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INNOVATIVE TENDERING PRACTICE: E - TENDERING APPLICABILITY FOR THE PROCUREMENT OF ETHIOPIAN FEDERAL ROAD CONSTRUCTION PROJECTS

BY

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CERTIFICATION

The undersigned have examined the thesis titled **'Innovative Tendering Practice: E-tendering Applicability for the Procurement of Ethiopian Federal Road Construction Projects'** presented by Hilina Belachew Demisse, a candidate for the degree of Master of Science, and hereby certify that it is worthy of acceptance.

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DECLARATION

I declare that this thesis prepared for the partial fulfillment of the requirements for the degree of **Master of Science in Construction Management** titled '***Innovative Tendering Practice: E-tendering Applicability for the Procurement of Ethiopian Federal Road Construction Projects'*** is my original research work and has not been presented in any university.

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ABSTRACT

Construction procurement is considered to be one of the most critical stages throughout the lifecycle of construction projects. However, bidding practice which is one of the steps in procurement is identified as one of the major shortcomings of the Ethiopian construction industry. The fact that the current Ethiopian construction tendering practice is paper-based has several drawbacks like human errors in document production, poor audit trail, access problems, security concerns, insufficient copies, and time-consuming being the major ones.

This paper analyses the current practice of paper-based tendering in road construction projects along with its challenges & how it can be improved via e-tendering implementation. To answer these questions, the perception & experience of tendering professionals involved in the road construction projects was assessed via a questionnaire & interview survey. Few e-tendering practitioners were also interviewed about their experience while implementing the system. Accordingly, the result showed that e-tendering was perceived to be advantageous and would improve the time, cost, communication, documentation, tender evaluation, resource consumption, and transparency of the tendering process. However, the result also revealed many factors related to management, organization, environment, & technology that may hinder the implementation of the system. Thus, due to the potential benefits of e-tendering highlighted in this paper, it requires more attention from the government & the procuring entities for its greater expansion & adoption to ultimately contribute to the growth of the country's economy. Accordingly, findings from the literature review, survey, and document review were finally incorporated in the conceptual framework developed for e-tendering implementation in the study area. The framework was validated using a focus group discussion & a semi-structured interview with tendering professionals engaged in the study area and amendments were made accordingly. Its clarity, comprehensiveness, relevance, simplicity, & future applicability was also assured via the questionnaires developed.

Keywords: procurement, tendering, construction, e-tendering, road construction projects, e-procurement (EP)

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ACRONYMS

AAU: Addis Ababa University
APL: Adaptable Program Lending
APP: Annual Procurement Plans
BA: Bachelor of Art
BDU: Bahir Dar University
BSc: Bachelor of Science
CA: Certificate Authority
CCA: Canadian Construction Association
CGEC: Center for Global Electronic Commerce
CI: Construction Industry
CSFs: Critical Success Factors
DTTP: Distributed Trusted Third Party
ECOM: E-Commerce Online Marketing
EFA: Exploratory Factor Analysis
e-GP: Electronic Government Procurement
EOI: Expression of Interest
EP: E-Procurement
e-PMU: e-Procurement Project Management Unit
e-PPSC: e-Procurement Project Steering Committee
EPSA: Ethiopian Pharmaceuticals Fund and Supply Agency
e-PWG: e-Procurement Working Group
ERA: Ethiopian Roads Authority
ERP: Enterprise Resource Planning
ETB: Ethiopian Birr
e-TEG: Electronic Tendering Expert Group
EU: European Union
FA: Factor Analysis
FAQs: Frequently Asked Questions
FDRE: Federal Democratic Republic of Ethiopia
FITLOG: Foundation for Information Technology in Local Government
FPPA: Federal Public Procurement and Property Administration Agency
GDP: Gross Domestic Product
GoE: Government of Ethiopia
ICB: International Competitive Bidding
ICT: Information, Communication and Technology
ID: Identification
ISO: International Organization for Standardization
IT: Information Technology
ITB: Invitation to Bidders

ITT: Invitation to Tenderers
KMO: Kaiser-Meyer-Olkin
KPIs: Key Performance Indicators
LoR: Level of Readiness
MA: Masters of Art
MCIT: Ministry Communication and Information Technology
MDB: Multilateral Development Bank
MiNT: Ministry of Innovation and Technology
MoF: Ministry of Finance
MoFEC: Ministry of Finance and Economic Cooperation
MoFED: Ministry of Finance and Economic Development
MoR: Ministry of Revenue
MoT: Ministry of Trade
MoUDC: Ministry of Urban Development and Construction
MoUDH: Ministry of Urban Development and Housing
MoUWD: Ministry of Urban Works and Development
MRO: Maintenance, Repair and Operation
MSc: Masters of Science
NCB: National Competitive Bidding
NeGP: National e-Government Plan
NUDIST: Non-numerical Unstructured Data Indexing, Searching, and Theorizing
OECD: Organization for Economic Cooperation and Development
OSD: Operational Services Division
PCC: Public Contract Code
PDF: Portable Digital File
PKI: Public Key Infrastructure
PPA: Public Procurement Agency
PPDS: Property Disposal Service
PPPAA: Public Procurement and Property Administration Agency
RFI: Request for Information
RFP: Request for Proposal
RICS: Royal Institution of Chartered Surveyors
RII: Relative Importance Index
SBD: Standard Bidding Document
SPSS: Statistical Package for Social Science
STS: Secure Time Server
TTP: Trusted Third Party
UK: United Kingdom
UN: United Nations
UNDP: United Nations Development Programme

UNICTRAL: United Nations Commission on International Trade Law
VM: Value for money
WB: World Bank
WFP: World Food Programme
WTS: Web-based Tendering System
XML: Extensible Markup Language

Chapter One: Introduction

1.1 Background

The construction sector is an industry considered as the nucleus for a nation's economic growth and has a great impact on the improvement of the built environment (Borg, 2015). It is the economical backbone of many countries often contributing 7%-10% of GDP (Ngai *et al.*, 2002). As per the African Economic Outlook 2015 edition, the contribution of the Ethiopian construction industry by 2015 to the GDP of the country was around 9.4% (Falcioni, 2015). To this, the road transport sector, among the other sectors in the industry, is supposed to create a network over a wide array of infrastructural facilities and roads serve as key infrastructural units providing linkages to other modes of transportation like shipping, railways, and airways (Telgen and Ambaw, 2017). Hence, as providing other advanced means of transportation is comparatively expensive, the road transport sector is essential for developing countries (Worku, 2011). A well-developed road transport sector in developing countries is assumed to fuel up the growth process through a variety of activities, creation of market access being the major one.

However, the construction industry, in general, has been criticized for low productivity growth (Sveikauskas *et al.*, 2016). The industry has even attracted criticism for its inefficiencies in the outcomes such as time and cost overrun, lower productivity, inadequate customer satisfaction, and poor (compromised) quality (Egan, 2003). The same is true in the case of the Ethiopian construction industry, where it is believed that the state of the local construction industry has been reported to be underperforming ((MoUDC), 2012). The performance of the Ethiopian construction industry with respect to construction project management practice was found to be unsatisfactory (Ayalew *et al.*, 2016).

According to Vee and Skitmore (2003), construction procurement is considered to be the most critical stage throughout the lifecycle of construction projects. It is at

this stage that the contractual and legislative agreements between stakeholders are shaped (Lou and Alshawi, 2009). International Standards Organisation (2010) defines construction procurement as a process that creates, manages, and fulfills contracts relating to the provision of goods, services, and construction works or disposals or any combination thereof. In this regard, construction procurement is one of the main instruments and/or areas that can boost the performance of the industry, since a successful construction procurement is a base for a successful project; hence it needs improvement to do so (Neupane *et al.*, 2012).

In developing countries, Chekol and Tehulu (2014) assert that public procurement is a key tool towards achieving development goals like reducing poverty & providing health, infrastructure, education, and other services. Improving the public procurement system will impact the economic growth of the country, which will result in budgetary savings and efficiency in government expenditures, thereby creating wealth and reducing poverty as well (Chekol and Tehulu, 2014). Concerning this, the FDRE Public Procurement and Property Administration Agency (2014) asserts that expenditure on public procurement takes the lion share from the annual Government budget i.e., 64% and 14% of the annual budget and GDP of Ethiopia respectively. Whereas Telgen and Ambaw (2017) claim that, the expenditure on public procurement for infrastructure development[1] comprises about 62% and 15% of the annual budget and GDP of the country. From this transport alone covers around 30% of the annual budget expenditure (Telgen and Ambaw, 2017).

Despite the role of procurement for the growth of a nation, several challenges and loopholes hinder its performance. Scott and Julius (2015), stated a report done by the World Bank asserting the national procurement system as one of the major areas where the greatest amount of financial corruption resides. As tendering is one of the steps in procurement, attention has to be given. The fact that the current Ethiopian construction tendering system is paper-based has several drawbacks. In

[1] Infrastructure developments in transport, energy, water, agriculture, education, health & other sectors as well (Telgen and Ambaw, 2017).

conventional/paper-based tendering, tender documents are paper-intensive, not portable, expensive, tedious, and troublesome to produce (Ren and Kamarudin, 2016). Often problems arise when tender documents are ready to be distributed to interested bidders after the preparation is completed (Lou and Alshawi, 2009). Accordingly, 'human errors in document production, incomplete information or tender document, possible mix up of documents, insufficient copies, possible leakage of restricted information, problems in issuing of addendums and voluminous tender documents' are some of the problems that occur (Egan, 2003).

Governments all around the world have tried to provide their citizens easy access to government services as well as making their operation more efficient & transparent by incorporating ICT, specifically the Internet, as a means to update public sector processes (Elias *et al.,* 2005). Accordingly, e-procurement comes into the picture by integrating ICT with the procurement system. Electronic procurement, which is also called e-procurement or EP afterward, refers to the implementation of the internet in the procurement process to purchase goods, services, or works. On a similar base, the Royal Institution of Chartered Surveyors (RICS) e-tendering guidance note (2005) defines e-tendering as 'the electronic exchange of any tender document as part of the procurement process' (Lavelle and Bardon, 2009).

RICS (2010) asserts that EP benefits both the clients and tenderers to a great extent. Accordingly reducing tendering costs, enhancing security and confidentiality, decreasing administrative and transaction costs, making the tendering process fast and reliable are some of the advantages among the many. However, based on previous researches, (Eadie *et al.*, 2010; Rankin *et al.*, 2006; Ren and Kamarudin, 2016; Sitar, 2011; Tindsley and Stephenson, 2008), some factors are identified as challenges or barriers to the implementation of EP. The result of Tebeka and Yessuf (2019) has revealed that 'man-power retention, inconsistent and disruptive infrastructure, integration with the legacy system, top management, and employees' commitment and attitude, supplier integration, fear of system security, weak and inconsistent support, poor performance monitoring and evaluation practices were some of major challenges identified'.

There are several studies undertaken by different scholars, (Eadie *et al.*, 2010; Davila *et al.*, 2003; Tebeka and Yessuf, 2019; Tindsley and Stephenson, 2008; Tran *et al.*, 2011) related to identifying the critical success factors of e-tendering implementation in the construction industry and other industries as well, and the potential benefits gained from different countries' perspective. But, as per the researcher's knowledge, some limited empirical studies and articles have been undertaken regarding its application in Ethiopian public procurement especially in the construction industry.

