the regional governments, etc., along with the Authority itself are the mechanism through which the process is effected.

The network and programme development core process, although conducted at a network and programme level, comprises the project conception processes as it establishes the objectives and justifications to embark on a given project. Internally (within ERA), the process is effected by the combination of the EPD and the PPD while, externally, it is influenced by different stakeholders such as financiers, the different organs of the state that involve in the RSDP development and approval and network development consultants. The network development part of the process, in addition to the government prioritization, is controlled by the network development contract the Authority enters with the network development consultant. The major factor that controls the programme development is the government prioritization. Finance and capacity are the major constraints of the RSDPs. The major outputs of the process are the network master plan, the RSDP documents and the annual investment plans.

The project development core process is mainly effected by the EPD and the Regional Directorates, within ERA, and externally by the design consultants. While the procurement part of the process is controlled by the related procurement laws and directives (which is also true for procurement for network development consultant although not indicated in the model), the design part of the process is controlled by the design contract and design standards. Constraints include capacity of the consultants and different environmental forces. The major output of the process is the design document often compiled into the works (and supervision) contract that is used as a control of the implementation core process.

The project implementation core process is effected by the coalition of the ERA (represented by the Regional Directorate), the contractors and the supervision consultants. The major control for the process are the works and supervision contracts while it is constrained by different factors

such as capacity of the coalition and environmental forces like inflation. The major output of the process is the constructed asset itself.

The asset management core process, which is overseen by the different branches of the Asset Management DDG and influenced by various stakeholders such as commuters, takes the asset constructed as its input. The major output of the processes, besides a functioning asset, is a feedback to the network planning and programme development core process.

The following sections present details of the project delivery process components of the model as practiced by the Authority. Under sections 5.3.1, 5.3.2 and 5.3.3 below, respectively, the details of the network planning and programme development core process, the project development core process and project implementation core process are addressed. The sections also present a further breaking of the core processes into sub-processes.

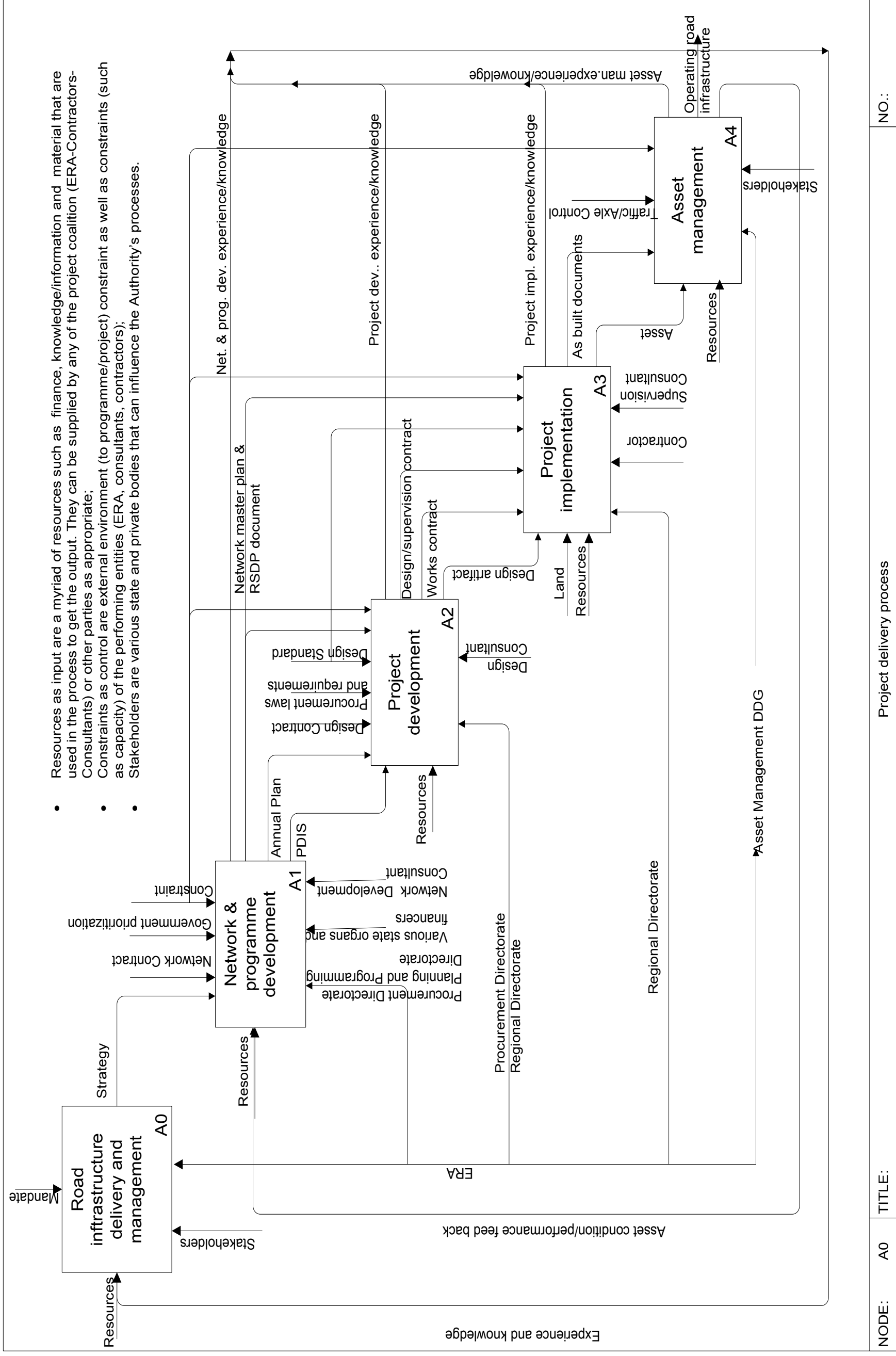


Figure 5: 4 ERA infrastructure delivery and operation processes.

### 5.3.1 The planning and programming (project conception) processes

As stipulated in the regulation that re-establishes ERA, one of the Authority's mandates is to plan for and oversee the implementation of the plan for the achievement of the objective of developing and administering roads. As part of its mandate, ERA sets cascading objectives for road networks, Road Sector Development Programmes (RSDPs)<sup>85</sup> and individual projects within the RSDPs and develops individual links under the umbrella of the programme level objectives. Consequently, ERA's project conception processes start in the network master plan development and are further refined in the RSDPs. During this early phase, the particular project conception process, by itself, is overarched by the network planning and programme development processes with the objectives set and the subsequent actions taken to achieve the road network (and programme) level objectives.

Figure 5.5 below, developed in IDEF0 modeling approach, presents the major sub-processes of the planning and programming core process. The main sub-processes are the preparation and procurement for network master plan development, the master plan development, the programme development and the annual plan development sub-processes.

The preparation and procurement for network master plan development sub-process involves preparation for procurement of master plan developing consultant and procurement of the service suppliers. It is effected internally by the PPD and EPD and externally by potential suppliers. The major control for the sub-process is the objectives set for the network to be developed and the procurement laws and directives. The major output is a network master plan development service contract.

The master plan development sub-process develops the road network master plan. While the PPD conducts the contract administration and reviews of the outputs, the contracted consultant

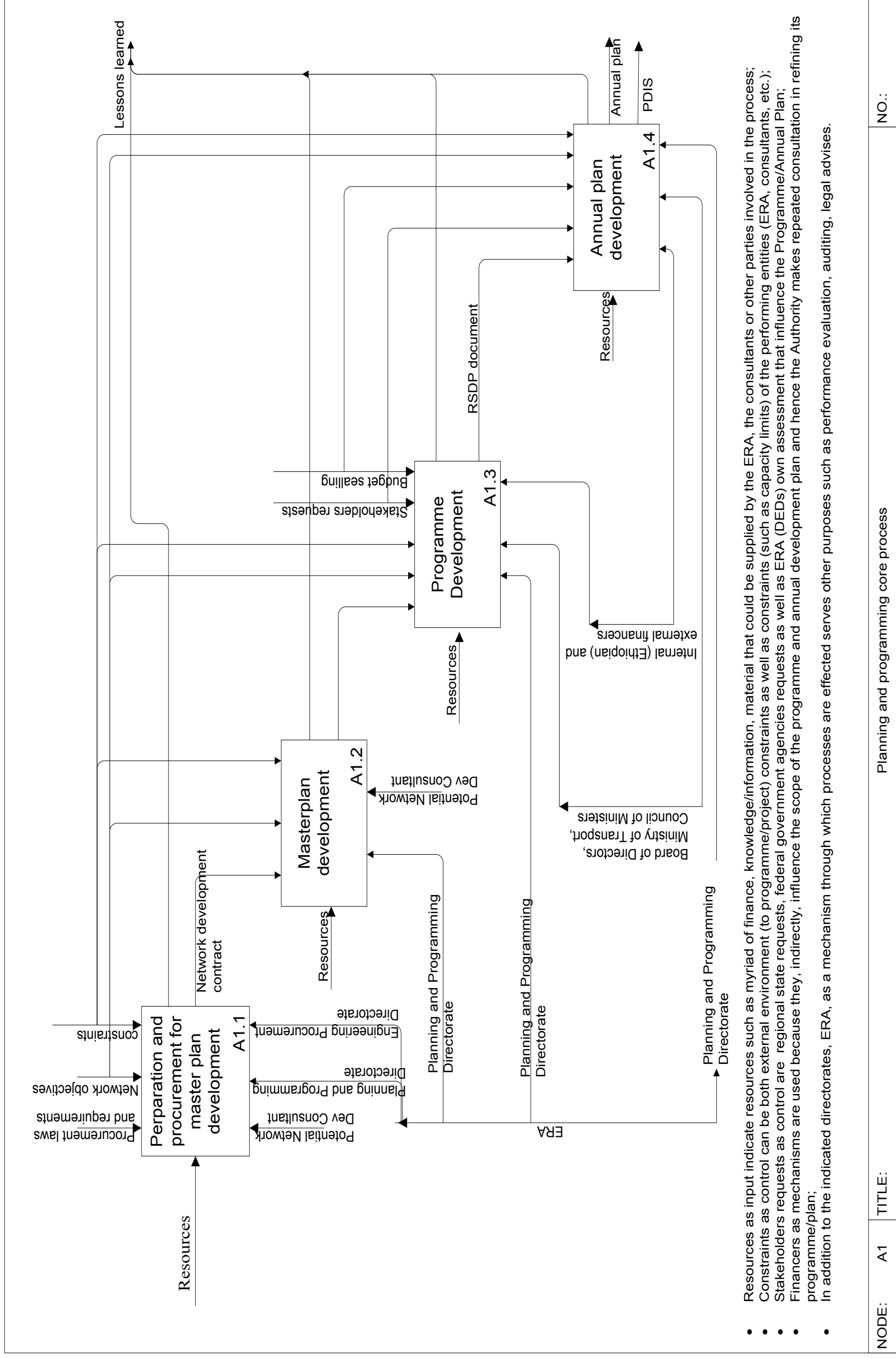
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<sup>85</sup> For example, meant for the duration of RSDP I & II, (1997-2007), the road sector policy of the nation had a broad range stated objectives. They include improving service delivery through strengthening the road sector management capacity, up keeping and restoring existing network, opening up development potential areas, involving stakeholders in policy formulation and program development, improving road safety situation, reducing environmental and social impact and strengthening axle load enforcement as well as increasing private sector participation and financing by phasing out force account construction, encouraging public-private partnership and applying road usage (toll roads) pricing principles.

conducts the product-oriented processes of actually developing the network master plan. The sub-process is principally controlled by the master plan development contract and the network objectives. The major output of the sub-process is the master plan itself.

The programme development sub-process develops the RSDP for the specific period envisaged. It takes the network master plan, additional stakeholders' demands and budgetary constraints as its control and produces the RDSP document as its major output. The sub-process is effected internally by PPD while different state organs and financers will also have contribution in the sub-process.

The annual plan development sub-process identifies the list of projects the Authority engages on in a given fiscal year and prepares major strategies of projects that enter into project development phase. The sub-process is controlled by the RSDP prioritization and strategy, additional stakeholders' demands and budgetary constraints. The PPD produces the document with different state organs and financers also influencing the processes and the output. The major output is the annual plan and a project development initiation sheet that is used in initiating the project development phase. The sections below present detailed descriptions and analysis of these sub-processes and their management as practiced by the Authority.



- Resources as input indicate resources such as myriad of finance, knowledge/information, material that could be supplied by the ERA, the consultants or other parties involved in the process;
- Constraints as control can be both external environment (to programme/project) constraints as well as constraints (such as capacity limits) of the performing entities (ERA, consultants, etc.);
- Stakeholders requests as control are regional state requests, federal government agencies requests as well as ERA (DEDs) own assessment that influence the Programme/Annual Plan;
- Financers as mechanisms are used because they, indirectly, influence the scope of the programme and annual development plan and hence the Authority makes repeated consultation in refining its programme/plan;
- In addition to the indicated directorates, ERA, as a mechanism through which processes are effected serves other purposes such as performance evaluation, auditing, legal advises.

NODE:	A1	TITLE:	Planning and programming core process	NO.:	
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Figure 5: 5 Planning and programming core processes

### 5.3.1.1 Sub-processes of the network planning and programme development process

#### i. The [network] planning processes

In ERA's road network planning, the product-oriented processes<sup>86</sup> are executed by the network development service consultant. The major processes executed by ERA, therefore, involve the identification and drafting of the criteria of the network to be developed, the planning and execution of processes associated with procurement of the network development service provider, the administration of the network development service contract along with the review of the various deliverables and finally the close out of the contract.

#### ➤ Network development criteria setting and master plan development service procurement

One of the major factors that initiate the network planning processes is the evaluation of ERA that the existing network master plan does not reconcile with the realities and is fundamentally incapable of responding to the demands/needs<sup>87</sup>. When the Authority identifies this gap, as part of the initiation process, it develops network master plan development criteria that dictate the objectives of the network master plan development. Making these criteria key components of its ToR, the Authority embarks on network master plan service procurement.

Deriving from the criteria set by ERA in its ToR<sup>88</sup>, the network development service consultant then develops both the generic and specific objectives for the developed network (ERA, 2002)<sup>89</sup>.

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<sup>86</sup>Partial exploration of the deficiencies of the existing network (to fill gaps to data provided by ERA) and analysis, forecast and the reconciliation of demand and supply are the major targets of the product-oriented processes. They generally involve the major sub-processes of input data acquisition; input data validation, modeling, and prioritizing and sensitivity analyzing and costing (ERA, 2009)

<sup>87</sup> Such identification can be manifested, for example, by a consistent need for incorporation of links that are not in the master plan into the Authority's programmes (see below in programming).

<sup>88</sup> ERA, in its ToR for the Sheladia produced network, for example, set six major criteria against which the road network development plan needed to be scrutinized. The criteria are: the network analysis and development should take consideration of the size of the country and its structure of production and population distribution; the cost to the economy of unreliable, deteriorated network; the fiscal implications of inefficient transport operations; road network's importance in creating regional balance (and connectivity); contribution of the road network in poverty alleviation; the importance of the road network in opening up new, virgin land for agricultural production, mining and other economic activities, or in intensification of existing economic activities.

Nevertheless, it is worth noting that the objectives at this level are network level objectives. In this regard, while it can be argued that the overall objectives of road transportation network can be achieved through the implementation of the individual links the network is made of, the specific objectives set for individual links could only be a subset of the road network objectives. Individual links, in addition to improving the general connectivity, may have other specific objectives. Therefore, in addition to their contribution to the overall network objectives, individual links should be evaluated based on the specific objectives set for them. In this regard, the Authority conducts feasibility studies, socio-environmental impact assessments and potential to deliver the objectives the particular links are meant for during its project development phase (see section 5.3.2). Therefore, the planning and programming processes of the Authority deal with objectives at the network level and leave for the accurate characterization of the individual projects for the subsequent processes.

Once the criteria for the network development are set, to initiate the network development service procurement processes, the PPD hands over the ToR it has developed to the EPD. The EPD then plans and executes the procurement of the service<sup>90</sup>.

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<sup>89</sup> For example, the Sheladia produced master plan set generic aim that is meant ‘to define an optimum size of the federal road network for the country, considering longer term development needs and prioritize them for implementation’ (ERA, 2002, chapter 1: 2). I.e, the aim is to develop a road network that is both within the Country’s resources to implement and maintain on the one hand and solve the Country’s accessibility problems while meeting its development objectives on the other. The major issues addressed under this super arching aim are:

- In terms of mobility, connectivity and equity, the network is expected to provide desired mobility and provide connectivity to all the population and having equitable distribution by keeping regional balance;
- Economy wise; from the demand side, the network is desired to improve transportation efficiency by optimizing on mobility and vehicle operating costs; to facilitate full exploitation of export potential and develop alternate export and import corridors; facilitate opening up new, virgin land for agricultural production, mining and other economic activities and intensification of existing economic activities. From the supply side, the network is desired to be affordable to construct and maintain with reasonable allocation of funds;
- The network is also desired to contribute to overall development and poverty alleviation and facilitate movement to all parts of the country for effective intervention to ensure food security and emergency support.

In terms of specific objectives, in addition to the balancing of the economic dimensions in terms of developing a network that the country can sustainably maintain and that facilitates economic efficiency and development potentials, the major objectives set are mean distance access (connectivity), mobility, equity, linkage of major/important centers/corridors with specific envisaged levels to be achieved set (see Appendix 5.2)

<sup>90</sup> The procurement related processes are, in general, similar to the other service procurement processes such as the design service procurement processes discussed under the project development core process below.

➤ **Network master plan development service contract administration**

The PPD administers the master plan development processes. Time and cost are monitored and evaluated based on the payments and progresses through deliverables. For quality monitoring, in addition to monitoring the deployment of the appropriate resources and employing of the stipulated methodologies, the Authority conducts various reviews. In this regard, the major reviews the Authority conducts concentrate on the data acquisition and validation, the modeling and preliminary appraisal of the network development and the optimizations, prioritizations and sensitivity analysis processes conducted by the consultant. Appendix 5.3 presents the major issues the Authority focuses in reviewing and evaluating the outputs of these product-oriented processes.

The major final output of the network development (planning) processes is the master plan itself. In this light therefore, the Authority closes its network development sub-processes after receiving the master plan, reviewing it and, after correction are incorporated, accepting it. The service provider also submits a consultancy completion report incorporating all the major incidents and knowledge learned along the process.

**ii. The programming processes**

The network planning stage identifies a long list of potential projects which the programming stage qualifies further. The stage formulates detailed implementation program of the identified projects establishing duration of implementation and assigning/earmarking budget (or sources). While the planning stage takes a relatively long time horizon, for example ERA's latest plan looked for 23 years (2002-2025), the programming phase normally takes medium time horizons<sup>91</sup>. In the programming phase, the Authority selects projects (from the master plan or other newly incorporated links), sets project strategy and prepares annual development plans for the programmes. In this light, therefore, the programming processes encompass three major tasks of programme development along with public investment plan preparation, formulation of

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<sup>91</sup> RSDP I and II each had five years durations while RSDP III was for three years. The currently running RSDP IV is a five years programme.

project strategy and a recurrent (annual) preparation of annual development plan. The sections below discuss these major sub-processes.

➤ **Program development/public investment plan development**

In identifying projects to be incorporated into the RSDPs, the ERA uses a multi-criteria evaluation approach<sup>92</sup>. The selection criteria are given relative weights and each potential link is ranked based on scores on the multi-criteria (summation of relative weights of criteria). Incorporation into the RSDP as well as priority within the RSDP is determined based on the ranking from the demand side and the constraints on the Authority's annual and total (RSDP period) budget from the supply side.

ERA, as a body that implements publically financed projects, as per Proclamation 648/2009 and Regulation 190/2010), is also required to prepare both annual and cumulative budgetary demands of the projects, and get it approved<sup>93</sup>. In addition, the Authority is required to prepare and submit its demand for foreign currency to the National Bank of Ethiopia (NBE) and its budget demands for preservation works to the Road Fund Administration.

The major output of the programming process is the list of projects to be implemented for the programming duration along with tailored (earmarked) sources of finance and recommended project implementation strategy that is best suited to each project. At this stage, the project implementation strategy covers high level planning of major tasks that need to be done between project development and physical implementation of the works. The major issues addressed

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<sup>92</sup> For example, for RSDP-IV (the five year programme that runs from 2010/11-2014/15) five criteria of traffic level (30%), network connectivity (20%), current condition (20%), importance in terms of import-export corridor and keeping regional integration (20%) and investment potential (10%) are used for preliminary selection of road upgrading projects. For new projects, a different set of five criteria of links that significantly reduce inter- town and inter- region distances (30%), contribution to economic development potential (20%), connectivity to surplus food and cash crop areas (20%), accesses that connect large and isolated rural communities (20%) and main roads within emerging regions and isolated areas (10%)<sup>92</sup> are used for prioritization (ERA, 2011).

<sup>93</sup> The stage may also involve preparing and submitting project profile, updated feasibility study and project appraisal and other documents as relevant to appropriate financiers' consumption. The process also involves preparing mid-term Public Investment Plan. As stipulated in Regulation 190/2010, the Federal Government's mid-term expenditure plan needs to be prepared for three years forecast.

include formulating contracting strategy (project delivery methods), procurement method and contract management strategy.

➤ **Preparing annual development plan**

The preparation of the annual development plan involves the determination of scope of annual operation, and using the RSDP year's program as an input to determine the annual final list of projects with approved budget. From this annual final list of projects with approved budget, Project Development Initiation Sheet (PDIS) for each project is prepared as final output of the planning and programming core process. The PDIS document defines the project scope in such a way that it enables to initiate appraisal or development of the specific project and is handed over to EPD to be used as an input for the subsequent procurement for design service sub-process.

**5.3.1.2 The management of the processes**

The planning and programming phase of the project delivery life cycle is planned, managed and partially executed by the different teams of the PPD. The network master plan development is executed by external consultants through the monitoring of the road network planning team. The programme development, on the other hand, is conducted in-house by the Authority, in consultation with different organs of the state –such as MoFED. The EPD conducts the procurement of the network development service provider. Data collection such as traffic data and road/bridge asset condition assessment (which are inputs for network planning) are conducted by the Road Asset Management Directorate of the Authority<sup>94</sup>.

In terms of the procedures, for the works to be executed by outsourcing, the Authority's ToR normally stipulates the major requirements of the processes, the demanded personnel requirements for the service<sup>95</sup> and the management structure to be adopted. The ERA team's task

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<sup>94</sup> Other inputs for the planning, such as agricultural production, demography, mining locations are collected by the different organs and hierarchies of the state.

<sup>95</sup> For example, the ToR for the currently (2012/2013) undergoing network planning service (contracted to a joint venture of a Korean company (Kyong Dong Engineering Co.LTD) and a local company (Civil Works Consulting PLC), requires a professional input of a highway engineer, GIS expert, transport planner, environmentalist, highway management specialist, transport engineer and sociologist.

in this regard is, therefore, to oversee the proper implementation of the service contract and conducting reviews.

In terms of the governance of the processes, the ToR preparation for procurement for network master plan development is conducted by the Planning and Programming Directorate (PPD). Then, the ToR is handed over to the Engineering Procurement Directorate (EPD) for the service procurement. The EPD in turn hands over the signed contract to the PPD for contract administration. The PPD then conducts the monitoring of the progress of the service, reviews the deliverables and administers the contract.

For programme development, while the process involves various organs of the state such as requests from different federal state branches, regional states, discussions with the MoFED and the National Bank, approval hierarchically from Board of Directors to Parliament, the process is conducted under the auspice of the PPD. The network planning team is responsible for programme development while the budgeting team looks into the budget requirements of the projects.

### **5.3.1.3 Key issues with the network planning and programme development processes**

The above section presented description of the processes and how ERA manages them. The subsequent section looks the major issues associated with ERA's practices and compares these practices to existing theories and other international practices. The major focus has been the key areas the Authority's practices deviate from the literature identified (or recommended) practices and their possible implications on the Authority's performance. For the sake of stereotyping it with the conceptual framework presented in chapter two, comparison of the Authority's practices are seen in terms of processes, governance and the environment. As noted before, the study did not address the resource component and hence same is not presented here.

**i. The processes**

a. Objectives/criteria setting

A clear and achievable objective gives a clear and defined mission to achieve. In line with this, the ERA presents its high level criteria for its network development through its ToR which are later channelized to objectives for the network developed. In addition, as it is also the practice with other similar agencies (US DoT, 2010; ATC, 2006), the ERA normally devises objectives at a network level and embarks on their achievements through programmes rather than individual projects.

This hierarchical approach from network to programme and then to project level objective setting gives an interlinked and focused transportation infrastructure delivery. However, both the demand and supply of transportation systems have different characteristics and challenges of their own. For example, the fact that the demand for transportation is derived (due to the fact that transport is needed for other economic and social needs) makes demand identification and quantification difficult (Ortuzar and Willumsen, 2011). On the supply side as well, the demand can be met both through infrastructure and non-infrastructure solutions<sup>96</sup>. In this regard, usually, the solution provided for demand in transport is accused of concentrating on providing the infrastructure solution based on projection of the current demand (even though it should set to discourage the current demand pattern) (Baker, 1974) or providing infrastructure solution instead of improving the service side of the supply (Poter, 2007).

When vetted along this line, ERA's network planning appears suffer both from demand explication (see below under environment) and supply provision for the demand as it concentrates only on the infrastructure solution. Neither the Authority's criteria against which the network is developed nor the subsequent network developed did make any explicit attempt to look into non-infrastructure solutions-such as improving services, locomotive quality or look for

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<sup>96</sup> Demand for transport is normally derived from the demand for commodities or the need to commute for work, leisure, education etc. In addition, demand is both variable (with uniform pattern but different over a day or a season) and dynamic (changes pattern). Non-infrastructure solutions may involve measures to discourage current travel pattern through different means such as use of appliances and controlling methods (Arnott, 1994) or to improve capacity of the existing infrastructure through appliances (TRB, 2010) or improve service (Poter, 2007)

possible existing none infrastructure highway capacity (TRB, 2010) improvement measures to cater for the demand.

Even in terms of the infrastructure solutions sought, while it can be argued that the criteria the Authority stipulated for the development of its network is general enough to accommodate wide issues, the objectives set for the network development (ERA, 2002 network) does not reconcile with similar international practices. In this regard, for example, multi-modal transportation infrastructure delivery optimization demands that a country's road network development should be tailored and integrated with overall transportation network policy and strategy (May, 1997). Nevertheless, in Ethiopian context, currently, the country lacks a clear transportation sector policy that aims for integrated optimization of the overall transportation sector<sup>97</sup>. The absence of such a policy and overall strategy may affect the optimum transport infrastructure delivery.

However, even in isolated road transport planning form, the Authority's criteria for the road network development (ERA, 2002) issued for the consultant, lacks specific requirements for which the network should be developed. In this regard, for example, in the US, the Safe Accountable Flexible Transportation Efficiency Act - a Legacy for Users (SAFETEA-LU) of 2005, stipulates the major planning factors as competitiveness, productivity and efficiencies, increasing accessibility and mobility of commuters and freight, safety for both motorized and non-motorized users, protection and enhancement of the environment, promoting energy conservation and improving quality of life. In the ERA's context, however, while access improvement, mobility maximizing, economic efficiency and poverty reduction are the corner stone of the ERA's (2002) network, it does not have objectives related to environmental impact<sup>98</sup>, desirable resultant land use patterns, flexibility, potential improvement quality of life such as through planned settlement patterns, etc.

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<sup>97</sup> The Ministry of Transport, with the support of the European Union, has sanctioned the development of transportation policy along with the development of multi-modal transportation network master plan for the country (the COWI-GOPA master plan (2008)). However, the master plan is not officially accepted due to espoused reasons of flawed approaches. Related with this, in addition to road networks, Ethiopia is working to significantly increase its rail and air transport networks.

<sup>98</sup> ERA conducts Environmental Impact Assessment during the project development stage of the project delivery lifecycle. However, one of the many requirements of sustainable transportation planning is to cater for it during the planning stage as well (TRB, 2005).

In addition, in regards to the identified objectives of the network master plan, the specific objectives (for example those used for ERA's 2002 master plan) are not given the due arguments why the achievements of same are desirable ones. I.e., rational for setting the specific objectives (and the assumptions associated with their derivation) at that level is not thoroughly argued and they do not appear to be in line with the country's overall economic and integration visions<sup>99</sup>.

b. The planning and programming processes

The ERA has standards, manuals, specifications and norms that guide the product-oriented processes of the project development and project implementation core processes. However, for the project planning and programming core process, aside from the quality assurance manual (Volume 2), the Authority has not developed (or adopted) and prescribed any official document for developing networks and programmes. However, having such guideline would serve as a framework for the resource base to develop the plan and the major issues it ought to address in the development of the plan (ATC, 2006). In the absence of such framework form ERA, the methodologies, assumptions and outputs by the developers or the quality of the reviews of ERA cannot be effectively critiqued<sup>100</sup>.

However, to comment on a few observations, although ERA's (2002) network established a 200,000Km national network, it synchronized only the 30,000Km federal road networks. In this regard, however, international guidelines (ATC, 2006 for example) suggest a synchronized

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<sup>99</sup> In this regard, given that the country's main target is to satisfy the MDGs and subsequently transform itself into a middle income country, one would expect, a thorough justification and objective setting along the broader objective of achieving the MDGs and transformation into a middle income country. In this light, for example, the International Road Federation Statistical Report (2006) indicates that the current average road density per square kilometre of lower middle-income countries is 0.30 km/km<sup>2</sup>. Taking this density as a reference, Worku (2011) notes that Ethiopia needs a total road network of 330,000km as opposed to ERA's (2002) 200,000km as the optimum national road network –although ERA's target network density also considered the Country's capability to deliver (and maintain) the said network at optimum level as a constraint. In addition, regional as well as Trans-African integration have not been explicitly considered in the network. ERA's own study notes that, for the country to be competitive, it needs to increase its density to 0.26 km/km<sup>2</sup> (ERA, 2014).

<sup>100</sup> For example, Sheladia took Ethiopia's growth based on World Bank records of Ethiopian economy in its analysis. Given the discrepancy, there is no justification why same is the appropriate base (say as compared to the MoFED's).

metropolitan, local, regional and federal transportation network as more reliable and efficient networks.

In regards to the programming of projects, one of the major challenges is the network master plan's inability to guide the programming (with network unidentified projects incorporated in the programmes). Many reasons including the instability of the factors that are used in the network development (see below under environment) can be argued to contribute to this problem. In addition, while the Authority identifies criteria (and weighting factors) against which projects are picked into the programme and notes that prioritization on the selected combinations would likely lead to a feasible project (when feasibility is studied under the project development process), there is no formally devised algorithm or justification that indicates same. In addition, the objectives and prioritization linkage from network development and programme development is not apparent. Nevertheless, just like the case of optimization in multi-criteria network development (Sayers *et al.*, 2003) having rational selection criteria that is tailored and prioritized along the network objectives is necessary both for effectiveness and consistency.

## **ii. The management (governance) of the processes**

For network development, as noted above, the actual product-oriented processes are implemented by outsourcing with the Authority overseeing the contract management related processes. The Authority's main involvement is in the development of the Terms of Reference (ToR) and overseeing issues associated with the procurement of the service, the monitoring of the implementation of the contract it enters with the resource base and performing evaluation of outputs as well as gate reviews. However, while the Authority conducts the evaluation of the outputs and reviews key deliverables before approving subsequent processes, in the absence of any prescribed standard (except the ToR, which generally is very shallow) the consultant is required to adhere to, both the consultant's output and the Authority's revision lack any reference they can be checked against. In addition, the Authority can be argued to lack the competence (for example as compared to what it requires the consultant to deploy for the execution of the network master plan development in its ToR) to make proper revision of the consultant's output.

**iii. The environment (the context)**

One of the major challenges road network master plan development faces is the capturing, applicability and stability of the inputs taken in the development of the network. In order to devise a network plan that responds to the current and future demands, however, a quality data that is comprehensive, accurate and consistent is needed to make proper forecasting and planning.

In terms of capturing of the major factors that affect the network, in Ethiopian context, ERA's master plan seems to have drawbacks in accommodating the demands of users as can be manifested by the incorporation of links which are not identified in the master plan into the federal road network and into the RSDP for implementation. In this light, therefore, although demand itself is transient (and hence demands for some links may developed after the master plan is compiled), the fact that the Authority has to incorporate significant number of links<sup>101</sup> not identified by the network master plan indicates challenges in capturing the major factors that affect the network in the first place.

In terms of applicability and stability of input data, planning, by its nature, involves forecasting of future events and hence is significantly influenced by the ability to forecast the major factors that affect the network's demand and the ability to supply it. However, in ERA's network development case, given the tandem problem of changes in the general environment (for example, Ethiopia experienced infrastructure investment fuelled inflation in recent years (IMF, 2012)) on the one hand and lack of quality data to base the forecast on the other, both the objectives set and the network plan devised to achieve it suffered.

In this respect, the collection of major data inputs affecting the network development does not lie within the Authority's jurisdiction (or the Authority does not have systems for doing same). The general environment, which provides most of the input to the network development processes and the events that test the applicability of the forecast, has a major effect. Therefore, while the

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<sup>101</sup>Although the Sheladia network was developed up to 2025, the Authority notes that it has completed the implementation of the master plan (and most of RSDP IV incorporates links not identified in the master plan).

Authority by itself can be expected to improve some of its processes (such as traffic count, traffic axle control and design standard development/modification) that may improve the stability of the network developed, major parts of the inputs for the network development are controlled by the environment (see for example foot note 92 above).

In this regard, for example, at the national macroeconomic level, taken from the World Bank's Economic Report on Ethiopia (2002), the analysis and forecast for the Sheladia's network was based on the annual estimated economic growth rates (for the period 2002 -2025) for low, medium and high scenarios of 4.5%, 6.0% and 7.5% respectively. Corresponding to this forecast economic growth, it used a transport demand elasticity<sup>102</sup> ranging from 1.0 to 1.5 for different vehicle types. In this regard, although with a different time span to the network horizon, the government puts the average economic development of the Planned for Accelerated and Sustained Development to End Poverty (PASDEP) 2005/06- 2009/10 period at 11%<sup>103</sup> and envisaged a low and high economic development scenarios of 11% and 14.9% respectively for the 2010-2014/15, Growth and Transformation Plan (GTP), period<sup>104</sup>. This difference in projected economic outlook has the potential to seriously affect the network model's ability to accurately forecast the demand for links as well as the country's ability to supply same. Indeed, cognizant of this fact, although the current network is developed to serve up to 2025, the Authority has already sanctioned the development of a new network master plan<sup>105</sup>.

In addition to the unpredictability of the factors, in Ethiopian context, there are not well developed databases from which the various input factors can be solicited and analyzed. The

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<sup>102</sup> The relationship between transport demand and economic growth rate-often expressed in real GDP, is called transport demand elasticity.

<sup>103</sup> There are reservations to this claim, however (for example IMF, 2012).

<sup>104</sup> On another dimension, the network analysis assumed a per kilometer cost of [routine] maintenance of paved roads at ETB 8,000 (6,000 for unpaved roads) while in reality, analysis of the Authority 2012/13 Ethiopian Fiscal Year outlay indicates an aggregated (for both paved and unpaved) per kilometer cost of ETB 37,552.62.

<sup>105</sup> The Authority's ToR for the new master plan to be developed identifies changing the current radial nature of the road network (generally it emanates from the capital Addis Ababa) to create direct links between districts and the need to improve and modernize the road networks in line with the accelerated economic growth rate of the country as main targets. The TOR states the objectives of the master plan development process as: 1) determine the size of the road network that makes best possible to national, regional and local economies; 2) identify links that improve the size and quality of the network in line with the country's aspire to become a middle income country; 3) propose roads that maximizes the growth and productivity of the entire economy and redress geographical disparities. The scope includes identification of missing links, identification of links for upgrading and identification of expressways.

absence of such a reliable database makes the forecasts (and thereby the network developed) unreliable in predicting the future demand<sup>106</sup>.

#### **5.3.1.4 Key factors that influence ERA's network planning and programme development processes**

The performance of ERA's network planning and programme development processes are affected by some key factors. In addition to the project management processes, the quality of a road network developed is affected by the quality of the input data and the product-oriented processes of modelling, optimization and sensitivity analysis, the capacity of the network consultant in executing these processes, the availability and quality of manuals and standards that guide the network development processes, ERA's capacity in defining its ToR, soliciting the appropriate consultant, conducting the service contract administration and conducting the reviews for the deliverables, etc.

Similarly, the quality of the RSDP/Annual Investment Plan is affected by various factors such as the quality of the network master plan itself, the reliability/feasibility of additional requests that are coming from stakeholders, the quality of the product-oriented processes that produce the RSDP/Annual Plan, ERA's capacity in executing them, etc. Figure 5.6 below, developed from the document analysis, the literature comparisons and the interviews conducted, presents a causal diagram that depicts the key factors (and their interrelationships) that affect the quality of ERA's network master plan and RSDP/Annual Plan.

Before explaining these factors and their interrelationships, however, it is probably necessary to introduce the application and use of Causal Loop Diagrams (CLDs). CLDs are communications tools that are used in system dynamics that depict interrelationship between variables in a circular manner rather than the commonly taken linear relation of cause and effect (Senge, 1994). They are qualitative diagramming languages used for representing feedback-driven

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<sup>106</sup> In addition, judging by the fact that the Authority had to contract with international firms, the Ethiopian market may not have a supply of competent firms that can render the service for network development.

systems (Shaffernicht, 2010). One of the attraction of CLDs as communications tools is that they are easy to understand, with little explanation if need be, by non versed people.

A CLD has three fundamental components (Lane, 2008) of:

- A variable that represents the factors the influence each other in real life. There are three types of variables: State variables are the variables that change by the accumulation or reduction. They are the key variables shown to influence each other of the CLD. The rate variables are the variables that determined the rate of accumulation or reduction of the state variables. Auxiliary variables are variables which do not directly influence state variables;
- An arrow that represents the causal relation between variables. The linking arrows are usually associated with polarities. Positive (+) polarities indicate direct relationship between variables while (-) polarities indicate indirect relationships (i.e, as the influencing variable increases the influenced variable decreases or vice versa). Time delay, which may make the relationship between the influencing and influenced variables not obvious could also be feature of CLDs;
- Loop polarities designate balancing or reinforcing nature of loops (as opposed to links). A positive feedback loop is a reinforcing loop while a negative one is a balancing loop.

Lane (2008) notes that CLDs can be used either for the ‘exposition’ of relevant aspects of a study to clients (after having conducted simulations) or for ‘model conceptualization’ used as an evolving thinking tool which represents a team’s (or an individual’s) understanding of a problem. Here the CLDs are used to represent causal assumptions in a way that they also served as model conceptualizations (Lane, 2008) to elicit mental models. Here, the CLDs are used as an evolving thinking tool which represents the researcher’s (and later the interviewees) understanding of the major factors that affect the performance of ERA’s core processes. As also supported by Lane’s recommendation (2008), here, CLDs main focus is on the loop structure rather than the comprehensiveness of the variables needed to fully model the system.

A few of the drawbacks of CLDs (see Lane (2008) for details) are that they could create link polarity as well as loop polarity confusion or even mistakes. To counteract these potential

problem, in this work, both the loop and link polarity are deliberately left out. Rather, as presented with each of CLDs developed, an explanation of the relationships between the various variables is presented. Furthermore, one of the key features of CLDs is that they form a complete loop. However, in CLDs developed in this study, a complete loop is not formed. The fundamental reason for this is that, given that the CLDs are developed for core processes of each phase of the project life cycle (as opposed to the whole project), the whole system is not shown in one CLD. Nevertheless, the different phases inter-feed to each other. The Project Development Initiation Sheet (PDIS) as part of the Annual Investment Plan development of the planning and programming core process is used as an ‘external’ factor that influence the project development processes. Similarly, the works and supervision service contracts are taken as the factors from the project development core process that influence the project implementation core process.

Therefore, developed with this simplifications and modifications, Figure 5.6 below presents the major factors that affect ERA’s network master plan and RSDP/Annual Plan documents. As shown in the figure, the quality of the network master plan developed is directly influenced by the quality of the input data and the rigor and quality of the network modelling, optimization and sensitivity analysis conducted. The quality of the input data is mainly affected by the environmental factors of quality of data collected by the various sector areas, the predictability and stability of the environmental forces that affect the planning, comprehensiveness and quality of data gathered by ERA and meticulousness of the data acquisition and validation process conducted by ERA’s service consultant that develops the master plan. The network modelling, optimization, prioritization and sensitivity analysis are influenced by the capacity of the service consultant and the personnel mobilized (including the governance/management system devised by the consultant), the quality of the input data, the monitoring and evaluation conducted by ERA and the availability of manuals, standards and norms that guide the execution of these processes. In addition, the process is influenced by the comprehensiveness of the objectives set for the network analysis as presented in the Authority’s ToR.

ERA’s ability to meticulously articulate its network development objectives; formulate appropriate ToR and employ suitable selection approach and process affects the quality of the

consultant selected. In addition, the suitability and capacity of the consultant selected and the personnel to be employed for the service are affected by the pool of available consultants that can render such services and trained/experienced personnel in the area.

The quality of the RSDP document and the Annual Investment Plan developed by ERA is mainly affected by the quality of the network master plan developed, the environmental forces that may force the Authority to incorporate links not identified in the net work (or adjust prioritization of links within the network) and the meticulousness of its programme development processes. In addition, the output is affected by the Authority's own capability to interact with stakeholders (the state, financiers) and develop the programme.

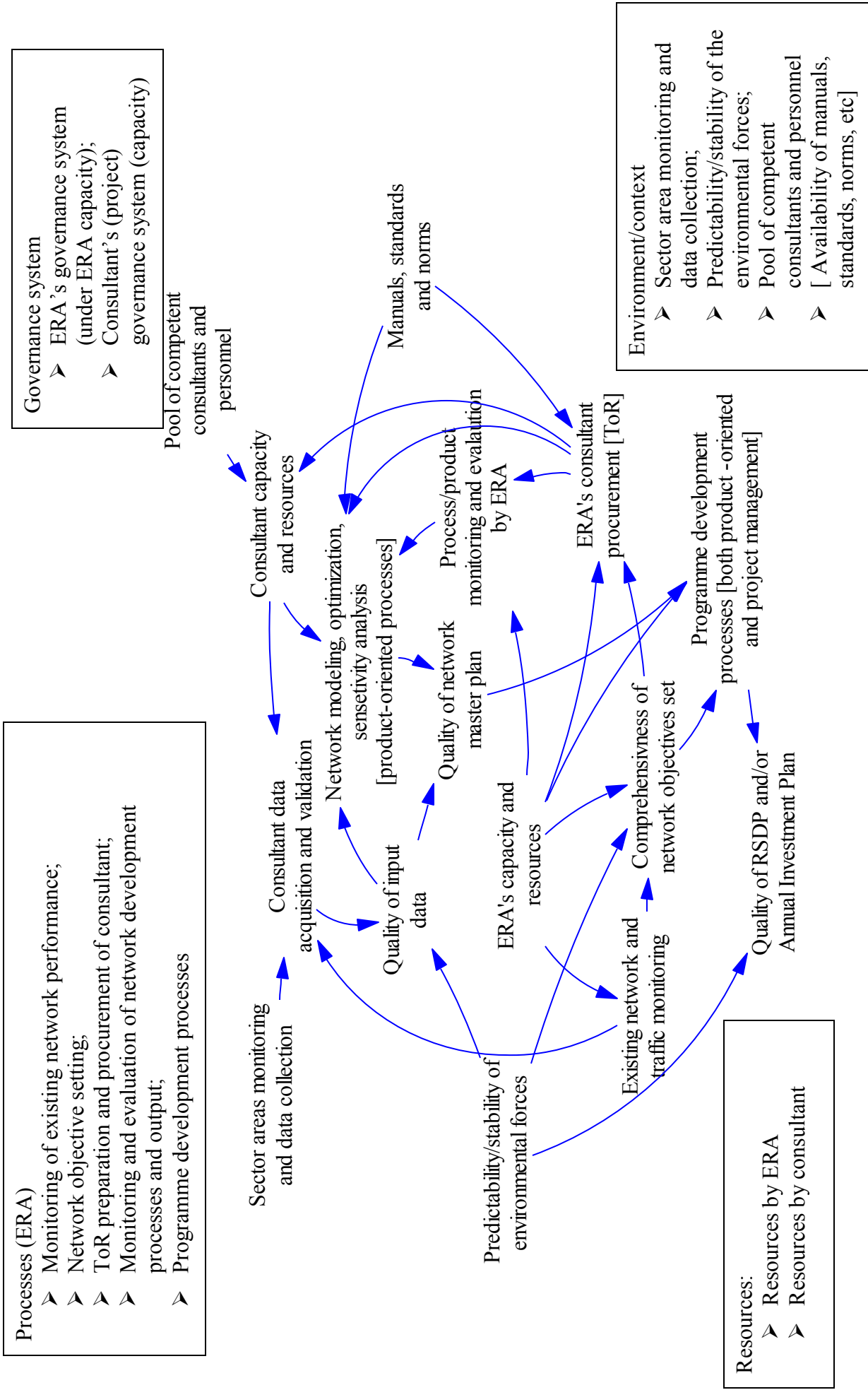


Figure 5: 6 Causal diagram: Planning and programming core processes

### 5.3.2 The project development processes

As discussed in the preceding sections, ERA prepares RSDP documents that identify projects that have associated priorities, time frame for implementation (within the RSDP period) as well as earmarked budget. Subordinate to the RSDP, annually, the Authority prepares a refined annual plan for budget allocation purpose and identifies projects that enter the project development core process for the fiscal year. Budget allocated projects enter the project development core process.

As highlighted in section 5.2.2 above, the Authority's project development phase (and the associated processes) can be split into three sub-phases of procurement of design service, engineering design and works and supervision service<sup>107</sup> procurement. Generally, aside from the procurement related processes, the Authority outsources the actual execution of the development processes. ERA, by devising the requirements of the design services contracts and how they are run, creates the framework of the system to be adopted in the execution of the processes by the resource base. Therefore, given that this study looks into the management processes from ERA's perspective; it concentrates only on the processes that involve the design, creation and subsequent management of the system that the Authority establishes for the resource base to create the phase's main product – the design artifacts.

In another dimension, currently, ERA uses either the DBB or the DB delivery approaches. The two approaches have fundamentally different perspective in risk apportioning and the processes followed are dependent on the delivery strategy adopted by the Authority. The phases and processes<sup>108</sup> employed, the governance structure setup and the management approach adopted also differ. However, given the fact that ERA only recently embarked on DB and its performance in that respect has not consolidated yet, this study concentrates on the DBB approach.

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<sup>107</sup>At times, particularly for bridge projects, the Authority may award both the design and supervision service contract to a single consultant.

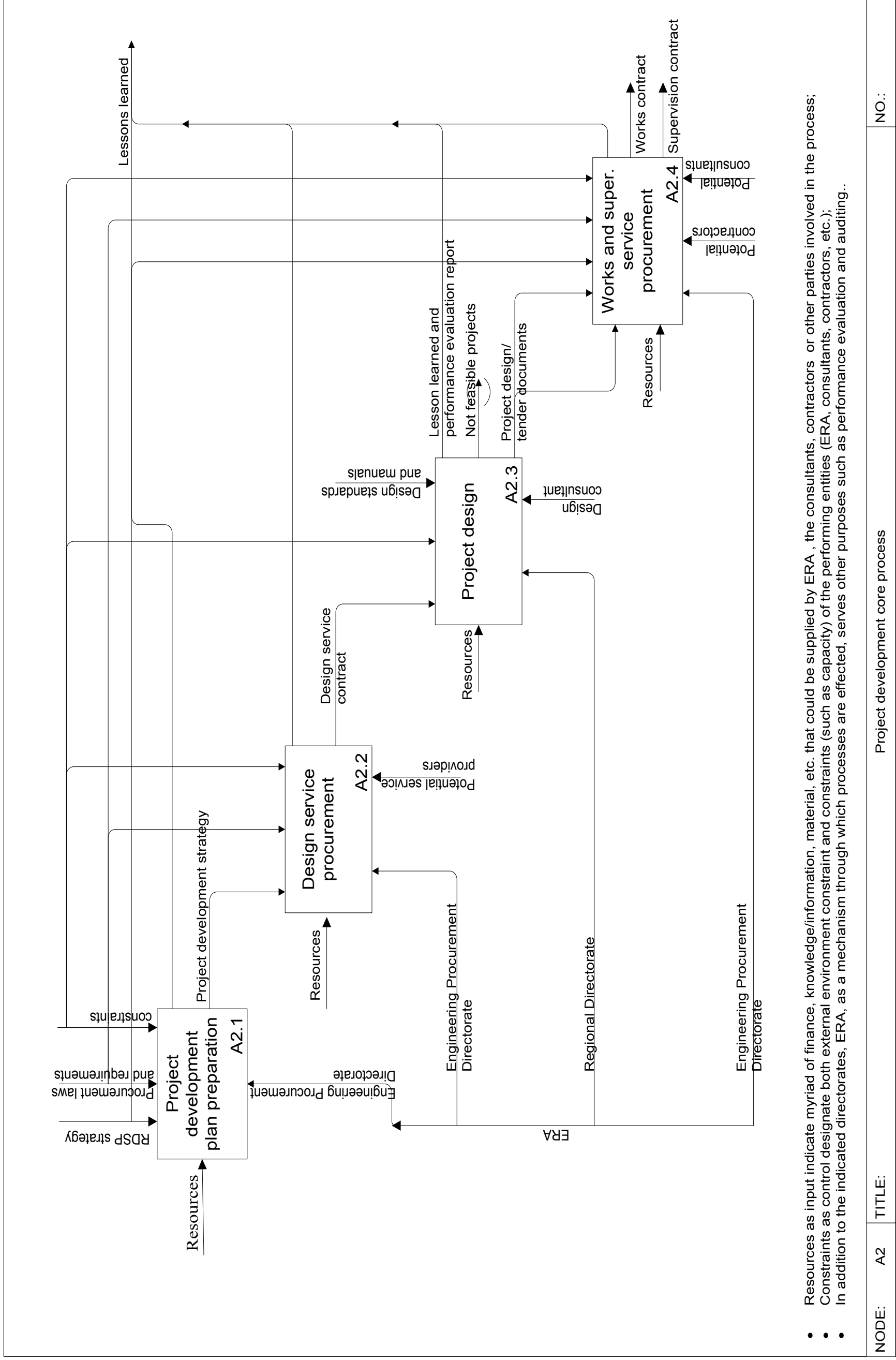
<sup>108</sup>One of the major features of the DB is that it merges the project development phase with the project implementation phase. Associated with this, therefore, for example, the Employer/ERA is not expected to conduct design service procurement separately from works procurement. In addition, the risks transferred to the contractor, obligations and rights of each parties, the governance system set, the power and mandates of each party and that of the supervision consultant are different from the DBB approach (see section 3.4.3 for detailed summary of the different delivery mechanisms used in construction).

Developed in IDEF0 format, Figure 5.7 presents the sub-processes under the project development core process for the DBB delivery. The major sub-processes are the devising of project development operation plan; service (design) procurement; the project design contract administration and works and service (supervision) procurement<sup>109</sup>.

Project development operation plan preparation takes the PDIS from the planning and programming core process and prepares project descriptions, procurement strategies and project schedules. The sub-process is effected in house by the Authority under the auspice of EPD.

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<sup>109</sup> In its most recent projects, ERA is pushing for Right-of-Way obstruction removal parallel with procurement for works and hand over an obstruction free roadway corridor to the contractor. However, this study associated RoW removal with the implementation phase as that has been the practice by the Authority over the years and the shift's benefits and effects has not been gauged yet.



- Resources as input indicate myriad of finance, knowledge/information, material, etc. that could be supplied by ERA, the consultants, contractors or other parties involved in the process;
- Constraints as control designate both external environment constraint and constraints (such as capacity) of the performing entities (ERA, consultants, contractors, etc.);
- In addition to the indicated directorates, ERA, as a mechanism through which processes are effected, serves other purposes such as performance evaluation and auditing..

NODE:	A2	TITLE:	Project development core process	NO.:	
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Figure 5: 7 Project development core processes

In addition to various constraints such as capacity of ERA, scheduling constraints, etc., the sub-process is controlled by the RSDP strategies for the project and the prevailing procurement laws and directives. The major output of the sub-process is a refined project development strategy.

The design service procurement sub-process involves the planning, management and execution of both expression of interest and procurement of design services providers. The major issues addressed involve drafting of documents to solicit Expression of Interests (EOI) and Request for Proposal (RFP), evaluation of EOIs and RFPs and award of contract. The major bodies that effect the sub-process are the EPD and the consultants that participate in the procurement. The sub-process is controlled by the project development strategy adopted and the procurement laws and guidelines. It is also constrained by various factors such as capacity and urgency. The major output of the sub-process is the design service contract.

From ERA's perspective, the project design sub-process involves the administration of the design service contract that involves performance monitoring and quality assurance. The major controls in effecting the sub-process are the design contract and design standards. The mechanism through which the sub-process is effected through outsourcing the product-oriented processes with ERA's Regional Directorate serving as the party that oversee their proper execution. The major outputs of the sub-process are the various designed reports, tender documents for the works contract and obstruction identification reports. As an output the process may also find out that the project is not feasible; in which case the major output will be the infeasibility report.

The works and supervision service procurement sub-process involves the planning, managing and execution of both works and supervision services procurement. The sub-process is controlled by the RSDP strategy (such as capacity building) and the relevant procurement laws and guidelines. The tender document of the previous sub-phase serves both as an input to and as a control of the procurement processes. The sub-process is effected internally by the EPD with the potential suppliers (contractors and consultants) playing the role of preparing and submitting tender documents and negotiating for contracts. The major final products of the sub-process are

the works contract and supervision service contract. The subsequent sections provide detailed description and analysis of these sub-processes as practiced by the Authority.

### 5.3.2.1 Sub-processes of the project development core process

The following sections present detailed description of the above identified major sub-processes of ERA's project development core process.

#### i. Project development operation plan preparation

The project development operation plan's main objective is to adequately scope each project received from the programming processes of the previous phase. The issues addressed include:

- **Contracting (implementation) strategy determination:** The ERA, as an organ of the state rearranged to concentrate on planning, management and regulation of the road sector (and not an executioner), outsources the product-oriented processes of project delivery. Consequently, depending on the specific nature of each project, the Authority determines contracting strategy for projects. At this stage, the contracting strategy decided upon is determining project delivery methods suitable for the specific project. The Authority notes that, the selection of the delivery strategy is primarily based on the criticality of time, degree of design development, ability and competence of market, client's sought distribution of risks and flexibility, availability of budget, project complexity, size and cost<sup>110</sup>;
- **Procurement and contracting strategy determination:** With no prejudice to Proclamation 649/2009 that sets the federal public procurement procedures and preferences, via Regulation 247/2011, the Authority is given the power to determine the procurement strategies it may adopt. However, generally in line with the preferred methods of procurement in the Proclamation, the Authority's most common method of procurement for works is open competitive bidding while the often used approach for procurement of services is the request

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<sup>110</sup> However, aside the assertion that it conducts its selection considering the said factors, up to now, the Authority does not have a formally developed objective delivery method selection mechanism. Neither the factors to be incorporated in the decision making nor their weightings are objectively identified and consistently implemented.

for proposal. In terms of evaluation criteria, the Authority uses the least evaluated bidder approach for works and quality and cost-based evaluation approach for services. At this stage of the process, therefore, the Authority determines the procurement approaches it intends to use in the procurement of the services and/or the works of the project. The Authority also decides on the contracting approach, contract management strategies and the issues related with the determination of different features of the contract<sup>111</sup>. Such issues as pricing techniques, risk apportioning, dispute management approaches, approaches to specifications (method-based or performance-based<sup>112</sup>), major deliverables and associated deadlines of the contract including contract duration are addressed here;

- **Developing project delivery schedule:** During the programming processes of the previous phase, a time tailored programme of projects is prepared. In this sub-process, therefore, as part of the preparation work of the project development operational plan, the project schedule of each project is reviewed and milestones of each are set in the schedule. Accordingly, the accomplishments of each project would be seen in line with this schedule – which by itself is extracted from the main operational plan developed by programming sub-processes of the previous phase;

## ii. Procurement of design services

The ERA procures different types of services such as network development, project development (design) and construction supervision services. Nevertheless, with the major differences being on the ToRs for the different service procurements, the Authority adopts similar processes for the procurement of the services. Consequently, the following processes and issues addressed, which are tailored for design service procurement, can be taken as the processes adopted for procurement of the other services as well. In regards to design service procurement, the major processes followed and issues addressed are:

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<sup>111</sup> Currently, for works contract, the Authority mostly uses FIDIC-based procurements and standard contract documents for international contracts and PPA-based standard bidding documents for national procurements.

<sup>112</sup> Generally, the Authority adopts a method-based contracting for construction, rehabilitation and upgrading projects while, at least in recent times, the Authority is adopting a performance-based contracting for maintenance projects.

- **Service procurement initiation:** This sub-process is informed by the outputs of the project development operation plan sub-process. In the event that the project development operation plan sub-process stipulates for procurement of services (for example separate design service procurement may not be needed for DB projects), this sub-process collects the basic information that would initiate the procurement and assignment of staff (team) who will deal with the project. In addition, the process includes preparing procurement schedules;
- **Expression of Interest (EOI) preparation, soliciting and evaluation:** In procurement of services, the Authority uses a request for Expression of Interest (EOI) to solicit interests for the services to be rendered by potential suppliers. This request provides prospective applicants with basic information about a given project so that applicants would express their interest in such a way that they have adequate experience and capability to render the service. The Authority uses a standard form of request for EOI that demands potential suppliers to indicate their experience in similar projects, company financial status, potential professional personnel to be assigned for the service and company establishment indicating facilities owned by the firm that are of relevance to the service. The Authority announces requests for EOI in media (and recently on its web site). The invitation is often open for any potential supplier that satisfies the eligibility criteria set. After soliciting EOI, the Authority evaluates the application and short-lists limited suppliers (usually from three to seven as stipulated in the Proclamation 649/2009) and invites them to submit their proposal for the service;
- **Request for proposal preparation and soliciting proposal:** Request for Proposal (RFP) is a document prepared by ERA that details the scope of the service; stipulates the contract requirements and defines conditions for tendering. Often the Authority uses a standard form of RFP<sup>113</sup> with adjustments for particular needs of a given project. The ToR portion of the RFP provides the objectives of the service; the scope of the desired services and the expected standard; experience and past performance required of the supplier; experience and competence of the key personnel to be assigned for the service and their expected minimum

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<sup>113</sup> A major change on the overall structure and content of the RFP is done at times, usually after a major review of the process or associated with changes in legislation (for example one was done in 2012).

level of input; deliverables and reporting requirements; governance structure for the service; service duration; etc. During this stage, the Authority, therefore, compiles its RFP document for the project, invites for proposal submission and oversees the processes for soliciting proposal;

- **Evaluation of proposal, negotiation and contract award:** For service procurement, the Authority uses a Quality and Cost-Based Selection (QCBS) approach. QCBS uses a competitive process among short-listed firms that takes into account the quality of the proposal and the cost of the service in the selection of the successful service provider. The proportion of quality and cost in the evaluation is skewed towards quality<sup>114</sup>.

ERA conducts the evaluation of the proposals in two stages: first the quality, and then the cost. The quality component of the evaluation generally consists of the consultant's relevant experience for the assignment, the quality of the methodology proposed and the qualifications and competence of the key staff proposed. The relative weight given for each is theoretically dependent on the nature and complexity of the service. However, the Authority, in its current practice, often allocates five percent for firm experience, thirty five percent for methodology and sixty percent for key personnel. The scores given to each section is determined by the responsiveness to the terms of reference. The Authority also sets minimum threshold for quality (often 70%) to be considered for the service. The financial proposal of only suppliers that passed the minimum threshold is considered.

After the evaluation, the Authority may opt to negotiate with the supplier that scored the highest technical-financial result combination - the 'successful bidder'. Excluding prices or issues related to prices, the Ethiopian procurement law (Art. 45 of Proclamation 649/2009) allows for negotiations on matters that affects performance of the service that are not dealt within the bidding document. Therefore, the Authority, as it often does, is free to negotiate with the successful bidder on issues of the ToR, the methodology, staffing, particular

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<sup>114</sup> The proportion is generally a function of the nature and complexity of the service which in turn dictates the importance of the quality of the service. However, ERA consistently proportions them as 80% for quality and 20 % for cost.

conditions of the contract, etc. However, it is accepted that these<sup>115</sup> discussions should not substantially alter the original ToR or the terms of the contract, lest the quality of the final product, to the point that the initial evaluation is rendered irrelevant. If negotiations fail to reach to an acceptable contract with the ‘successful bidder’, the Authority reserves the right to negotiate to the next ranked bidder or cancel the bid all together.

### **iii. Design service contract administration**

The design service procurement sub-process ends with an output of a service contract document that is transferred to the responsible Regional Directorate for follow up and implementation. In this regard, given that the actual product-oriented processes are executed by the contracted consultant, the major responsibility of the Authority is to administer the service contract and conduct reviews.

The detailed particulars of the contract administration processes are guided by the substantive and procedural requirements of the contract the Authority enters with the service provider. In general, however, the Authority follows a fairly standardized approach to the administration. ERA’s approach for design of roads is divided into two sub-phases of preliminary design that includes the route selection, feasibility study, Environmental Impact Assessment and Social Impact Assessment (EIA/SIA) and preliminary engineering design and final phase that includes the detailed engineering design work, resettlement action plan preparation and preparation of tender document for the works contract.

While the Authority conducts other issues such as monitoring of progress and effecting of payments, the major issues it conducts under this sub-process is review and comment of the various outputs. The Authority’s ToR specifies the requirements and contents of the various reports to be submitted. The ToR also specifies the duration, within commencement date, the draft reports are due. The major deliverables the Authority reviews under this sub-phase are inception report, route selection report, feasibility study, EIA and SIA reports, detailed specific

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<sup>115</sup> For the sake of transparency, fairness and impartiality public procurement laws are meant to achieve (Proclamation 649/2009) this requirement.

standard selection report, surveying report, preliminary engineering design report, soil and material investigation report, hydraulics investigation report, detailed engineering design report, quantity of works and cost estimation report, tender document, consultancy completion report. A summary of the major issues addressed under each of these reports is presented in Appendix 5.4.

In terms of monitoring and administration of the progress of the service, the Authority's ToR specifies the duration for the design services as well as the various milestones (of reports). In addition, often tied to submission of specified reports, the contract generally presents payment schedules for the service. The Authority, therefore, monitors both the financial and physical (based on reports and schedules) performance of the project. The contract demands the design consultant to produce a monthly progress report indicating the status of the project and works planned for the subsequent month.

#### **iv. Works and supervision services<sup>116</sup> procurement**

One of the major outputs of the previous sub-process is a compiled tender document that is used for works procurement<sup>117</sup>. Therefore, when ERA decides to initiate the procurement of works<sup>118</sup>, the Authority announces invitation for bid and uses this tender document in its works procurement processes. The major tasks conducted during this sub-process include:

- **Invitation for tender and management of the pre-tender submission phase:** In line with the Ethiopian Federal Public Procurement Law, the Authority conducts most of its procurement for works through open competitive bidding. The invitation for bid sub-process, therefore, handles the invitation process as appropriate. In addition, at this stage, the Authority handles request of explanations, pre-bid meetings, issuing of addenda, if any, etc. Generally, the procedures to be followed in conducting these tasks are set in the Instruction to Bids (ITB) and Bid Data Sheets (BDS) of the tender document;

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<sup>116</sup> The processes adopted in supervision services procurement are essentially similar to that of design service procurement and hence are not discussed here.

<sup>117</sup> The EPD reviews the draft tender document (particularly the conditions of tendering and contract parts) before final submission of the tender documents by the design consultant.

<sup>118</sup> Procurement of works could be delayed, particularly if budgets are not made available.

- **Tender soliciting, opening and evaluation:** The procedures to be adopted in tender opening and the evaluation criteria to be used in qualifying (under the post qualification tendering approach) and selecting the ‘successful bidder’ are presented in the ITB, BDS and Evaluation Criteria documents. Therefore, as per these requirements, the EPD solicits, opens and evaluates the tenders;
  
- **Negotiation and contract award:** The Authority may open negotiation with the ‘successful bidder’ on items that affect the performance of the project. As often noted in the Authority’s invitation for negotiation, the award of the contract is contingent on the outcome of the negotiation.

### **5.3.2.2 The governance of the project development processes**

#### **iii. The governance of the project development operation plan and design service procurement processes**

The project development operation plan sub-process is a process at phase transition whereby it receives the outputs of the planning and programming phase and kicks off the project development phase. In terms of governance, the process is administered by the EPD. For the design service procurement, which is also executed under the EPD, the directorate assigns a team to oversee the processes. The team then manages and coordinates the processes while it also communicates with responsible parties. However, while the assigned team leader (and a possible responsible engineer under the team leader) executes and manages most of the processes, proposal evaluation is normally done by a proposal evaluation team to be formed by EPD and award of contract has to clear the Contract Award Committee (CAC) of the Authority (also see below under works procurement).

**iv. The governance of design contract administration processes**

The transition from design service procurement to design service contract administration involves changes in directorates that oversee the two processes. After the service contract is signed, the EPD hands the contract to the concerned Regional Directorate and where the contract is ultimately handed to the assigned Regional Directorate's design and implementation team. The team leader of the design and implementation will assign a project engineer to serve as a focal point of the administration.

The responsible team, assisted by standards and checklists<sup>119</sup>, the contractual specifications (ToR), methodologies proposed by the consultant, the ERA's design manuals and standards, etc., conducts the review of the various outputs of the design consultant (or facilitates for the review of the documents by relevant directorates such as Planning and Programming Directorate for feasibility study). The team also regularly monitors and reports, generally monthly, the progress and cost of the service.

In addition to reviews of the major deliverables, the team is required to review the contract document and initiate for amendments if same is required, prepare checklists, comment on the consultant's programme, monitor and report status and progress of the service, respond/coordinate to respond to the consultant's and/or other stakeholders' requests, review and evaluate invoices by the consultant, conduct field visit as necessary, etc.

The Regional Director, at a higher level, oversees the progress of the service and looks after key issues and communications. Although most issues of the administration service are handled at the Regional Directorate level, some issues, such as variations may be needed to be handled by the Engineering Operations DDG, the Director General and /or financiers.

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<sup>119</sup> The Authority has produced quality control manuals for the various processes it executes, including for feasibility study and design (volume IV).

**v. The governance of the works and supervision service procurement**

After the design of the project is completed, the respective Regional Directorate hands over the tender documents prepared as part of the project design contract the Authority enters with design consultant to the EPD. In addition, the Regional Directorate provide progress reports and updates of the status of the design service for the particular project to the Planning and ICT DDG which in turn will plan its budgetary requirements for the project. The EPD then, in consultation with the Planning and ICT DDG for allocated budgets, embarks on the works and supervision service procurement process. At a general level, the type of procurement to be adopted is already decided in the Annual Operation Plan (AOP) and hence the EPD can embark on the procurement process of the specified procurement type. The EPD will assign one of the teams under it to oversee the details of the procurement processes. Tailored with project's master procurement schedule included in the AOP, the procurement team is expected to develop the project specific procurement schedule and effect the process.