1.2 Statement of the problem

Even though public procurement is an important function of a government, it is facing several challenges[2] (Musanzikwa, 2013). Bid procurement practice, as per Ayalew *et al.,* (2016), was identified as one of the major shortcomings of the Ethiopian construction industry. Even if the objectives of public procurement in the construction sector can be achieved through the traditional paper-based tendering, it has many inherent limitations (Emiru, 2015). To this, Elias *et al* (2005); Berhanu (2019) assert the following drawbacks; high processing cost, time-consuming and slow process due to human errors & manual procedures, high paper usage and storage, restricted mobility, or highly dependent on geographical location of bidders. Telgen and Ambaw (2017) state that the current construction procurement approach is characterized by high corruption[3] prevalence. Accordingly, a lack of accountability in the public procurement system contributes significantly to opening opportunities for corruption. Concerning this, delays in some of the assessed

[2] As per Kumar (2018), the major problems in the public procurement sector in Ethiopia includes; challenges in procurement planning and implementing the plans, lack of transparency in the procurement process, delay in procurement evaluation and contract award process, lack of accountability, poor contract management, inconsistency in using procurement standards, poor data management and lack of access to procurement information; and poor coordination between & among procuring entities.

[3] Corruption is a major issue in the public procurement system of developing countries and it's estimated that countries annually lose 20%-25% through their public spending through malfunction of officials and Ethiopia is no exception to this statement (Telgen and Ambaw, 2017). In relation to this, the tender evaluation may become biased, unfair, and dishonest due to unprofessional or unethical procurement committees (Kusumarukmi and Adi, 2019). Similarly, the leak of the lowest bid price is another problem to be considered in paper-based procurement or tendering.

Ethiopian Roads Authority's (ERA's) projects[4] implementation has occurred due to procurement-related factors. Accordingly; poor quality of bidding and/or design document production, problem in internal coordination to finalize paper-intensive bidding documents, inadequate technical information availability[5] , lengthy bid evaluation, and selection process, time-consuming bidding procedure, and poor response[6] from bidders are mentioned as challenges and problems in the current tendering practice ((Transport and Digital Development Global Practice), 2018; (Transport and ICT Global Practice Country department AFCE3), 2015).

Tindsley and Stephenson (2008) assumed e-tendering in the construction sector to be more cost-effective and time-saving than the current, traditional method of tendering. Tindsley and Stephenson (2008) also claimed EP to benefit the construction industry as a whole if fully implemented. Streamlined document handling, reduced paperwork, clear audit trail, easier incorporation of later changes to be made in the tender document, and efficiency savings are some of the benefits discussed under the study. Moreover, another study shows that adopting e-tendering, especially in developing countries, helps to fight corruption that resides in the current public procurement practice by increasing transparency, increasing competition among bidders, and making information to be accessed easily during tendering (Neupane *et al.*, 2012).

To this effect, the study focused on the implementation of e-tendering, in the procurement of Ethiopian federal road construction projects. Besides the role of the road sector in the country's growth, federal road construction projects were selected since the ERA was the only company engaged in the construction sector selected as a public pilot organization for e-tendering implementation.

[4] Although the assessed projects were very small in number when compared to the overall ERA projects, the need for the update of the procurement procedures was already indicated in the project completion report.

[5] Such inadequacy of information leads to several rounds of clarifications requested by bidders, which makes the process lengthy. A summary of the borrower's project completion report was prepared for the World Bank financed Road Sector Development Stage III projects (Adaptable Program Lending; APL) in 2015 and it, assert that, on average it took 13 and 24 months to award works and supervision consultant service contract respectively, resulting in further challenges as exhibited during implementation such as staff substitution.

[6] According to the completion report for projects under APL4 one project was bid twice due to poor response during the first bidding process (Transport and Digital Development Global Practice) (2018).

1.3 Research questions

The study raised and tried to answer the following basic questions;

1. What are the current practice and gaps of the tendering practice for the Ethiopian federal road construction projects?
2. Which of those gaps could be improved through e-tendering?
3. What are the perceived Critical Success Factors (CSFs) and barriers of implementing e-tendering for the procurement of Ethiopian federal road construction projects?
4. How best can e-tendering be intervened or introduced for the procurement of Ethiopian federal road construction projects?

1.4 Objectives of the Study

1.4.1 General Objective

This research aimed to investigate the suitability/applicability of e-tendering in the procurement of Ethiopian federal road construction projects.

1.4.2 Specific Objectives

The general objective of this thesis was divided into the following four specific parts;

1. To assess the current practice and gaps in the procurement of Ethiopian federal road construction projects.
2. To identify the gaps that could be improved through e-tendering.
3. To identify the perceived CSFs and barriers of e-tendering implementation in the procurement of federal road construction projects in Ethiopia.
4. To develop a framework or intervention mechanism for the implementation of e-tendering in the procurement of Ethiopian federal road construction projects.

1.5 Scope and delimitation of the research

Due to the limited resources & time that the researcher had and the fact that ERA was the only organization engaged in the construction sector chosen for piloting EP in Ethiopia, the scope of the research was limited only to the public procurement of Ethiopian federal road construction projects. In addition to this, the procurement cycle was only limited to the tendering phase; other phases in the procurement cycle like contract management were not covered under this study.

1.6 Limitations of the study

The lack of similar researches, regarding e-tendering implementation in the Ethiopian context, was one of the major limitations of the study. Similarly, finding literature about the current tendering practice of federal road construction projects was another limitation the researcher faced. There was hardly any literature that indicated the problem that resides in the road sector during the procurement process. The very limited number of organizations currently practicing e-tendering in Ethiopia along with the pandemic (covid-19) that has occurred halted the researcher from an in-depth investigation of the local practice.

1.7 Significance of the study

As per the data obtained from the Ministry of Finance and Economic Development (MoFED), road construction is the major sub-sector that takes the lion share, accounting for nearly half of the government's expenditure on the industry ((Ethiopian Economic Association), 2008). Since construction procurement is considered to be one of the most critical stages throughout the life cycle of construction projects, improvement in this area will enhance the performance of the industry as a whole.

The findings of this research were expected to improve the knowledge on the values/advantages of e-tendering, its basic features, and the factors affecting its implementation in the road construction sector.

Based on the findings of the research, the study came up with recommendations for improved procurement performance of the road sector and proposed e-tendering as a means to enhance the performance of the Procurement in the road sector. Thus, the value of this study lied in developing an implementation framework or a simple intervention mechanism for the adoption of e-tendering in the study area or for academic purpose as well.

1.8 Structure of the thesis

The thesis was organized into five chapters. The general outline adopted for the thesis report is as follows;

Chapter One: Introduction

The core issues to be addressed in the thesis are mentioned in this section. It gives a broad background into the subject under study. The basic research problems to be addressed in the research along with the research objectives are also included. It articulates the significance of the research and puts forward the scope and delimitations of the study.

Chapter Two: Literature reviews

This chapter presents a literature review relevant to the study in twelve sub-sections. Concepts and principles related to e-tendering, its potential benefits along with the challenges and factors affecting the implementation of the system is were presented. It further presents the global practices and research gaps identified.

Chapter Three: Research methodology

Research paradigm, different methodologies and techniques used in the study are formulated in this chapter. A detailed description is given as to why such approach and methodologies are adopted.

Chapter Four: Analysis and discussion

The chapter analyzes and interprets the data obtained during the data collection. It reassures that each objective of the research is addressed and tries to relate the research objectives to the findings. The framework developed for e-tendering implementation along with the validation procedures and results is also presented in this chapter.

Chapter Five: Conclusion and recommendation

Finally, the conclusion and recommendations made for any further study is presented in this chapter.

Chapter Two: Literature Review

2.1 Public Procurement

2.1.1 Introduction

Procurement may be defined as ‘a means for acquiring goods, works and services at the best possible total cost of ownership (the right price) in the right quantity, right quality, at the right time, and in the right place for the direct benefit or use of the procurer’ (Nortey *et al.*, 2012). Similarly, the concept of procurement in construction has been defined in many ways. McDermott (2005) has attempted a more sophisticated definition as ‘the acquisition of new buildings, or leasing from the open market, or by designing and building the facility to meet a specific need.’ Whereas, McDermott (2005) accepted the following definition; ‘procurement is a strategy to satisfy clients’ development and/or operational needs concerning the provision constructed facilities for a discrete life-cycle’.

From the United Nations (UN) point of view, public procurement is the overall process of acquiring goods, civil works, and services including all functions from the need identification, potential sources selection or solicitation, contract award, and its administration to the end of service or life of the asset (Thai, 2009, cited in El-Gayed, 2013). A report of the UN in 1999 also argued public procurement as a government procurement process including different sub-processes ‘such as preparing project specification, requesting, receiving and evaluating bids, awarding contract and payment’ (Neupane *et al.*, 2012). Similarly, Indah Kusumarukmi & Joko Wahyu Adi (2019) stated public procurement as ‘the procurement of goods/services funded partly or fully from loans or grants within the country received by the government. Another definition of public procurement, as per Komakech (2016), to take from the construction point of view is that ‘it is an acquisition of commodities and contracting of construction works and services. The resources to effect such procurement can be from state budgets or foundation funds, local authority budgets, domestic or foreign loans guaranteed by the state, foreign aid as well as an income gained from the state’s economic activity’.

For this paper, procurement & public procurement will be defined as follows using the definition of the Ethiopian Federal Government Procurement and Property Administration Proclamation No.649/2009 (Federal Negarit Gazeta) (2009);

- *Procurement is 'a means of obtaining goods, works, consultancy, or other services through purchasing, hiring, or obtaining by any other contractual means.'*
- *Public procurement means 'procurement by a public body using public funds.'*

2.1.2 Public procurement objectives & principles

The core objectives of public procurement, as per Komakech (2016) are;

- To encourage transparency and openness in public procurement
- To promote economic efficiency
- To promote public confidence in the procurement procedures
- To promote equality and fairness
- Elimination of corruption in public procurement

To achieve sound procurement practice and preserve public trust and public interest, procurement principles must be applied (MOF, 2013). Accordingly, the journal asserts that public principles should be used to guide and make the right decisions about procurement practices.

As per (Federal Negarit Gazeta) (2009) and MOF (2013) public procurement and property administration shall have to comply with the following core principles:

- ensure value for money (VM) in the use of the public fund for procurement;
- nondiscrimination among candidates on grounds of nationality or any other criteria not having to do with their qualification, except in cases of preference specifically provided for in the Proclamation;
- transparency and fairness of the criteria based on which decisions are given in public procurement as well as of decisions in each procurement;

- accountability for decisions made and measures taken concerning public procurement and property administration;
- careful handling and proper use of public property.

Such basic general procurement principles shall govern the administration of government or public procurement.

2.2 Review of Ethiopian public procurement

To standardize the public procurement and to consolidate a fair contract, several standard forms of the contract had been drawn up by independent professional & commercial organizations, financial institutions, and public agencies at a different point in time (Gezahegne, 2011). However, in Ethiopia, public authorities, ministries & agencies are responsible entities with the mandate to draft and issue conditions of a contract, especially for construction. The following figure depicts the general trend of Ethiopian Public Procurement.

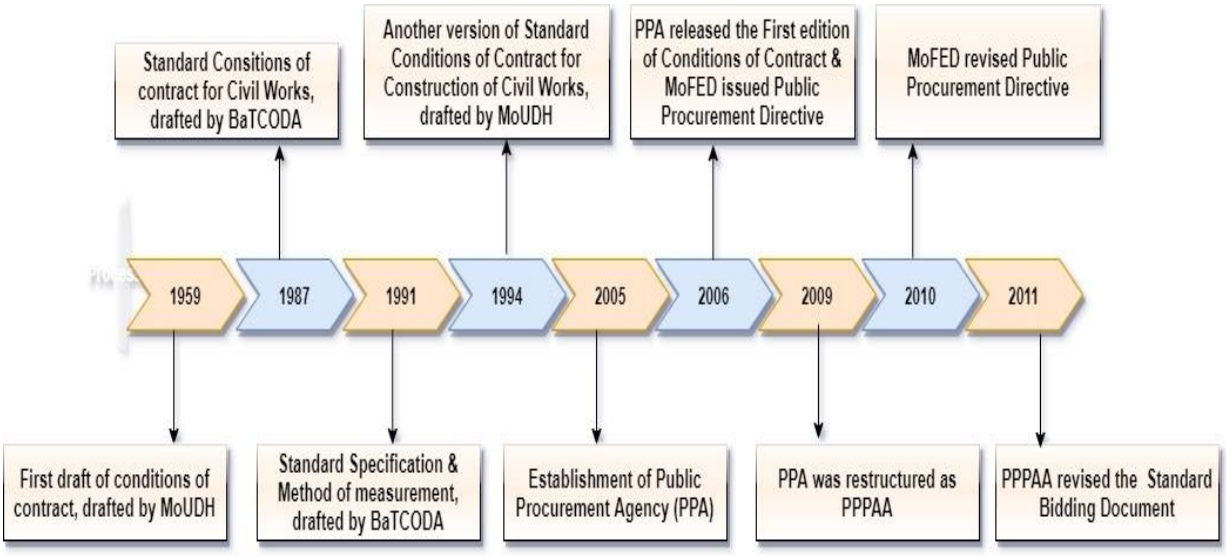


Figure 2. 1 Evolution of Public Procurement in Ethiopia

Source: Adapted from (Emiru, 2015)

2.3 Concepts of EP

Different scholars have tried to define EP in their way. Their definition also varies both with the depth and scope of the study. The following table depicts the various definitions of EP by many scholars at different points in time.