In overseeing the procurement processes, the team is expected to follow standard documents, guidelines, standard letters, standard forms, checklists and other procedures that are mandatory and specified under Public Procurement Proclamation, the associated directive, financiers guidelines, etc. The team is also expected to adhere to quality control and assurance manuals recently developed by the Authority.

While most of the tasks under the processes are expected to be executed by the team and its members, some key issues are handled by the EPD director, the Engineering Operations DDG or even the Contract Award Committee (CAC). In this regard, for example, in bid opening, the CAC members are expected to be present and the CAC secretary is expected to facilitate the opening ceremony. In addition, selection of Tender Evaluation Team (TET) members, assessment of the evaluation of the TET members, etc. is conducted by either the CAC as a team, the CAC chairman or the CAC secretary. The award of contracts may pass through the hierarchies of the CAC, the DG and the Board.

### 5.3.2.3 Key problems of ERA's project development processes and their governance

The project development (design) stage of projects is the stage where the requirements of the client are identified, constructive aspects are explored, the standards of quality are defined and are compiled through design reports, drawings and technical specifications. The stage involves complex multidisciplinary processes involving many parties and performed in a series of iterative steps (Ogunlana *et al.*, 1998; Baldwin *et al.*, 1999). It incorporates key processes that define up to 70% of the final product's cost (Kochan, 1991).

Nevertheless, notwithstanding their importance, the design processes have been claimed to be one of the most neglected<sup>120</sup> areas (Koskela *et al.*, 1997) that made the design stage mostly 'black box' and 'ill-defined' (Austin *et al.*, 2007:2) in the project delivery processes. Bibby (2003) summarizes the major problems of the design approaches currently being practiced as a) low attention for design in planning manifested by low priority in schedule; poor understanding of information flow and discipline dependency and unbalanced resource allocation; b) poor integration of design and construction as well as the different disciplines during the design phase manifested by design not tailored to site conditions and having constructability challenges (Arditi *et al.*, 2002); different disciplines working in 'silos' and communicating 'over the walls' (Anumba & Evbuomwan, 1996) and at times even taking adversarial positions (Kalay *et al.*, 1998) that creates integration problems (Karhu and Lahdenpera, 1999); c) poor information management such as relay of wrong information, delay in information and overloading with unnecessary information, deficient analysis and wrong decisions that may result in potential waste ( and total construction costs) due to rework (Huovila *et al.*, 1997; Love *et al.*, 2000) and design changes that consume considerable proportion of the designers total work hours (Koskela, 1992).

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<sup>120</sup> Due to clear and realizable advantages to be gained in improving performance on site (in implementation) and the relatively small cost of design (Austin *et al.*, 1993); developers or contractors see the investment in design as risk capital (Heath *et al.*, 1994). This is among the reasons cited for design being neglected.

Love *et al.* (2009) and Love *et al.* (2012) argue that pathogenic practices<sup>121</sup> such as recycling design details, specifications and other contract documentation and following slack practices such as rushing/avoiding audits, checks, verifications, and reviews prior to releasing documentation for subsequent consumption as major pathogens that lead to errors and omissions. Fragmentation of the various disciplines that are involved in design and the personnel<sup>122</sup> working in ‘silos’ and non-collaborative and uncoordinated design processes exacerbates the problem as errors may go unnoticed until late downstream. Similarly, summarizing from the literature on studies in various construction industries Lopez *et al.* (2010) categorized major causes of design errors and omissions under personal (loss of biorhythm- combination of physical, emotional and intellectual mental state and adverse behavior), organizational (inadequate training/inexperience, ineffective utilization of automation, inadequate quality assurance, competitive professional fees), project (client/end user issues, time constraint, ineffective coordination and integration and inadequate consideration towards constructability).

With the recognition of the importance of design (Kochan, 1991) and the appreciation of the consequences of faulty/poor design (for example, Love *et al.*, 2000) there are attempts to combat the above challenges. One of the approaches being pursued is the concept of design management. Design management, a closely aligned discipline to project management, separates the management of a project’s design from the design itself<sup>123</sup> (Gray and Hughes, 2001). It involves the planning, coordinating, controlling and monitoring of design processes and design resources while interfacing with other project phases and (external) parties. The application of concurrent engineering (Ballard & Koskella, 1998) and lean construction principles (Huovila *et al.*, 1997) along a shift towards integrative collaborative design (Austin *et al.*, 2007) are being prescribed for design and design management. Approaches such as value management along with effective

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<sup>121</sup> Busby and Hughes (2004) categorized project pathogens under: Practice - arising from people’s practices, Task - arising from the nature of the task performed, Circumstance - arising from the situation or environment the project is being implemented. Organization - arising from organizational structure or operation, System - arising from an organizational system, Industry - arising from the structural setup and norms of the industry and Tool -arising from the technical characteristics of tools.

<sup>122</sup> For example see foot note 131 for how many key professionals the ERA’s ToR demands to get involved in road design projects.

<sup>123</sup> Related with this, a while ago, Markus and Arch (1973) pointed out that, in a categorization that parallels the PMBoK’s product-oriented and project management processes, design processes can be categorized into two patterns. Those consisting of individual decision making processes which are concerned with the creation of alternative solutions and those consisting of management process which can be called design management

use of associated tools such as quality function deployment (Clausing, 1994) and process mapping (Chao *et al.*, 2004) as quality assurance, life cycle analysis to optimize along the product life span, constructability analysis to reconcile the design to the potential situations on site and environment (Arditi *et al.*, 2002), collaborative design to effectively coordinate the design processes, outputs and professionals involved in the design (Austin *et al.*, 2007) along with effective use of information technology (Ballard & Koskella, 1998) are among the principles, techniques and tools recommended to improve the design processes and their outputs.

In ERA's projects, problems associated with the project development core processes and the outputs they deliver are identified as one of the major issues that are affecting the Authority's project implementation phase. For example, the World Bank's evaluation (World Bank, 2012) of the eight projects financed by the Bank under its Adaptable Programme Loan (APL2) indicates that, at completion, the APL2 financed projects experienced 330% (average) cost increases from the appraisal stage and were delayed by 2-3 years from original (works contract) completion date. The report indicates that a significant part of (85% including price adjustment - which is also aggravated due to the design related delays) the additional cost can be associated to poor estimation at appraisal and flawed design due to which the scope of the works contract had to be changed significantly. The report reveals that the additional cost was used to address the gap between appraisal and contract bids<sup>124</sup> that was created due to unrealistic estimate at appraisal (although price escalation between design and bidding time also contributed) and later due to design changes, variation orders and price adjustments..

Similarly, a study on ten projects implemented by the Authority (Tsegaye, 2009) indicates that errors in estimation of quantities, inadequate subsurface investigation and interpretation, poor material investigation and interpretation, inadequate/inaccurate topographic survey data, lack of

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<sup>124</sup> The lowest evaluated bids were higher than the engineer's cost estimates (lowest bid at 150% of engineering estimate) and the client eventually rejected four of the bids and chose to retender the contracts as the received bids were higher than both the budget and the engineer's cost estimates. Long time gap between completion of design (estimation) and bidding is also said one source contributing to the significant discrepancy. In addition to design related problems, the literature note optimism bias (Kahneman and Tversky, 1993) including Everything-Goes-According-to-Plan principles (World Bank, 1994) economic and political reasons to strategically misrepresent appraisal of projects (Flyvbjerg *et al.*, 2002) in underestimating of cost and duration and/or overestimating of benefits (as well as misrepresentation of risks) as major causes of discrepancies. These causes could also be presumed to have contributed to the cost discrepancy, particularly given that, in this particular case, benefits forecasted at appraisal for some projects had to be significantly downgraded in evaluation after completion.

design details, omission of works, change of alignment, poor specification, poor drainage assessment and additional works from local administration as the major causes of variation orders during implementation of the projects. These causes, aside from the interrelated issues of additional work requests by local administration and change in alignment<sup>125</sup>, are all directly related to poor/flawed design.

Cognizant of the problems associated with design and works tender documents it uses for contractor procurement, the Authority has taken the initiative to re-assess its project development approaches. In this regard, dispatching a circular in May 2011, the Authority expressed its serious concerns about the quality of design processes and outputs as well as concerns on unethical practices (particularly in supervision). Consequently, the Authority is seeking accountability from the resource base and has taken an administrative measure of debarring some firms and professionals from participating in future tendering for specified period. In parallel, the Authority has devised consultant performance monitoring and rating system meant to 'objectively assess the consultant's performance and provide them opportunity for improvement'. In addition, the Authority, as also recommended by the World Bank's evaluation of its APL2, is modifying its approach by having panel of experts to review the outputs (and processes) of the design consultant and has started to apply the approach on selected projects. Currently, the Authority is undergoing a 'modernization' programme that is also focused in improving, among other areas, its capability in managing the design processes. In addition to the Authority's noted negligence and slack performance, most of the above issues such as overload of design professionals, poor cooperation and collaboration between design professionals, inadequate consideration of constructability, competitive fees (which leads to compromise on quality and due effort), etc. can be argued to contribute towards poor design by the resource base.

The following section addresses the major issues associated with the Authority's approaches and their drawbacks as compared to 'accepted' practices. In view of stereotyping it with the conceptual framework developed in chapter two, in this analysis, the issues associated, including

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<sup>125</sup> Even these causes of variation orders can be argued to be addressed during design with appropriate consultation with local authorities. In addition, local authorities request is only one cause of change in alignment.

the drawbacks, with the project development core process are categorized as those associated with the processes, governances systems and the environment. Inferring from the Authority's recent actions, the crucial factors contributing to the problematic outputs are the resource base's capability and commitment to implement the provisions of the ToR. Nevertheless, as noted above, for the sake of scope delimitation, this study did not address the resource base's capability and commitment in effecting the processes. Besides the resources base's slack practices, however, the design and implementation of the processes and their governance system as well as the Authority's inability to implement the checks-and-balances that are implemented in the system devised are affecting the process's output. In addition, the challenges induced by the environment also have a telling effect on the quality of the output.

**i. The processes**

*a. The preparation for and design service procurement processes*

In procuring design services, ERA generally follows international institution accepted processes. In this regard, the Authority's major procurement document, the Request for Proposal, is generally similar to the World Bank's Standard Request for Proposal (for services) (World Bank, 2004). In addition, the Authority normally adopts similar qualifications requirements to the World Bank's, the African Development Bank's and FIDIC's (World Bank, 2002, AfDB, 2008, FIDIC, 2011) while following comparable tendering and qualification processes. Nevertheless, although the Authority generally follows the above institutions' procedures, it fails to properly adapt the standards to the needs and peculiarities of its projects. Some of the key areas that Authority's practices are lacking are:

- The Terms of Reference (ToR): Most of the provisions of ERA's ToR stipulate the required features of the product-oriented processes and the products delivered and hence detailed analysis of same is beyond the scope of this work. Looking from the project management processes point of view, there are some problems which may compromise quality and affect performance. In this regard, firstly, the Authority generally uses a standardized ToR. The ToR is generally uniform in terms of the duration of the service, the characteristics of the service sought, key personnel requirements for the service, etc. without tailoring to the

specific scope, complexity, novelty and other features of the project. Related with the quality of the service to be rendered, the ToR normally stipulates previous (firm) experience on similar assignments, methodology to be adopted in rendering the service, and key personnel proposed for the service as major requirements for quality assurance<sup>126</sup> and the Authority uses same as its major evaluation criteria. Nevertheless, although such standardized approaches will help to standardize the services to be rendered, the ToR should be appropriately tailored to the particular features of the service sought. In addition, in terms of the requirements of the ToR that relates to the methodology of the service, however, the literature (Huovila *et al.*, 1997; Ballard & Koskella, 1998; Hauser and Clausing, 1998; Arditi *et al.*, 2002; Austin *et al.*, 2007) recommend new approaches to design such as concurrent engineering, collaborative design, life cycle appraisal with associated use of techniques such as quality function deployment, process mapping, reference class costing, constructability analysis<sup>127</sup> as ways of improving the design quality.

Related with this, one of the deliverable requirements of ERA's ToR is engineering cost estimates. However, the conventionally used cost-based estimating<sup>128</sup> that is used for appraisal and budget allocation (before bid) purpose (and often to compare bids) is found, internationally, seriously flawed due to optimism bias and strategic misrepresentation of project appraisers. In this regard, the cost benefit forecasting of infrastructure projects is heavily criticized in a series of seminal work by researchers from Denmark (Flyvbjerg *et al.*, 2002; Flyvbjerg *et al.*, 2005; Flyvbjerg *et al.*, 2006; Flyvbjerg *et al.*, 2009). The core point of the criticism is that, the currently existing appraisal of transport infrastructure projects is consistently affected by optimism bias and strategic misrepresentation thereby the appraisal not representing what would actually transpire in implementation. Following the highlighting of these critical flaws of the existing practice, prominent planning agencies (for example American Planning Association 2005) and government financing branches (for example United Kingdom's HM Treasury, 2003) are recommending for engineering estimates to be

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<sup>126</sup> The study did not address the experience and competence needs of such services. Therefore, comments in regards to these issues are not qualified to be made.

<sup>127</sup> The ERA's ToR actually stipulates checks for compatibility (with actual site condition) at completion of design, but it does not amount for full constructability analysis and often not implemented in practice.

<sup>128</sup> Mochtar and Arditi (2010; 2000) distinguish cost-based estimating and price-based estimating and argue in favor of the latter due to its consideration of market attributes.

augmented by reference class forecasting<sup>129</sup>. The ERA's ToR does not actively foster any of such 'recommended' approaches towards engineering cost estimation<sup>130</sup>;

- Screening and qualification of firms: The Authority uses the major international financing institutes' generally preferred<sup>131</sup> (World Bank, 2002, AfDB, 2008) approach of quality and cost-based selection of service suppliers. In this approach (see section 3.4.5 for more), quality is given the major weight for selection with cost mainly used as judiciary for comparable technical proposals. In practice, however, analysis of the Authority's service supplier procurement reveals that the marks for methodologies part of the evaluation appear to segregate along a common mark. This would create two fundamental problems: 1) with methodologies being the service provider's declaration of the approaches for the service, not rewarding it congruently does not foster innovative approaches for design and design management; 2) with the pool of professionals in the area limited (and hence most bidders submitting same professionals for key positions), segregating evaluation of methodology around a common mark deprives the Authority the range for quality evaluation of service providers. This is mainly because, despite the Authority allocating a significantly skewed weighting for technical proposal (often 80% technical, 20% financial), the Authority's evaluation of the technical proposal will segregate around common marks thereby effectively making the evaluation competition on financial offer. Nevertheless, studies abroad show that, when design consultants' services are procured through competitive tendering where fees are reduced and the quality of the services offered is restricted (Winch and Scheider, 1993). In this regard, Love *et al.*, (2009) argue that when design is constrained by strict time<sup>132</sup> and cost parameters, design consultants compromise on the design approaches (such as through short cut) and trade-off the future risk posed against fee maximization;

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<sup>129</sup> Reference class forecasting is a forecasting approach that predicts the potential cost of the planned project based on actual outcomes in a reference class of similar projects to that being forecasted. It takes 'the outside view' of comparing with other similar projects and involves finding comparable projects (broad enough to be statistically meaningful), establishing probabilistic distribution to the reference class projects' outcomes and establishing the likely outcome of the project being forecasted.

<sup>130</sup> Related with this, when contingencies are allowed in estimates, the ERA normally allocates about 10% contingency. While this percentage could be a reasonable one with detailed cost estimating for the construction stage (AbouRizk *et al.*, 2002), in principle, the contingency to be allotted should be contingent on the risks and possible changes anticipated.

<sup>131</sup> However, for example, FIDIC (2011) advises the use of quality-based selection as the preferred option.

<sup>132</sup> For example the World Bank (2012) review on the causes of poor design in its APL2 projects identified not enough time allocated for design as one cause.

- Duration of services: The ERA's ToR for design services normally stipulates similar service duration (often 10/12 months) and man- month of the key personnel (although only the minimum input is set) irrespective of the scope and complexity of the service. This approach naturally offsets the proportionality of effort (and duration) needed against scope and complexity of the service. Therefore, while the ToR only sets minimum requirements (for man month) and the supplier is free to make adjustments beyond that as needed, the practicality matter of competition normally dictates compliance to the minimum required and consequentially may compromise the quality of the design process. Parallel with this, the Authority generally uses a uniform weighting factor (in evaluating qualification) irrespective of the project scope<sup>133</sup>. However, while such an approach could be valuable for standardization and can be used for projects with comparable complexity, the use of universal weightings for the final selection process may not be appropriate, as the service to be rendered is 'invariably influenced by the client and project requirements' (Ng, and Chow, 2004:151);

In general, the ERA's ToR has key drawbacks and does not particularly focus on some of the issues identified as critical success factors in design quality improvement. In this light, for example, Love *et al.* (2012) identified key contributors of rework (due to design problems) as the degree of compression of the design schedule, extent to which design audits, reviews and verifications is undertaken, extent of completeness of drawing and bills of quantities, extent of design coordination, resource availability, extent to which design constructability check is undertaken, extent of staff workplace stress, competitive tendering of design consultant services. As presented above (and below), these are also the major drawbacks of the Authority's ToR or design management practices.

*b. The design management/ service contract administration*

While ERA monitors the design processes and conducts design reviews, its approach is geared towards monitoring progress and deliverable deadlines rather than ascertaining quality of

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<sup>133</sup> Both the World Bank (World Bank, 2002) and the African Development Bank (AfDB, 2008), for example, only suggest ranges - presumably to be fixed, within the range, for individual projects based on the project characteristics and employer's needs.

deliverables. Although the system (both the ToR in the service contract and the Authority's project development core process) sets that the Authority will monitor the development processes and conducts gate and deliverable reviews, the Authority lacks the resources (both capacity and competence<sup>134</sup>) to effectively discharge these reviews. It is argued that (World Bank, 2012) given the twin factors of the Authority's high turnover of staff in the areas it is thought to possess the expertise (at least from its structure) and that it may not be structured and staffed to have the expertise at all, makes the reviews conducted by the Authority unreliable. Consequently, the Authority's review of deliverables is mainly of procedural rather than of substance. In this regard, while, as a matter of principle, it is the responsibility of the resource base to produce a quality output, the Authority's recent move towards having panel of experts (which could also be done by independent firms experienced in the area) review the design processes and outputs would enable in having a thorough review of the processes and outputs. Although the Authority is adding extra expense in looking for external reviews, the values gained in having the thorough review and corrections taken before contracting for works could offset the fees the Authority has to pay for the review.

*c. The supervision service and works procurement sub-processes*

Similar to service procurement, in general, ERA's approach to works procurement is comparable to major international institutions' approach (for example World Bank (2011) and FIDIC (1994)). In this regard, with some adjustments to suite the Authority's particular needs for example in evaluation criteria set, the procedures adopted are generally in line with the above international institutes' standards. Nevertheless, the implementation of the processes has some drawbacks:

- Selection of project delivery approach: Mainly spurred by the problems associated with design, the Authority, in recent times, has started to use the DB delivery approach as an alternative to the conventional DBB it has been using for long. However, with only two DB

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<sup>134</sup> For example, while the Authority's ToR stipulates qualification and competence requirements of highway engineer, hydraulic engineer/hydrologist, structural engineer, material engineer, geotechnical engineer, contract engineer, transport economist, sociologist, environmentalist and surveyors as part of the consultants offer, the Authority lacks the expertise to review many of the outputs of these professionals.

project<sup>135</sup> completed when this study was made, comparison between the two options in terms of performance criteria the Authority sets is not available. Nevertheless, as argued in the literature (see Table 3:1) in chapter three, there are key factors associated to the market (availability of competition), the project (less risky, well defined client performance needs) and the coalition (well qualified) that makes DB more attractive than DBB. However, rather than basing on analysis of these factors, the Authority's selection of delivery strategy appears to heavily concentrate on post contract risk aversion (due to the faulty design if DBB is used). Nevertheless, in the absence of the above noted major factors, the DB approach is argued to be prone to opportunism, and with the check-and-balance in the DBB approach not available and what is required is performance, it is susceptible to quality compromise.

In this regard, therefore, the Authority has experience on only two delivery approaches. However, contingent on the major dictating factors (including the currently existing procurement laws), the Authority may gain advantage in fostering other delivery approaches such as construction management, serial tendering, lane rental, as well as use the DBB as appropriate to the situation. In this regard, for example, construction sector studies in other countries such as Egan (2002; 1998) and Latham (1994) in the UK, the Construction Industry Institute (CII, 1989; 1991) in the USA suggest partnering and integration of supply chain as one of the major recommendations to improve construction sector competitiveness and value creation for clients. Therefore, it could be advantages to the Authority to look into partnering and how it could be transcended with public sector's responsibility of equitability and responsibility in creating opportunities. As a subset of partnering, public private partnership have emerged as one of the dominant form of infrastructure delivery (AECOM, 2005) and being pursued by various governments as an infrastructure delivery approach (Kwak *et al.*, 2009). Exploring its applicability may also give the Authority an opportunity, among others, to relive funds to finance projects;

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<sup>135</sup> Hargele- Dolobay- Dolo Odo and Alamata-Mehoni-Hewane Road Projects

- Supplier selection: The Ethiopian law makes preference to single-stage post qualification open competitive bidding for works procurement<sup>136</sup>. In addition, for supplier selection, the Authority normally uses the least-evaluated bidder approach. Therefore, in works supplier selection, save for the eligibility and qualification requirements, the sole selection criteria the Authority uses is price. In addition, save for some recent approaches towards performance and output-based (its DB and maintenance contracts for example) contracting, the Authority normally uses a method-based approach to specification. These approaches, as discussed in chapter three, have been found ineffective as they do not lend to optimization between the time-cost-methodology for the contractor and, at times, the least bidder approach results in low bidding<sup>137</sup> from incompetent or out of job suppliers. The recommended counteract, as discussed in the chapter three, is multi-criteria selection of suppliers;
- Construction contract time determination: The Federal Highway Authority (FHWA, 2002) of the US notes that contract time for the implementation of highway projects should be reasonable. It argues that if time is insufficient, bid prices may be higher and there may be an unusual amount of time overruns and contractor claims while, on the contrary, if the time allowed is excessive, in addition to inconveniences to road users as well as loss on potential saving on vehicle operating cost and early potential benefits accrues, there may be cost inefficiencies as well as pushing projects into more expensive time zones. In the wake of this, the FHWA suggests that contract time durations should be determined with due consideration of scope of work and scheduling based on established productivity rates and scheduling techniques. The ERA's project (implementation phase) contract time determination is a standardized approach contingent on the stretch length of the road without doing detailed scheduling based on scope of the particular project and adaptation to its peculiarities and resource demands. This approach is prone to the problems noted above;
- Selection of mode of payment: For works contract of the DBB projects, the Authority uses unit price and admeasurement (post work measurement) based payment. As noted in chapter three, this approach has the major advantage of paying for what is actually executed.

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<sup>136</sup> In general, public procurements are expected to be founded on the basic pillars of competition, value for money, fairness and equal opportunity, transparency and efficiency (UNOPS, 2012).

<sup>137</sup> In this regard, many construction sector recommendations (for example Strategic Forum for Construction in the UK (Egan, 2002) and CESA procurement guideline (CESA, 2011) in South Africa) advise against the least bidder approach.

However, the approach demands clear stipulation of specifications, methods of measurement and bill items. In this regard, analysis of claims submitted to the Authority normally reveals that claims based on vague specifications, method of measurement and/or problematic bill items are common, thereby affecting the effectiveness of the payment mode and opening room for opportunism. Related with this, the mode of payment for supervision consultancy is time-based. The time-based mode of payment, coupled with the Authority's practice that supervision service contracts will be extended if the works contract is extended<sup>138</sup>, does not give any incentive, from the supervision consultant's side, for expedient completion of projects;

- For supervision consultant procurement, ERA's ToR normally stipulates that the consultant renders both technical (engineering) and project management services for the proper execution of the works. In this regard, in essence, the supervising consultant, as the ERA's representative on site, is the project manager. Indeed, in recent contracts practiced in other countries (for example, in New Engineering Contracts in the UK), the supervising consultant is taken as the project manager managing the contract to achieve the employer's overall objectives and the supervisor monitoring the work with the aim of ensuring compliance with the contract (Eggleston, 2006). Therefore, the supervising engineer is expected to have the competence and experience of the project manager<sup>139</sup> to effectively oversee the supervision of the project implementation. The Authority solicits methodologies, work plans and organization structures that the service provider is going to adopt in its execution of the service. In addition, the ToR stipulates the minimum specified input of key personnel for the service. In this respect, as noted above, while the educational and experience requirement of the key personnel generally is that of technical requirement, the ToR does not give emphases for other project management skills.

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<sup>138</sup>However, starting from 2013, ERA has started terminating existing supervision contracts (and replacing supervisors) after the contract period.

<sup>139</sup> Drawing from an extensive review of the literature, Krüger *et al.*, (2007) summarize the project management competence and experience needed of a construction consultant in the capacity of project supervisor.

**ii. The governance (management) of the processes**

In regards to governance of the design processes, structure wise, Gray and Hughes (2001) note that while there needs to be a single point of responsibility to control the production of and compilation of design information, design management is the responsibility of the whole project team. This approach is a similar structure to the Mintzberg's (1980) professional bureaucracy where most of the power and responsibility lies among the operating core. The professional bureaucracy approach to organization structure is a loose structure which concentrates on the outputs of the operating core (the professionals) without major emphasis on the strict follow up of the procedures adopted. Mintzberg (1981) suggests that the professional bureaucracy is suitable for stable but complex environment.

In this regard, it can be argued that ERA also follows a professional bureaucracy in its design management structure. The Authority's ToR demands the resource base to establish its governance structure, with the team leader as the hub of communication, while the Authority oversees the projects through the assignment of a counterpart project engineer. Nevertheless, as it is practiced, most of the responsibility of the different components of the design lies on the different professionals assigned for the respective component of the design.

However, even for professional bureaucracy, the Authority's approach to the management of the design processes is too loose. In this regard, for example, aside from the specified duration on delivery of the various reports (which the various professional produce), the Authority's ToR does not specify the level of coordination, collaboration and communications (such as face to face discussions) needed by the various professionals<sup>140</sup>. Nevertheless, as noted in the above sections, such approaches towards a cooperative and collaborative design are argued as the means to counteract the working 'in silos' and communicating 'over the walls' approach in design and the negative consequences the practices create.

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<sup>140</sup> Dispatching a circular to its consultants that at the time are working on design projects, in September/October 2014 (around the time this study is completed), ERA requested, among others, regular meetings between the professionals to discuss potential problems and update the design status.

In terms of work load and actual management of the processes and resources, although the Authority<sup>141</sup> stipulates the man month requirements of each key personnel in the service, given that professionals work in multiple projects; it is, at times, illogical to expect the man months<sup>142</sup> be fulfilled in the delivery of the service. In this regard, a study by Love *et al.* (2009) indicates that excessive workload can contribute to the recurrence of errors that arises due to designer's greater propensity to commit procedural violations. On the other hand, however, assigning not experienced personnel, who could help in relieving the load on experienced personnel, also has similar effect on design quality as incompetence to conduct particular roles is a factor that contributes to errors in design and documentation (Sunyoto and Minato, 2003).

In terms of the follow up and monitoring of the processes, the Authority's approach concentrates more on progress rather than performance. In this light, while the Authority follows progress through reports and cross checks for performance (particularly quality performance) through review of documents produced, the Authority, as noted at various places, lacks the capacity and competence to properly evaluate the quality of the outputs produced by the resource base.

### **iii. The environment (context)**

In construction project delivery processes, it can be argued that, while the implementation phase of a project is relatively capital intensive, the project development phase, as the phase that is most associated with innovation and engineering, is more knowledge-driven where intellectual

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<sup>141</sup> From conjecture, it can be argued that the construction industry in Ethiopia is among the relatively high paying industry- particularly for professionals. However, professionals may value themselves in comparisons with their peers on international works (both locally or moved to other countries) and seek to improve their income through increase of work load. This, coupled with design fees being relatively small when compared to international projects, can be argued to force the local professionals to seek 'feeling the gap' through over loading.

<sup>142</sup> In this regard, for example, the Authority normally demands full duration of service availability for the team leader which implies that the team leader may not be involved in any other project. However, in practice, a given team leader could be working in more than one project (even on those projects where the Authority itself is the employer). However, again a recent development (2014), the Authority appears to move towards limiting the number of projects a given professional may be working on at a given time.

<sup>143</sup> In addition, generally, although some procurement standards (for example World Bank's) do not allow to substitute key staff, unless some specific circumstances dictate, it is presumed that what is required is the attributes and not the specific personnel proposed in the contract. In this light therefore, it is generally accepted that the consultant could replace the personnel with another personnel that satisfy the needed attributes. However, there are also some studies that indicate (Chapman, 1999) that personnel change, particularly late personnel change after commencing their works in the service, as cause of design quality compromise.

capital underpins better performance. However, in Ethiopian context, both the national business context and construction industry can be argued to be low in knowledge base and competitiveness when compared to developed nations' businesses and construction industries. Ethiopia is a developing country which, when compared to developed nations, does not have big accumulated knowledge base and experience in planning, designing and implementing projects<sup>144</sup>. In addition, as discussed in chapter one, Ethiopia's construction industry (and the general economy) has undergone frequent upheavals and re-arrangements that could also potentially hamper its ability to create a stable industry and build on accumulating capacity and knowledge.

Furthermore, the ERA complains (for example through its letter that demanded design accountability ERA, 2011)) that professional negligence by individuals and firms alike are the major cause of poor design. This implies that, notwithstanding the fact that the Ethiopian law (Art 2636 of the Civil Code) obliges professionals to carry out their jobs with due diligence, standard of care and good trade practice; the industry has developed a slack norm. Rather than taking professional practices as a source of pride and professionalism and professional certifications<sup>145</sup> as symbol of achievement and assurance of quality, the industry has taken the path that view such practices just mere source of income generation and the professional certifications mere administrative burdens and procedures.

In this light, therefore, the cumulative knowledge base, the normalized professional standard practices and work ethics, the accountability demands, etc. can be argued to be not matured when

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<sup>144</sup> For developed nations, in post-industrial economies, knowledge and innovation has emerged as the major determinant of competitiveness and source of national growth and development thereby making knowledge as the most important strategic resource and learning the most important capability (Zack, 1999).

<sup>145</sup> Related with this, internationally both engineering education and professional practices are accredited by professional bodies by identifying the competencies needed and establishing a rigorous certification of the compliance for those competencies. In Ethiopia, engineering education (by Higher Education Relevance and Quality Agency – HERQA) and engineering professional practices (by Ministry of Urban Development and Construction - MoUDC for both individuals and firms) are accredited and certified by the state organs through satisfaction of requirements taken as procedural rather than thoroughly established competence criteria and correspondingly put accreditation and certification mechanism. However, professional engineering certification is, as put by the National Society of Professional Engineers (NSPE) of America, both 'a symbol of achievement and assurance of quality' that comes with a responsibility whereby professional engineers 'shoulder the responsibility for not only their work, but also for the lives affected by that work and must hold themselves to high ethical standards of practice' that should be issued through a thorough qualification and certification rigor.

compared to similar industries in developed countries. This has a vicious negative consequence on the performance of design of projects.

#### **5.3.2.4 Key factors that influence ERA's project development performance**

ERA's project design is affected by various factors that could be associated with the processes of delivery, the governance system, the capacity and competence of the resources and the environment. Figure 5.8 below presents a causal diagram of the key factors that influence ERA's design output and works tender document preparation.

The quality of the main output of this core process, the works and supervision service contract, is affected by the works/service procurement processes, the availability of competent suppliers and the quality of the design document itself. The works/service procurement processes in turn are affected, internally, by the Authority's manuals, standards and norms in planning and effecting its procurement processes and the Authority's capability and the resources used in effecting these processes. Externally the processes are affected by the regulatory frameworks and directives that govern and guide public procurements that are supplied by the environment. The availability of competent suppliers is an environmental force to ERA's delivery system and is generally influenced by both the industry and the national business context.

The quality of the design document that defines the scope of the works is affected by the availability and adoption of appropriate design manuals and standards, the quality of the design service contract in stipulating the required resources, processes and outputs, the competency and capability of the design consultant and the personnel assigned in executing these processes, the work load on the service consultant and personnel assigned as well as the design philosophy and the management system adopted by the service consultant. It is also influenced by ERA's capacity in conducting appropriate contract administrations and design deliverable reviews.

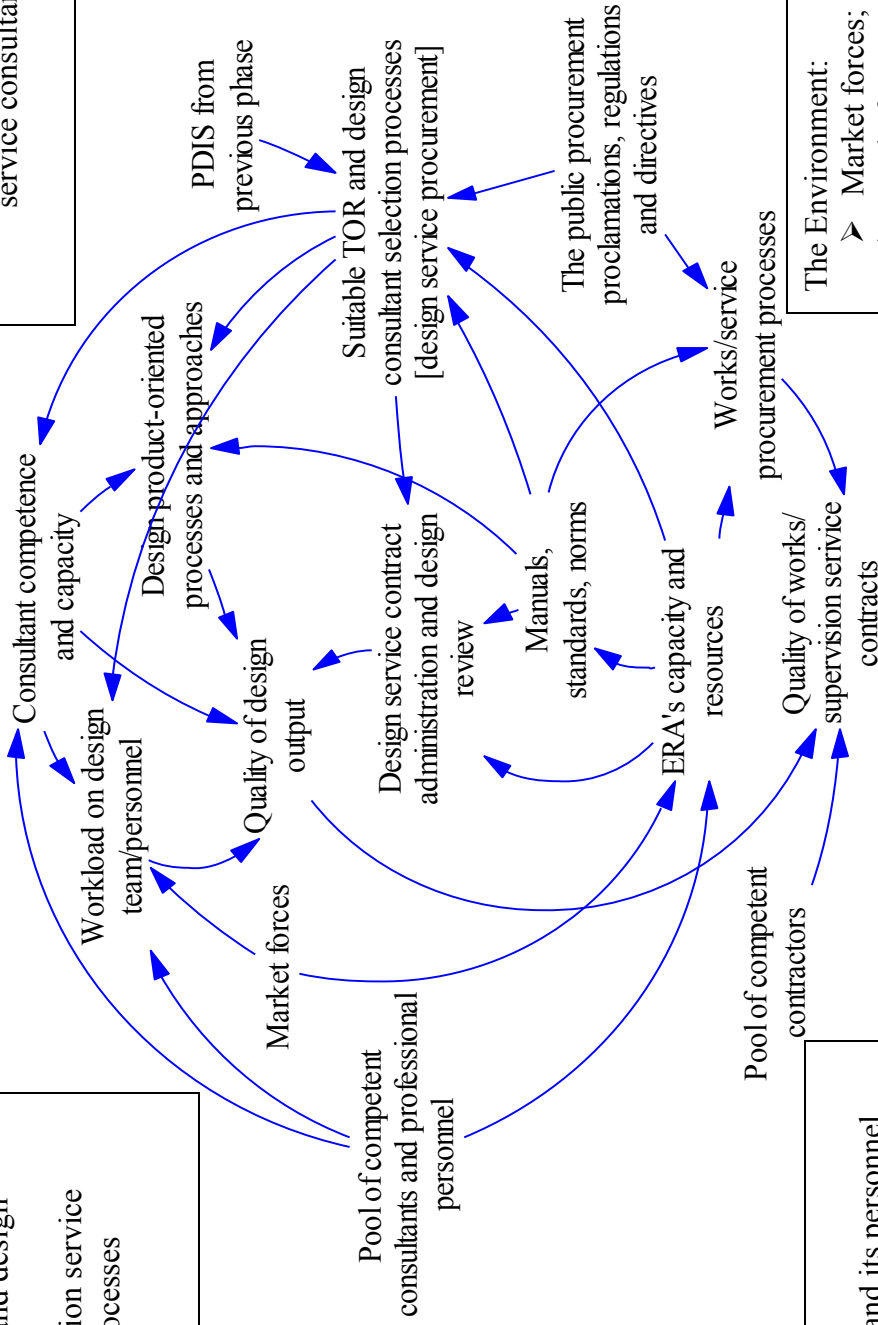
The competence and capacity (in effecting both the project management and product-oriented processes) and resource deployment of the service consultant is affected by ERA's procurement processes and approaches and the pool of competent service suppliers and personnel the

environment can supply. ERA's procurement approach in turn is influenced by the public procurement regulatory frameworks and guidelines while the quality of the ToR developed is influenced by the quality of the Project Development Initiation Sheet's (PDIS from the previous core process) in describing the project and its special characteristics and ERA's capacity in devising a suitable ToR contingent on the specific characteristics of the project. The procurement processes are influenced by both ERA's capacity and the norms and manuals in procurements. ERA's capacity and resources in turn are influenced by the environmental factors of both market forces and pool of competent personnel in the industry.

The workload on the service suppliers and the personnel assigned on the service is affected by ERA's approach to service procurement approaches (such as quality and cost-based selection or quality-based selection), the market forces such as fees and prices in the industry, availability of pools of competent personnel as well as workloads and management approaches adopted by the design consultant. ERA's design service contract administration and the quality of its design review is influenced by its capacity, the availability of manuals and standards against which design outputs are reviewed, the stipulations in the ToR that requires the requirements in the deliverables the consultant submits. The quality of the manuals, standards and norms are generally influenced by ERA's capacity and resources in compiling them.

- The [management] processes:
- Preparation for and design service procurement;
  - Design service contract administration and design review;
  - Works/supervision service procurement processes

- Governance systems:
- ERA's governance system;
  - The service contract;
  - The management system of the service consultant



- The resources:
- The consultant and its personnel
  - ERA's personnel
  - The contractors and its personnel;

- The Environment:
- Market forces;
  - Pool of competent suppliers and personnel;
  - Procurement legal frameworks and directives

Figure 5: 8 Causal diagram: Project development core processes

### **5.3.3 The project implementation process**

The project implementation phase is the phase that changes the design artifacts of the previous phase into the physical construct which will be ultimately used to achieve the objectives the project is set for. In ERA's case, given that the Authority outsources the actual execution of projects, the application area processes that actually create the physical construct are executed by the resource base. Therefore, the processes executed, the governance structures set up and the management approaches employed are fundamentally different when seen from the resource base's and ERA's perspectives. For example, for the resource base, an effective supply chain management, planning, management and coordination of the mobilization and utilization of the resources needed to execute the actual work, the optimization of performances, the execution of project works to the contractual requirements are some of the critical issues that are given emphasis for performance. From ERA's point of view, however, the main focuses are: 1) the creation and subsequent management of the system (through which the resource base is brought together and subsequently governed) that is facilitating enough to enable the resource base create the asset within the constraints and deliverables the Authority sets; 2) the monitoring of the performance of the resource base and effecting adjustments when necessary to cater for issues that arise.

Most of the processes associated with the design and creation of the system through which the implementation is managed are addressed under the previous phases. In this phase, although there are changes and adaptations to the designed system contingent on changing/emerging constraints/issues, the major issue ERA deals with is the implementation of the system as set. Therefore, the phase takes the major output of the previous phase (compiled into works/supervision contracts and other engineering reports) and oversees the creation of the constructed asset.

As practiced by ERA, the project implementation and commissioning phase (project implementation merged with commissioning and contract closure phase for process stereotyping purposes) can be divided into three sub-phases of project startup and mobilization, project execution and finally handover/acceptance of the product. Within each of these sub-phases, the

ERA, in association with its supervision consultant, executes various processes. The processes the Authority executes under this phase can be categorized as overseeing the project coalition setup and project design/contract document review sub-process; contract and change management sub-process; project commissioning and contract closure sub-process and a parallel effected sub-process of right-of-way management. Figure 5.9 presents IDEF0 based process model of the implementation processes.

The project coalition setup and design review sub-process is the sub-process that focuses in mobilization and the setup of the resource for the project works and the review of the contract document. It is controlled by the works and supervision contracts as well as ERA's standards and manuals and constrained by various issues such as market forces. The sub-process is effected both in house by the Regional Directorate responsible for the project and through outsourcing to the contracted supervision consultant and contractor. The major outputs of the sub-process are the revised design of the project, monitoring and quality assurance manuals and the mobilized resources.

The project quality assurance and monitoring sub-process involves the bulk part of the works contract and change management. It is controlled by the works and supervision contracts, the revised design of the project, the quality assurance manuals and is constrained by issues such as capacity. The sub-process is effected by the Regional Directorate in house and externally by the contracted supervision consultant and contractor.

Parallel with the quality assurance and monitoring sub-process, the Authority conducts a Right-of-Way (RoW) obstruction removal sub-process. The RoW obstruction removal sub-process is controlled by the revised design, the works contract and the land/properties expropriation and compensation laws and directives and is effected by both the Regional Directorates and the contracted supervision consultants and contractors as well as the local authorities.

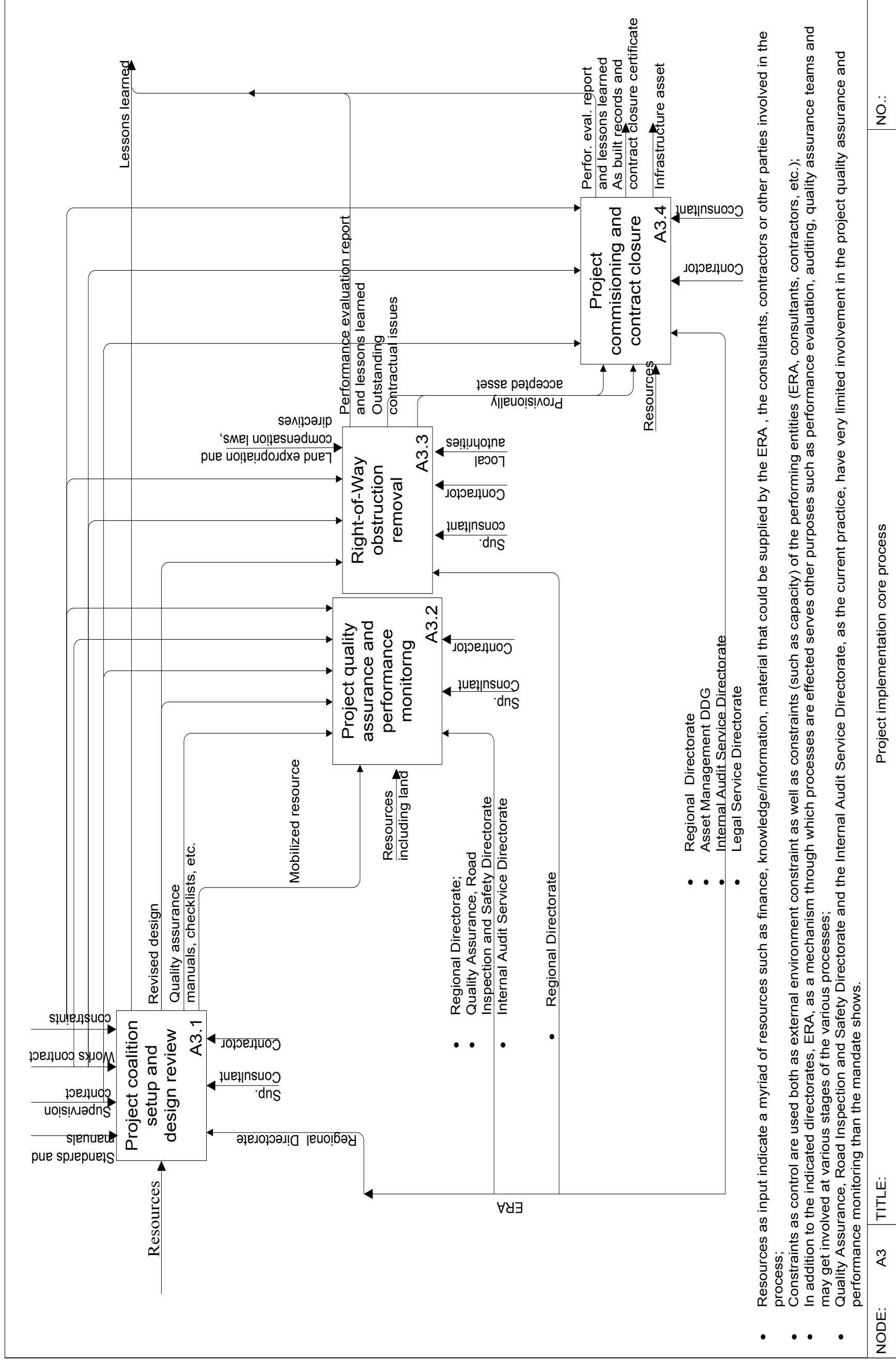
The major output of the quality assurance and monitoring and RoW obstruction removal sub-processes is the provisionally accepted constructed asset itself. In addition, there could be unsettled contractual issues from the sub-processes that would be carried to the subsequent stage.

The project commissioning and contract closure sub-process generally involves the tasks performed during the defect liability period<sup>146</sup> after the provisional acceptance of the project and during the finalization of outstanding contractual issues. The sub-process is controlled by the works and supervision contracts. The major parties that effect the sub-process are Regional Directorate, Asset Management DDG, Internal Audit Service Directorate and Legal Service Directorate from ERA and the contractor and the supervision consultant. The major outputs of the sub-process are the final constructed asset and the as built records.

The subsequent sections describe the details of the processes and various tasks the Authority executes under each of the above sub-processes. The sections also address the governance approach adopted by the Authority in managing the sub-processes.

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<sup>146</sup> Defect liability period is a period of time (usually one year) spanning from provisional acceptance of the constructed road (or part of it) to its final acceptance. During this period, save for normal wear and tear that may result due to usage of the asset, the contractor is contractually responsible to correct defects that are witnessed on the road.



- Resources as input indicate a myriad of resources such as finance, knowledge/information, material that could be supplied by the ERA, the consultants, contractors or other parties involved in the process;
- Constraints as control are used both as external environment constraint as well as constraints (such as capacity) of the performing entities (ERA, consultants, contractors, etc.);
- In addition to the indicated directorates, ERA, as a mechanism through which processes are effected serves other purposes such as performance evaluation, auditing, quality assurance teams and may get involved at various stages of the various processes;
- Quality Assurance, Road Inspection and Safety Directorate and the Internal Audit Service Directorate, as the current practice, have very limited involvement in the project quality assurance and performance monitoring than the mandate shows.

Figure 5: 9 Project implementation core process

### 5.3.3.1 Sub-processes of the implementation process

#### i. Project coalition setup and design review

After the works and supervision contracts are signed as the major output of the project development core process, the EPD hands over the contract document to the responsible Regional Directorate for implementation. The Regional Directorate assigns the project under one of the design and implementation team, with a counterpart project engineer assigned to act as the hub of the project administration and management. Mostly, aside from minor product-oriented processes related with field work (such as camp establishment), most activities done at this stage are reviews, preparations and mobilizations<sup>147</sup>.

In terms of reviews, at this early stage, in coordination with the actual physical condition on site, the supervising consultant is expected to provide a detailed review of the various components of the roadway design and the contract documents the ERA entered with the contractor. The major aim of this *ex post* contract design and contract document revision is to check if the exiting contract and design reconciles with the actual physical, social, environment, economic and other pertinent conditions that may affect the performance of the works (and the product). Given the major design related problems discussed in the previous section, the design and document review is meant to help the Authority make adjustments, including budget revision, in response to the likely conditions the project is expected to face.

The preparation works include recruitment and staffing of the resource base (of which staff replacements by the supervising consultant is approved by the ERA), preparation of quality control and assurance manuals<sup>148</sup> by the contractor and consultant respectively, preparation of formats, checklists by the consultant for quality follow up and systematic quality assurance, preparation of work programmes by the contractor and getting it approved. Other activities that could be categorized under the preparation works include the review and approval of the

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<sup>147</sup> Although not contractual, the ERA, generally notes that it expects this sub-phase to take three months. However, in practice, it usually takes longer than that.

<sup>148</sup> To serve as a base, the Authority has quality assurance manuals, of which, in its latest edition (2012 edition), Volume 6 is for construction administration

contractual requirements from the contractor's programme (and methodology), insurance, advance payment requirements, etc. - often stipulated in the contract to be submitted within a specified duration of commencement. The Authority reviews and comments on the quality assurance standards, check lists, formats to check that they are in accordance with the Authority's quality assurance manual whereas the consultant is expected to revise the contractor's quality control plan and checks the quality control system of each construction activity so that the final road fulfills the requirements set for it.

The mobilization sub-process (from the resources base's perspective) involves mobilizing resources for the execution of the contract works. While the ERA directly oversees the mobilization of the consultant, the consultant, in turn, oversees the mobilization of the contractor.

## ii. **Contract and change management**

From ERA's perspective, the major issues of the project implementation phase concentrate around contract administration (management) and change management<sup>149</sup>. Most of the tasks the Authority addresses under this sub-process can broadly be categorized as either contract administration related whereby the major objective is to ensure conformance to contract or change management related whereby the Authority has to deal (even at times instigate) with deviations from the contract.

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<sup>149</sup> Flexibility, 'the capability to adjust the project [process and product] to prospective consequences of uncertain circumstances within the context (Husby *et al.*, 1999) is an important factor in construction project success. Change clauses, clauses that allow the employer to modify the terms of the contract *ex-post* basis are one of the major tools in construction contracts that enable the contracting parties accommodate the eventualities of changing conditions and scopes (and accommodate flexibility). The clauses will allow the employer to issue change orders and the contractor to execute the change orders unless they are categorized as 'cardinal changes' (Cox, 1997), in which case the contractor may refuse to comply with the orders, or result in the frustration of the contract. However, the ERA identifies changes after projects are contracted out (for implementation) as one of the major factors contributing to both cost overrun and delays. In the wake of this, generally, the Authority has a negative attitude towards changes after contracting of works. Nevertheless, while changes due to negligence (be in setting objectives, in design or in procurement) should be view negatively, the Authority may have to cater for potential changes (mainly those that arise due to events which may be difficult to forecast) that may improve the project's (or its product) performance (Olsson, 2006).

The Authority conducts the major part of its contract administration (for the works) through its supervision consultant. The supervision contract puts the consultant as both a contract administrator that oversees the implementation of the works contract and a technical expert that identifies, analyzes and with limitations on the consultant's power often stipulated in the works contract, either instructs the contractor or advises ERA for changes that may improve the project's (product's) performance

In this regard, ERA's ToR for supervision services often puts the major objectives of the supervision service contract as:

- To ensure that the road is constructed in accordance with the technical specifications and engineering drawings or any amendments thereto and meet the standards quality of the end product;
- To optimize the use of available material resources to minimize costs to the client to maximize the quality of the works and to expedite construction and ensure environmentally as well as socially sustainable construction; and
- To ensure that the road is constructed within the contract price and time for completion allowed under the contract or any agreed amendments thereto.

In implementation of the processes, while ERA concentrates on issues that need the Authority's particular attention such as variation order, claim handling, additional budget transfer, dispute handling, and overall monitoring of the progress and the quality assurance system, the day-to-day monitoring of performance and quality assurance on site is conducted by the supervisor. The supervision and works contract normally define the responsibilities of both ERA and its supervisor in managing these processes. The issues dealt with under either of contract administration or change management can be stereotyped into either for quality assurance purpose (of the processes or products) or performance monitoring, evaluation and taking subsequent action.

The quality assurance tasks the ToR of the supervision contract stipulates, in addition to design reviews discussed above, include the supervision consultant address issues related with

identification/re-establishment of ground control points; review and approval procedures of the contractor's working drawings and computation schemes; construction works/methodology inspection and approval procedures; construction material investigation, testing, approval and site inspection procedures; construction safety procedure compliance; issuing drawings, specification, or any further explanation the contractor may need; design changes identification, issuing instructions and variation orders; measurement of works; issuing replies to contractor's requests, claims, etc; assisting in disputes; keeping of recordings, etc. The performance monitoring related issues often stipulated in the Authority's ToR include progress (monthly) monitoring and reporting; payment certification and updating of costs; monitoring the contractors resource mobilization, work progress, and potential issues for delay/cost overrun; monitoring environmental and social impact of the project, etc<sup>150</sup>.

In regards to performance evaluation and taking corrective action, if performances are not within the limit they are envisaged, generally, the contract documents stipulate the steps and level of actions, including contract termination, to be taken on a consultant/contractor. However, in practice, the Authority is averse to termination of contracts and often, particularly in terms of delay, tries to accommodate for the delay by refraining from initiating termination clauses even for projects delayed beyond the maximum period for liquidation damage limits<sup>151</sup>.

### **iii. Project right-of-way obstruction removal**

Obstruction along the right-of-way is one of the major causes of claims for both time extension and cost compensations. Cognizant of this fact, as noted in the project development phase, the Authority's BPR study (ERA, 2009) recommends that the Authority conducts right-of-way obstruction removal in parallel with the tendering of the works contracts and hands over to the

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<sup>150</sup> The ToR also stipulates the competencies (in terms of key personnel) needed and facilities/resources to be deployed to oversee these tasks and also demands the consultant to indicate its project organization structure through which it intends to discharge its duties.

<sup>151</sup> Liquidated damage duration limit is the maximum duration of time, stipulated in a contract, a project can be delayed without justifiable and excusable reason from the contractor. During this period, the contractor will be expected to pay predetermined liquidation damage to ERA but may not be terminated for delays. However, arguing that re-tendering projects (for example Sanja-Kirakir Road Project) would be more expensive, the ERA rarely exercises its contractual right to terminate contracts that are delayed beyond this limit.

contractor an obstruction free right-of-way<sup>152</sup>. However, in practice, the Authority still conducts the right-of-way obstruction removal during the implementation phase of the project<sup>153</sup>.

Identification of obstructions along the right-of-way, estimation of compensation and payment of same and finally obstruction removal and site handover are the major sub-processes conducted under ERA's right-of-way obstruction removal scheme. As it is practiced currently, the supervision consultant, along with the contractor, during design review phase and throughout the project's progress time, identifies the right-of-way obstructions and presents its recommendation. The Authority also assigns a right-of-way agent to serve as a focal point of obstruction removal.

Compensation for removal of properties is determined by teams set up comprising representatives from the local communities and local authority members. By law (for example Art. 18 of Regulation 247/2011), the Authority is authorized to use land and quarries free of charge without paying royalty but with compensations for loss in property and damages due to displacements<sup>154</sup>.

#### **iv. Project commissioning and contract closure**

The project commissioning and contract closure sub-process involves the tasks the Authority executes after the substantial completion of the project and the provisional hand over of the product. The major tasks executed under this sub-process include outstanding dispute/claim (if

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<sup>152</sup> While the approach that strived to hand the contractor an obstruction free site could significantly reduce RoW related delays and associated complications, including the opportunistic tendency of contractors to hide their deficiency behind it, it has its own challenges: 1) given the problems in design (which at times also involves re-alignment as a solution), pre-implementation RoW obstruction removal may create redundancy and extra compensation payments; 2) given the often long time gap between design completion and implementation commencement, chances of re-encroachment into RoW could create another challenge if removal is done along with design; 3) in its current practice, aside from the road corridor related obstructions, the Authority cannot identify and remove obstructions for contractor/consultant camp establishment, potential material sources and their access as these sites are normally identified first by the contractor and then requested for possession.

<sup>153</sup> However, in its latest ToRs for design service procurement (starting early 2013), ERA has started putting RoW obstruction identifications part of the design process.

<sup>154</sup> In Ethiopia, land is a common property of the state and the public. Therefore, the land by itself is not a private property for which compensation can be sought for. However, compensation is needed to evict a private person from the land he has been lawfully making a living from (earning benefits). Refer to Ambaye (2013) for detailed description of Ethiopian land expropriation legal frameworks and practices as well as criticisms of the exiting compensation systems and practices.

any) resolution, monitoring the performance of the product over the defects liability period, identifying defects and overseeing defect corrections during this period, conducting final statement of the works and effecting final payments and issuing of certificate of performance. In essence, these tasks are an extension of the contract management and, as applicable, change management sub-process discussed above. However they are treated separately from the above contract/change management sub-process because they exhibit a distinct difference as they are not normally execution iteratively and generally demand a significantly reduced resource from the resource base. In addition, the project commissioning and contract closure sub-process generally overlaps with the operation phase of the product life cycle.

### **5.3.3.2 The governance of the project implementation processes**

The management of the implementation processes is done through two tiers. The Authority, as an employer in the contract, oversees the overall performance of the processes and acts on limited issues that are identified in the contract to be beyond the scope of the consultant. The consultant oversees most of the site implementation processes. Generally, the supervision contract demands the consultant to furnish complete engineering services in all aspects with the limitations in its powers (in terms of contract and change management) stipulated in the works contract.

From ERA's perspective, as noted above, the Regional Directorates are the 'owners' of the implementation processes. The assigned counterpart (project) engineer within the Regional Directorate, in consultation with the team leader, follows the implementation processes. The project engineer acts as the hub of the communications from ERA's side whereby progress are monitored, efforts are coordinated and productions are conducted as per the standards set in the contract. Besides the follow up of the implementation processes, the implementation and design team is also responsible to channel any issue that needs the employer's hierarchical attention (such as changes). It also compiles progress reports and distributes same to the different bodies of the Authority.

For the right-of-way obstruction removal, the Authority assigns a right-of-way agent to serve as the Authorities obstruction related focal point of the particular project. However, by law, the removal is overseen by local authorities. The Authority's position is mainly to act as a facilitator.

### 5.3.3.3 Key problems with ERA's project implementation processes

The project implementation phase: 1) consumes a considerable proportion of a project's production cost and 2) is the culmination of the project life cycle thereby cumulative effects of decisions in previous phases are manifested. Consequently, the phase is the stage at which major characteristics of a project's performance challenges manifest themselves<sup>155</sup>. On the contrary, however, by the time the phase is being implemented, the majority of project, procurement and project participant-related critical success factors identified in Chan *et al.* (2004) discussed in chapter three (section 3.2.3) are decided upon. Nevertheless, if these critical success factors are not tendered effectively during those phases, they not only affect project's performance but may also expose the client to none value adding expenses through opportunism (Williamson, 1975) and wastages through rework (Love *et al.*, 2002) and disruption of performance (Thomas and Napolitan, 1995).

In ERA's case, studies (World Bank, 2012; CoST, 2011; Turkey, 2011) show that ERA's projects fail when measured against the project success criteria the Authority sets. Analysis by Turkey (2011) indicates that out of the 30 upgrading and rehabilitation road projects investigated, 24 projects (80%) suffered cost overrun during the implementation phase. In addition, Turkey's (*ibid*) desk study revealed that the major causes of cost overrun are variations, right- of- way problems, price adjustments (due escalation) and design problems. Furthermore, given that the Authority's projects are delivered through contracts, the Authority is vulnerable to opportunism and hold up problems by suppliers if the initial requirements are to change *ex-post* contract basis. Further, changes, if they are not spotted on time and issued accordingly, may create disruption of performance by the resource base or even rework (Abdissa, 2003).

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<sup>155</sup> Although the project phases identified in sections 5.1.2 above puts project commissioning and contract closure phase as the last phase, the phase is a significantly reduced one (in terms of resource consumption).

Critical success factors (CSFs) for construction projects identified in the literature often do not stereotype CSFs into project phases. One old study in this line (Pinto and Prescott, 1988) identified project mission, project trouble-shooting, project plans, technical knowhow and client consultation as CSFs for the implementation phase of projects. Similarly, Khang and Moe (2008) identified setting up of the project management team, reviewing and revising of project plan and kick off the project, carrying out the project activities as planned, controlling the project budget and expenses, monitoring, evaluating, and reporting project progress and performance and managing relationships with stakeholders as key factors that influence the implementation phase of projects. Using the literature's CSFs that affect the implementation phase of projects, the following section stereotypes and analyzes the Authority's approach to the management of the implementation phase of the project delivery.

**i. The processes**

**a. The project coalition setup and design review<sup>156</sup>**

The coalition setup and design review sub-process comes near the start of the implementation phase. Consequently, it can be argued that the sub-process is generally prone to challenges and problems to comply with schedule. On the other hand, however, given that the Authority's contracts with the resource base normally require the Authority's representative's consent to remove resources (particularly machines) out of the project site (for example Sub-Clause 54.1 of FIDIC 1992 edition over which ERA's international projects are based), in addition to efficient performance once on site, the timely mobilization of resources by the resource base is a critical factor that the Authority must focus upon for better progress of works.

However, comparison of early project progress reports with project programmes reveals that, consistently, the projects miss the programme established mobilization date. Even during later stages of the project implementation phase, the reports indicate that missing on resource mobilization is one of the major causes for poor project performances. In this regard, for

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<sup>156</sup>Save for the scope difference, most of the practices and challenges associated with design review are those discussed under project development

example, CoST (2010a) for Adigoshu-Lugdi, CoST (2010b) for Semera-Didigesala, CoST (2010c) for Humbo-Arbaminch projects consistently identify delay in mobilizing resources (from contractors) as one of the main causes of delay in the projects.

Parallel with this, the ERA (ERA, 2014) complains that its project monitoring and supervision process is being affected due to unavailability of the supervision staffs on site (including due to staff turnover but mainly missing from site while still working on the project). It accuses that most staffs are available on site for less than 15 days for every two month.

b. Contract and change management

➤ Project quality assurance related issues

In construction context, the Construction Industry Institute (CII) (1989) defines quality as ‘conformance to established requirements’. Related with this, quality management refers to the management of sets of quality issues involved in producing a product, process, or service (Burati *et al.*, 1992) that are generally grouped under the interrelated sub-processes of quality planning, quality assurance and quality control (PMI, 2008).

In ERA’s context, the Authority is the employer in the contractual arrangement. Therefore, while it may not be the direct executors of processes where defective outputs are produced, the Authority plans for quality assurance of the outputs and processes of its projects. In parallel with the incorporation of the specifications, plans, tests, checks that need to be fulfilled in implementation of projects, the Authority solicits the service of a supervising consultant to monitor and inspect the effective follow up of the quality assurance mechanisms engrained in the contract. The supervising consultant, in addition to conducting inspection of the works and conducting tests to assure quality, conducts design reviews and gives technical assistance services to assure the quality of projects product.

Nevertheless, given the Authority’s belief (expressed in its letter in May 2011 demanding accountability from consultants) that its supervising consultant may involve in unethical practice

along with the site unavailability of the supervision staff, it can be feared that quality is the most that suffers. Further, while the works contract gives the mechanisms through which the cost and time performance can be revised (and the Authority is in full control of the approval of these revisions), in terms of quality, the contract expects conformance to requirement where, in the event that the processes and products do not satisfy the stipulated specifications, rework is the generally required rectification. However, the Authority<sup>157</sup> does not have a direct involvement in both the tracing of defects and the rectification processes<sup>158</sup>.

On the other hand, however, the Authority asserts that the ‘negligence and inappropriate conducts’ of supervising consultants and professionals, ‘have become detrimental to the implementation processes.’ In this regard, in the literature, unethical practices, particularly corruption, asset misappropriation and bribery related ones have been cited as a major problem in construction<sup>159</sup>. Various characteristics of the nature of the works, the industry’s structure and the way it delivers projects are cited as reasons that make construction prone to corruption. Features such as the relative big size of projects in relation to the firms executing them and the system allowing small firms to easily enter the sector and taking up works significantly more than their size; the uniqueness of projects that prevents accurate comparison with others projects; complexity of projects that makes them prone to mistakes which will be abused when found upon as well as non-standard production processes that foster asymmetric knowledge stocking between clients and providers; the fact that a significant portion of the works being concealed after execution and becoming not easily accessible to future inspection; the fact that projects are structured through phases and contracts that disperse accountability among different separate entities; the often adopted competitive bidding in works tendering that may allow for low tendering (Sohail and Cavill, 2008; 2006; Shakantu, 2006; Stansbury, 2005) are argued to make construction more susceptible to corruptive practices.

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<sup>157</sup> Although the Quality Assurance, Road Inspection and Safety Management Directorate of the Authority is mandated to assure the quality of road delivery processes and the products, inspect the performance of roads and safety of roads, in practice, the Directorate has minimal involvement in project delivery processes

<sup>158</sup> Related with this, however, while there are relatively few studies in terms of cost-and time performance failures (World Bank, 2012; CoST, 2011; Turkey, 2011 for example), there are no identified empirical works about the quality performance of the projects implemented by the Authority and the associated cost of non-conformance.

<sup>159</sup> For example, Transparency International’s Bribe Payers Index consistently puts construction as the most corrupt sector. Similarly, the American Society of Civil Engineers (cited in Sohail and Cavill, 2006) claim that corruption accounts for a staggering estimated amount of USD 340 billion of the worldwide construction costs each year

The literature also indicate the main causes of corruption as greed, institutional cultures of corruption, the lack of accountability of public officials, the low salaries of public officials, lack of morals, poor law enforcement or lack of punishment of corrupt officials, and lack of information and transparency in bureaucratic systems with complex processes and regulations (Kenny, 2009; Sohail and Cavill, 2008; Shakantu, 2006). In addition, Sohail and Cavill (2008) identify anti-bribery legislation, blacklist of companies caught bribing; public disclosure, monitoring by independent oversight agencies and civil society, internal anticorruption code of conduct, integrity pact during both tender and project execution phase, action taken on corrupt practices by trade or professional association as ways of combating corruption.

In this regard, in ERA's context, although the Authority incorporates anti-bribery pledges in its contracts, it asserts that its supervision consultants may get involved in unethical practices that affect the projects performance. On the other hand, the current practice through which the Authority controls its projects based on a report from its site representative and occasional site visit does not provide the Authority enough independent information to identify malpractices and take appropriate action. However, while the Authority has introduced a mechanism to counteract for the failure of design consultants through the introduction of panel of experts to review the design output and processes, to date, the Authority did not devise and implement any mechanism to counteract the said problem of supervision consultants.

➤ Project monitoring and controlling

Project progress monitoring, controlling and evaluation of performance is one of the key project management processes that the project management team has to do (PMI, 2008). Monitoring and evaluation of projects, along implementing corrective action when needed, completes the plan-do-check-act of the project management processes cycles (ASQ, 1999). Therefore, monitoring and evaluation is contingent of the appropriateness of the plan (base line) against which performance is compared with. In this regard, ERA's practices, both in terms of its baseline establishment and performance evaluation and taking corrective actions has considerable drawbacks when compared to best practices suggested in the literature.

i. ERA's baseline against which performance is compared

The starting point in the plan-do-check-act cycle is the plan. Luafer and Tucker (1987) note that, normatively, planning focuses on establishing what should be done to achieve objectives, how the activities identified be executed, what resource is needed to execute the identified activities and when should the activities be executed to realize the objectives and respond to the constraints of the project. The aggregation of these will also provide the expenses to be incurred to achieve the objectives.