Table 2. 1 Definition of EP from different sources[7]

What is EP?	Source
'The creation of private, Web-based procurement markets that automate communications, transactions, and collaboration between supply chain partners. It is about enhancing collaboration, streamlining processes, controlling costs, and enhancing information exchange within and across organizational boundaries.'	(Aberdeen Group, 2005)
The use of the internet in the purchasing process, excluding old purchasing applications like ordering by telephone or fax.	(Boer et.al, 2001)
'The use of integrated (commonly web-based) communication systems for the conduct of part or all of the purchasing process; a process that may incorporate stages from the initial need identification by users, through search, sourcing, negotiation, ordering, receipt and post-purchase review'	(Croom and Brandon-Jones, 2007)
'The use of the Internet by governments to purchase goods, works, and services they require in an effective, efficient, and transparent manner.'	(Komakech, 2016)
'The process of utilizing Web-based technologies to support the identification, evaluation, negotiation, and configuration of optimal groupings of trading partners into supply chain networks, which can then meet demands with greater efficiency.'	(Minahan, 2001)
'The use of ICT to carry out one or more transactional or	(Nasrun *et al.*,

[7] Hereinafter, if the source is not mentioned specifically, then it means the sources of figures and tables are original.

What is EP?	Source
strategic procurement activities. EP is the automation of an organization's procurement process using web-based applications.'	2016)
'It includes web technology-based purchasing solutions aimed at simplifying commercial transactions within and between organizations and IT solutions for ordering, logistics & handling systems as well as for payment systems'	Sitar (2011)

For this paper, EP is defined from the public procurement perspective as 'The use of the Internet/ICT by the public body to purchase goods, works, and services they require in an effective, efficient and transparent manner' (Komakech, 2016).

2.3.1 EP lifecycle

Costa *et al.* (2013) typically subdivided the EP life cycle into two broader steps: **e-tendering/pre-award** and **e-execution/post-award** (see fig 2.2 below)**.** The e-tendering phase subsumes the e-noticing, e-submission & e-decision + e-auction, whereas e-execution covers the remaining steps. Some scholars like Costa *et al.* (2013) make e-execution start from the e-contract management where e-award is seen as a separate stage in between.

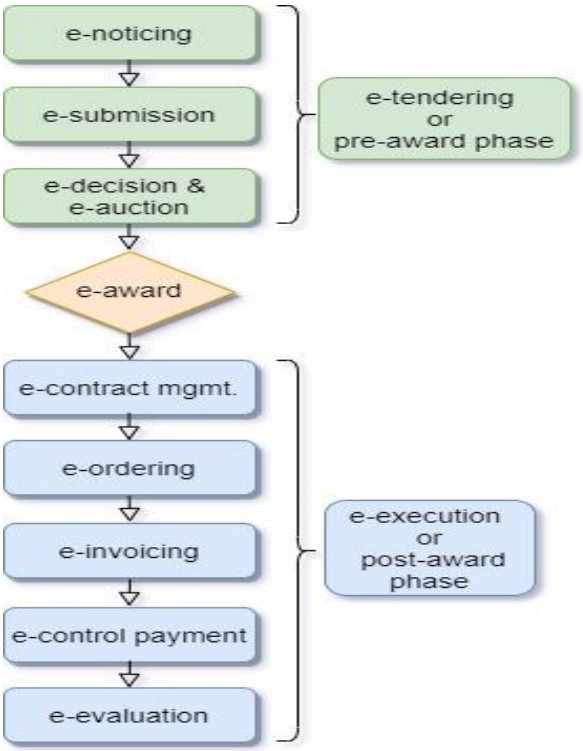
i) E-tendering/Pre-award phase: includes;

E-noticing: refers to 'the publication of procurement notices via an electronic platform' (Becker, 2018). As per Costa and Grilo (2015), an adequate & well-developed procurement strategy and an ex-ante[8] determination of procurement needs are the necessary prior steps before conducting e-noticing.

E-submission: is a phase where potential suppliers & Contractors can place their offer once the notice is published (Becker, 2018). European Commission 2017b; European Defense Agency 2016 (cited in Becker, 2018), claim that this phase includes the submission of the technical and financial proposal along with further

[8] Ex-ante e-evaluation refers to the process of multi-criteria evaluation of needs and procurement strategies (Costa and Grilo, 2015).

legally required documents like legal entity or financial identification forms. Accordingly, submission is usually via structured online forms and/or via the possible means of submitting digital documents like Extensible Markup Language (XML) or Portable Digital File (PDF) files.



E-decision & E-auction: this step is triggered once the submission phase has been concluded and its purpose is to conduct a multi-objective analysis of the submitted tenders. This stage in simple terms, as per Costa and Grilo (2015), is all about the electronic evaluation of proposals, subsequent communication, and evaluation of results along with the discussion and analysis of results. The conclusion of e-decision and e-auction refers to the finishing of the pre-award or e-tendering stage.

Figure 2. 2 EP lifecycle

Source: Adapted from (Becker, 2018)

E-award: here in simple terms suppliers with the best proposal(s) selected previously during the e-decision stage will be notified and awarded the respective contract (Becker, 2018).

ii) E-execution/ Post-award phase includes;

E-contract management: is initialized next to e-award as contract award marks the beginning of the actual contractual relationships between procuring authority (the client) and the supplier (Becker, 2018). Even if it is modeled as an individual step, Costa and Grilo (2015) assert that contract management is a continuous activity of monitoring contract performance and document management.

E-ordering: this stage includes the activity of sending or electronically submitting an order document and the electronic transmission of delivery instructions for ordered goods and services from the public buyers to suppliers (Costa and Grilo, 2015; Becker, 2018).

E-invoicing: as the name tells, this is concerning the claim for payment of goods and services ordered and delivered as per the previously agreed conditions between the public procuring authority and the supplier (Costa and Grilo, 2015).

E-payment or e-control payment: it is the management and execution of the agreed electronic payment (Costa and Grilo, 2015).

E-evaluation or ex-post e-evaluation: this is when the procurement process is concluded. At this stage, the contract execution is evaluated based on the set of pre-defined multi-criteria evaluations (Costa and Grilo, 2015).

2.3.2 Main Forms of EP

From the definition of EP, a large number of EP forms can be distinguished (Boer *et al*., 2001). Accordingly, some forms are well developed while some are quite young and immature. Each form of EP is described as a process i.e., a form of activities that has to be conducted by one or more employees. Neupane *et al.* (2012) identified the most common types of EP available in the market through some works of literature as follows;

- E-informing: a system used to gather and distribute purchasing information from and to internal and external parties using Internet technology. E-informing is a term for tender notification or e-notification.
- E-sourcing[9] : a process that uses internet technology to identify a list of new suppliers for specific categories of purchasing requirements.
- E-tendering[10]: a process of utilizing internet technology to send a request for information and prices to suppliers and to receive their responses through

[9] This enables the purchaser to increase competitiveness during the tendering process for the particular purchasing category (Boer *et.al*., 2001).

[10] This paper is focused predominantly only on the e-tendering form of EP, which includes e-noticing, e submission and e-decisions & e-auctions i.e., execution phase of procurement will not be covered under the study area.

the same. Boer *et.al,* (2001) agree that at times the analysis and comparison of responses may be supported via e-tendering, but the system doesn't support or include closing a deal with a supplier.

- E-reverse auctioning: as per Sitar (2011), this form enables the buyer or the purchasing organization to buy goods or services from the supplier with the lowest price and/or a combination of both the lowest price and other conditions using the internet technology.
- E-ordering: facilitates the operation of the purchasing process via the use of internet technology. Ordering (requisitioning), order approval, order receipt, and payment processes are operations included in a purchasing process.

  E-contract management: improves the effectiveness and efficiency of contracting processes of companies using internet technology.

2.4 Introduction to E-tendering

Tendering is believed to be a long and complicated business process that produces a lot of contractually related legal liabilities (Ren and Kamarudin, 2016). Betts *et al.* (2006) consider tendering as 'one of the fairest means of awarding government contracts and the method most likely to secure a favorable outcome for a government in its spending of public money'.

The notification/publication of tender through printed media (like a newspaper) is where the traditional tender process commences (Elias *et al.,* 2005). After the notification, eligible and interested bidders will respond to the tender advertisement by purchasing the tender document, filling the requirement, and submitting the document before the closing date. The detailed flow of the traditional tender process is shown in figure 2.3.

In contrast, e-tendering, as per Elias *et al.* (2005), 'has evolved over the past decade from dial-up modem-to-modern computer access to a more elaborate internet-based tendering system.'

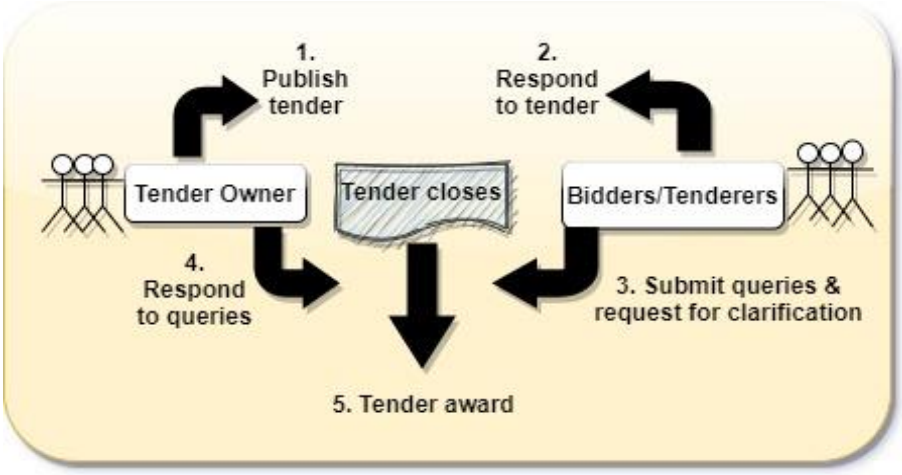


Figure 2. 3 Work Flow of Traditional Tender process
Source: Adapted from (Elias *et al.,* 2005)

Similar to the EP, the various definition of e-tendering exists. Ren and Kamarudin (2016) defined e-tendering as the process of entering and conducting a tendering process electronically. It is an electronic-based process- where bidders undertake the whole tendering process through electronic media without a paper-based transaction. As per Patil *et al.* (2016) e-Tendering is related to the process of undertaking the whole tendering cycle online, which includes submission of price bid to harness efficiency, economy, and speed of internet. Similarly, Kohli (2012)

defined e-tendering as ‘conducting on the internet the equivalent of the manual tendering process, with the ostensible objective of enhancing transparency and efficiency of Public Procurement. Eadie *et al.* (2007) asserted e-tendering to be different from a strategy but a means of using an electronic system to carry out the procurement or tendering system.