In ERA's context, for the implementation phase, the scope of the project as well as the quality standards expected are stipulated in the contract document with the contract also stipulating that the contractor shall produce detailed programme of the works, resource deployment schedules, methodologies, as well as cash flow requirements of the project. Nevertheless, in practice, the approach to planning in ERA's projects has two fundamental flaws: Firstly, as noted in section 5.3.2.3, ERA determines the contract time without making an appropriate scheduling based on the scope of the works and other potential factors that may affect the delivery of the project. This forces contract times to become incompatible with the scope and constraints expected (Wubishet, 2004) and puts the contractor in a predicament of planning for unrealistic objectives that affects its supply chain as well as optimization approaches. Secondly, while the Authority, through the supervising consultant, revises the suitability of the contractor's programmes, in practice, rather than a thorough review of the substantive components of the programme and the need for the reconciliation of the scope of the work with the resource and time frame proposed by the contractor, the practice is generally a mere procedural issue.

ii. ERA's project monitoring and corrective actions

In terms of the actual monitoring of performances, in the literature, the monitoring of construction projects, particularly from the contractor's point of view, is criticized for being reactive only designed to 'taking corrective action when the ship appears to be off course' (Ballar, 2000:2(7)). Even in terms of the reactive corrective actions to be made, often project control system are not used for such purposes and as noted by Diekmann and Thrush (1986:29)

“[w]ithout corrective actions a project control system becomes merely a cost/schedule reporting system.” In ERA’s case as well, although the contractors produce the work programmes (with associated resource deployments schedule) and reporting may reveal that such programmes are not being implemented, timely corrective actions are not taken (for example the CoST reports cited above).

Therefore, it can be argued that, even though issues that may affect project performance are identified through the project monitoring and control system, they may not be followed by the appropriate corrective action. In this regard, particularly in terms of resource deployment by the resource base, one of the major problem could be the fact that, although the contract demands the contractor to produce a resource loaded programme and methodology of the works, this submission is only subsidiary to the contract whereby the contractor may not be obliged to stick to the programme<sup>160</sup> (Chappel, 2011). The implication is that, the Authority may not instruct the contractor to execute the works as per the methodology and the resource mobilization proposed as it is generally accepted that the contractor can modify his methodology and can update his work as well as resource deployment schedule (Eggleston, 2001). On the other hand, however, due to a combination of availability of concurrent causes of delay from ERA’s side (design related problems and right-of-way obstruction being the consistent ones) and the opportunistic tendency of contractors to hide their own deficiencies through the client’s, often, the problems of the resource base in delivering its responsibilities goes without major scrutiny.

Parallel with this, ERA’s works contract normally states that, if the supervising consultant believes that actual performance does not conform to the approved programme, the consultant can instruct the contractor to update the programme. Nevertheless, the Authority’s practices reveals two major weaknesses. Firstly, even if actual performances indicate a possible delay from schedule, consistent programme revision is not made. Secondly, and perhaps more importantly, given the fixed contract completion dates that cannot be changed without formal approval of extension of time, revised schedules appear to be only to fulfill the formality without catering the contractor’s capability to bring the schedule on track.

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<sup>160</sup> Contractually, the contractor is expected to complete the works by the contract completion date (or any partial milestone date, if agreed). Nonetheless, he may not be obliged to progress strictly in accordance with the master schedule agreed.

c. The right-of-way obstruction removal

Article, 40 (8) of the Constitution of Ethiopian gives the power to the state to expropriate land from the private land holder for public use but puts an obligation on the state to pay, in advance, compensation ‘commensurate to the value of the property’. As a subsidiary, Proclamation 455/2005 and Regulation 135/2007, and in ERA’s case Regulation 247/2011 give ERA the right to expropriate land with appropriate compensation. Article 6 of Regulation 247/2011 grants the Authority to ‘cause the use of, free of charge, land and quarry substance required for the purpose of road works, camp, office storage of equipments and other related services.’ The implication is that, the Authority has the right to use land and quarry material without payments of royalties but with compensation to properties and displacement. However, the Authority can only initiate the processes (along with effect compensations), with the power to expropriating the land and valuating of compensation given to the *wereda* administrations or urban municipalities (Proc. 455/2005).

In this regard, further to the fact that the Authority does not directly influence the RoW removal process, Art 5(1) of Proc. 445/2005 states that the implementing agency (in this context the ERA) should ‘prepare detail data pertaining to the land needed for its works and send same, at least one year before the commencement of the works, to the organs empowered to expropriate land in accordance with this Proclamation and obtain permission from them’. The land holder is required to handover the land within a minimum of ninety days.

This lead time of one year for the responsible agencies and potentially another minimum ninety days for the land holder is a considerable practical complication for the Authority. Indeed, this long duration to obstruction removal (which also often gets abused by local authorities) along with the dual factors of the supervising consultant not timely submitting RoW obstruction along the whole road way stretch (ERA, 2014) and contractors’ propensity to hide their own deficiency through the convenience of obstruction to effectively manage their resources means, RoW related problems become major causes of claims. In a related problem, the Authority notes that lack of consistent approach to property valuations and obstruction removal procedures and lack of integration and cooperation between public bodies whose properties may have to be relocated

result in inflated demands for compensations and delays (particularly for public property relocation) in RoW clearance.

Furthermore, the Authority does not have an effective system that protects its RoW limits thereby forcing the Authority to pay compensation and associated consequential costs on its upgrading and rehabilitation projects (Ambaye, 2013). In addition, currently the Authority conducts RoW removal in a disintegrated manner by RoW agents who are assigned as supports to Regional Directorates. It does not have an in place system that coordinates RoW obstruction removals and improves on lessons learned.

## **ii. The governance/management of the processes**

The ERA's approach to project implementation heavily depends on the supervising consultant for the quality assurance and project monitoring and controlling processes. It is the supervising consultant's site team that coordinates the projects performance, assures quality and monitors progress. The Authority conducts its construction time- cost and quality monitoring based on reporting from supervision consultant and occasional own corroboration through site visits.

As part of discharging its responsibility of supervising the implementation of the projects, the supervising consultant is required to establish its governance structure. However, detailed analysis of the competence and expertise needed for effective project supervision is beyond this study. At a general level, however, the experience and composition of personnel demanded by ERA's ToR of the supervision consultants is in line with Krima *et al's*. (2007) summary for project management functionalities during the implementation stage. Nevertheless, Zimmerer and Yasin (1998) criticize that, historically in the construction industry, strong technical skills and knowledge have been the key selection criteria for supervisors and the team. They argue that today's complex project environments, however, require greater skills in leadership and other 'soft skills'. In this regard, as noted in section 5.3.2.3, ERA's supervision team selection predominately focuses on the technical and contract management expertise with only scant attention given to the soft skills of leadership, conflict management, motivation skills, communication skills which are identified to be key for project management success (Verma,

1995). In addition, although the Authority identifies unethical practices and absenteeism from site by supervision staffs as some of the key problems during the project implementation phases from ERA's (and its site representative's) perspective, it has yet to devise a system that contracts for these problems.

For the right-of-way obstruction removal, the process is mainly managed and effected by the local authorities. The law gives regional rural land administration authorities or municipalities<sup>161</sup> the mandate to constitute members of the committee, to appraise the property as well as oversee the obstruction removal. In this regard, therefore, aside from timely identification and submission of obstructions lists and effecting of compensation payments, the Authority has little control in the management of the obstruction removal processes. In addition, the current approach creates an accountability loophole whereby both the Authority and its resource base could blame the right-of-way obstruction removal processes for their own failings.

### **iii. The environment/the context**

The environment in developing countries like Ethiopia poses various and complex challenges that affects project performance. Arguing in this line, Ofori (1993:175) notes that the problems of construction industry in developing countries are 'more fundamental, more serious and more complex, and their solution much more pressing than those confronting their counterparts elsewhere'. Drawing on various researches conducted on challenges of construction industries in developing countries, Ofori (*ibid*) summarizes the common problems, most of which are environmental forces over which the industry does not have direct control. He identifies shortage of construction materials most of which most are imported, low level of technological development of most of the industries that supply inputs to construction, lack of both management and technical skills and poor social image of the industry, unfavorable environment for construction with complex procedure, regulations and contracts, low and fluctuating construction activities as key challenges.

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<sup>161</sup> However, if the property on the land to be expropriated is a public one, in accordance with Art. 6 of Proc. 455/2005, it is the owner of the property that estimates the value of the property.

In line with this, the Ethiopian construction industry faces considerable challenges from the environmental forces<sup>162</sup>. Inflation, currency devaluation and shortage of foreign currency, shortage of input resources most of which are imported (material and machinery), weak industries and supply chains with which construction interacts, low skilled manpower supplies, bureaucracies, red tapes and ethical conundrum<sup>163</sup>, etc. being some of them. In this regard, both the construction industry (for example lack of competent resource base, skill, knowledge, supply chain accumulated in the industry) and the national business context within which the Authority's projects are implemented can be argued to pose challenges on the projects performances.

Baloi and Price (2003) categorized such environmental forces that affect project performance, but which may not be catered for in cost estimation as global risk factors<sup>164</sup>. For ERA, working in an environment that poses many challenges, but may be difficult to plan and cater for, affects the Authority's project performance both directly and indirectly. The materialization of such environmental forces obliges the Authority to deal for the unplanned consequences the incidents may create (such as compensation for disruptions). In addition, given the fact that, contractually (for example FIDIC, 1992), global risk events, if they materialize and affect project performance, are normally excusable compensable events for which the contractor is given additional time and compensated for the losses and extra expenses he may have incurred, they expose the Authority to opportunism by its suppliers.

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<sup>162</sup> For example for the road sector, all machineries & parts, fuel and lubricants, bitumen and reinforcement bars (mostly) are imported. Although recently relatively at small level, inflation has been very high in Ethiopia towards the end of the last decade; heating 40% in May 2008 (IMF country report, 2008).

<sup>163</sup> In its 2011 letter to consultants about accountability ERA notes that 'negligence and inappropriate conducts' of supervising consultants and professionals 'have become detrimental to the implementation processes.'

<sup>164</sup> Baloi & Price (2003) make distinction between environmental (to project) risks as organization specific, global risks and Acts of God. Organization-specific risks are 'internal risks related to an organization's resources and management' and are normally taken to be under the contractor's control. Global risks are risks 'that are not directly present in cost estimates yet they may lead to significant financial disasters' (*ibid*: 264) for which contracts should provide 'fair and sensible allocation of these risks between the parties'. Acts of God are risks normally considered as *force majeure* in contracts and are generally excusable but non-compensable risks which are also insurable.

#### **5.3.3.4 Key factors that affect ERA's performance in project implementation**

The performance of ERA's implementation core process is affected by various factors. These factors can be categorized under the processes executed by ERA itself and its resources bases and stakeholders, the governance and management systems the Authority and its resource base sets and implements for the project, the capability of ERA itself and its resource base in effecting these processes and governance systems and the various environmental forces that influence the projects. Figure 5:10 below presents, with the factors aggregated, a causal network diagram of these key factors.

The ultimate performance of the project's product, the road asset, and the project itself is mainly influenced by the performance of the product-oriented processes, the monitoring and supervision of the works and the contract and change management. The execution of the product-oriented processes is influenced by the capacity of the contractor; the experience, capacity and competence of the resources deployed and their utilization; the monitoring and supervision of the processes and products; the quality of the works contract in defining the scope of the works as well as the effectiveness of the contract and change management employed.

The contract and change management to be employed is affected by the various market/environmental forces that affect the project's operations such as inflation, change in expected condition; the quality of both the supervision service and works contracts in defining the scope of the service and works respectively the rights and obligations of the parties and the deliverables required; the monitoring and supervision conducted to check compliance with contract or identify adjustments required; both the supervision consultant's and ERA's capacity and resources in conducting the contract and change management and the RoW obstruction removal processes. The project monitoring and supervision is affected by the requirements of both the service and works contracts; the competence and resource mobilization of the supervision consultant's and ERA's capacity and resources deployed to monitor and follow up the project performances. ERA's capability and the legal and administrative responsiveness affects the efficiency of the ROW obstruction removal process.

The contractor's resource mobilization and utilization is affected by the requirements in the works contract along with the methodologies and work and resource deployment schedules submitted; the contractor's capacity and resources; the effectiveness of contract and change management employed which also manifests the monitoring of the status and progress. The contractor's, the consultant's and ERA's capacities are affected, in addition to their own systems, processes, norms etc, by the environmental forces of the pool of competent personnel in the industry; the market forces; the pool of competent suppliers (particularly for contractor) as well as the suitability of ERA's contracts that solicited appropriately qualified contractor/consultant.

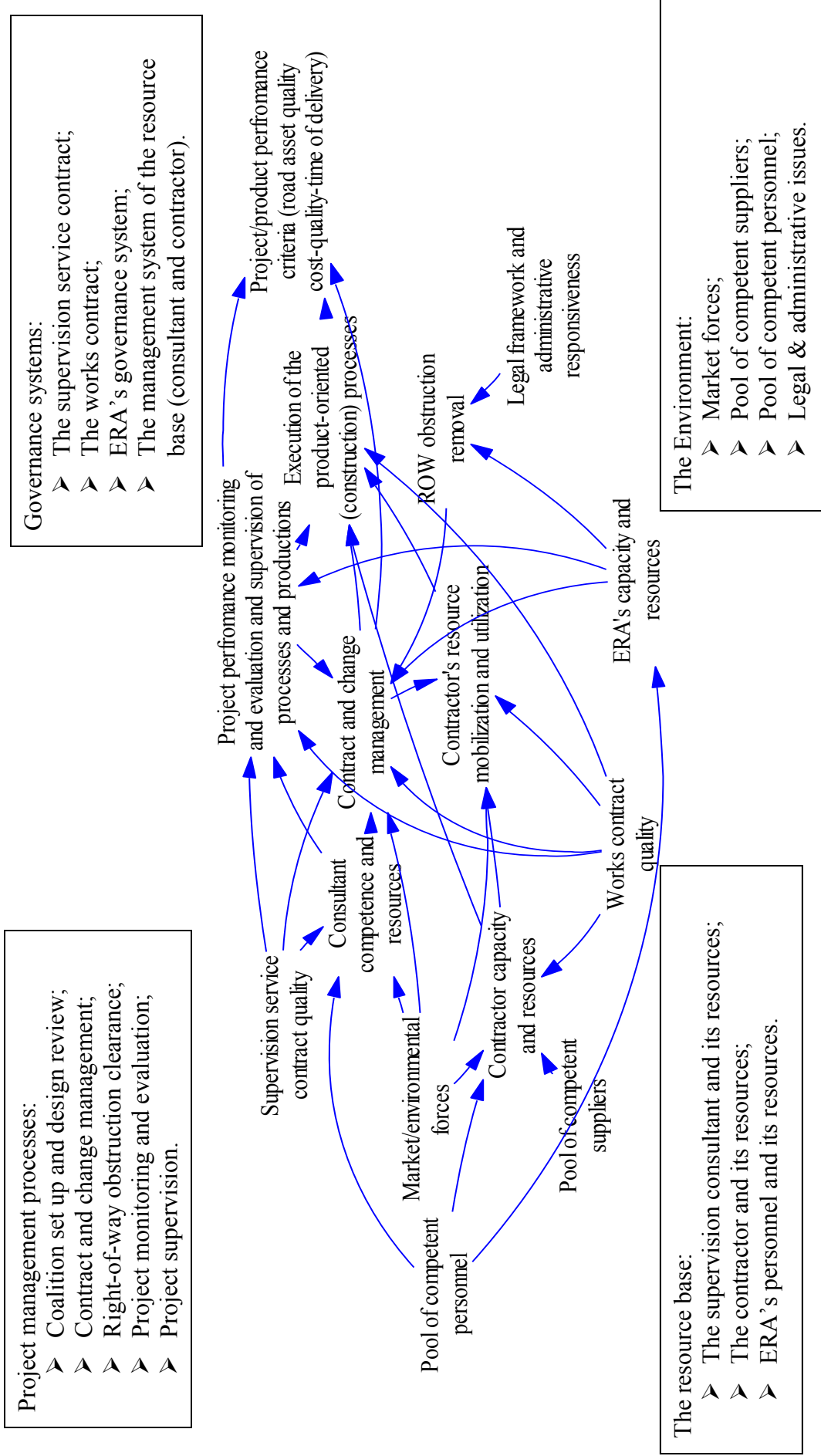


Figure 5: 10 Causal diagram: Project implementation core processes

#### **5.4 Project product (asset management) phase**

Once a project is completed and final acceptance is conducted, the constructed asset will be transferred from the Engineering Operation DDG to the Asset Management DDG. Then the Asset Management DDG executes asset preservation, asset operation and feedback processes.

The project handover and contract completion sub-phase of the implementation phase involves the transition of the project's product and associated documents from the contractor to ERA and the conclusion of the contract. This sub-phase signals the end of the project delivery processes. The combined output of the previous core processes is a constructed asset that is meant to serve the objectives the project is incepted for. The end of the sub-phase leads to the subsequent phase, the asset management (operation) phase.

The operation phase of the product life cycle of the Authority will look after the performance, the safety and integrity of the constructed asset. The follow-up of the operation of the constructed asset includes the asset operation issues of axle load control, right-of-way protection, traffic management, environmental protection as well as asset preservation maintenances. In addition, during this phase, the Authority conducts the asset conditions assessment, performance review and asset condition prediction which will lead to either asset preservation tasks (such as routine maintenance) or a new project (of periodic maintenance, rehabilitation or upgrading). The feedback from the operation phase completes the cycle of project inception to product management phases followed by the Authority.

#### **5.5 Conclusion**

ERA generally uses a functionally leaning project organization structure with different directorates being the 'owners' of the different phases of the project. In addition, the Authority does not assign any single person to overlook the project throughout its life. In terms of project life cycle, ERA's project delivery phases can be distinctly categorized as planning and programming phase where network master plan, road sector programme and annual plans are developed; project development phase where the major output is the design artefact and works

procurement document, project implementation phase where the major output is the constructed asset itself and the project commissioning and contract closure phase that links the project life cycle to the operation phase of the built asset. In the DDB project delivery, the Authority typically follows a sequential project delivery approach whereby output of the preceding phase is used as an input to the subsequent phase. The major drawback of this sequential and fragmented project delivery is the lack of a single point of responsibility and hub of communication for a given project.

ERA uses two tiered performance criteria tailored to its programmes and projects. At the programme level, the Authority sets and evaluates its performance based on general criteria of physical and financial performance, network performance and capacity building performance criteria for the RSDP period. For projects, ERA sets performance criteria in the service and works contracts it enters with the resource base. Generally, the Authority uses time-cost-quality as its performance criteria and conducts evaluation through either its own directorates or supervising consultants (for implementation phase). However, while the Authority conducts performance evaluation of both its programmes and projects fairly regularly, the approach has major drawback of the use of non-optimal contract values as the values against which performance is evaluated and the fact that performance is monitored and evaluated by parties responsible for the performance itself thereby being susceptible for externalizing and hiding.

Parallel with the project phases, ERA's project delivery processes can be categorised into three major core processes. They are network planning and programme development core process, project development core process and project implementation core process.

The network planning and programme development core process is further subdivided into procurement for master plan development services, master plan development contract administration, RSDP document preparation, annual project planning and budgeting sub-processes. While the procurement sub-process is executed by the EPD, the other sub-processes are planned, managed and executed by the PPD.

As compared with international practices, ERA's network planning and programme development approach has two fundamental weaknesses of focusing on infrastructure solution and, even in infrastructure solution, isolated road transport planning without nationwide synchronized transportation system provision. In terms of procedures, for the networks and programmes it developed, although ERA provides *ad hoc* criteria and weighting factors, it does not have a well established approach or justifications.

In this regard, the quality of a road network developed is affected by the quality of the input data and the product-oriented processes of modelling, optimization and sensitivity analysis, the capacity of the network consultant in executing these processes, the availability and quality of manuals and standards that guide the network development processes, ERA's capacity in defining its ToR, soliciting the appropriate consultant, conducting the service contract administration and conducting the reviews for the deliverables. Similarly, the quality of the RSDP is affected by various factors such as the quality of the network master plan itself, the reliability/feasibility of additional requests that are coming from stakeholders, the quality of the product-oriented processes that produce the RSDP and ERA's capacity in executing them. The unavailability and instability of the major input factors that affect network planning and programme development have a major consequence on the quality of the network and RSDP document developed.

The project development core process is further sub-divided into project design service procurement, project design service contract administration and works and supervision service procurement sub-processes. The design service procurement itself is subdivided to sub-sub processes of preparation of project briefs; expression of internet preparation, solicitation, and evaluation; ToR preparation, solicitation, evaluation and contract award while the design service contract administration sub-process, from the ERA's perspective, involves both monitoring of progress of the service and conducting of key reviews. The works and supervision service procurement sub-process involves procurement of both supervision services, which essentially is comparable to the design service procurement, and procurement of works. The procurement of works involves the preparation for tender and invitation for tender, soliciting and evaluation of tender, and negotiating and contract award.

In terms of governance, while the procurements of services and works are planned, managed and executed by the EPD, the design contract administration is conducted by the regional directorates. The ERA normally assigns a focal point person to follow up the design service contract administration.

Problems associated with the project development core processes and the outputs they deliver, including the quality and exhaustiveness of the works tender document, are identified as one of the major factors that are affecting the Authority's project performance. There are different causes of the problematic design outputs. Not adequately tailored ToRs to the peculiarities of projects, slack practices by the resource base, lack of competence within the Authority to conduct thorough review of deliverables and the fact that monitoring of processes is more procedural than substantive, lack of explicit and enforced collaborative design approaches thereby leaving professionals working individually and producing unsynchronized outputs, undeveloped cumulative knowledge base, not well normalized professional standard practices and work ethics, etc. are some of the key causes.

The ERA's project implementation core process can be further divided into project coalition setup and project design/contract document review sub-process; contract and change management sub-process; project commissioning and contract closure sub-process and a parallel effected sub-process of right-of-way management. The sub-processes are mainly executed by the supervision consultant and under the tutelage of the responsible regional directorate that oversee the overall management of the processes.

Delayed mobilization of resources by the resource base, negligent and inappropriate conduct of supervising professionals, the Authority's lack of direct involvement in both the tracing of defects and the rectification processes, project monitoring and evaluation conducted more as a procedural issues as opposed to a substantive matter meant to identify problem and seek for potential solutions, long and protracted right-of-way obstruction removal system, unstable general market, weak industries and supply chains with which construction interacts, low skilled

manpower supplies, bureaucracies, red tapes and ethical conundrum are some of the problems associated with the Authority's project implementation.

Including the proper execution of the product-oriented processes by its resource base, the performance of the phase is affected by various factors such as the monitoring and supervision of the works and the contract and change management. The contract and change management is in turn affected by the quality of both the supervision service and works contracts in defining the scope of the service and works respectively the rights and obligations of the parties and the deliverables required; the monitoring and supervision conducted to check compliance with contract or identify adjustments required; both the supervision consultant's and ERA's capacity and resources in conducting the contract and change. The project monitoring and supervision is in term affected by the requirements of both the service and works contracts; the competence and resource mobilization of the supervision consultant's and ERA's capacity and resources deployed to monitor and follow up the project performances.

The purpose of this chapter was to present and discuss the findings of the research. Accordingly, it has presented both description of ERA's project processes and their management and key problems of these processes and systems. The chapter first focused on the general issues of ERA's project management set up, its project phases and the performance criteria the Authority adopts. Then, the chapter presented ERA's project processes divided into three core processes. Under each core process, the chapter presented further sub-processes and description of ERA's execution and management of same. In addition, under each core process, the chapter identified the key factors that affect the outputs of each phase of the project delivery and analyzed the key deviations of ERA's practices that may have been contributing to poor performance. The subsequent chapter presents the conclusions and recommendations of the study.

## **6 CONCLUSION AND RECOMMENDATION**

### **6.1 Introduction**

As stated in chapter one, this study started with the major objectives of exploring the practice of the construction management processes in the Ethiopian construction industry and comparing it with ‘international’ practices particularly looking into potential differences, implications on the Ethiopian performance and possible recommendations for improvement. Taking the Ethiopian Roads Authority’s (ERA’s) project delivery processes as case in point and recommendations in the literature and other industry practices as starting reference points, the study tried to achieve these objectives. As presented in chapter five, the study first presented description of the processes and their management as they are practiced by ERA. It then compared these practices with the literature’s ‘best practices’ to identify the major gaps, possible implication on performance and, with due regard to contextual factors, provided recommendation for improved performances. It also identified key factors that influence ERA’s performance for each of its core processes.

This chapter summarizes the major findings and discusses how the objectives the study embarked for has been achieved. The chapter starts by presenting summary of the major findings. This is followed by a discussion of how the research objectives are achieved by revisiting both the objectives set and the research questions posed in chapter one. The chapter also presents a brief summary of the theoretical implications of the research and the contribution to knowledge. Lastly, the chapter presents recommendations for future studies.

### **6.2 ERA’s management of its construction processes**

ERA delivers its mandates through ‘management by projects’ whereby projects make the basic unit around which objectives are defined (though the objectives are generally aggregated to get programme level objectives), operations are planned, resources are assigned and performances are monitored. Parallel with this, the Authority’s work systems and approaches (such as its

financial management system, performance evaluation system) are project focused. The following sections provide the major findings of ERA's approaches to its project delivery.

*i. ERA's project delivery approach, project phases and project organization*

The Authority predominantly uses the market delivery approach (in regards to market –hierarchy dichotomy) with the major product-oriented processes of the project delivery main processes executed through outsourcing. Aside from part of the programme development, most of procurement and part of contract administration processes that it executes in house, the Authority uses the market for its project delivery. Indeed, while the Authority may choose either the hierarchy or market delivery for the planning and programming and project design processes, although currently it does not have the expertise for network planning and project design, Regulation 247/2011 appears to preclude in house delivery of the works part (main part of the implementation core process) of the project delivery unless 'in the case of emergency situations or where it becomes necessary on any other grounds' (Art. 6(6)). Even on economic grounds, however, given the number of projects the Authority embarks on at a time, organizing all its project into hierarchy can be argued to incur the Authority more transaction cost than using the market (Williamson, 1978).

In terms of project delivery approach, currently, the Authority employs two approaches: The Design-Build (DB) and the Design-Bid-Build (DBB). For the DBB project delivery, the Authority's projects pass through distinct phases of network planning and programming (that encompasses the project conception phase), project development, project implementation and project commissioning. The Authority executes the project phases sequentially with outputs of one phase or sub-phase used as input to the other with no overlap between phases/sub-phases. In this regard, the confirmation of a budget for a given project and the project's incorporation into the Annual Investment Plan triggers for design service procurement based on the schedule for the year. The conclusion of the design service contract, the output of the design service procurement sub-phase, is used as the major trigger of the design sub-phase. The works tender document –the major output of the design sub-phase, is the major input for works procurement, and hence conclusion of the document compilation is one major criterion for embarking on the procurement

for works. The conclusion of works contract (along with the supervision service contract), the major output of the works procurement sub-phase, is the major trigger for the project implementation phase.

In terms of project organization, the Authority uses a generally fragmented setup of the project coalition where it normally uses distinct firms for the design, supervision and construction tasks. In this regard, while the construction industry in general is accused of fragmentation (particularly at the design-construction interface) (Latham, 1994 for example), ERA's preference for the design firm to be different from the firm that oversees the implementation of the design (the supervision firm) puts further fragmentation. It is argued that one of the consequences of the fragmentation between design and construction is the development of antagonistic relationship between consultants and contractors (Kalay *et al.*, 1998). Similarly, the separation of the design and supervision of the implementation of the design can also be argued to open room for misunderstanding of design priorities and assumptions. This may further exacerbate the perceived design related problems the Authority is facing. Parallel with this, even in managing the projects, while the Authority assigns personnel (from within its hierarchy) to be focal point of the different phases of the project, it does not assign any single person/party to oversee the project throughout its life span so as to manage the project as a single whole entity.

*ii. ERA's performance indicators, performance monitoring and evaluation approaches*

ERA sets interlinked objectives for its networks, programmes and specific projects. At a general level, ERA's network objectives are to develop and maintain a road network that is both within the Country's resources to implement and maintain and solve the Country's accessibility problems while meeting its development objectives. For the programme level, the Authority sets its RSDP period bound objectives that further qualify its network objectives. Broadly, the RSDP objectives can be categorized as improving mobility and accessibility, protection and preservation of existing networks and capacity building of the domestic road construction sector. The objectives for specific projects are subsumed by these programme level objectives and, generally, are meant to satisfy one or a combination of the network and programme level objectives.

The Authority uses the achievement of these objectives as its core performance indicators. In this regard, for the programme level, with the objectives usually set time and cost tailored (RSDP period and RSDP budgets), the achievements of the objectives with respect to the time elapsed and cost spent are assessed correspondingly. The achievement of the other RSDP objectives such as capacity building (of the domestic road construction sector), road network improvement and road riding quality improvement specified in its RSDPs are evaluated by the Authority. For the project levels, the Authority generally uses cost-time-quality performance criteria often set in contracts as its base values against which performance is evaluated. Congruent to the fragmentation of the different phases, however, the criteria are generally set (at least in the contracts) only for the different phases (in the design contract for the design phase and in the works (or supervision) contract for the implementation phase) rather than for the whole project as a single entity.

However, while the key performance indicators used by the Authority are set in its RSDP documents (for programme) and in its different phase contracts (for the various phases of projects), the planned values against which performance is compared are not established systematically. In this regard, while the investigation of the optimality of the Authority's programme against resources allocated and risks anticipated is beyond the scope of this work (although as noted in chapter five there are other studies that show drawbacks in this regard), there are problems of optimal planning both for programmes and projects. For programmes, the Authority's planning does not reflect a clear relationship between capacity and scope of work planned. One consequence of this is that, often, the Authority is forced to revise its plan or fail to achieve its objectives (with project slipping into the subsequent RSDP period). Similarly, the Authority does not have any systematic approach to setting all components of the planned values (for example project/phase planned time) for projects. As a consequence of this random contract duration setting and the fact that the Authority normally uses a method-based specification, the cost-time-quality performance indicators may not result in the trade-offs in the way these performance indicators are meant to be.

In terms of performance monitoring and evaluation, the Authority uses tiered system of monitoring and evaluation. At a programme level, the Authority's Monitoring and Evaluation Team, monitors the 'high level' physical and financial performance of the various projects. The analysis of these performance monitoring is used for programme performance evaluation. The Regional Directorates, with a focal point of 'counterpart engineers', report performances to the Monitoring and Evaluation Team. At a project level, particularly for implementation phase, the supervising consultant monitors the performance of projects and provides progress reports to the Regional Directorates. Nevertheless, with the Authority's both Internal Audit Service Directorate and Quality Assurance, Road Inspection and Safety Management Directorate ill-staffed and not performing the detailed audits and quality assurances, the Authority's current approach of project performance evaluation lacks a proper check-and-balance. Currently, the performance evaluation is conducted by the parties responsible for the execution of the various processes, projects and programmes.

*iii. ERA's project core processes and their management*

ERA generally follows consistent project delivery processes that could be categorised under network planning and programme development; project development and project implementation and commissioning core processes. The Authority further divides these core processes into sub-processes and fairly consistently executes each sub-process in implementing a given project. In general, however, while the Authority follows clear and traceable processes in its project delivery, the Authority's approaches to the process management are designed for consistency and control than for efficiency. This section presents summary of the major findings for each core process.

*a. Network planning and programme development core process*

Under the network planning and programme development core process, the Authority executes two major distinct sub-processes of network master plan development and road sector development programme development with the major outputs of a long terms plan (road network master plan) and medium term programme (RSDPs) respectively. In effecting these processes,

ERA adopts a combination of in house and market delivery. The Authority conducts procurement of master plan service provider, programme and annual plan development and the contract administration part of the master plan development in house. The product-oriented processes of the master plan development are conducted through outsourcing.

Unlike its other core processes where ERA provides relatively clear stipulations about the quality of the product-oriented processes and the expected products and has manuals and standards to assist same, the Authority does not have manuals, guidelines, standards or specifications for its network and programme development processes. In addition, the ToR the Authority uses for the network planning processes is weak to guide the actual product-oriented processes. Besides the lack of manuals and standards to follow in the execution of the processes, ERA's network and programme development process faces other challenges. In this regard, drawbacks in criteria (objectives) setting, challenges in follow-up on the competent implementation of the development processes; lack of quality input data for planning and programming and the volatility of the environment under which ERA implements its processes negatively affect the processes and outputs.

Various key factors affect the quality of the outputs of ERA's network planning and programme development processes. In addition to the management of the processes, the quality of the road network master plan developed is affected by the quality of the input data and the product-oriented processes of modelling, optimization and sensitivity analysis. The quality of RSDP and annual investment plan documents is influenced by the quality of the network itself, ERA's capacity and allocated resources for programme development, and the product-oriented processes that the Authority executes to develop its RSDPs and annual plans.

*b. Project development core process*

ERA's project development core processes involve three major sub-processes related with procurement of design services, the management and administration of the actual design processes and procurement of works (contractor) and supervision services. ERA executes the

procurement related processes and the design service contract administrations. The actual designs are executed through its contracted service providers.

ERA identifies project design as the most problematic phase that is having considerable negative consequence on the Authority's overall project delivery. The Authority associates most of the problems in project development to the resource base's negligence and slack practices. However, the Authority's approaches such as its ToR not fostering contemporary developments in design and design management, procurement approach that does not encourage innovation and not tailored to the peculiarities and complexities of each project, its performance evaluation approaches geared towards procedural issues of time of delivery rather than evaluation of the quality can also be argued to have contributed towards the usually poor design output.

Besides the poor design and tender documents, ERA procurement of works and supervision services has some drawbacks that may result in poor project implementation. Project delivery approaches that may not be suitable to the project and coalition characteristics and environmental constraints; contractor selection based on least evaluated bidder that may result in unsuitable contractor; contract durations that are not contingent on the scope and complexity of the project and are not tenable to resource/cost optimization; supervisor selection predominately based on technical competence and experience are some of the key factors that may contribute to the overall poor performance of the Authority's projects.