While all the above descriptions & definitions hold, e-tendering for this study is defined as the process of entering and conducting a tendering process electronically, where bidders undertake the whole tendering process through electronic media (Ren and Kamarudin, 2016).

2.4.1 Development stages of e-tendering

Ren and Kamarudin (2016) claim that it’s so unlikely for most government and business organizations to choose e-tendering fully over the paper-based tendering system as it is relatively being a new concept and consists of uncertainty. Due to this, they prefer to develop the system through phases. As per Ren and Kamarudin (2016), there are three phases for the development of e-tendering. They also stress that most of the internationally developed countries like Australia, Hong Kong, and Malaysia have developed and used e-tendering only up to the 2nd phase. A detailed description of the three phases of development is mentioned underneath;

- **1st Phase:** this is only a one-way communication where the tender advertisement & the tender document will be posted and uploaded by the Client or by the Clients’ representatives whenever there is a tender. This phase includes principal to tenderer communication. Following this, interested tenderers will download the document but submission will still be on paper-based transactions.
- **2nd Phase:** unlike the first phase submission will be done electronically. Here, there is two-way communication between the Client & the tenderers, as all the addendum & negotiation occur electronically. However, the tender award is still not done electronically.

- **3rd Phase:** almost the same process as the previous phase except here the tender is awarded; a contract is formed & administered electronically through collaborative software.

As per Fong and Yan (2009), e-tendering service has evolved from online information browsing to integrated business solutions over the years. Accordingly, the roadmap for the evolution of e-tendering is classified into four groups and it's presented under figure 2.4.

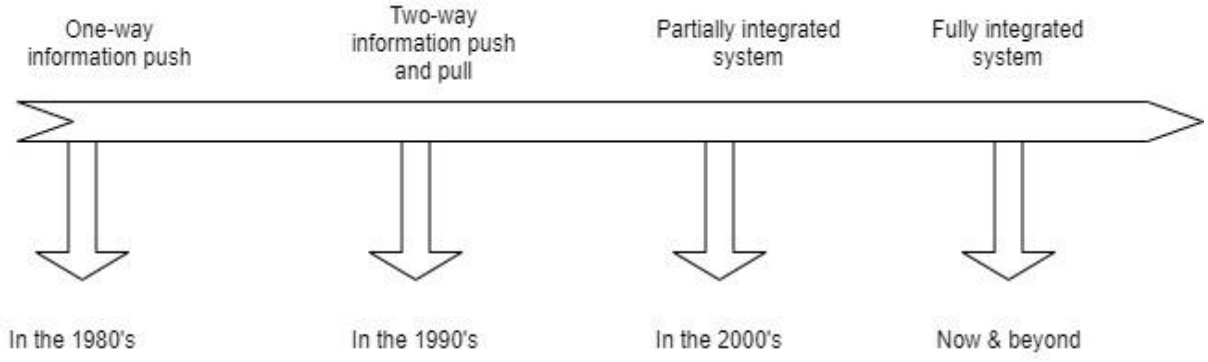


Figure 2. 4 E-tendering evolution over the years
Source: Adapted from (Fong and Yan, 2009)

2.4.2 E-tendering workflow process

The full lifecycle of a traditional/conventional paper-based tendering process, from initial notification of requirements via Expression of Interest (EOI), the issuance of the invitation to tender, and the receipt and evaluation of final tenders, must be handled and included in e-tendering (Elias *et al.*, 2005). In a tendering system, from the contracting authority's perspective, any actor who wishes to purchase services or products will prepare a tender document, evaluate the bid, and forms a contract with the winner of the tender. Elias *et al.* (2005) assert that to manage the tendering process electronically the execution of activities must be supported electronically, partially, or totally. At most points, the functionality and process aspects of the current e-tendering system are similar and tries to mirror the legal requirements of

the paper-based tendering system (Betts *et al.*, 2006). Accordingly, the *Principal*[11] and the *tenderers*[12] are the main parties in a tendering process, but a trusted third party may have to be introduced in the case of an e-tendering system (Du *et al.*, 2003). Refer to the figure below to see the workflow in an e-tendering system.

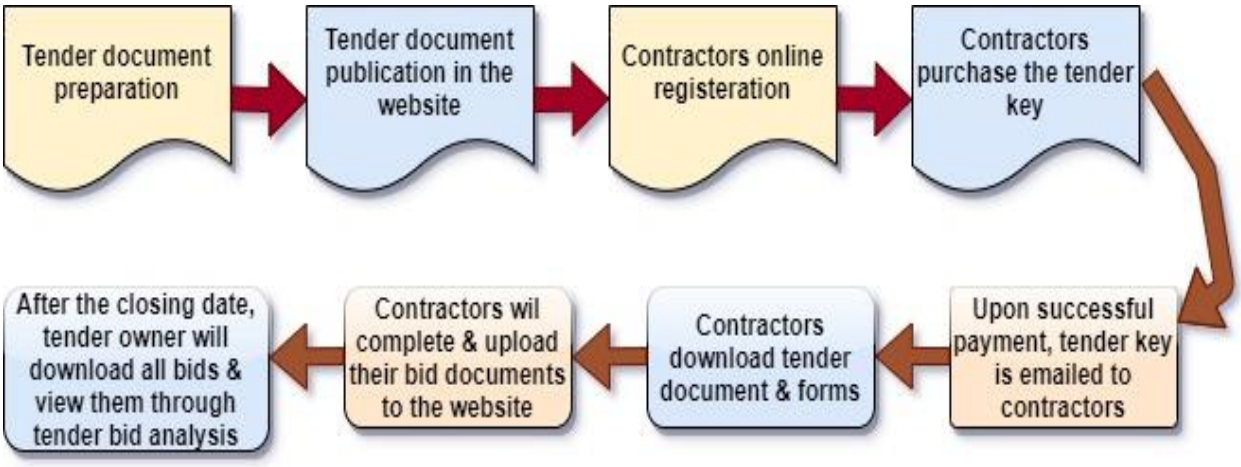


Figure 2. 5 E-tendering workflow process

Source: Adapted from (Elias *et al.,* 2005)

To ensure that genuine offers are made and accepted and to get the confidence of contractors, the exchange of information between the client and the contractors has to be conducted in a secure environment across the internet (Elias *et al.*, 2005). Similar to the paper-based tendering system, submitted tender documents must be stored in a secured environment until the closing date and time is reached. The Client should not be allowed to see any information until the time and date for bid opening, as set by the server clock, is reached. Contractors will be able to submit an amended document and previous copies will be overwritten but will be made available via an audit check. All documents and any communications need to have

[11] A Principal, as per the Code of tendering, Australian Standard, 1994 (cited in Du et al., 2003), is any party inviting and receiving tenders. A principal may include a Contractor or Sub-Contractor, but for this study, the term principal refers to the Ethiopian Roads Authority.

[12] Similarly, the standard defines *tenderers* as 'any party submitting tenders, including Contractors, Sub-contractors & suppliers. For this particular study, the term tenderers refer to Contractors & consultants engaged in the construction works & service of federal road projects in Ethiopia.

a date and time stamp. Similarly, the server should forbid late submission against the tender after the closing date and time. In such scenarios, an automatic electronic message should be issued to late contractors with a particular text set by the system administrator (Elias *et al.*, 2005).

2.5 EP in the construction industry

By considering the many advantages of EP, several countries are encouraging its adoption in the public procurement process especially in the construction industry (Costa *et al.* 2013). However, in terms of adoption & implementation, EP is still in its early phase globally (Kohli, 2012). Even though the efficiency gains from e-commerce applications, particularly EP, are well known, its implementation especially in the construction industry is lagging as compared to other industries (Tran *et al.*, 2011).

Costa *et al.* (2013) assert that in Portugal, public procurement is completely paperless and, gradually, by looking at its advantages the private sector is also implementing EP, especially in the construction industry. This was enforced since July 29, 2008, due to the Public Contract Code (PCC) which was approved by Decree-Law 18/2008. Portugal is even claimed to be the first country, within the European Union, implementing and enforcing EP. Another EU member state with an already advanced EP system to consider is Estonia. It was in 2001/2002 that Estonia began to build an e-government system (Costa *et al.* 2013). By this time e-notification as part of the EP became mandatory. Similarly, in some countries like India, EP is becoming mandatory for public procurement above a certain threshold value (Kohli, 2012).

Generally speaking, every country has different trends while adopting EP in the construction industry and also has faced several challenges. Here some part of the summary of research conducted for different countries for EP adoption in the construction industry is presented;

- **India:** the government of India approved the National e-Government Plan (NeGP) in May 2006 and EP is an integral component of this system. Shukla *et al.* (2016) confirm that many companies in the country use the EP to achieve greater efficiencies.
- **Austria:** In Austria, the adoption of EP in the construction industry (CI) is very low as compared to the automotive industry (Shukla *et al.,* 2016). The probable reason for its low adoption, unlike the automotive industry which concentrates on mass production, is due to the different nature of the projects, which differ from each other in materials ordered, etc. Shukla *et al.* (2016) assert enhanced efficiencies due to reduced complexity in the procurement process, improved collaboration, and reduced process cost as the basic advantages gained by most of the Austrian construction companies from implementing EP.
- **Canada:** organizational and technical issues are mentioned as the basic barriers to the adoption of EP in the Canadian construction industry (Shukla *et al.,* 2016).
- **Malaysia:** Daud *et al.* 2013 (cited in Shukla *et al.*, 2016) have used descriptive analysis to find out factors influencing the usage of EP among contractors in Malaysia. Accordingly, the following are five factors identified in the study area; usage of EP, perceived ease of use, perceived usefulness, intention or willingness to use EP, and attitude towards using EP to understand. Again another study conducted by Hashim *et al.* 2013 (cited in Shukla, Khan, and Shah, 2016) asserts the perceived values of EP in the CI in Malaysia. The study concluded tactical[13] and operational[14] values to be more important than strategic[15] values.

[13] Tactical Value: includes lower procurement cost and reduced time of preparing cost plans.

[14] Operations Value: related to reduced non-value adding activities and more efficient process.

[15] Strategic Value: includes improved firm growth and success and reduces and eliminates the problem with suppliers.

2.6 EP practice in Ethiopia

Currently, the public organization mandated to lead the EP initiative in Ethiopia is the Federal Public Procurement & Property Administration Agency (FPPPAA) and is working in coordination and collaboration with the Ministry of Finance and Economic Cooperation (MoFEC) and Ministry Communication and Information Technology (MCIT) as well as other stakeholders ((Federal Public Procurement and Property Administration Agency), 2018). Similarly, a strategy document and a roadmap (which covers five years from 2018-2023 G.C) have been developed to guide the introduction of the electronic Government Procurement (e-GP) system. About the already existing EP system in the country, Kumar (2018) revealed that MCIT and Bahir Dar University (BDU) are already using the EP system. The following figure shows a conceptual model of the EP platform perceived to be implemented in Ethiopia.