In general, the quality of the final output of ERA's project development core process, the works and supervision service contracts, is affected by the works/service procurement processes and approaches adopted, the availability of competent suppliers and the quality of the design itself. The quality of the design documents is affected by the capacity and competency of the design service supplier, the manuals and standards adopted for the design, the product-oriented processes executed and the work load on the consultant and the personnel assigned for the service.

*c. Project implementation and commissioning core process*

The project implementation core process that actually produces the physical asset involves, from ERA's perspective, major sub-processes of resource mobilization monitoring and design review, contract and change management, right-of-way obstruction removal and project commissioning and contract closure. The product-oriented processes of the actual construction of the asset are executed by the contractor while most of the site contract administration is conducted by the supervision consultant. ERA, through its Regional Directorates, conducts the overall contract administration and monitors the overall performance of the projects.

Studies and ERA's evaluations reveal that the most important factor that is affecting the performance of the implementation phase is the problems associated with faulty/problematic design/contract document. In addition, late (inadequate) mobilization of resources, deficiencies of ERA (and its supervisor's) in effecting the contract and change management, project monitoring and supervision processes, problems with right-of-way obstruction removal and the associated issue of accountability for it also contribute towards poor performance. The challenges from the national business context such as volatile market and undeveloped/immature supply chain also affect the phase's performance.

Indeed, the performance of ERA's project implementation core processes, expressed in the performance of the road asset and the project time-cost-quality performance criteria the Authority sets is influenced key process, governance, resource and environment related factors. The project (and its product's) performance are affected by the performance of the product-oriented processes, the monitoring and supervision of the works and the contract and change management. The execution of these processes are affected by the capacity and competence of the parties that execute them, the quality of the contracts the parties enter and various environmental forces such as market, pools of competent suppliers, legal and administrative responsiveness.

### 6.3 Research questions/objectives revisited

#### a. *Research questions*

Two fundamental research questions that the research embarked to find answers for were posed in chapter one. This section discusses how the study answered these questions. The questions posed were:

- What are the construction project management processes the Ethiopian construction industry, implicitly or explicitly, uses as part of its project delivery? Related to this, to what extent are these processes different from ‘accepted practices’?

Grouped under three core processes of network planning and programme development, project development and project implementation, ERA’s project delivery processes are presented in sections 5.3.1, 5.3.2 and 5.3.3, respectively, of chapter five. ERA’s network planning and programme development core process has four sub-processes: The preparation of network development criteria and service provider procurement documents and the procurement of same; the management and administration of the master plan development contract; the programme development and the annual investment plan development sub-processes. The project development core process also has four sub-processes of the project development plan preparation; the design service procurement; project design contract administration and deliverable reviews and the works and supervision service procurement sub-processes. The project implementation core process has three core processes of project coalition setup monitoring and design review; project quality assurance and performance monitoring and project commissioning and contract closure sub-processes and one interrelated and parallel executed sub-process of RoW obstruction removal.

In general, ERA’s core processes and the sub-processes under each core process can be argued to be similar to the processes identified in the literature as discussed in section 3.3.2 (for example Kagioglou *et al.* (2000)). However, in terms of the execution and management of the processes, ERA’s approach shows some key deviations. One of the major differences is that the Authority

manages its project delivery by phases without setting a clear system to manage the project as an entity.

- What potential inefficiencies are harbored in the processes and their management? To what extent are these non optimal performances influenced by the general environment the industry is related to via the supply chain?

When seen in the context of the recommendations in the literature for better performance, there are various non-optimal practices in ERA's management of its processes. ERA's project governance set up, including the choice between the DB and the DBB delivery approaches, is not tailored to the specific characteristics and the peculiarities of its projects. The Authority's design for and management of the contracts through which it executes its product-oriented processes of network development, project design and project implementation are standardization focused meant for consistency than adaptable to the peculiarities of the projects. Besides, its performance monitoring and evaluations are made more to justify decisions already made (for example already fixed contract durations) than a thorough assessment of the various factors affecting performance and looking for ways of improving same. The performance evaluations are also executed by parties who are responsible for the performance and hence susceptible to obscurity and hiding.

The Authority also adopts a more fragmented project delivery approaches (both by parties and project phases) than the literature accuse the DBB approach to manifest. The Authority does not fix a single point of responsibility (structure) for the whole project life cycle and does not manage projects as a single entity (phase). Furthermore, even in managing its phases (and the associated processes), the Authority's approaches have key drawbacks that could affect its performance on the phases and ultimately on the overall project.

The Authority's network planning and programme development core process, where projects are conceived and the business case for the projects are justified, can be argued to have problem in establishing a clear and optimum link between the business case (the *raison d'être* of the project), the objectives for the project and the selected approach to achieve the objectives. ERA's

approach to solve the Country's transportation demands is not well optimized both in demand explication and supply provision. Demands for links are either not properly explicated or vary considerably thereby forcing the Authority to incorporate links not planned for. From the supply side, the Authority predominantly concentrates only on the infrastructure solution without trade-offs with other potential non-infrastructure solutions. The infrastructure solutions provided themselves are not optimized in consideration of multi-modal transportation infrastructure provision and are not well synchronized even within the road sector. The Authority also lacks clear guidelines (manuals, standards, norms) for the planning, management and execution of its planning and programming processes.

ERA's project development processes suffer both from the devising of the system (the contract) that governs the processes and the management of the system. The contract (ToR) does not provide for contemporary approaches (such as collaborative design, concurrent engineering, value management, reference class forecasting) that are recommended to combat noted problems in design (such as working in 'silos', 'over the wall' communications, constructability/site adaptability problems, poor estimation and forecasting). The ToR is also not tailored to the specific characteristics and peculiarities of projects. In addition, the selection of the service providers is focused on transparency and accountability than effectiveness and efficiency of project design. Similarly the selection of contractors and the determination of the works contract period are not tailored to the scope, complexity and peculiarities of the project. In terms of the management and governance of the processes, ERA's approach is focused more on meeting deadlines/milestones than monitoring performance and implementing corrective measures. In addition, quality control measures taken (such as report reviews by the Authority) are more procedural than suitably devised and implemented check-and-balance rigors.

The project implementation processes, in addition to the consequences of the above noted design, contract document and supplier selection associated problems, face resource mobilization and works execution as per contract; contract administration, project monitoring; supervision as well as RoW associated problems. Resources are not mobilized as per the programme of the project. The project monitoring and supervision faces both design (where performance indicators are not optimally set) and implementation (where the monitoring and evaluation is not followed

by proper corrective action) problems. Both the governance system and implementation of the RoW obstruction removal create expediency as well as compensation determination problems.

As presented in the corresponding sections in chapter five, while ERA itself can improve its process implementation practices, its performance is also affected by the general environment it is operating under. Such issues as the negligent, slack and unethical practices in the industry; lack of accurate and valid input data (collected by various sector areas of the state); the lack of developed knowledge base; poor supply chain and volatility of the general market are influences of the environment over which ERA has little control.

*b. Research objectives*

Further to the above key research questions; the research set three major objectives. The following sections present short discussions of how the study achieved the objectives it has set out. The objectives of the study were:

- Develop a conceptual framework that serves as a basis for improved performance in the delivery of construction projects;

The need for such a framework is driven by the fact that there does not appear to be a consolidated project management theory that can be used as the theoretical basis for improved project performance. Therefore, both to guide the study and serve as a potential theoretical reference point for other studies, the study analytically developed a framework that is underpinned by the most basic pillars of projects and project management. The framework takes the processes (things to be done), the resources that execute (used to execute) the processes and the system that brings the resources and the processes together as the most important basic pillars of project and project management. It argues that these three fundamental pillars, along with contextualization that are contingent on the peculiarities of projects and the environment under which they are implemented, present the ‘first level’ conceptualization of construction project management. Therefore, as presented in section 2.4 of chapter two, developed based on these three pillars of project processes, project resources and project governance and management

systems that are tied together through contextual adaptation, the study formulated a basic level framework for construction project management. The study then used this conceptualization to categorize and assess ERA's practices in terms of the basic pillars identified bar the resources. However, although the study argues that the conceptualization bases itself on the most basic factors of projects of processes, resources, management and organization and context and these factors are comprehensive enough to conceptualize construction project management hence can be used as a broad level guide for the study, it did not imperially test the applicability of the model itself.

- Explore the current practices of the management of the construction processes in Ethiopia and investigate the major drawbacks of the system as seen in the context of Critical Success Factors and Key Performance Indicators for construction projects (from literature), with a major objective of looking for possible ways of improving the Ethiopian system;

Exploring the current practices of the management of the construction processes and looking for possible drawbacks with the aim of improving these drawbacks has been the central theme of the study. Accordingly, using ERA as its case, the study developed ERA's project process models and presented discussions of ERA's approaches to the management of its processes. Further, by comparing with literature (including from other construction industries practices), the study identified that there are key differences from what is recommended as 'best practice' in the literature and ERA's management of its processes. In this light, the study implied that ERA's approach in organizing its projects (section 5.2.1.1), the management of its project phases and their interfaces (section 5.2.2.1), the devising and setting of its key performance criteria as well as the monitoring and evaluation of same (section 5.2.3.1), the planning and management of its core processes of network planning and programme development (section 5.3.1.4), project development ( section 5.3.2.5) and project implementation (section 5.3.3.3) harbor drawbacks that may affect the Authority's overall project performance.

- Cross analyze these practices against 'accepted practices' and theoretical principles in the area to suggest improvements that are tailored to the potential challenges and peculiarities of the Ethiopian construction environment.

In the above noted sections, besides presenting identified drawbacks in ERA's practices in the management of its processes, the study identified key interrelated factors that could improve ERA's performance. Using suggestions from the literature and adaptation to ERA's contexts through interviews, the study identified key factors, and their interrelationships, that affect performances and developed them into causal loop diagrams that corresponding to each of the core processes of the Authority's project delivery process.

#### **6.4 Implication for theory**

The theoretical implications of this study can be seen in two perspectives: 1) knowledge contribution with regard to the management of construction processes in developing countries, along with insights into the challenges the practices face in such environments and 2) conceptual developments for the global (international) project management body of knowledge. Both parts of the contribution are directly related to the research objectives and subsequently became the findings and conclusions of the study.

As highlighted in the various sections of chapter five, both the practices in managing the construction processes as well as the difficulties experienced have peculiar characteristics that are both informed and influenced by the maturity of the performing companies, the industry knowledge bases and practices, the national business contexts, the performance and capacity of the industries construction is related to through the supply chain, etc. Therefore, the findings in terms of the management of the construction processes in such environments will give an insight into these peculiar practices and challenges when seen from developing countries' project management perspectives.

As part of the contribution to the global project management body of knowledge, the study developed a conceptual framework for project management (Section 2.4). The framework developed, particularly made necessary by the lack of consolidated theory for construction project management, can be taken as a 'first level' conceptual framework over which further theories and researches can be based on. The framework deliberately used the most basic pillars

of what needs to be done (processes), who will execute these processes (the resources) and how the processes and resources are brought together and managed (the governance and management system) as its fundamental starting point in conceptualizing construction project management. It is argued that, when the different features associated with these factors are effected contingent on the specific conditions the projects are implemented, a better performance for the project is an improved likelihood.

As discussed in chapter two, existing attempts to construction management theories tend to focus on either the processes (Koskella, 1992) or organization (Winch 2002; Walker, 2007). A synthesized theory that combines both issues and incorporates the resource dimensions presents a comprehensive approach that takes into consideration the basic factors that affect construction project performance. Rather than prescribing a unified approach to construction project management, the framework also highlights the importance of context. Therefore, the conceptualization gives a context-based comprehensive approach to construction project management that could be used as the foundation of basic concepts. It gives a general framework under which future research in construction project management can be grouped and stereotyped.

## **6.5 Recommendations for further studies**

One of the major challenges of the study is the bulky nature of the issues addressed. While scope delimitation could have been used to focus the study to smaller level, as argued by Nguyen *et al.* (2004) in the context of critical success factors, in industries where the body of knowledge of project management is not matured; the more complicated the dissection the study to smaller level, the less likely that the lesson learned will be adopted. Therefore, given the relative immaturity of the Ethiopian construction project management body of knowledge and lack of previous studies in the area, the research adopted a rather general level of conceptualization of construction projects and addressed the whole project life cycle processes. This has an inevitable weakness of not addressing issues in detail. In the light of this, therefore, it could be advantages:

- To break each component of the basis pillars of the study, address each in detail and identify the major issues associated with each and how they can be feed to each other for improved

project performance. Related with this, this study had to leave the resources component of the framework as the study only looked the processes from the client's (ERA's) perspective whereas addressing the resources component would demand looking into the practices, capacity and competence of the resource base. In addition, while the study addressed ERA's processes and their management as practiced by the Authority thoroughly, the effect of the environment/context cannot be claimed to be addressed to the detailed required. Therefore, looking into these components in detail and analyzing their impact and consequences on the Authority's project performance may reveal important factors and approaches that will help improve performance;

- To break the projects into phases and look in detail each phase rather than the whole project. The project life cycle as a whole is too bulky for a detailed study of such nature. Therefore, now that this study has created the overall project framework and the major processes within each phase, subsequent studies may take each phase separately and address them in depth. However, due care must be taken to look into the interfaces and inter-links between phases;
- One of the drawbacks of Causal Loop Diagrams (CLDs) that are used to indentify key factors that affect ERA's core processes and their outputs is that, if used without simulation, behaviour can only be inferred (Lane, 2008) and this could lead to wrong conclusion. In this regard, while the study identified the major factors that affect the outputs of each of ERA's core processes, it neither established a detailed and ranked effect of the factors nor tested their relationships. Therefore, it could be helpful if further studies are conducted that further enrich the factors themselves, rank their priorities in affecting the outputs, present a simulated link between the factors and test their implications in practice. Such studies, preferably more quantitative ones, will give a priority based focus for efforts to eradicate the problems and improve performances;

In addition, at a general level, for studies focused in practices of developing countries such as this one, one of the major challenges faced is availability of readymade (or easily retrievable) database (and knowledge base to tap into). While the lack of established knowledge base forced the research to focus on general issues as opposed to details (Nguyen, *et al.*, 2004) and delimit the scope at a project level, the lack of easily retrievable data sources made replication (Miles and Huberman, 1994) of ideas over an issue difficult to achieve. Also, though the study has

identified contextualizing as one of its key components of its conceptual framework, given most studies about ‘best practices’ are conducted under developed nations’ business environment, adapting and contextualizing them is difficult. In the wake of this, therefore, while it is hoped that such studies are frequented in developing countries’ and the peculiarities of managing projects in such environments are captured and the industries accumulate both data base and knowledge base, from the experience of the difficulties faced in explicating rich data and undeveloped knowledge base on the one hand and adapting studies done for incomparable industries on the other, even for general level studies such as this one, the study recommends use of combining of approaches such as triangulation of research methods and data sources to curb the study against quality degeneration due to lack of data and knowledge base.

## **6.6 Reflection on the quality of research approach and output**

As noted in chapter four, there are various recommended research quality rigours that help ensure quality of both case study research processes and the output thereof. In general, ascertaining the different aspects of the validity and reliability of the research is taken as key measure of quality. Table 4:3 in chapter four presented summary of the major validity and reliability related rigours to be applied in case study research works. The Table also presented the approaches the study employed in fulfilling these rigours.

The application of the measure of the rigours are scattered from conceptual (proposition) framework building through to research design, data collection, analysis and drawing conclusion. Correspondingly, in this research, efforts have been made to apply these rigours throughout the study. The study critically formulated the problem statement and developed a conceptual framework to guide the research processes. It also identified and discussed key accepted practices in the management of the construction processes and used same both to inform the data gathering and analysis processes as well as a reference against which ERA’s practices are compared. As discussed in chapter four, the case selected was an extreme case which is thought to manifest best proximity to international practices of the management of the construction processes. This helped to get rich data for the study than the industry average. In data collection, triangulation of data sources (between documents and interviews) was employed to corroborate

findings. Data analysis was conducted in iterative manner with gaps identified filled through repeated document analysis and interviews. Finally, the key findings, presented in the IDEF0 and CLDs formats were revised by key informants while the whole document was reviewed by personnel who have deep involvement and knowledge of the practices of the Ethiopian construction industry.

As noted in chapter four, a case study research approach can be used for descriptive and analytical studies where contemporary phenomena with a real life context are sought and it is more suited to analytical generalization than statistical generalization. Therefore, while the transferability of the findings from ERA's practices to the practice of the Ethiopian construction industry in general needs critical investigation particularly given that the case selected is not the a typical case; given the procedures adopted and the rigour measures taken, the generalizations to the theories and propositions can be made with a fair degree of dependability. In this regard, as also presented in section 4.5, where specific measures taken to ascertain the quality of the research are presented, it is believed that the procedures adopted and the quality assurance measures taken would ascertain the construction validity, internal validity, external validity as well as reliability of the research.

## **6.7 Conclusion**

The purpose of this chapter was to summarize the major findings and present the conclusions reached and recommendations made. Accordingly, the chapter presented summary of the major findings in regards to ERA's project delivery processes and their management. It also revisited the research questioned posed and the objectives set and explained how the questioned were answered and the objectives were achieved. The chapter then discussed the contribution of the study to the general body of knowledge and presented its recommendations for further studies. Finally, the chapter briefly re-addressed the research quality measures taken to assure quality of the research processes and output.

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## APPENDICES

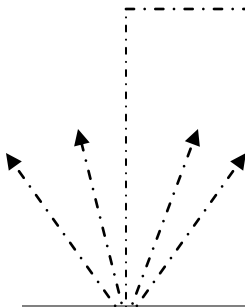
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**Appendix 3:1 Pre-qualification based works tendering procedure**

1. Invitation to prequalify

Place prequalification ads in wide circulation media indicating:

- Employer & Engineer
- Outline of project (scope, location, programme, etc)
- Enquiry issue and tender submission dates
- Instructions for prequalification applications
- Submission date and place of prequalification data



Issue prequalification instructions and questionnaires requesting from each companies/joint ventures:

- Experience in intended type of work and country
- Organization and structure
- Resource (Managerial, technical, labor, plant, etc!)
- Financial statements

Request prequalification document

Respond d to questionnaire

2. Issue and submission of prequalification documents

Acknowledge receipt

Analyze prequalification information provided by firms:

- Company/JV structure
- Experience
- Resource
- Financial stability
- General suitability

3. Analysis of prequalification information and selection & notification of selected tenderers

Elect companies/JVs to be included in list of tenderers

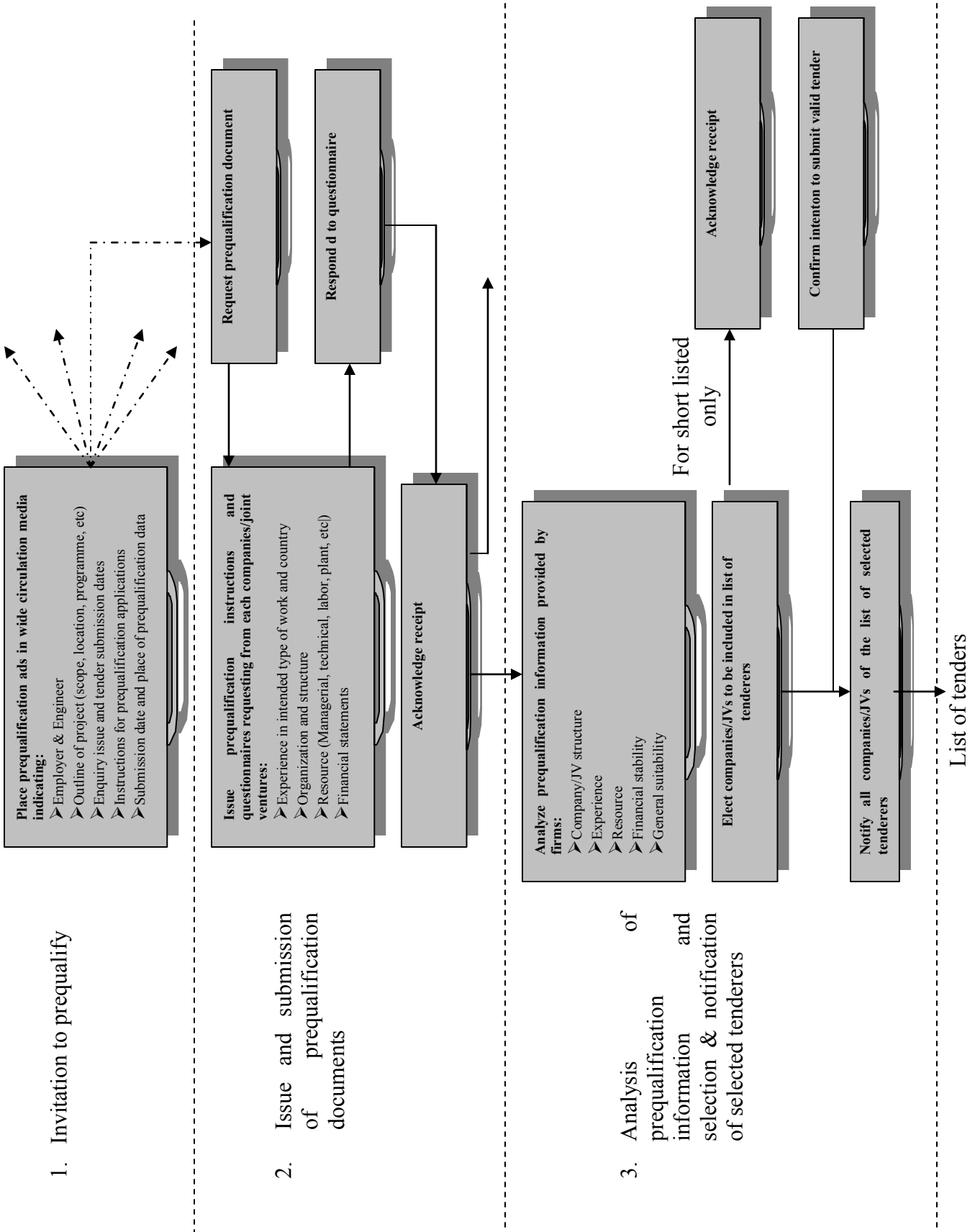
For short listed only

Acknowledge receipt

Confirm intention to submit valid tender

Notify all companies/JVs of the list of selected tenderers

List of tenders



Section/issue

Employer/Engineer

Tenderers

List of tenderers

4. Enquiry documents

- Prepare enquiry documents
- Letter of invitation to tender
- Instructions to tenderness
- Conditions (general and particular) of contracts
- Specifications
- Drawings
- BOQs
- Information data (data sheets)
- Form of tender and appendices

5. Issue of enquiry documents

Issue enquiry documents

Acknowledge receipt

6. Site visit by tenderers

Arrange date and time for site visit (if that is the case as specified on instructions to tenderers)

Commence preparation of tender

Apply for a visit to site

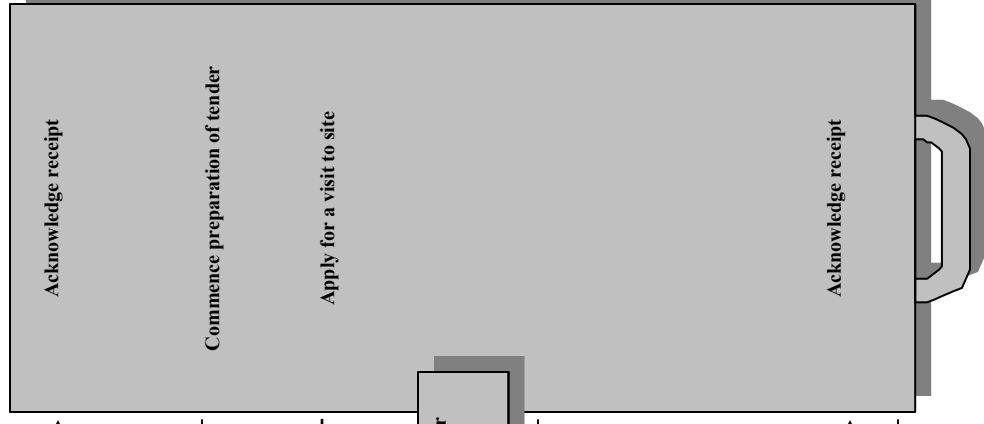
Accompany (engineer or employer or both) tenderers on site visit

7. Amendments to enquiry documents

Prepare addenda (if any) to documents

Issue addenda to tenderers

Acknowledge receipt

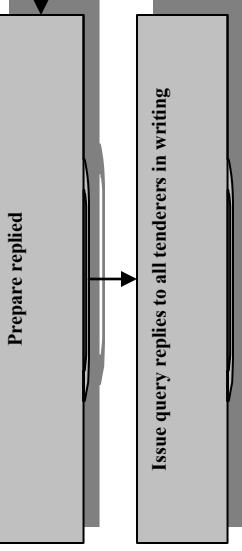


Section/issue

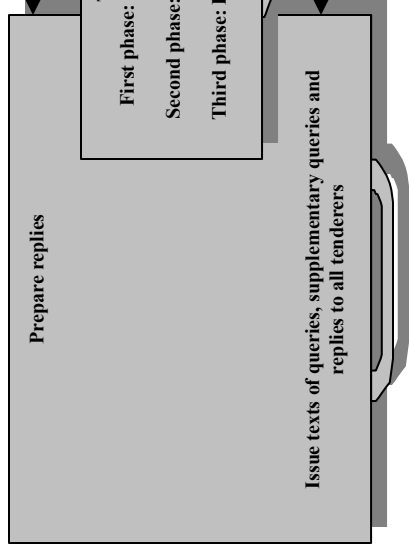
Employer/Engineer

Tenderers

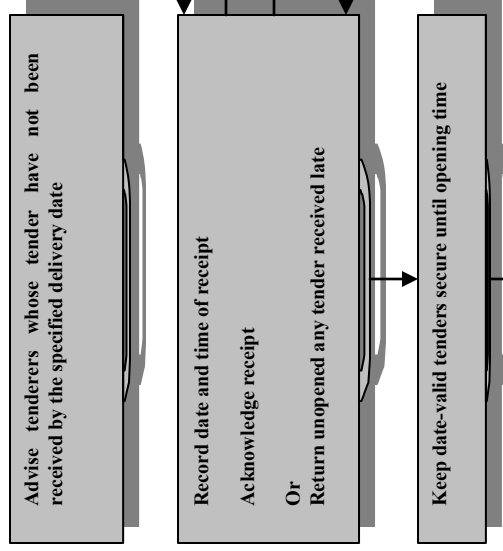
8. Tenderers' queries and correspondence



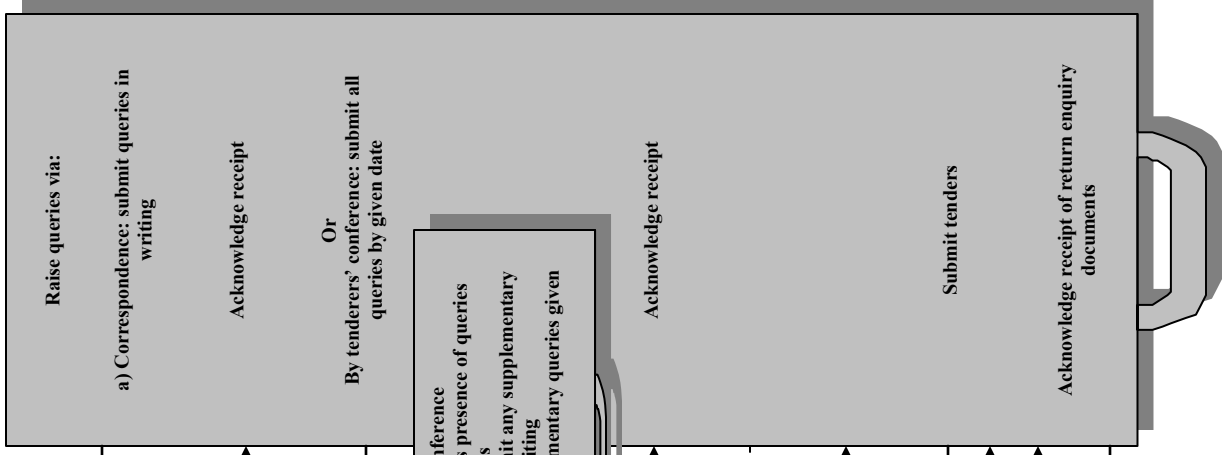
Or (tenderers' Conference method)



9. Submission and receipt of tender



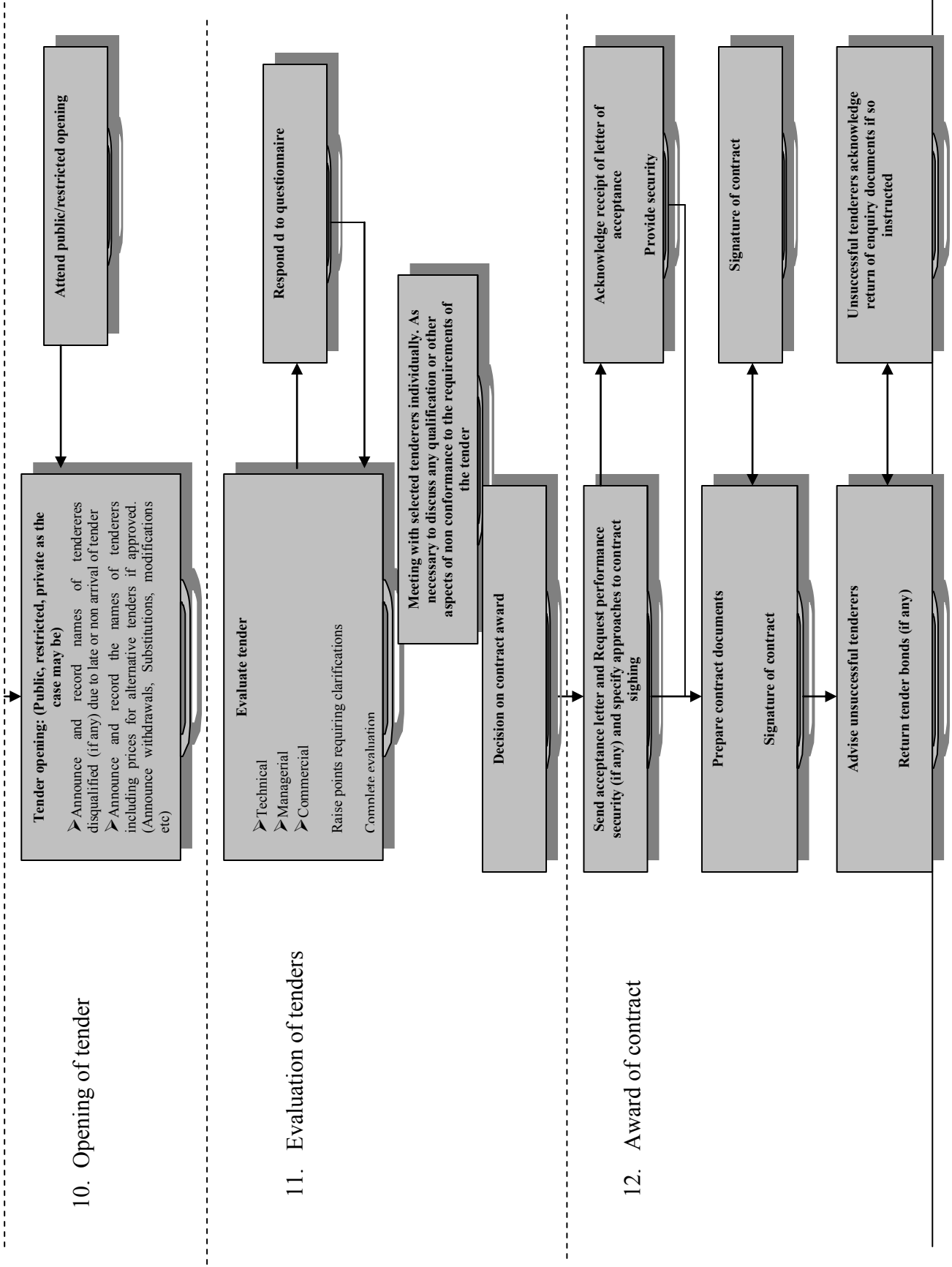
Tender opening



Section/issue

Employer/Engineer

Tenderers



**Appendix 4:1 Sample of the questionnaires and responses**

## Yout doug/tonit

- network
- ① What is master plan do they use?
- ② How is mp development devised and monitored
- i) Who prepares MP development criteria / how?
  - ii) How is the procurement for MP development handled?
  - iii) What are the quality / performance criteria set?
    - Time
    - Quality Experience, Personnel Methodology?
  - iv) Who oversees the MP development processes.
  - v) What are the key issues the Authority concentrates
    - \* Objective setting
    - \* Data validation
    - \* Output synchronization
    - \* Competitive market?
  - vi) Major challenges
    - Environment
    - Management
    - Resource base.
- ③ How Effective is MP in guiding programming?  
Programme projects V.

RSDP → Master plan  
IN → Demand from Regional Government

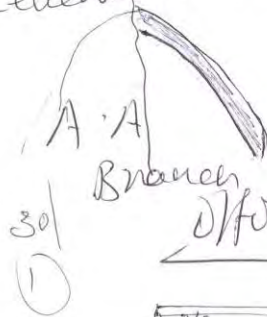
3.52

Rober  
0115150386

Ethiopian Revenues and Customs Authority

የግብርና ጽ/ቤት

Eastern



ለአድራሻ 0115525390

ለጽ/ቤት 0115153688

① What masterplan network do they use know!

② How is masterplan development devised and managed

-> who prepares Mp. development criteria?

-> How is it prepared?

-> How is the procurement for mp development handled

-> what are the performance criteria stipulates

-> who oversees the mp development process

-> what are the major challenges

-> during development

Rober  
△

0911

85 16

-> what are the major challenges

-> during development

③ 45

How effective is the mp in funding programming?  
=> how often do you take out 7 mp projects  
=> what criteria do you use?



34, 873, 57

## Project programming

- ① Multi-criteria selection of projects for the programme . . . . ?
  - Who/how is the criteria set?

→

## Monitor & Evaluation.

- ① programme level performance evaluation -

- ① project

- ② objective - accessibility, . . . .

- ② project level performance

- Budget v. Actual cost v. Efficiency.

- Time

---

## Budgeting.

- ① Budgeting for projects v. Annual budget

- Budget for projects at programme level

- Who prepares project level Annual budget?

- Budget fluctuations?

- what is the say by ERA in budgeting.

- Are projects downgraded / cancelled / infeasibility to receive budget?



5) Evaluation bias

-> Contractual Compliance

-> Satisfaction near completion

6) Variation

- How are they incorporated - check balance

Wednesday  
Nov 6, 2013 → write A to Tadesse - Team Leader  
feasibility (economic) - Budgeting  
- Price Indicat  
- catw-

\* Reference Class Forecasting  
→ Average cost - per/km depending  
on surface type.  
Annual plan more refined than  
RSDP.

\* Annual Plan  
→ Government request → direction.  
→  
→ Continuous renegotiation  
Separ factory work / money  
Demand side

Supply side / Annual Plan  
What is ERA's input

ERA → MOFED → Committee 7 members → participate  
→ Budget heavily with MOFED  
→ Budget Search. (by MOFED.)  
→ Refined budget | Renegotiate  
Rep. 28 Billion for 2016 | prices  
2016 Accepted

RSDP - undefined budget could  
be with in RSDP.  
Donors GOE } Internal budget transfer with  
projects.

RSDP  
Consu } budget title  
Super }

\* Macro economic framework  
Expenditure plan  
Budget control.

Monday Note 1/12/2013 → with A to Abdulkarim  
Team Leader ~~Network~~ Planner  
Program Criteria Setting → potential for feasibility

It's not right to build a federal (high level) road. It has to be feasible.

The Sheradda Masterplan has ended at RSDP IV

- RSDP IV - Master plan
- Regional Government demand
  - DEO identification
  - Federal Government Agencies

Traffic  $\frac{x_2}{x_1} \rightarrow x_2$   
Ex:  $\frac{x_2}{x_1} \times y$

Effort only after feasibility

10.23 IRR | IOC MOFED

Economic rate of return  
Financial rate of return

Strategy only to identify roads but the test is the feasibility

Programme

- Identification Multi-city  
equity  
MCA

Implementation time plan

Priority based on MCA

RSDP - is a government document  
only after approval  
MOT and Councils of  
Ministers

\* Additional/priority projects will  
come with additional budget

\* Allowances/Additional budget

↳ RSDP physical performance  
is not endangered

ERA -> Board Directors (direct  
influence in selection  
roads)

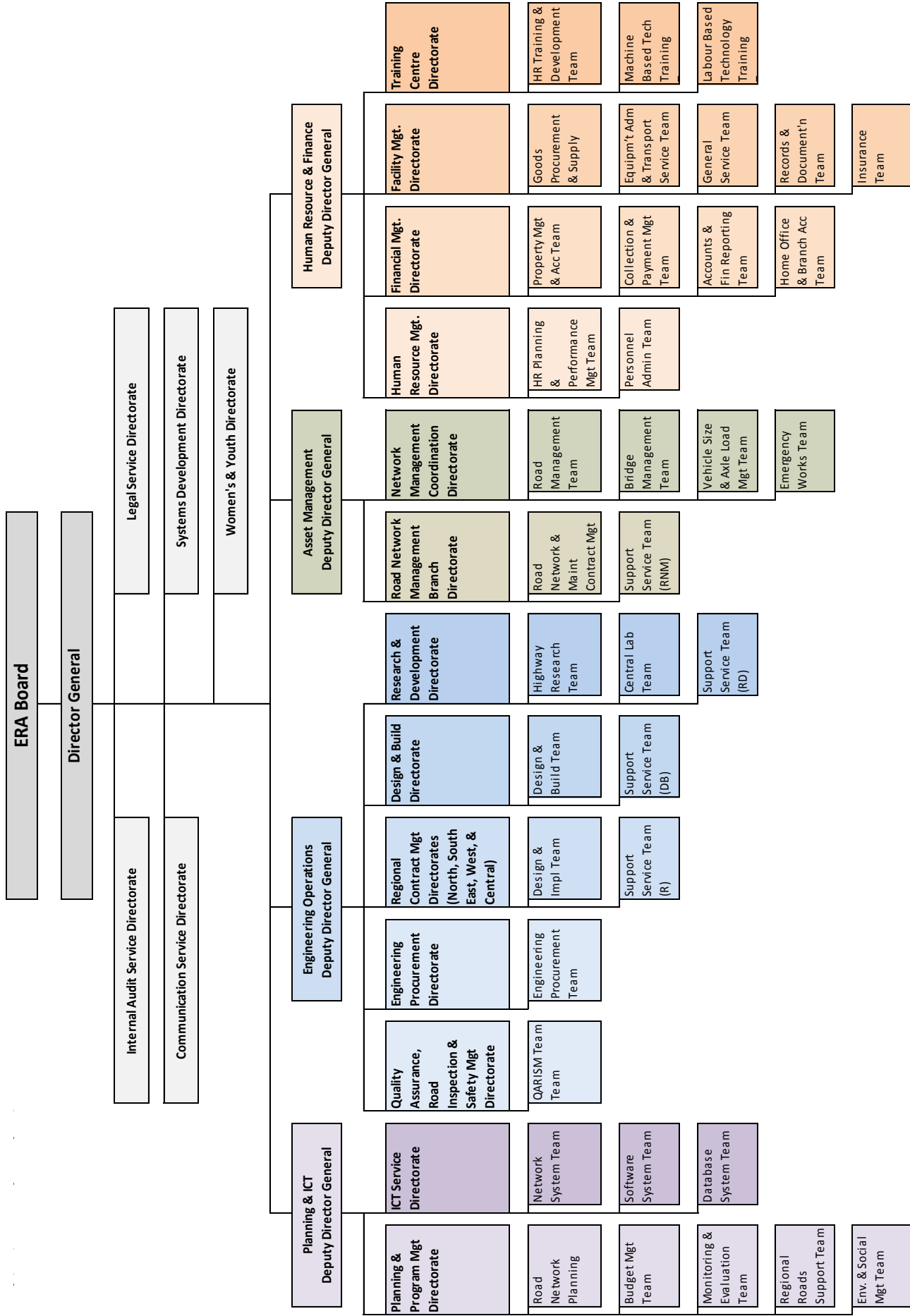
- MOT - D Influence

- PM/DPM for infrastructure

Councils of Ministers

Protect  
Selection

## **Appendix 5:1 ERA's Organization Structure**



Appendix 5.1: ERA's Organization Structure

**Appendix 5:2 Specific objectives of ERA's 2002 Road Network Master Plan**

## Appendix 5:2 Specific objectives of the Sheladia produced ERA network master plan (ERA 2002)

In development of federal road network master plan (ERA, 2002) from ERA's criteria set in the ToR, the network master plan development consultant, Sheladia, identified the following specific objectives:

No.	Objective	Explanation	Objective set
1	Mean distance accessibility <sup>165</sup>	Ratio of a given area to the length of road within that area. Helps to measured accessibility in terms of the distance to the nearest section of the road network for any population.	2.4km while 12.4% of the population (assuming 50% of areal habitation) would be beyond 5km from a road network.
2	Mobility index	Ratio of travel time by the physical route (speed determined by the condition) between an origin and destination and the travel time by the air distance at desired speed <sup>166</sup> . It is taken as the measure of the efficiency of the road network.	In Stage 4, the average mobility index is below 1.5 for nearly 95 percent of the traffic zones (which are 154 overall) and it is below 2 for 100 percent of the traffic zones.
3	Equity	Is a deliberate action taken by planners to offset for disparity that would have been created if the analysis is based solely on economy and traffic. Equity helps to enable to promote basic level economic and social development objectives.	After stage 4, only Somali and Benshangul-Gumuz <sup>167</sup> Regional States have mean access distance and the population living 30Km away from federal road is more than the national average.
4	Linkage to major centers	<ul style="list-style-type: none"> <li>➤ Demographic/political centers: linking all regional headquarters, main cities/towns, ports and main international entry points;</li> <li>➤ Import/export corridor<sup>168</sup>: Ethiopia has already developed all the import/export route lines to paved roads<sup>169</sup> with the only</li> </ul>	

<sup>165</sup> For example, the UN flagged Millennium Development Goals (MDGs) sets a target of halving the world rural population that lives beyond 2Km of an all-season mode of transport by 2015. In this regard, ERA's (2013) 16 years RSDP performance evaluation report puts the rural population that lives within 2km access road at 43%.

<sup>166</sup> The desired speed is related to the design speed of the road project. ERA's design manual specifies ten Design Standards (DS1-10) that can be applied for the different functional standards of trunk, link, main access, collector and feeder roads. The design speed for each DS varies with flat, rolling, mountainous and escarpment terrain types.

<sup>167</sup> Under its current constitution and governance setup, the Federal Democratic Republic of Ethiopia is comprised of nine regional states of the Tigray, Afar, Amhara, Oromiya, Somalia, Benishangul- Gumuz, South Nations and Nationalities, Gambela and Harari Regional States and two city administrative councils of the Addis Ababa City Administration and the Dire Dawa City Council. The regional governance structure is put hierarchically in descending order as Region, Zone, Wereda and Kebele administrations.

<sup>168</sup> Following the secession of Eritrea in 1993, Ethiopia has become the world's most populous landlocked country. Ethiopia's access to sea and hence sea based bulk external trade corridors is, therefore, dependent on both its

		<p>exceptions being the southern lowland roads to Djibouti (which also joins the southern highland part beyond Diredawa) and the unpaved part of the road to Mogadishu beyond Kebri Dehar in Ethiopia;</p> <ul style="list-style-type: none"> <li>➤ Agricultural: Linking agricultural production/market improvement area. The federal road network links will be supported by additional linkages as part of the regional and local road network such as the currently undergoing Universal Rural Road Access Problem;</li> <li>➤ Manufacturing: In the master plan, with the Stage 2 network (ie. on completion of RSDP II), all of the existing industrial areas will have good accessibility. Developments of Stage 4 network will give very good inter regional mobility and can support the industrial development of all regions;</li> <li>➤ Mining: The implementation of RSDP II will provide the required access to these areas and the development of Stage 4 network will provide excellent accessibility to all the potential areas. Additional access roads may be needed for exploitation of potential areas, as per the individual project requirements;</li> <li>➤ Tourism: The important tourist attraction centers will have good connectivity with Stage 4 network development;</li> <li>➤ Poverty alleviation: Providing balanced access to population all over the country, developing new linkages to areas with large potential, providing direct linkages between the production and consumption centers, development of export routes etc.</li> </ul>
5	Economic dimensions	<p>Demand side: Consideration of how the existing network serves the different sectors of economy as well as identification of economically potential areas where lack of road network is hindering the development (and providing potential solution).</p> <p>Supply side: Analysis of constraint and challenges and the ability of the Authority constructing, managing and maintaining the road network.</p> <p>The Network Master Plan indicates that a federal road network of 30,000Km<sup>170</sup> will be the most efficient network that balances the demand and supply dimensions.</p>

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capacity in developing its infrastructure within its borders and the permission and development of same in the countries the country's major import/export is handled.

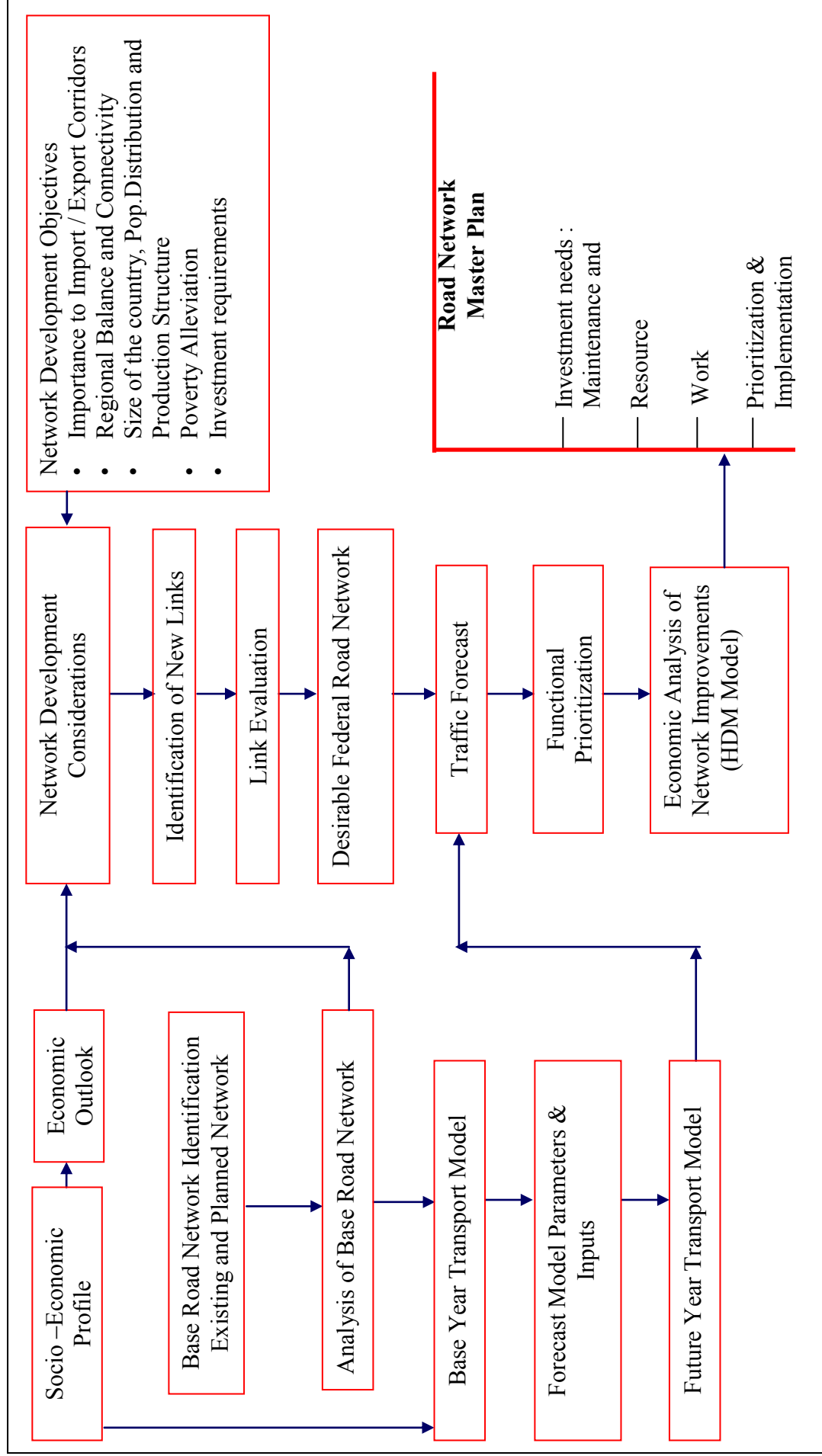
<sup>169</sup> However, given the traffic, it may be necessary to upgrade the exiting one carriage way double lane roads to higher standards.

<sup>170</sup> According to ERA's 2012/13 performance report, the federal network has reached 25,756km by the end of the 2012-2013 Ethiopian Fiscal Year .

**Appendix 5:3 The product-oriented processes under the planning and programming core process and their major deliverables**

### Appendix 5:3 Major deliverables of the product-oriented processes under the planning and programming core process

In the development of the 2002 Federal Road Network Master Plan, the consultant employed the key processes indicated in Figure 1 as presented by consultant (ERA, 2002).



Therefore, ERA's major involvement during the network development stage is to review the deliverables of the network development consultant. The major deliverables it reviews are:

**a. Data acquisition and validation**

The Authority's ToR generally demands the consultant to collect (or solicit) various data. The data to be collected include regional and local demographic and economic data, transportation (traffic) and travel behavior (along with analysis and forecasting of attracted and generated traffic<sup>171</sup>), the current transport infrastructure condition, economic indicators such as GDP and elasticity of traffic<sup>172</sup>. The analysis of these data generally determines the feasibility as well as the design standard of the road. Therefore accuracy and sensitivity of these data, to be used for the network modeling and ultimate planning, is crucial in generating a transportation model that effectively catches the existing situation, forecasts the possible scenarios and caters for it. In the wake of this, therefore, the Authority, reviews the Consultant's input data for their accuracy.

**b. Model development and preliminary appraisal**

Analysis of transport systems is conceptually divided into two parts: the "supply side" and "demand side". The "supply side" consists of analysis of the capability of the available transport infrastructure and the analysis of the capacity of the country to add additional links while maintaining it. The "demand side" analysis, on the other hand, focuses on determining the demand for the mode of transportation based on the politico-socio-economic characteristics of the project area and the origin-to-destination service levels and activities.

In the demand supply analysis, although such issues like equity, political sensitivity, environmental impact, social impact are important factors that affect the incorporation of a given route into a given network, the most often used factor (often in combination with the others in a multi – criteria approach to project appraisal) is the economic viability of the route/link.

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<sup>171</sup> Normal traffic (for rehabilitation and/or upgrading projects) is the traffic that is currently using the existing road assuming that the road is serviceable (otherwise normal traffic part for new roads is developed from analysis of production and movement pattern of people). Diverted traffic is the traffic that may be attracted to the road due to, for example, the better surface condition of the existing road, due to its shortcut or due to less traffic, or due to change in mode of transport (for example from pack animal to motorised) etc. This is an existing traffic that could have used another road or mode of transport had the road been not constructed. Generated traffic is a new traffic that is generated due to the execution of the project say due to the associated economic activities the new road may bring or reduction in transportation cost.

<sup>172</sup> Although they may need augmenting through first hand collected data (for example, COWI and GOPA, a Danish and German consultant JV that also studied the Ethiopian network, in developing another master plan for Ethiopia, conducted a traffic count to augment the existing data), different organs of the state collect and compile most of these data. For example, the Central Statistics Agency conducts national census of demography and household earnings while particularly for agriculture, the local agricultural offices keep the input demands and outputs of the locality. The ERA itself conducts volume and distribution of traffic counts at its various count locations along selected existing links. In addition, although may not be detailed enough (such as indicating number of lanes, width, shoulder width and type, design speed) and at times has misrepresentation (particularly for bridges), the Authority keeps database of its roads categorized along functional classification of the roads in the different districts and along the different routes and the bridges and crossing structures along its roads. GDP level economic recordings and forecast are made by the government itself (through the Ministry of Finance and Economic Development) and by the international financing agencies such as the IMF. The Authority's ToR generally stipulates the data sources to be used for its network development

Therefore, the appraisal needs a thorough characterization of costs and benefits associated with the project as well as determination of the return expected on the capital employed. Accordingly, the Authority's ToR normally demands both the demand and supply side analysis incorporating 'missing links identification model and road improvement identification model' (ERA's ToR). The Authority normally prescribes the use of recognized modelling tools<sup>173</sup> in analyzing and developing the network. The Authority's review is meant to check the meticulousness of the analysis of both demand and supply of the network as well as compliance to the required standards stipulated in the ToR.

### **c. Optimization, prioritization and sensitivity analysis**

The major objective of any optimization technique is basically to come up with the correct amount of each independent variable with the goal of maximizing or minimizing a certain dependent variable under a set of pre-determined constraints. In this ERA's network planning context, it focuses in optimizing between various needs such as expansion and asset management projects against budget and capacity constraints. In this regard, for example, the Sheladia developed ERA's network was constrained by the country's ability to both finance and implement the said network and the analysis, with some suggestion for the country to improve its implementation capacity<sup>174</sup>, resulted that a federal road network of 30,000Km was the optimum level. The analysis also looked into priorities of infrastructure intervention needed.

Network planning is future-oriented endeavor that requires forecasts of costs, benefits, demands, prices, etc. that are susceptible to uncertainties and changes. Given these factors have none proportional impacts on the selection output, changing project results have to be tested under possible changing environmental and other project conditions. The purpose of testing the sensitivity of the project for possible changing input variable (sensitivity analysis) is to determine the degree of stability of the estimated/forecasted. As part of this effort, the Authority requests tests on the inputs of the network development processes and possible implication of changes.

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<sup>173</sup> Such as the Highway Design and Maintenance Standards Model (HDM-4), the Quick Response System II (QRSII) and , for the development and maintenance of low-volume regional roads, the Roads Economic Decision Model (RED).

<sup>174</sup> In relation to this, the ERA is conducting some capacity building endeavors. As its capacity building endeavor consolidates, the Authority envisages 100 construction contractors and 60 consulting firms to get involved in the road construction sector. The Authority is also facilitating and sponsoring the training of professionals that could serve the road sector.

**Appendix 5:4 Major deliverables of the project development core process**

### Appendix 5.4: Major deliverables of ERA’s product-oriented processes

The ERA’s project design phase is divided into two major stages of preliminary design stage and detailed design stage. The preliminary stage involves preliminary assessment of the major features of the project and culminates in establishing the feasibility or not of the project. If the project is found feasible, it goes to the subsequent stage where detailed design of the features of the project are conducted and are compiled into different reports, drawings and specifications. During these two stages, in its most recent format (starting from circa 2012), ERA’s ToR for design service procurement specifies the following major deliverables to be produced by the design service provider. Figure 1, below presents these major deliverables. Therefore, the Authority reviews these deliverables against the ToR requirements, adopted standards and manuals and general engineering principles.

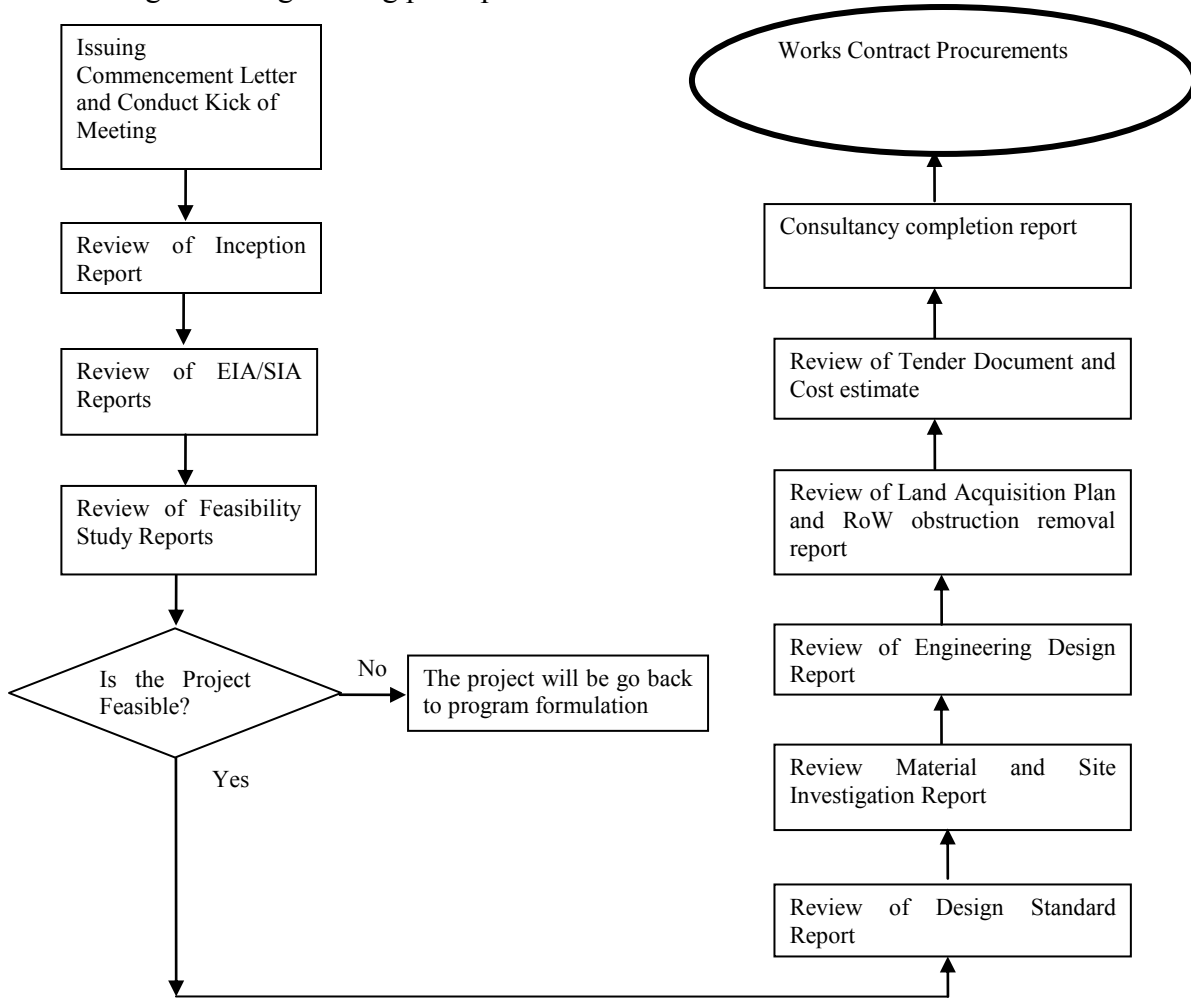


Figure 1: Major deliverables of project design product-oriented process

#### a. Review of preliminary engineering design

The major review the Authority conducts include review of preliminary topographic surveys of the proposed alignments that is necessary to prepare preliminary engineering design and subsequently for appraisal in the feasibility study; review of preliminary soil, material and

shallow foundation investigations to identify and test appropriate subgrade, material and foundations for the project; preliminary hydrology and hydraulics studies; preliminary geometric design, preliminary pavement design; preliminary drainage and structural design, preliminary quantity and cost estimation. The Authority's various manuals and standards normally stipulate the requirements of each output and hence the Authority has to ascertain conformance to requirements and/or justify deviations;

- **Inception report:** The Terms of Reference of the Request for the Proposal often stipulates that the design service provider shall prepare inception report. To a major extent, the TOR also stipulates the issues to be addressed in the inception report. In this light, with no prejudice to the TOR setting particular requirements as needed, the major issues that are addressed in the inception report include: general information about the project; initial findings of the consultant and review of available documents; detailed work programme incorporating comments of the Employer to same; review of the proposed methodologies and interventions and confirm/adjust same based on review of available information and/ or to suit the field condition during visit; a review of the organization structure proposed and staffing of same; mobilization of consultant's personnel; any constraint that could otherwise affect the project's performance and possible way of mitigating same;
  
- **EIA and SIA report:** ERA's TOR stipulates that the study be conducted in accordance with the requirements of the country's Environmental Protection Law and guidelines provided by the Ethiopian Environmental Protection Authority (EPA). The EPA's Environmental Impact Assessment Procedural Guideline produced based on the Environmental Impact Assessment Proclamation No. 299/2002 states that the primary purpose of EIA is 'to ensure that impacts of projects, policy and programs, etc. are adequately and appropriately considered and mitigation measures for adverse significant impacts incorporated when decisions are taken.' EIA studies generally assess issues related to the physical, biological as well as socio-economic environment. In this regard, the EPA guideline for EIA assessment for roads and railways<sup>175</sup> identifies potential impact assessments on the economy, the environment, population, health outcomes, gender, participation, external factors, hazard management and presents their potential beneficial and adverse impact along with possible enhanced and mitigation measures.

In addition to following the Environmental Protection Proclamations and the associated directives and guidelines, the Authority's TOR also stipulates to follow the ERA Standard Environmental Procedures, Resettlement/Rehabilitation Policy Framework, Sectoral Policy for HIV/AIDS in Workplaces, Safety Audit Manuals, etc. in assessing environmental impacts for projects the Authority implements. In this light therefore, the Authority's main task is to review the feasibility, EIA and SIA studies by the consultant and ensure that they address the major issues for feasibility, EIA and SIA. Cross checks are made to assess if the consultant has followed appropriate procedures, laws, directives, guidelines and standards in its studies and assessments;

- **Feasibility study report:** Feasibility studies of the different links that comprise the road network is conducted during the project planning and programming phase. However, the

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<sup>175</sup> The EPA notes that although the guideline was produced in 2004.

feasibility study conducted during planning and programming is a parametric<sup>176</sup> estimate which is tailored to qualifying the link to incorporate within the network and prioritize it. Therefore, once a link is selected for implementation, detailed feasibility of the link (project) is conducted by the design service supplier of the Authority.

Detailed feasibility study demands the assessment and determination of the various factors that dictate the process. Such factors as planning time horizon (discounting period), the residual values at the end of the planning period, investment costs (implementation resource cost, land use cost, resettlement cost, environmental appraisal cost, future maintenance costs, etc.), traffic operation costs/benefits, discounted cash flow rate, economic development<sup>177</sup> etc., need to be determined.

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<sup>176</sup> An estimating technique that uses a statistical relationship between historical data and other variables to calculate an estimate for activity parameters, such as scope, cost, budget, and duration. The ERA's planning stage normally uses a historical recordings of per kilometer road (per span length of bridge) to determine estimated cost.

<sup>177</sup> ERA's ToR ties planning horizon to the traffic count which in turn determines design standard of the road. For lightly trafficked gravel roads a planning time horizon of 10 to 15 years is suggested while for heavily trafficked main roads 20 to 25 years of time horizon is recommended.

Residual value are the market value for the fixed assets (or liquidation value of assets in the case they are sold out at end year) and includes the appraisal of the net revenues the project can generate beyond the time horizon, before any substantial revamping or replacement of the old investment. It can be determined from the previous experience based on such factors as design standard, traffic forecast, market/price forecast, etc.

At this stage, where the consultant is expected to have produced preliminary design of the project, the quantities of work estimated from a preliminary engineering design of the road are used for the estimating of the detailed resource cost whereas resource rates are determined from the market prices with tailoring of productivities and rate differences as applied to the specific project localities. In this regard, good investments generally have a positive impact and contribution to a given national economy, particularly when most of the consumed resources are solicited within that country, and hence effect of same should be incorporated in the appraisal. Land use cost can be determined from rental income loss or loss in agricultural production. Resettlement cost, which is based on the principle that the total the amount offered should make people just as happy to move as to stay, may either be identified as a total monetary compensation or as the cost of repurchasing equivalent land and buildings plus a resettlement inducement. The environmental appraisal is tied to the EIA study result and is meant to cater for measures that should be taken to minimize the effects of environmental disruption. Based on maintenance needs of similar standard project and tailored to the local conditions and traffic flow estimated, the consultant will estimate routine recurrent /periodic maintenance cost of the alternative design option considered for the project. Vehicle operating costs/savings include costs involving fuel consumption, lubricating oil consumption, spare parts consumption, vehicle maintenance, labor, tyre consumption, vehicle depreciation and crew costs in commercial vehicle as well as savings from passenger/freight time.

Discounted rates are often compared to the return on government bonds as a minimum benchmark. For investment in public sector it would be safe to use the real interest rate on public bonds of maturity equivalent to the project horizon. In addition, rather than using pure financial discount rates, a slightly different rate, a social discount rate that reflects the view on how future social benefits and costs should be valued when compared with present ones is recommended for economic analysis of public projects where the benefits accrued may involve social benefits. In Ethiopia, public investment needs to clear the minimum set internal rate of return (IRR) of 10.23% set by the MoFED.

Infrastructure developments, such as roads, are associated with developments in various social, economic, environmental sectors. Therefore, in addition to the transport cost saving, it is necessary to look into the wider development implication of the project at hand. Economic development analysis should look into potential agricultural, mining, social, environmental developments, etc. and the associated business and employment

The ERA also conducts gate review at the end of the preliminary design stage to check the feasibility of the project. At gate review, if the project is found feasible to implement, the processes move to the subsequent stages of detailed engineering design, resettlement action plan preparation and finally tender document preparation for the works contract. However, if the project is found to be not feasible, it will be sent back to the planning and programming phase for future consideration or scope adjustments.

#### **b. Outputs of detailed engineering design stage**

Stage two of the design service contract administration involves the administration of the major task of the detailed engineering design, resettlement action plan preparation and tender document preparation for the works contract that is prepared by the contracted consultant. The phase develops on the findings of the preliminary engineering design and comes up with the final design and associated documents.

The detailed engineering design part of the work involves various investigations, testing, studies and surveys. Based on these investigations, studies, and surveys, detailed design documents and engineering drawings of geometric design, pavement design, drainage structure and element design, structural analysis and design as well as designs of traffic engineering and road furniture is made. From the Authority's point of view, its major task is to review these and related outputs from the design consultant and make recommendations. In regards to the detailed engineering design, RAP preparation and tender document preparation phase of the design service contract, the TOR usually specifies major deliverables of:

- **Detailed design standard report** that specifies the design standards the consultant is going to adopt in his design of the project. In this regard, the Authority's TOR often requires designs to be to accepted engineering standards and principles. To serve for such purposes, the ERA has produced various design manuals and standards<sup>178</sup> and stipulates for them to be used in the design. The design consultant, therefore, has to stereotype and clearly justify the selection of the standards to be adopted for the various components of inputs for the design, the computation approach to be used, the element design as well as justify departures, if any;
- **Soil and material investigation report** that characterizes the sub-grade soil along the proposed road corridor, the presents characteristics of sub-base and base course of the

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opportunities within the project influence zone and thoroughly investigate same to come up with description and quantification of associated economic benefits the implementation of the project may provide.