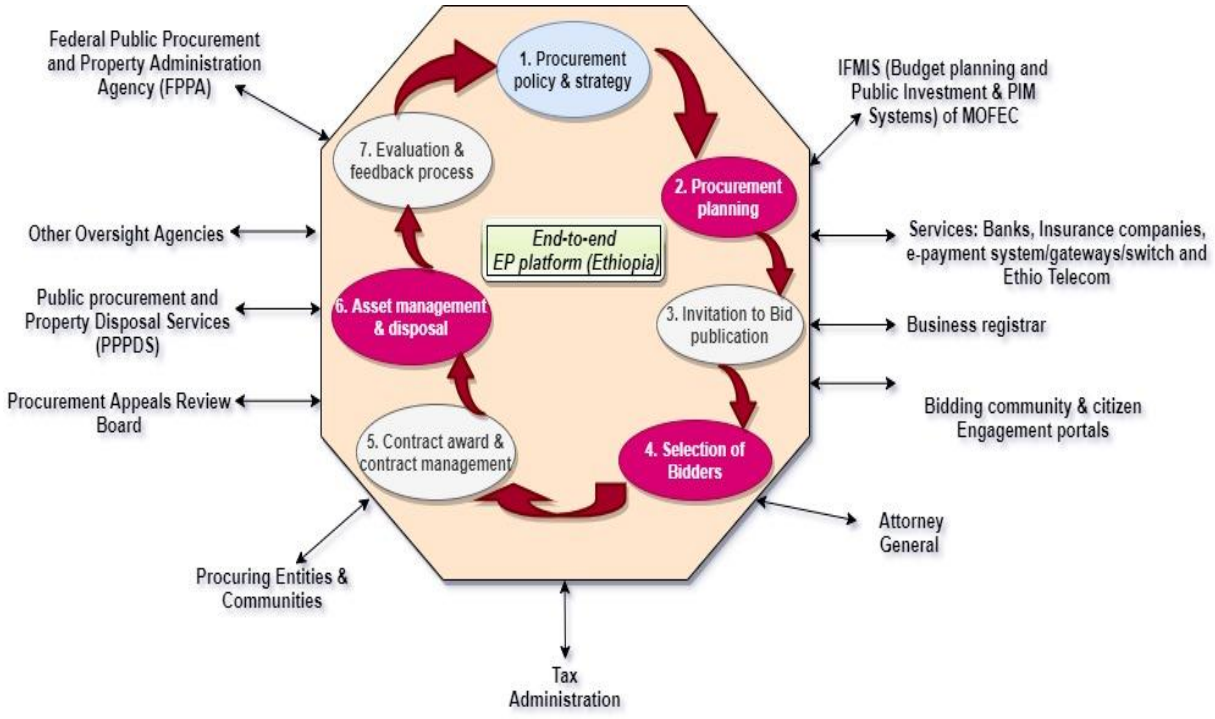


Figure 2. 6: Conceptual model of interaction of End-to-End EP Platform

Source: Adapted from ((Federal Public Procurement and Property Administration Agency), 2018)

All the modules and functionalities that need to be included in the above EP system or platforms are briefly described in the EP strategy of Ethiopia.

2.7 Comparison between traditional Tendering and e-tendering

The following sub-section represents the different outlooks of numerous authors and scholars regarding the comparison made between conventional or paper-based tendering and e-tendering. The same is presented in the following table:

Table 2. 2 Comparison between traditional tendering and e-tendering

Perspective/ Area	Traditional tendering	e-tendering	Source(s)
Cost	Higher processing cost	Relatively cheaper and economical (as printing & transporting is reduced)	(Amarapathy *et al.*, 2013; Elias *et al.*, 2005; Patil *et al.*, 2016)
Time	Time-consuming & slow	An automated & accurate process allows a dramatic reduction in the timeframe of the tender period	(Elias *et al.*, 2005; Patil *et al.*, 2016; Ren and Kamarudin, 2016; Tindsley and Stephenson, 2008)
Accessibility	Restricted mobility[16]	Higher accessibility[17]	(Patil *et al.*, 2016; Ren and Kamarudin, 2016)
Resource consumed	High paper usage and storage	e- documentation (No physical storage space is needed)	(Elias *et al.*, 2005; Patil *et al.*, 2016; Ren and Kamarudin, 2016)
Audit trail	Poor audit trail	Clear, systematic, & accurate audit trail.	(Elias *et al.*, 2005; Ren and Kamarudin, 2016)
Information safety & availability	Poor information safety & availability	Information safety[18] & availability is guaranteed	(Elias *et al.,* 2005; Patil *et al.*, 2016; Ren and Kamarudin, 2016)
Accuracy	Prone to	Automated and accurate	(Becker, 2018; Costa

[16] As paper-based tendering requires tenderers to physically come to collect the documents, the process is highly dependent on the geographical location of bidders.

[17] E-tendering allows tender documents to be viewed & downloaded anytime, anywhere with the internet.

[18] Since all tender documents are stored online and backed up via remote servers.

Perspective/ Area	Traditional tendering	e-tendering	Source(s)
	human errors		*et al.*, 2013; Neupane, 2014; Patil *et al.*, 2016)
Transparency	Direct human interaction[19]	Less human interaction promotes sufficient publicity & process transparency	

2.8 Drivers for implementation of e-tendering in the CI

Eadie *et al.* (2010) have classified the variables having an impact on the uptake of EP into two sections: drivers and barriers of implementing EP. The study asserts that these are the determinants of whether the implementation of EP will be successful or not. Accordingly, those which result in a positive effect in the implementation process are called drivers promoting EP and conversely those producing negative results as barriers (presented in the next subsection).

The adaption of EP in the construction industry can be improved by showing its value gained in the other industries especially in the manufacturing sector (Chen and Rankin 2006, cited in Shukla *et al.,* 2016). Many scholars and authors have stipulated the potential benefits gained through the adoption of EP and used/listed them as the driver for its implementation. The following table shows the different outlooks of scholars & authors regarding the advantages or drivers of EP specifically e-tendering.

Table 2. 3 Drivers for implementing e-tendering

Attribute	Source(s)
Time-saving: Due to avoiding a postal system that leads to the reduction in the tender period, faster & accurate responses to questions & points of clarifications, less time for tender analysis due to a computerized system, reduced	(Nesan Lenin, 2011; Eadie et al., 2007; Ezanee *et al.*, 2005; Gürbilek, 2013; Minahan and Degan; Patil *et al.*, 2016; Tindsley and Stephenson, 2008)

[19] The direct human interaction of procuring entities with suppliers/bidders may lead the procurement officials to get bribed or use their power for personal enrichment in this way a corruption-free process may not become possible. Changing the quoted rates or prices is also possible.

Attribute	Source(s)
tender life cycle, due to reduced procurement staff	
Cost-saving: Primary price-cutting instrument.[20] [21] Printing cost or paper cost, copying & postage costs, associated staff time (fewer man-hours spent on clerical work), and overhead costs will drop. Cost-saving may come from accessing a broader base of suppliers thus obtaining better price & quality, or both, less project retendering.	(Aberdeen Group, 2005; Amarapathy *et al.*, 2013; Asplund *et al.*, no date; Costa *et al.*, 2013; Davila et al., 2003; Eadie *et al.*, 2007; Gürbilek, 2013; Lavelle and Bardon, 2009; Tindsley and Stephenson, 2008; RICS, 2010; Patil *et al.*, 2016)
Greater transparency: It enhances transparency for it makes more information to be available on the internet. It avoids the scope for favoring preferred bidders or abusing discretion in tender evaluation. It increases the anti-corruption capabilities of public procurement.	(Becker, 2018; Faria, 2003; Gürbilek, 2013; Lavelle & Bardon, 2009; Neupane *et al.*, 2012; Patil *et al*, 2016)
More sustainable tender process: e-tendering makes the tendering process more environmentally friendly[22]	(Patil *et al.*, 2016; RICS, 2010)
Advanced tender evaluation assessment: the use of a computerized tender analysis leads to a fairer and fuller assessment of tenders.	(Gürbilek, 2013; Komakech, 2016; Lavelle & Bardon, 2009; RICS, 2010)
Improved productivity[23] **& greater market access:** it reduces the need for additional communications[24] , it reduces re-tenders & time spent at the analysis stage of the process,	(Aberdeen Group, 2005; Becker, 2018; Davila *et al.*, 2003; Eadie *et al.*, 2007; Lavelle & Bardon, 2009)
Increased competitive advantage[25] **:** EP yields better market access as the market is opened to entrants located far away and that may not	(Eadie *et al.*, 2007; Faria, 2003; Gürbilek, 2013; Komakech, 2016; Patil *et al.*, 2016)

20 Paper work-related costs. It's relevant especially for low-value items i.e., higher procurement cost than the item cost, Costs related to data error & inaccuracies inherent to the manual process.

21 Shorter cycle time reduces stocking requirements, bringing with it a reduction in inventory level.

22 This reduction in waste, particularly the production of multiple copies of paper-based information, can also lead to a less environmentally demanding and more sustainable tender process i.e., making the process more environmentally.

23 Productivity is increased during the tendering process by decreasing paper handling & speeding up communication & interaction.

24 As many of the web-based systems can check automatically for unusual or incomplete entries, the need for additional communication may decrease.

25 Competition is a key issue geared to adding value for money in public procurement. More bidders will participate if they are confident enough that they have all the necessary information to allow them to submit their best offer and where they feel that their submissions will be assessed objectively.

Attribute	Source(s)
otherwise participate. It increases competition among participants.	
Improved communication: requirement communication is easier due to a quicker & more accessible manner gauge. This results in a shortened communication cycle time.	(Eadie *et al.*, 2007; Eadie, Perera and Heaney, 2010; Faria, 2003; Gürbilek, 2013; Zou and Seo, 2005)
Improved efficiency in procurement & business[26] **:** by minimizing the procurement cycle time, maximizing VM, fostering accountability, and clear audit trails.	(Eadie *et al.*, 2007; Forrester, 2001 – 2003 Komakech, 2016; Kumar, 2018; Sitar, 2011; Zou and Seo, 2005)

2.9 Barriers and challenges of e-tendering implementation in the CI

Even though there are indeed positive outcomes from the introduction of e-tendering, barriers also exist to its successful adoption. Despite the apparent use of EP, many organizations have also been slow in their adaptation (Patil *et al.*, 2016). Sitar (2011) states that identifying the main barriers of EP is vital for Managers to help them facilitate the implementation process.

The implementation process of EP is very complex; thus, it was mentioned as one among the many explanations for the low rate of its adoption. It is due to the complex nature of its implementation that the main benefit of EP can be achieved only in the long term (Sitar, 2011). The report categorizes the different barriers from many works of literature into four: management barriers, organizational barriers, IT barriers, and users' barriers.

According to Eadie *et al.* (2007), the first piece of research to investigate drivers and barriers of EP in the construction industry was Rankin *et al,* 2006 in Canada. Accordingly, the study confirmed that the list of drivers and barriers identified from the procurement of goods and services in other industries could also be applied to the construction industry. Ranking of drivers and barriers for the construction sector

[26] Greater business efficiency is gained since EP creates a strategic advantage through an improved customer relationship with better information access and flexibility of the system.

was possible by applying the already established drivers & barriers from other industries (Shukla *et al.*, 2016). However, Eadie *et al.* (2007) assert that with the greater complexity and nature of the construction industry, the barriers to construction EP could be performing differently to those in the general goods and services industry.

Ren and Kamarudin (2016) claim that most of the contractors are willing to be part of e-tendering projects if they are invited to. Saving in storage space and security issues are the basic factors regarding their willingness and unwillingness to participate in e-tendering respectively (Ren and Kamarudin, 2016).

Another barrier mentioned by Tindsley and Stephenson (2008) is that, unless the whole supply chain system is moved to a completely paperless system, tendering costs are just transferred to the Contractors and subcontractors, who in turn see little or no benefits at all. EP is also considered a time-consuming process from a sub-contractors' point of view (Tindsley and Stephenson, 2008). Bidders or contractors become too reluctant to experience it because they think there are too many concerns and uncertainties. Such uncertainties and concerns are related to a lack of integration of new tools with the already existing process, lack of reliability of internet-based communication, lack of structured business process or system (Nesan, 2011).