<sup>178</sup> ERA has its own design manuals and in its ToR suggests, as much as possible, designs to be in accordance with its design manual and to accepted engineering principles and standards. The Authority's design related manuals and standards include Geometric Design Manual, Pavement Design Manuals (separate volumes for flexible and rigid pavements), Drainage Design Manual, Bridge Design Manual, Site Investigation Manual, Pavement Rehabilitation and Overlay Manual, Standard Drawings, Standard Technical Specifications as well as [standard] bidding documents. In addition, in 2012, the Authority has produced quality manuals for its overall quality management and monitoring, for its planning for its procurement of both services and works, for feasibility study and design, for environmental and social management, for construction management and for maintenance management.

existing road (if not a new road), foundation investigation outputs of structure sites, general information about the project site with respect to availability of construction materials, review of available material and findings of investigation of sources of construction material. The report will be accompanied by investigation and testing results as well as justification/recommendation for compliance to the technical specification;

- **Detailed engineering design report** that presents all the assumptions and criteria used in the analysis and design of various elements of the design project together with details of all standards used and the construction strategies and implementation program recommended. Environmental and social issues are also addressed in the report. The report is generally the most comprehensive report that compiles all the technical findings of the various studies. In addition to revision of the feasibility studies, EIA findings, design standards and deviations from standards, material and site investigations findings as necessary, the report addresses the following major issues:
  - ✓ **Topographic survey** that presents the details of the survey outputs of the alignments and major features along the corridor. This report includes a summary of the key findings of the topographical survey review and the finalization of survey notes, computations, and all other deliverable of the additional survey works carried out as specified in the TOR. It generally is accompanied by Digital Terrain Models (DTM) and Digital Elevation Models (DEM) of the corridor;
  - ✓ **Hydrological and hydraulic structure report** that summarizes all hydrological and hydraulic analysis/calculation together with assumptions and criteria used for the design of drainage structures. The report incorporates detailed calculations with regard to waterway openings for major water courses during peak flood conditions, with any required protection of the road, slopes and structures, list of structures showing existing discharge capacity, estimated design flood and proposed new culvert or bridges and a description of the structural condition investigations is included in this report;
  - ✓ **Structures report** that presents the selection of the type of structures for each crossing point identified, determines the sizes of structures based on hydrological, geometrical, geotechnical, etc. compatibilities. It also determines the type of material used for the design and presents the detailed design of each of the structures;
- **Quantity of work and cost estimation report** that presents estimated quantity of works and engineering cost estimates<sup>179</sup> for both construction and supervision of the works. The report incorporates the estimated BoQ, the cost estimate along with detailed CBS and amount of input items, input rates, productivities adopted, proportion of cost of major items such as cement, fuel, etc. to the project in both local and foreign currency, as appropriate. The Authority's standard format requires the detailed BoQ to be prepared subdivided and synchronized with the standard technical specification item numbers. The standard specification and corresponding measurement methods are divided into sections of general items, site clearance, drainage, earthwork, sub-base, road base and gravel wearing course,

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<sup>179</sup> As it is, the Authority uses least evaluated bidder approach in tendering. Therefore, the main purposes of the engineering estimate are to serve for budgeting and as a simple reference (only to check departure from the estimate) in tendering.

bituminous surfacing and road bases, rigid pavements, structures, ancillary works and testing materials and workmanships. The BoQ, in addition to the above, may specify schedule of days work<sup>180</sup>. The ToR stipulates that the report shall be kept confidential at all times, during preparation, at submission and afterwards;

- **Complete sets of tender document** which will serve as a basis for tendering the project based on either International Competitive Bidding (ICB) or National Competitive Bidding (NCB) procurement method as recommended by the ERA. Mostly, the Authority specifies that the documents will be prepared based on FIDIC conditions of contracts and procurement procedures for ICBs and on the Public Procurement and Property Administration Agency's (PPPAA) (of Ethiopia) for NCBs. The set of tender document normally compiles the various works of the design processes in the form on specifications, drawings and contractual stipulations. Table 1 below provides a summary of the major component of the tender document as often specified in the Authority's TOR.

Section	Item	Description
<b>Bidding Documents: Volume I</b>		
Section I	Invitation for Bids	This is a document that alerts tenderers to the nature of the supplies, services and engineering and construction works required by the employer and should contain sufficient information to enable them to respond appropriately. It often includes the name and address of the employer, a brief description of the project (type, size and location) including desired time for completion, the means and conditions for obtaining the bid documents and the place from which they may be obtained, the place and deadline for the submission of bids, the place and time for opening of bids, etc.
Section II	Instructions to Bidders (ITBs)	This is a document in the tender to furnish instruction to bidders on the preparation and submission of the bids. Although it may repeat some of the information in the invitation to bid, the instructions are mostly concerned with instructions about filling out the bid form, bid due date, location to deliver the bid, examination and evaluation of bids method of awarding the contract, bid security information, conditions to become non-responsive to the bid, etc. There are existing standards like the FIDIC's or PPA's Standard Bidding Documents (SBDs), over which the IPBs can be based on.
Section III	Bid Data Sheet (BDS)	The bid data sheet principally modifies the general stipulation of the ITBs to the specific needs and demands of the employer. It generally stimulates the specifics of the bidding process as in bid submission, request for clarifications, pre-bid meeting, addresses, bid submission dates, etc., which generally public procurement procedures demands the

<sup>180</sup> Day work, in contracts, is work done that is paid on daily basis and often ordered when item rates are not available within bill of quantities (for bill of quantity based contracts) for extra items to be executed.

		employer to specify. In effect, the Employer puts his specific demands in modifying/adding to/deleting from the standardized ITBs through the BDS.
Section IV	Condition of Contract Part I: General Condition of Contract (GCC)	States the applicable conditions of contract and associated contract specific data that collectively describe the risks, liabilities and obligations of the contracting parties and the procedures for the administration of the contract. Standard general conditions of contract such as those produce by FIDIC or the PPA can be adopted for the GCC.
Section V	Condition of Contract Part II: Condition of Particular Application (CPA)	This document provides more specific and relevant information and conditions to a particular project. It is a supplementary and modified sections of the GCC or provides additions/deletions to it as found fit to the particular project or employer's needs. The CPA includes additional employer's requirements. In this regard, while the CPA normally is meant to deal with issues related to the peculiarities of the project and the employer's needs, the standard conditions noted above give guidelines on the major issues the need to be addressed in this document.
Section IX	Form of Agreement	This form formalizes the legal process of offer and acceptance and often includes identification and full address of the signing parties, short description of the project and the work, date of commencement and signature, completion time of the project, the contract price, etc.
	Performance Security( both Conditional and Unconditional)	The form presents security clauses to be included in the successful contractor's performance security that guarantees its performance of the works as per the terms and conditions of the contract. The Authority advises the use of standard forms of such security forms and modifying same to the specific circumstances.
	Bank/Insurance Advance Payment Security (Conditional and Unconditional).	The form presents stipulations as to the conditions and provisions to which the contractor's guarantor commit itself in exchange for the employer to provide advanced payment to the contractor. Although the banks could have their own forms, the Authority advises the use of a standard form that clearly stipulates the terms and conditions for release of advanced payment.
	Anti- Bribery Pledge Form	This is a form that requires the contractor to pledge in not getting involved in any form or shape of bribery or corrupt endeavors.
	Advanced Payment Disbursement Agreement Form	This document stipulates how the advanced payment is to be used and disbursed. By using the advanced payment disbursement form, the two parties (employer and contractor) agree on the items the payment is to be used on.
	Advanced Payment	While the advanced payment disbursement agreement stipulates the agreement the parties made on how to use the

	Disbursement Schedule	payment, the advanced payment disbursement schedule presents the time tailored cash flow schedule for same.
Section XI	No used	Not used
Section XIII	Dispute Settlement Procedures	This document sets the procedures how disputes can be minimized and settled, should same arise. Often the Authority opts for Dispute Resolution Advisor/Board, Adjudication, Arbitration, forms of dispute settlement mechanisms.
Section XIV	Eligible Countries	This document stipulates the countries from which inputs to the project can be brought and used. It is produced based on with due regards to the Federal Democratic Republic Ethiopia's Government unilateral imposition of commercial sanction, the United Nation Security Council sanctions as well as financier's limitations for same.
<b>Bidding Documents: Volume II</b>		
Section XII	Qualification Questionnaire	This is a document used as an instrument to assess the capability of potential suppliers for the specific magnitude and complexity of the project and for short-listing of invitation for participation in the tendering processes. The document presents such a questionnaire incorporating questions related to the technical, financial, managerial, etc. demands. It is used for post-qualification tendering approach of procurement, if employed.
<b>Bidding Documents: Volume III</b>		
Section VII	Form of Bid	This is a form that the supplier uses to summarize the bid and pledges himself/herself to the bid.
	Appendix to Bid	The Appendix to Bid summarizes and specifies the general issues stipulated in the Condition of the Contract such as Amount and limit of liquidation damage, length of defect liability period, etc.
	Form of Bid Security	The form presents the formats under which the Bid Security should be presented and the condition under which bid security will be forfeit.
Section VIII	Bills of Quantities (BOQ)	Provides the work items specified in the engineering and construction works which are described elsewhere in a specification within the scope of work section of the contract. Along with the work items, the document provides estimated quantities of the work items.
<b>Bidding Documents: Volume IV</b>		
Section VI	Technical Specifications	This document specifies and describes the supplies, services, or engineering and construction works which are to be provided and any other requirements and constraints relating to the manner in which the contract work is to be performed. It has two components: Standard and Special. The ERA has produced Standard Technical Specifications for Construction of roads. The Special Provisions to the Technical Specifications are produced based on a thorough analysis of

		the design requirements and the construction work methodology needs.
<b>Bidding Documents: Volume V</b>		
Section X	Drawings	These are the products of the design processes and present the design artifact. They describe the size and dimensional requirements of the various items within the scope of the project.
<b>Bidding Documents: Volume VI</b>		
	Reports	In addition to the tender document mentioned here above, the design consultant will also prepare, as also stipulated in the TOR various reports which may be consulted by potential bidders during tendering stage. Such major reports include Material Reports, Hydrologic/Hydraulic Report, Design Reports, etc.

- **Land Acquisition Plans and Right-Of-Way Obstruction Identification Report** present a listing of the affected plots, population, economic values and the resettlement action to be taken along with the areas to be expropriated and the cost of resettling. In addition, the report includes obstruction identifications within the ROW. The production of report is mainly guided by the Authority's Resettlement/Rehabilitation Policy Framework (2002), financier's requirements such as World Bank's RAP Handbook and policy guidelines. The resettlement action plan document should outline eligibility criteria for affected parties, establishes rates of compensation for lost assets, and describes levels of assistance for relocation and reconstruction of affected households;
- **Consultancy Completion Report** that presents compilation of the various issues that transpired during the design processes, the key findings and lessons learned. The report is required to be a comprehensive report that describes the aims of the project and the achievements, presents the consultant's final statement as well as lesson learnt. The report will summarize the overall progress and outputs of each task executed as per the TOR and be consistent with the various prior progress of other reports made.

**Appendix A: Comments from examiners and responses**

**Examiner A (16<sup>th</sup> August, 2015)**

<u>Correction Recommended</u>	<u>Comment/Response</u>
<p><b>1. Summary</b></p> <ul style="list-style-type: none"> <li>The title of the thesis might need to be changed to reflect the contents of the thesis. There is nowhere in the thesis that the Ethiopian construction industry.... is discussed as representation of developing countries. In addition, there is no argument that shows ERA's is a representation of the management of the construction processes in Ethiopia</li> <li>The thesis needs to clarify the construction process management model that is developed: is this the same as the conceptual model in page 34?</li> <li>In page 11, the industry the thesis refers to is not clear. Is the ERA's process model similar to Ethiopian construction industry's management processes as a whole?</li> </ul>	<ul style="list-style-type: none"> <li>The study notes that (page 13) '[t]he practice analyzed and critiqued is limited to the management of the construction project processes as practiced by the Ethiopian Roads Authority (ERA). Therefore, the work can only reliably be applied to the management of construction project processes in the road sector.' The second part of the title; 'A Case study of the Ethiopian Roads Authority' clearly scopes the subject matter of the study.</li> <li>The Figure (on Page 43 in the final) depicts the conceptual framework of construction project management the thesis adopted. ERA's construction process models are developed using IDEF0 modeling techniques and are presented in Chapter five. This is clearly noted in the document (see Page 12).</li> <li>The sentence (page 11) is qualified more to mean the Ethiopian construction industry. The Ethiopian construction industry is referred to in this section as part of the hierarchical narrowing of the scope of the study. However, the study clearly states that the work can only reliably be applied to the road sector in the country (see above).</li> </ul>
<p><b>2. Chapter one</b></p> <ul style="list-style-type: none"> <li>Page 11, where is the evidence in the thesis that 'the Ethiopian construction industry is said to harbor many inefficiencies and ineffectiveness in its delivery system and processes'? Reference or statistics (hard data) are required</li> <li>Page 11, where is the evidence in paragraph two 'One of the causes of the inefficiencies is.... 'Reference or statistics (hard data) are required.</li> <li>In page 11, last paragraph identifies four key issues that are needed for 'improved performance' The thesis needs to</li> </ul>	<ul style="list-style-type: none"> <li>The sentence refers to earlier presentations of the major drawbacks by starting, 'as highlighted earlier'. However, as per the comment, references are added at this particular line in the final version for the sake of better clarity (Page 11).</li> <li>Comment accepted. Reference added in the final version (page 11).</li> <li>The thesis, in the conceptual framework section (section 2.4), presents an analytical argument why the processes to be</li> </ul>

**Examiner A (16<sup>th</sup> August, 2015)**

<u>Correction Recommended</u>	<u>Comment/Response</u>
<p>clarify what informed the identification of the four key issues.</p>	<p>executed, the resources that execute these processes, the management through the processes and the resources are brought and operated, contingent on contextual/environmental factors, can be used as a 'basic level' blocks of construction project management. The issues are developed from a synthesis of the different project management paradigms discussed in the preceding section (section 2.3). Section (2.4) is improved to clearly indicate these.</p>
<p><b>3. Chapter two</b></p> <ul style="list-style-type: none"> <li>The thesis should justify why the management theories identified in table 2.1 were chosen and others that could have been were not. It should show that the chosen theories are exhaustive (optimal) to address the research objectives.</li> </ul>	<ul style="list-style-type: none"> <li>The thesis (page 17) clearly declares that 'the presentation is neither exhaustive nor meant to analyze theories of management as such'. The relevance of the identified theories to the Conceptualization of Construction Process Management is presented in Table 2 (last column). The use of the 'contemporary management theories' in project management theories is highlighted in the project management theory section (see for example page 21).</li> </ul>
<ul style="list-style-type: none"> <li>These (management) theories are limitedly discussed in the chapter and how they help to develop the conceptual framework</li> </ul>	<ul style="list-style-type: none"> <li>Comment accepted (section 2.4.1). The theories were limitedly discussed both due to space (word count) limitations and for the sake of brevity. The specific theories used in the conceptual framework are discussed in greater depth in the final. However, as noted in the thesis, the intention is not to discuss the management theories <i>per se</i> but rather to present the basis over which the conceptual framework is developed.</li> </ul>
<ul style="list-style-type: none"> <li>The chapter should clarify the difference between conceptual framework and theoretical framework. It would appear they are used interchangeably in the chapter.</li> <li>If Figure 2.1 represents the framework with respect to objective 1, it is not explicit how this was developed from</li> </ul>	<ul style="list-style-type: none"> <li>Comment accepted. A clear distinction is made and interchangeable usage of the two concepts is avoided.</li> <li>The framework synthesized the process-based (production) approaches of the TFV model and the organization</li> </ul>

<b>Examiner A (16<sup>th</sup> August, 2015)</b>	
<b><u>Correction Recommended</u></b>	<b><u>Comment/Response</u></b>
the identified management theories.	(coordination) focused approaches to project management. As discussed in Section 2.3.5.3, these approaches to construction project management are founded in the management theories identified. In addition, Section 2.4.1, included in the final, discusses how the theories identified are used in the conceptual framework developed.
<ul style="list-style-type: none"> <li>It might be relevant to discuss each of the management theories in Figure 2.1 with relevant references and how they help to develop the construction management process used as a benchmark for the study</li> </ul>	<ul style="list-style-type: none"> <li>Comment accepted. Section 2.4.1 is added to further discusses the theories used in developing the conceptual framework is section 2.4.2. The Section also discusses how these theories are used in developing the conceptual framework.</li> </ul>
<b>4. Chapter three</b>	
<ul style="list-style-type: none"> <li>No comment</li> </ul>	<ul style="list-style-type: none"> <li></li> </ul>
<b>5. Chapter four</b>	
<ul style="list-style-type: none"> <li>The justification for the case study should be more scrutiny based. What other cases could have been chosen and why they are not chosen.</li> <li>Where is the questionnaire for the semi-structured interviews and how was this developed and what formed the basis for the development of the questions?</li> </ul>	<ul style="list-style-type: none"> <li>Comment accepted. The different potential options (HDPOs, EEPKO, ERC) and the justifications for selecting ERA are discussed further in the final document in Section 4.3.2 (Page 99)</li> <li>Comment accepted: As noted in Table 4.2, the IDEF0 based process models and the CLD based causations, first developed from the document analysis, were the basis of the interviews and discussions with informants. The probing questions, attached as Annex (4.1) in the final, were also framed based on these early drafts of the models.</li> </ul>
<ul style="list-style-type: none"> <li>Page 91, What are the key probing issues picked form the document analysis and used in the interview? Where are they?</li> </ul>	<ul style="list-style-type: none"> <li>Comment accepted. The probing questions (and some of the responses) are attached as Annex 4.1</li> </ul>
<b>6. Chapter five</b>	
<ul style="list-style-type: none"> <li>It is not clear from the chapter how the data collection from interviews, project documentation project progress and evaluation, etc. fed into the chapter. What is the interview</li> </ul>	<ul style="list-style-type: none"> <li>Comment accepted. Explanation improved. Section 4.4 (i) presents the description of how the ERA's processes are captured and the IDEF0 models are developed while Section</li> </ul>

<b>Examiner A (16<sup>th</sup> August, 2015)</b>	
<b><u>Correction Recommended</u></b>	<b><u>Comment/Response</u></b>
<p>instrument that formed the basis of the interview?</p>	<p>4.4 (ii) presents issues are picked and the CLDs are developed. The probing questions (and some of the responses) are attached as Annex 4.1.</p>
<ul style="list-style-type: none"> <li>• The Chapter reads as a report on ERA operations and does not bring out the data collected and analysis undertaken in this respect.</li> </ul>	<ul style="list-style-type: none"> <li>• Comment accepted. The section improved. As also suggested by Examiner B, summary table included after Section 5.2. The conclusion also significantly expanded and elaborated.</li> </ul>
<ul style="list-style-type: none"> <li>• Section 5.2 presents various issues of ERA's practices and compares them with 'accepted international best practices. This should be addressed whether this should be fit for purpose for ERA's operation rather than trying to fit it to what is in the literature</li> </ul>	<ul style="list-style-type: none"> <li>• The comparison is actually geared towards ERA's objectives and performance criteria (and the achievements of same) and international practices are used as a reference when ERA's practices are found lacking.</li> </ul>
<ul style="list-style-type: none"> <li>• In Section 5.3, it is not evident how Figures 5.4, 5.5, 5.7 and 5.9 were developed. They are not equally discussed too. Figure 5.3, as it relates to these Figures, also needs to be explained.</li> </ul>	<ul style="list-style-type: none"> <li>• The Figures are developed through analysis of the various documents noted in Table 4:2. They were progressively elaborated through repeated interviews with major respondents (owners of the processes). The explanation associated with the Figures is improved in the final. Figure 5.3 presents the architecture and nomenclature of the IDEF0 modeling technique used in developing Figures 5.4, 5.5, 5.7 and 5.9.</li> </ul>
<ul style="list-style-type: none"> <li>• It is not explicit how Figures 5.6, 5.8 and 5.10 are developed and the data sources that informed their development. How was the data collected and how was the analysis undertaken (what is noted in page 44 is not sufficient)?</li> </ul>	<ul style="list-style-type: none"> <li>• As in the IDEF0 models, the CLD models were progressively developed first from the document analysis and subsequently through interviews with key informants. The explanation how these figures are developed is improved in the final (Page 107).</li> </ul>
<ul style="list-style-type: none"> <li>• The chapter premises that what is found in the literature can be taken as accepted international best practice against which ERAs practices should be compared rather than looking ERA's practices within the context the Authority operates.</li> </ul>	<ul style="list-style-type: none"> <li>• Each subsection of the chapter starts with the presentation of ERA's practices and the drawbacks they harbor. It is to improve these drawbacks that the 'international practices' are taken as possible references. Even then, by discussing 'environmental/context issues, the chapter clearly acknowledges the context dependency of adopting any</li> </ul>

<b>Examiner A (16<sup>th</sup> August, 2015)</b>	
<b><u>Correction Recommended</u></b>	<b><u>Comment/Response</u></b>
	recommendation.
<p><b>7. Chapter six</b></p> <ul style="list-style-type: none"> <li>Section 6.4 notes the conceptual framework developed in chapter 2.4 as one contribution to the global body of knowledge. It is not clear as it is and Figure 2.1 could have to be re-drawn to occupy a whole page and flashed out how it constitutes a conceptualization of project management and how it is developed from the identified management theories.</li> <li>Page 218, what is the meaning of the statement “It is argued that when these factors are contextually handled contingent on the condition the project is implemented, a better performance for improved project management is likelihood”?</li> </ul>	<ul style="list-style-type: none"> <li>Comment, also referred as part of the comments in chapter two, is accepted. The Figure is re-drawn as recommended and how it is developed is elaborated further.</li> <li>Comment accepted, sentence re-written.</li> </ul>
<p><b>8. General</b></p> <ul style="list-style-type: none"> <li>There are some references cited but missing in the list of References</li> <li>This is a formal writing avoid abbreviations like ‘doesn’t’. The candidate should read through the text to correct for syntaxes or, alternatively, find somebody to read the thesis for syntaxes and the use of English.</li> <li>No information is provided whether any aspect of the thesis research has been published (or planned for publication)? This is important for a PhD level work.</li> </ul>	<ul style="list-style-type: none"> <li>Comment accepted. Citation and bibliography cross-checked and corrections made.</li> <li>Comment accepted. Abbreviation like doesn’t, can’t, etc. have been removed using MS Word ‘find and replace’ technique. The thesis has been proof-read again by the candidate to correct syntaxes and grammars.</li> <li>The findings of the research have not been published as of yet. The plan is to publish the findings in the future.</li> </ul>

<b>Examiner B (16<sup>th</sup> August, 2015)</b>	
<b><u>Correction Recommended</u></b>	<b><u>Comment/Response</u></b>
<p><b>1. General</b></p> <ul style="list-style-type: none"> <li>• There are a number of minor grammatical/typographical errors that can be removed through proof reading</li> </ul>	<ul style="list-style-type: none"> <li>• Comment accepted. The whole document is proof read for syntaxes and grammatical errors.</li> </ul>
<p><b>2. Chapter one</b></p> <ul style="list-style-type: none"> <li>• No comment</li> </ul>	<ul style="list-style-type: none"> <li>• .</li> </ul>
<p><b>3. Chapter two</b></p> <ul style="list-style-type: none"> <li>• No comment</li> </ul>	<ul style="list-style-type: none"> <li>• .</li> </ul>
<p><b>4. Chapter three</b></p> <ul style="list-style-type: none"> <li>• No comment</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>
<p><b>5. Chapter four</b></p> <ul style="list-style-type: none"> <li>• No comment</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>
<p><b>6. Chapter Five (Main Study)</b></p> <ul style="list-style-type: none"> <li>• There is no strong justification for the investigation of the construction processes and management in only one organization- the ERA.</li> <li>• There is a difference in processes and the management of vertical constructions (such as buildings) and horizontal constructions (such as roads).</li> <li>• The review of the pros and cons of the ERA's management structure/practice, and its construction processes and their sub-processes is rather discursive. It would be advantageous to include tables at the end of each section that summarizes key advantages and shortcomings of ERA's practices as well as summaries of recommendations to improve ERA's structure, processes, management and overall performance.</li> <li>• In chapter five, Casual Loop Diagrams are abbreviated at CLD and CLD at places. Should be corrected as CLD throughout.</li> </ul>	<ul style="list-style-type: none"> <li>• Comment accepted. The justification for selecting ERA is improved (see section 4.3.2).</li> <li>• The study notes that (page 13), '[t]he practice analyzed and critiqued, is limited to the management of the construction project processes as practiced by the Ethiopian Roads Authority (ERA). Therefore, the work can only reliably be applied to the management of construction project processes in the road sector.'</li> <li>• Comment accepted. A table, as suggested, is included to summarize Section 5.2. However, the IDFE0 models and CLD diagrams for Section 5.3 summarize the major findings in those sections.</li> <li>• Comment accepted. A search using 'replace' on MS word identified one such discrepancy and same is corrected. The document is also proof read again to improve syntaxes and grammar.</li> </ul>

<b>Examiner B (16<sup>th</sup> August, 2015)</b>	
<b><u>Correction Recommended</u></b>	<b><u>Comment/Response</u></b>
<ul style="list-style-type: none"> <li>Section 5.5, is entitled conclusion but the contents are more of a summary of the chapter with no overall conclusion drawing over the appropriateness of ERA's practices and processes. The heading should be changed to summary. This is also applicable to section 6.7.</li> </ul>	<ul style="list-style-type: none"> <li>Comment accepted. Contents of conclusions to each chapter improved but headings kept as it would interfere for the summary presented in Chapter Five.</li> </ul>
<p><b>9. Conclusion, limitations and future work</b></p> <ul style="list-style-type: none"> <li>Given that the theoretical framework in section 2.4 was developed prior to the study, it would be good to see a reflection on the appropriateness of the framework following the completion of the research.</li> <li>Clearly articulate the conclusion and scientific conclusion of the study. A bullet list would be helpful.</li> <li>Specify what proportion of construction projects are road projects and explain why the management practices and construction processes within the ERA can be considered representative of the Ethiopian construction industry</li> </ul>	<ul style="list-style-type: none"> <li>Section 6.2, further subdivided in alpha-numerals item by item presents the major conclusions of the study.</li> <li>As also noted by Examiner A and responded there, the Ethiopian construction industry is referred to in this section as part of the hierarchical delimitation of the scope of the study. However, the study clearly states that (page 13) '[t]he practice analyzed and critiqued, is limited to the management of the construction project processes as practiced by the Ethiopian Roads Authority (ERA). Therefore, the work can only reliably be applied to the management of construction project processes in the road sector.'</li> </ul>
<ul style="list-style-type: none"> <li>Consider including a table at the end of each unit of analysis of Chapter 5 to summarize the key advantages and shortcomings of ERA's current management practices and processes.</li> </ul>	<ul style="list-style-type: none"> <li>Comment partially accepted. A summary table is included for section 5.2. However, for Section 5.3, the table would be redundant as the IDEFO based process diagrams and the CLD based causation diagrams present the major processes and factors of performance respectively. However, the conclusion at the end of the chapter is considerably improved (as also suggested by Examiner C).</li> </ul>
<ul style="list-style-type: none"> <li>Consider changing 'construction processes' in the title to 'Road construction processes'</li> </ul>	<ul style="list-style-type: none"> <li>The fact that the study can reliably be applied only to road sector works in the Ethiopian road context is clearly stipulated in the scope of the study. In addition, the title, with the additions 'the case of</li> </ul>

<b>Examiner B (16<sup>th</sup> August, 2015)</b>	
<b><u>Correction Recommended</u></b>	<b><u>Comment/Response</u></b>
<ul style="list-style-type: none"> <li>• Discuss the limitation of the study using appropriate heading 'Limitations'</li> <li>• The recommendations for further study represent incremental extension to the study undertaken by the candidate. It would be good to include suggestions on broader issues associated with the study of construction in developing countries that are worthy of further study based on the candidate's experience in conducting this study</li> <li>• Some of the references do not contain full bibliographic detail. Also some authors names are miss-spelt in the reference.</li> </ul>	<p>Ethiopian Roads Authority' clearly delimits the study's focus.</p> <ul style="list-style-type: none"> <li>• Comment accepted. Section 1.6 is re-titled as 'Limitations of the study'.</li> <li>• Comment accepted. A further recommendation on the challenges in conducting such studies in the context of developing countries is included in the final version</li> <li>• Comment accepted. All references are proof read again. Also bibliography and references are cross-checked for completeness.</li> </ul>

<b>Examiner C (16<sup>th</sup> August, 2015)</b>	
<u>Correction Recommended</u>	<u>Comment/Response</u>
<p><b>10. Chapter One</b></p> <ul style="list-style-type: none"> <li>• No comment</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>
<p><b>11. Chapter Two</b></p> <ul style="list-style-type: none"> <li>• The candidate could be a little more critical of some of the works that he has examined and cited. For example, it would have been reasonable to critique the prescriptive nature of Koskela and contract that with the theory building approach of Winch.</li> <li>• Page 26, The candidate may be over reliant on the work of Walker</li> <li>• On page 29, “Therefore, in the model, the actual transformation act is left as a ‘black box’” This is a very good point, but is this developed later in the thesis?</li> <li>• Fig 2.1 Page 34 is somewhat messy and is not really a theoretical framework. It would have been better to frame the research as institutional analysis.</li> </ul>	<ul style="list-style-type: none"> <li>• The approaches by the two Authors, and that of Walker, is compared and contrasted in Section 2.3.5.3 ‘comparison of the approaches’.</li> <li>• The section ‘Organization (structure) focused construction project management’ presents construction management as an organization. Walker and Winch are two of the strongest proponents of that line of thought. The section relied on these Authorities to critique the organization-focused approach.</li> <li>• The transformation component of the TFV theory generally relates to the production/construction processes in the thesis, the product-oriented (conversion processes) in conception and feasibility study, design and development, construction, and project closure are typically product- oriented processes and are beyond the scope of this study (see footnote 12 for example). Therefore, while the concept of a ‘black box’ of the transformation component of the TFV model is clearly presented, the issue is not elaborated further for scope delimitation reason.</li> <li>• Comment accepted. The Figure presents the conceptual framework of the study. As also suggested by Examiner A, the interchanged usage of theoretical framework with conceptual framework is avoided. In addition, the Figure is re-drawn to fit a full page and arguments are added.</li> <li>• The comment in regards to reframing the study approach using institutional analysis as also accepted. See response for same comment in general section below.</li> <li>• Comment accepted. The section improved (see sections 2.5).</li> </ul>
<ul style="list-style-type: none"> <li>• Page 40, conclusion, as in most of the thesis, is too brief</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>

<b>Examiner C (16<sup>th</sup> August, 2015)</b>	
<u>Correction Recommended</u>	<u>Comment/Response</u>
<p><b>12. Chapter three</b></p> <ul style="list-style-type: none"> <li>• Page 44, a critique is needed here.</li> <li>• I find it that many of the arguments in the footnote are apposite but should these not be argued in the main text rather than being relegated to a footnote?</li> <li>• Page 79, The summary of the chapter is too brief.</li> </ul>	<ul style="list-style-type: none"> <li>• Comment accepted. A critique of the KPIs is improved (see Section 3.2.1)</li> <li>• Many of the footnotes were progressively relegated from the main text during the thesis work. The issue is that, while the footnotes present related (mainly theories in early chapters and evidences in the analysis section) issues, they are not the central theme of the discussions in the respective topics.</li> <li>• Comment accepted. Summary expanded. See section 3.6</li> </ul>
<p><b>13. Chapter four</b></p> <ul style="list-style-type: none"> <li>• Page 88, can we state this simply as describe, explain, analyze? However, this is sound explanation of the approach.</li> <li>• Page 90, meaning of first full paragraph unclear, needs re-writing.</li> <li>• A through and well-organized chapter. However, there is no plan in place to show how the analysis is actually undertaken.</li> </ul>	<ul style="list-style-type: none"> <li>• It is not clear to which of the four statements on the methodological approach on page 88 the examiner is referring. This page has been re-read and, without detracting from the flow of the argument presented, the explanation has been improved.</li> <li>• Comment accepted. Paragraph re-written.</li> <li>• Comment accepted. Section 4.4 is improved to further elaborate the procedures how analysis was undertaken.</li> </ul>
<p><b>14. Chapter five</b></p> <ul style="list-style-type: none"> <li>• In terms of evidence, there is a lack of transparency at the moment in regards to the content analysis.</li> <li>• Page 203: the conclusion is weak</li> </ul>	<ul style="list-style-type: none"> <li>• Comment accepted. Annexure are added to show the early hand drafts of the models over which respondents critiqued. Also the probing interview questions, with some hand written discussion responses with the identified respondents, are added.</li> <li>• Comment accepted. As also commented by Examiner B, conclusions improved.</li> </ul>
<p><b>15. Chapter six</b></p> <ul style="list-style-type: none"> <li>• No comment</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>
<p><b>16. General</b></p>	

<b>Examiner C (16<sup>th</sup> August, 2015)</b>	
<b><u>Correction Recommended</u></b>	<b><u>Comment/Response</u></b>
<ul style="list-style-type: none"> <li>• The Analysis contained in chapter five is very thorough bursts there is no evidence to indicate how the content analysis and other techniques were undertaken and so validate the Figures and Systems diagrams. I would like to see an appendix that gives examples of the analysis undertaken in order to convince the reader that the conclusions drawn are appropriate.</li> <li>• The research cries out for a theoretical basis within which it can be presented and an institutional analysis would provide this framework. Indeed, I believe this is what the candidate has carried out without using the term in the thesis.</li> </ul>	<ul style="list-style-type: none"> <li>• Comment accepted. Analysis section improved. Annexure added.</li> <li>• Comment accepted. There are two issues here. Theories that are used in developing the conceptual framework for the study and the theoretical framework for the study. Section 2.4.1 is added to show the distinction, the arguments how the identified theories are used in developing the conceptual framework and the theoretical framework of the study.</li> </ul>