Tran *et al.* (2011) and Shukla *et al.* (2016) also classified the barriers and challenges of EP implementation in the CI of developing countries into the following four categories. The same, along with other barriers obtained from other pieces of literature, is presented underneath and it was adopted for this study;

Table 2. 4 Barriers & challenges to EP implementation in the CI

Source: Adapted from (Shukla *et al.*, 2016; Tran *et al*., 2011)

Perspective	Barriers/Challenges	References
Technology	Lack of system integration[27] standardization & compatibility issues (higher investment costs in a compatible system)	(Costa *et al.*, 2013; Davila *et al.*, 2003; Rankin *et al.*, 2006; Sitar, 2011; Zou and Seo, 2005)
	Insufficient assessment of systems before installation	(Sitar, 2011; Weigel and Ruecker, 2017)
	Security concern[28]	(Amarapathy *et al.*, 2013; Eadie *et al.*, 2007; Hilmi *et al.*, 2019; Lavelle and Bardon, 2009; Rankin *et al.*, 2006; Sitar, 2011; Tatsis *et al.*, 2006)
Management	Resistance to change (at managerial level)	(Amarapathy *et al.*, 2013; Costa *et al.*, 2013; Davila *et al.*, 2003; Eadie *et al.*, 2010; Hilmi *et al.*, 2019; Sitar, 2011)
	The development of confidence to use new technology	(Eadie *et al.*, 2007; Rankin *et al.*, 2006; Zou and Seo, 2005)
	Lack of leadership or upper management support	(Amarapathy *et al.*, 2013; Eadie *et al.*, 2007; Weigel and Ruecker, 2017)
	The higher cost of investment, the challenge in finding an affordable technical solution, expensive & complex nature of e-signature	(Costa *et al.*, 2013; Davila *et al.*, 2003; Eadie *et al.*, 2007; Rankin *et al.*, 2006; Sitar, 2011)
	Lack of skilled personnel & technical expertise, lack of training	(Amarapathy *et al.*, 2013; Costa *et al.*, 2013; Eadie *et al.*, 2007; Sitar, 2011)
Organization	Lack of resources, different organizational structure, company access to internet	(Sitar, 2011; Zou and Seo, 2005);
	Challenge in shifting the mindset of people (Magnitude of change)	(Rankin *et al.*, 2006; Stewart *et al.*, 2003; Sitar, 2011; Weigel and Ruecker, 2017)
	Staff turnover	(Hilmi *et al.*, 2019; Weigel and Ruecker, 2017; Zou and Seo, 2005)
Environment	Inadequate technological	(Stewart *et al.*, 2003)

[27] Interoperability & integration with other systems or system-to-system within & between organizations.

[28] Security threat or security of transaction & uncertainty i.e., data integrity and confidentiality violation.

Perspective	Barriers/Challenges	References
	infrastructure, Lack of a national IT policy relating to EP issues	
	Lack of an effective legal and regulation system, lack of system standards[29]	(Amarapathy *et al.*, 2013; Costa *et al.*, 2013; Stewart *et al.*, 2003)
	Lack of demand from customers/clients, lack of corporate executive-level support	(Zou and Seo, 2005)
	Lack of marketplace & suppliers' readiness, a "wait-and-attitude" among firms	(Tran *et al.*, 2011)

2.10 CSFs of e-tendering implementation in the CI

This section presents the CSFs that are likely to influence the success of e-tendering initiatives in the public sector, especially in the construction tendering process. A review of multiple sources of data that could provide multiple insights into EP CSFs is covered under this section. CSFs for the case of this study are defined as "areas or functions where events and actions must occur to ensure successful competitive performance for an organization" (Vaidya *et al.*, 2006; Clark *et al.*, 2012). Becker (2018) listed the following six points as a factor in assisting public authorities or entities involved in the implementation process.

- **Business process re-engineering:** transitioning from traditional procurement to EP is more than buying and installing an IT system, it needs redesigning[30] the entire underlying procurement system (Becker, 2018).
- **Digital end-to-end/system integration:** to fully benefit from EP, digitalizing the whole process from end-to-end (from noticing to payment/evaluation) is

[29] Due to the availability of an excessive number of e-platform.

[30] The journal states that the re-engineering should be conducted procedurally in three steps: discarding unnecessary process elements followed by simplifying the process as much as possible, only then the process should be automated with a suitable IT system.

mandatory, digitalizing a single step of the procurement process is insufficient (Becker, 2018).

- **End-user uptake + training:** Vaidya *et al.* (2006) assert that end-users especially public authority employees require appropriate training since both the working tools and the established working processes are changed through EP. Costa *et al.* (2013) even mentioned the lack of training as a major factor hindering the transition to EP in Portugal.
- **Top Management support**[31] : this has several implications. As stated by Vaidya *et al.* (2006), the first vision & goal driving the change should be provided by the executive management team, who are responsible for the transition to EP or the procurement process in general.
- **Security & authentication:** since EP involves financial transactions and is thus susceptible to fraud, considering all security dimensions (confidentiality, integrity, availability, accountability & authentication) is mandatory (The e-Tendering Expert Group (e-TEG), 2016). Becker (2018) claims that, in terms of authentication, it breaks down to either providing Product Key Infrastructure (PKI) based digital signatures or integrating existing electronic IDs.
- **Supplier adoption:** Becker (2018) agrees that acceptance and uptake are not the only internal problem of procuring authorities. Suppliers are often rather unwilling to embrace EP due to many reasons like perceived lack of legal support, fear of expected costs for implementation, being unclear about the benefits to be gained & they might even see EP as a means by which public sector agencies will simply attempt to force down prices (Andrade *et al.*, 2010 cited in Becker, 2018; Vaidya *et al.*, 2006). Integrating suppliers early on into the planning phase of public EP will prevent suppliers' adoption

[31] Boonstra (2013) described the five major categories where top management support is provided. These behavioral categories considered were; provision of financial, material, and human resources, developing and deploying expertise, use of formal power in the execution of projects, communication (formal & informal) between the top management, project team & the rest of the organization, and last but not least the establishment of a clear & well-communicated project framework coupled with new organizational structures are some of the support expected from top-level management.

issues since it allows them to properly address their fears and requirements during implementation.

In addition to the above six points raised, the following factors were also considered as CSFs for EP implementation (Vaidya *et. al.,* 2006); performance measurement, change management program, EP implementation strategy, and communication standard.

Hence to avoid redundancy of the different CSFs considered by different researchers, the study used the following four classifications of factors identified by Tebeka and Yessuf (2019) extracted from existing works of literature. These being; top management support & employee commitment, reliability of information technology & infrastructure, reliability of legal factors, reliability of users' (buyers & suppliers) acceptance, and reliability of monitoring and evaluation system for e-tendering adoption. The same is presented underneath (see table 2.6).

Table 2. 5 CSF s for successful implementation of e-tendering

Source: Adapted from (Tebeka and Yessuf, 2019)

Perspective	CSFs	References
Top management support & employees' commitment	• Staff training & capacity building • Provision of adequate resource (financial, material, and human resources) • Employee's commitment • The skill of procurement employees with IT perspective • E-tendering implementation strategy	(Boonstra, 2013; Costa *et al.*, 2013; Mohammed, 2013; Shukla *et al.*, 2016; Tebeka and Yessuf, 2019; Vaidya *et al.*, 2006)
Information Technology & infrastructure	• Consistency of internet connection • Availability of reliable ICT infrastructure within an organization • Compatibility of existing hardware & software with the e-tendering	(Ahimbisibwe, 2018; Becker, 2018; Shukla *et al.*, 2016; Tebeka and Yessuf, 2019)

Perspective	CSFs	References
	implementation system • Functional integration of the e-tendering system with other business processes • Security & authentication measures	
Legal factors	• Availability of legal framework • Availability of e-tendering operation instructions & manual • Availability of legal & administrative procedures	(Becker, 2018; Tebeka and Yessuf, 2019)
Users' (buyers & suppliers) acceptance	• Trust of buyers & suppliers on the system • Willingness of users • Provision of training	(Ahimbisibwe, 2018; Vaidya *et al.*, 2006; Tebeka and Yessuf, 2019)
Reliability of monitoring & evaluation system	• Existence of a project management team to monitor & evaluate the progress of its implementation • Continuous performance evaluation & feedback • Compliance with rules & regulations is ensured • Checking procurement guidelines are practiced & monitored	(Tebeka and Yessuf, 2019; Vaidya *et al.*, 2006)

2.11 Best practices

The state of EP implementation globally is very active and growing from time to time (Somasundaram, 2007). Becker (2018) has chosen two EU member states with already advanced EP systems: Portugal and Estonia.

i) **Portugal:** Portugal is claimed to be the first country within the EU to implement and enforce mandatory EP. With this, Becker (2018) claim that the deliberate embracement of and the unwavering commitment of policymakers to EP were the two decisive CSFs for the implementation of EP. By doing so, cost savings and shorter processing time are taken as a leading example from the several achieved advantages. Whereas, a lack of training for procurement personnel and issue with an electronic

signature, like its cost and complexity, are some of the challenges reported (Becker, 2018).

ii) **Estonia:** Becker (2018) asserts that it was in 2002 that Estonia began to build an e-Government system and started using a digital ID and a backend system, and more services were integrated into the e-government platform. Similarly, e-Notification as part of EP has been mandatory since 2001. Vassil (2016) also points out the widespread use of electronic identification cards became the basis for the success of converting Estonian's public service online.

In addition to this, as per Vassil (2016), the Estonian e-government ecosystem is 'strongly regulated by legal instruments that provide a framework for security and personal data protection that's stored within Population Register and other appropriate government data repositories'. European Commission 2016b (cited in Vassil, 2016) mentions the widespread availability and acceptance of e-government services including the EP platform which is "frequently referred to as best practice" for being "rapid and easy to use". Awareness-raising actions and extensive training programs to educate employees to enable them to use the available EP platforms are mentioned as the basic success factors for the success of the country's e-government system (Vassil, 2016).

Previtali (2018) agrees the functionalities supplied by different EP platforms also differ. Accordingly, the most widespread is e-notification followed by e-tendering, whereas e-awarding, e-ordering, and e-invoicing need a greater implementation effort. Regarding the best practices in each functional area, Previtali (2018) asserts Belgium, France, Italy, Norway, Spain, and the UK to have a more developed system for the e-notification and e-tendering phase. Whereas e-awarding and e-ordering are more developed in Denmark, France, Italy, Norway, and Scotland; while e-invoicing and payment are developed in Denmark, Norway, and the UK.

- **United Kingdom (UK):** Eadie *et al.* (2010) have discussed the barriers and drivers of EP in the UK construction industry in detail. Accordingly, cost-

saving especially costs related to process, transaction, and administration is identified as the basic driver for EP adoption. Whereas, the same study reveals that insufficient assessment of systems before installation and confidentiality issues are the basic barriers hindering its adoption (Shukla *et al.*, 2016).

- **France:** it was since 2005 that public EP was applied in France. As per Assar and Boughzala (2006), EP's main advantages were seen both from the purchaser (the public person) and the seller (the enterprises) perspective. Accordingly, reduced procedure delays & cost, better communication with bidders, more optimized competition[32] , rationalized procedures, and reduced risk of errors were some of the benefits from the purchaser side. Similarly, for the seller, the main advantages were improved access to information, simplified communication, reduction in payment delays, and improved security and confidentiality (Assar and Boughzala, 2006). Users' degree of trust in the system and lack of provision of collaborative tools under the available platforms were mentioned as the barrier to its adoption. All EP platforms of the country have been developed by external software providers. One point raised under the study regarding the number of available EP platforms was that sellers found it to be very fastidious to use many different platforms as there is no general pattern or model for the EP process (Assar and Boughzala, 2006).

Similarly, the following paragraphs show the different levels of EP implementation status in some African countries;

- **Uganda:** even if EP has several advantages, mainly increased level of efficiency and effectiveness, most public organizations in Uganda have not adopted it (Ahimbisibwe, 2018). The study affirmed that lack of awareness was the basic reason behind its low adoption. Other key challenges that were found to constraint the adoption of EP include users' reluctance to change,

[32] Easier and wider access to bidding enterprises will result in cheaper prices as well.

transaction risk associated with the EP process, security concern, the cost and time required to set up the system. The result of the study, Ahimbisibwe (2018) affirmed that the benefits to gain from the system far exceed the cost or expenses to incur while moving to EP.

- **Egypt:** like many other countries in the world, Egypt's construction tendering system is paper-based, which is highly corrupted, bureaucratic, costly, time-consuming, and less transparent (Cherif *et al.*, 2014). It was in 2007 that the Egyptian government launched an e-tendering portal to make it more secure, fair, and transparent. The government of Egypt has only implemented phase one of e-tendering, whereby construction tender documents are created and uploaded on the portal, and interested users can buy the document online and send their clarifications online. In addition, a brief concerning the evaluation of the submitted tenders is published online (Cherif *et al.*, 2014). The findings of the study also categorized the barriers and challenges of e-tendering implementation into four; security challenges, user acceptance, and staff resistance, accessibility issue, and legal barriers.
- **Tanzania:** manual procurement process in the Tanzanian construction industry is considered to be inadequate due to a lack of transparency in its different stages, tedious paperwork leading to wastage of time and money (Mohammed, 2013). EP adoption in Tanzania is at its infant stage. Some new features that have been used since 2010 by the government were the main indicators of EP evolution, those including tender portals (where suppliers can view all tenders available), an online publication of brief details of the awarded contracts, and Procurement Management Information System (PMIS) (Mohammed, 2013). The study revealed that Tanzanian public institutions would save cost and add value to the procurement process via EP adoption. Similarly, technological factors, organizational factors, and environmental factors were identified as the basic categories of factors influencing the adoption of EP in Tanzanian public institutions (Mohammed, 2013). Mohammed (2013) has explained three stages in a model for EP

adoption for Tanzanian CI; ‘first policy framework stage, second technology, people and process stage and finally efficiency and transparency stage’.

Lessons learned: from the experience of all the above countries, it can be noted that EP was found to be advantageous in the construction industry and other sectors as well. However, the adoption of the system in most countries is at its initial stage and a lot needs to be done to fully benefit from the system. Values gained from the system highly dependent on some factors in relation to the organization, technology, legal, and environment. Since the adoption of the system is at its elementary stage, awareness creation and training of users is very crucial.

2.12 Research gap identification

It has been noted that limited evident researches have been conducted previously regarding the implementation of EP in Ethiopian public procurement. A readiness assessment of Contractors & Consultants for e-tendering adoption in public procurement was conducted for the first time by Emiru (2015) which the author believes to be a pioneer study conducted regarding EP adaption in the Ethiopian construction sector. To this effect, the study focused mainly on the adaption of EP, specifically e-tendering, in the works & service procurement of Ethiopian federal road construction projects.

Chapter Three: Research Methodology

3.1 Introduction

A research methodology is a generic term used for the process of defining problems, gathering facts or data, analyzing data, and accomplishing objectives (Patel, 2017). It is a systematic way of solving a problem (Khotari, 2004). The following subsections give a thorough explanation of the research methodologies adopted for the study.

3.2 Research design

The strength of *what* a researcher finds largely rests on *how* it was found (Kumar, 2011). Thus, the main function of developing a research design in line with Kumar (2011) is to explain *how* an answer is found to our research questions. All the specific details of the research inquiry must be included and designed properly.

Therefore, the study adopted the following research design[33] to conduct the whole research to reach the right conclusion. Different research categories are used to classify the research under study. The same is presented in the coming sections below.

3.2.1 Research philosophy: Post-positivism

Post-positivism/pragmatic paradigm was chosen as the most appropriate philosophy for this research. The study tries to identify the loopholes in the existing works & service procurement of Ethiopian federal road construction projects and propose e-tendering as a solution by clearly stipulating its advantages. To get more accurate results, the research was based on data or information found in the natural setting and already existing records and literature. Multiples of methodologies[34]

[33] In general terms, a research design is a conceptual structure within which research would be conducted (Kothari, 2004).

[34] Methodologies refers to the different methods adopted for the study like the source of data, sampling design, data source size determination, data collection tools, and analysis method.

were used to reach the fact. But, the researcher's neutral involvement to organize and make analysis was necessary.

3.2.2 Research application: Applied research

Regarding the research application, if we examine a research endeavor, the broad categories are *pure (basic)*[35] and *applied (practical)*[36] *research*. The goal of this study was to investigate the suitability of e-tendering in the procurement of Ethiopian federal road construction projects. Due to this, the study fell under the applied research category concerning its goal or application. Thus, the information gathered can be used directly in the industry or in some other ways i.e., to enhance the understanding of the phenomenon.

3.2.3 Method of reasoning/theory development: Inductive

As per Trochim (2006), in logic, there exist two broad methods of reasoning: the *deductive*[37] *& inductive*[38] *approaches.* Accordingly, this study tried to identify the major loopholes & challenges of the current tendering of federal road construction projects in Ethiopia and assessed the basic features of e-tendering concerning its potential in addressing these problems. The researcher was not sure about the type and nature of the research findings until the study period ended. A conceptual framework was built upon the findings of the query survey, semi-structured interview conducted, and data collected through the documents reviewed. The framework developed was mainly to depict the intervention mechanism of e-tendering in the study area. Therefore, the idea was quite like an inductive theory building.

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[35] Pure (basic) research is all about explaining the world around us and tries to understand how the universe operates. It sets down the foundation for the applied research that follows.

[36] Applied research is designed to solve practical problems of the modern world, rather than to acquire knowledge (Zegeye *et al.*, 2009).

[37] A deductive approach is used when research starts with a theory, often developed from a reading of academic literature, and a research strategy is designed to test the theory. Generalization is made from the general to the specific, in order to falsify or verify a theory (Lewis and Thornhill, 2019).

[38] An inductive approach is when research starts by collecting data to explore a phenomenon in order to build a theory (often in the form of a conceptual framework). Generalization is made from the specific to the general, in order to generate and build a theory.

3.2.4 Research approach: Triangulation

Related to the methods or approaches of research, *qualitative*[39] *& quantitative*[40] *researches* are the two broad classifications used. Qualitative research was used 'to develop theories when partial or inadequate theories exist for certain populations and samples or existing theories do not adequately capture the complexity of the problem we are examining' (Creswell, 2007). Due to this, the research used a qualitative approach. The data obtained from the interview helped to identify the current practice of construction tendering, challenges of the same, and identified the potential advantages of e-tendering as per the respondents' perception of the concept and/or as per the experience of the practitioners of the system. For the most part, unlike quantitative study, it is designed and intended to achieve a depth of understanding rather than breadth. The data was finally be presented in the form of a description, not in numbers.

On the other hand, a quantitative type of research was also adopted for this study. Such an approach is particularly suited to find out about the state of something or to explain phenomena (Muijs, 2004). Challenges faced in the current procurement of the federal road construction projects, along with the possible advantages of e-tendering, and the possible CSFs and barriers to face during e-tendering implementation in the study area were identified through a quantitative (query survey) research approach.

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[39] Studies that do not attempt to quantify their results through a statistical analysis or summary are under a qualitative research. It describes the various aspects of behavior and other factors under the study (Zegeye *et al.*, 2009). Qualitative approach leads to *hypothesis-generating* research (Auerbach and Silversten, 2003)

[40] Quantitative research is 'the systematic and scientific investigation of quantitative properties and phenomenon and their relationship'. The main objective of such study is to develop and employ mathematical models, theories and hypotheses pertaining to natural phenomena (Zegeye *et al.*, 2009). The quantitative approach leads to *hypothesis-testing* research (Auerbach and Silversten, 2003).

3.2.5 Study design: Triangulation

The most commonly used study design[41] to conduct a scientific inquiry are *Experiments, surveys*[42] *, case studies*[43] *, archival analysis,* and *History* (Zegeye *et al.*, 2009; Yin, 2009). Hence, based on the research question type, the control the researcher has over actual behavioral events, and the degree of focus on contemporary as opposed to historical phenomena, each method has its advantage and disadvantages (Yin, 2009).

A survey kind of research design is used to scan or represents a wide target population (Zegeye *et al.*, 2009). Data was gathered and analyzed from representative respondents. The survey was mainly used to address the research questions of the study. This helped the researcher to access a wider perspective of participants in the tendering process of a works & service procurement of a federal road construction project. Factors affecting the implementation of e-tendering in the said study area were also identified through a questionnaire survey research design, using the respondents' perceptions. In addition to this, the data obtained from the questionnaire was cross-validated with the data gathered via an interview survey.

3.2.6 Source of data: Triangulation

Both primary and secondary data sources were used for this particular study. The primary data was predominantly collected through a semi-structured interview conducted with experts involved in the tendering phase of road construction projects and with e-tendering practitioners in the construction sector. Querying of selected groups from selected samples was another primary data source used.

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[41] A study design is one part of the research design. It is simply the design of the study, whereas research design is holistic and it includes other parts which constitute the research process (Kumar, 2011).

[42] The survey is one kind of study design used to 'collect data at a particular point in time with the intention of describing the nature of existing conditions, or identifying standards against which existing conditions can be compared, or determining the relationship that exists between specific events' (Zegeye *et al.*, 2009).

[43] A case study is an empirical inquiry that investigates an existing phenomenon within its real-life context (Yin, 2003).

The exhaustive literature review on the subject area was the major secondary source of data. Literature and archival documents were reviewed to assess the current practice and identify the gaps in paper-based construction tendering practice. The review was also helpful to identify the CSFs, the potential benefits, and barriers of e-tendering adaption in construction tendering in general. Sources of literature were books, journal articles, conference proceedings, academic reports, etc. The findings from the survey were cross-checked with the works of literature reviewed and discussion was made accordingly.

3.2.7 Data source selection/sampling design: Purposive sampling

Sampling techniques can generally be classified as *probabilistic*[44] and *non-probabilistic sampling*[45]. From these two sampling methods, non-probabilistic sampling was used for the study. The two non-probability sampling techniques that are used to choose a sample of subjects/units from a population are *convenience sampling*[46] and *purposive sampling*[47] . Etikan *et al.* (2017) stress that the choice of these techniques is highly dependent on the type and nature of the research. Accordingly, the most common method of sampling qualitative research is adopted i.e., purposive sampling.

i) For questionnaire & interview survey research design

For the survey research design used, a non-probabilistic type of sampling was adopted. Once the research questions have been set out clearly, thinking about what information is needed to answer research questions is vital (Muijs, 2004).

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[44] In probability sampling samples are presumed to be representatives of the population being studied and are used to generalize to that population (Schoch, 2020).

[45] In non-probability sampling, the subjective method is used rather than randomization to decide which elements are included in the sample (Etikan *et al.*, Musa and Alkassim, 2017). Such sampling is used when the aim of the researcher is not to generate results that will be used to create generalizations pertaining to the entire population. Also known as 'non-random sampling or biased sampling' (Omona, 2013)

[46] Convenience sampling (aka Haphazard sampling or Accidental sampling) is a type of non-probability sampling where members of the target population that meet certain practical criteria, such as easy accessibility, geographical proximity, availability at a given time, or the willingness to participate are included for the purpose of the study.

[47] The purposive sampling technique (also called judgment sampling) is 'the deliberate choice of a participant due to the qualities the participants possess. This method is used for gathering data in a qualitative type of inquiry and selects the most information-rich cases (Etikan *et al.*, 2017; Zegeye *et al.*, 2009)).

Accordingly, regarding the statistical generalization made, it's mentioned in the above sections that a questionnaire survey research design was used to assess the current practice of tendering & its challenge, to identify the challenges that could be improved via e-tendering, and to rank factors affecting the adoption of the same in the study area, as per the respondents' perception.

The next step is to identify the *population*[48] and the *sample frame*[49] of the study. Since the whole population under consideration cannot be studied due to the available resource the researcher had, a sample must be taken. The results found in the sample were used as an input for the framework development. As per 'Defining and Framing the Population' (2015), first there are two basic steps in the sampling process to consider i.e., defining the population and framing the population.

a) Defining the population

To define a population, defining the population unit[50] & setting population boundaries[51] is very crucial ('Defining and Framing the Population', 2015). Accordingly, depending on the research topic and the purpose of the study, the unit of the population in this study were defined as individuals or persons. The source of data was the same as the population unit i.e., individuals/experts working for organizations engaged in the road construction sector.

To tell who should or should not be measured, the population has to be stated in specific operational terms i.e., setting the population boundaries. The bounding criteria used for this study were professionals' area of operation (working for

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[48] Population is the group to which the findings of the research are generalized (Omona, 2013). It is also called 'the universe' or 'the sampling population' (Kumar, 2011; 'Defining and Framing the Population', 2015)).

[49] The sampling frame is 'the list or system that identifies members of the population so that samples can be drawn from' ('Defining and Framing the Population', 2015).

[50] Defining the population unit is all about indicating the population clearly and concretely, which can be a person, place, thing, organization, or phenomenon (Schoch, 2020).

[51] Population boundaries are the conditions that separate those who are of interest in the research from those who are not ('Defining and Framing the Population', 2015). It is related to the scope-what is and what is not included in the population.

employer, contractors & consultants involved in road construction), behavior (who participated in the tendering phase of the Ethiopian Roads Authority (ERA) for a minimum of five & six years for questionnaire & interview survey respectively), educational background[52] of professionals (people holding Bachelor of Science Degree & above in Civil Engineering or Construction Technology Management or any other related Engineering field).

Accordingly, the proper definition of population boundaries for the questionnaire survey took the following form "*The list of professionals working for Employer, Contractors, and Consultants involved in the tendering process of the ERA's road construction projects for a minimum of five years".*

Similarly, the population boundaries for the interview survey have the following form "*The list of professionals working for Employer, Contractors, and Consultants involved in the tendering process of ERA's road construction projects for a minimum of six years".*

The educational background criteria (stated in the above paragraph) hold for both questionnaire and interview survey.

The other population boundaries used for the second group of interviewees (e-tendering practitioners) was;

"The list of professionals/experts who have practiced e-tendering for the procurement of construction projects."

b) Framing the population

The frame of the population or sampling frame before sampling must be obtained after the population is defined. Based on the above-defined population, the best way of getting access to professionals involved in the tendering process of Ethiopia's Federal road construction projects was by using the concept of *snowball*

[52] Educational background & years of experience of professionals is used as a bounding criterion while defining the population. This is by assuming the level of awareness of professionals below the criteria set above is to be low to add value to the study.

sampling[53] *.* Such sampling is applied when samples with the target characteristics are not easily accessible (Naderifar *et al.*, 2017). In this study, the researcher asked the first few samples, if they knew anyone with similar educational background and professional experience in the tendering process to take part in the research. Information-rich key informants i.e., professionals having many years of experience in the road tendering process were located using snowball sampling.

3.2.8 Data source size: Data saturation

The size of the data to use is a function of the type of generalization the study makes at the end. Since the research made an analytical generalization[54], a method of purposeful sampling was used to determine the study's data source size. Several approaches are used for sample size determination[55] (Taherdoost, 2018). However, in the case of purposive sampling, the concept of data saturation[56] was used to determine the appropriate sample size (Naderifar *et al.*, 2017). Data saturation was mainly used in the study since it was not possible to find the exact population number and tracing these professionals working in road construction, specifically engaged in the tendering phase, with a minimum of five (5) years of experience was not practical.

[53] Snowball sampling is also known as the chain referral method. It's a well-known non-probability method of survey sample selection that's commonly used to locate hidden or hard to find population and useful to approach dispersed/small population. It's commonly considered as a purposeful method of data collection in qualitative study (Naderifar *et al.*, 2017).

[54] Analytical generalization is all about expanding and generalizing theories and enumerating frequencies like statistical generalization does (Yin, 2003). It is a mode of generalization in which a previously developed theory is used as a template with which to compare the empirical results of the research findings.

[55] Sample size determination is a technique of selecting the number of observations to include in a sample. This is vital to make inferences about the population from a sample (Ajay and Micah, 2014).

[56] Data saturation can be defined as the point in which new data tend to be redundant of data already collected. It's used as a criterion in qualitative research for discontinuing data collection and/or analysis. When similar instances or themes are seen over and over again, the researcher can be confident that a category is saturated (Baker *et al.*, Waterfield and Bartlam, 2018).

3.2.9 Data collection instruments: Triangulation

Schoch (2020) asserts the data to be collected are driven by the research questions. Since using multiple sources is a key element for collecting data, the concept of data triangulation was used in this research i.e., data were collected through a semi-structured in-depth interview, survey questionnaire[57] , and document review.

A questionnaire is a self-administered (by respondents) kind of response to queries.
A secondary data source i.e., document/record review was used as another instrument for data collection. Documents (or archives) were used as a major data source along with the data obtained via interview. The researcher has reviewed historical and/or contemporary documental sources that contain company records of what is being done or planned about e-tendering implementation at a national level, the current development status, or regarding the extent of adaption and/or any other relevant information about e-tendering was reviewed.
Leading the EP initiative & developing a single platform for its implementation in the public procurement is the mandate of the FDRE Public Procurement & Property Administration Agency (FPPPAA). With this, PPPAA's regulation and proclamation, e-tendering implementation strategy, draft EP proclamation or action plan, and any kind of legislative framework and the strategic procurement practice guideline (of e-tendering practitioners) were reviewed. Archival documents about the study area were also studied to better understand the existing practice and trends over time.
A semi-structured (focused) interview, specifically a face-to-face type of interview, was conducted with top-level management and experts from the procurement team in the samples to have a better insight into the current construction tendering

[57] Survey research design through questionnaires has been popular in various fields (Hassan *et al.*, Ahmad and Boon, 2019).

practice & to identify the gaps. It was also useful to identify the perceived barriers & CSFs of e-tendering's implementation during future implementation and/or during the initiation phase. The data from the interview also filled the gap identified from the document/archive and triangulated the data gathered through a query survey. While conducting the interview Yin (2003) suggests that key probing issues are selected from the document/archival study, concepts and other best practices addressed in the literature review.

However, interviews, especially face-to-face interviews are vulnerable to interviewer bias[58] and response bias[59] (Desta, 2015). Therefore, as much as possible, it is the researcher's responsibility to try to avoid such bias from happening. However, in this study given the positions and figure of the interviewees (experienced directors and team leaders who deal with many professionals and international institutions representatives as part of their works), biases of wishing to impress or being affected by the interviewer was not taken as a serious problem. In addition to this, interviewer bias was minimized by the way[60] the researcher conducted the interview. But some respondents were not willing to reveal some critical information, especially if that reflects (criticize) the performance of the interviewees or indirectly affects the reputation of the authority. To overcome this challenge, cross-referencing interview results with findings from document reviews, surveys, and other literature sources (if available) was used.

A semi-structured[61] or *partially-open-ended items* questionnaire survey was conducted (both in a printout and online form) to identify the current practice along with the challenges in the tendering stage of a works & service procurement of federal road projects. The perceived and potential CSFs & barriers affecting the

[58] Interviewer bias is when the way interviewees respond is affected by the behavior of the interviewer.

[59] Response bias is 'a situation whereby respondents don't give the facts or what they know of the construct for different reasons such as by wishing to impress or reflexibility' (Desta, 2015).

[60] The researcher (interviewer) tried to be as objective & professional as possible, focused on the study area only, avoided further interpretation of the questions and avoided using confusing/biased words during the interview.

[61] Semi-structured questions are the combination of both closed-ended responses with an open category or option (Lee, 2001).

implementation of e-tendering in the study area were also identified via a questionnaire. The same was triangulated with factors identified by participants during the interview with e-tendering practitioners.

A closed questionnaire[62] type is used, where each item of the questionnaire was evaluated with five points of *Likert scale*[63] *,* just to make it easier for the respondents to respond. Although, very few open questionnaires were also included to add their opinion other than the lists provided. A pilot test was carried out with a participation of a suitable number of volunteers to get feedback on the questions' content for further amendments if any. After the pilot study, the data collection was done using questionnaires in written forms and an e-survey using Google forms[64] . The data obtained through the survey were triangulated with the result obtained through interviews & document review.

The questionnaire survey instrument was administered in English and consisted of five sections. Section one assessed the professional and educational background of respondents; section two assessed the current construction tendering practice & its challenges; section three measured the values of e-tendering for the road construction tendering process (as per the perception & understandings of the respondents about the concept), and section four probed the CSFs & barriers of e-tendering adaption in the study area.

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[62] A closed questionnaire type is a kind of questionnaire with closed questions, where respondents are made to choose between answers provided by the researcher. It's not like an open-ended questionnaire where respondents formulate their own answers (Muijs, 2004).

[63] Rensis Likert's scale (1932), called a summated rating or additive scale, is one of the rating scales in which 'respondents indicate agreement or disagreement with variety of statements on an intensity scale' (Lee, 2001). It is widely used & very common in questionnaires due to its easiness in construction, high reliability & successful adaption to measure many types of affective characteristics. It enables statements of opinion to be directly translated into numerical data.

[64] Online questionnaire survey can be accessed at https://forms.gle/ECjtFwu1n3EkaaYg8

3.2.10 Data analysis and interpretation techniques: Triangulation

i) For qualitative data

Document analysis is a 'systematic procedure for reviewing or evaluating documents – both printed and electronic (computer-based and internet-transmitted material)' (Bowen, 2009). The author asserts that such an analysis method involves skimming, reading, and interpretation. The process of document analysis combines elements of content analysis[65] and thematic analysis[66]. For this study, both content analysis & thematic analysis were used to analyze the data obtained either through interviews or document reviews. The analysis of textual data or the interview transcripts[67] was computed using the most widely used qualitative data analysis program, QSR NUD*IST (Non-numerical Unstructured Data Indexing Searching and Theorizing) Vivo 10, also called NVivo[68].

According to Miles and Huberman (1994), there are two steps to analyze and display qualitative data i.e., exploring & describing, and explaining & prescribing. The former one is about describing the phenomenon under study after exploring what it is. The latter one presents an explanation as to why events happen and why they happened and will make a prescription regarding potential adjustments to the way phenomena are implemented. Accordingly, the study first described the current practice of construction tendering in the road sector along with its challenges. Then, based on the data from interviews & document reviews, best practices, and concepts in the literature, the study sought an explanation for the challenges identified and prescribed better ways of doing it. This was done through

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65 In content analysis, findings or information are organized into categories related to the central questions of the research (Bowen, 2009). Content analysis is a systematic and objective means of making a valid inference from verbal, visual, or written data in order to describe & quantify a specific phenomenon. Data or content analysis includes the following basic steps; 'describing, interpreting, drawing conclusions, and determining significance' (Schoch, 2020).

66 Thematic analysis 'is a form of pattern recognition within the data, with emerging themes becoming the categories for analysis' (Bowen, 2009). Emerging themes are used to describe the phenomenon (Fereday, 2006). In thematic analysis, themes are identified via a "careful reading and re-reading of the data" (Rice & Ezzy, 1999 cited in Fereday, 2006).

67 A transcript is a written verbatim (word-for-word) account of verbal interaction, like an interview or conversation (Heath *et al.*, 2013).

68 NVivo is a retrieve, code, and theory-building tool, that helps researchers to replicate all of the abilities of the 'paper and pen' system into the software (Jones, 2007).

the e-tendering implementation framework that has been developed at the end of the study.

ii) For quantitative data

To analyze the data obtained from a survey questionnaire, the most widely used statistical analysis software package i.e., *Statistical Package for Social Science (SPSS)*[69] was used. SPSS 25.0 software was used to conduct the descriptive statistics, reliability test, and to check the validity of the instrument. The results of the analysis were also presented in graphs & tables as shown in the next chapter along with the details on the data description & analysis.

3.2.11 Research quality assurance techniques

The quality of a research design is judged by certain logical tests and the concepts related to these tests are trustworthiness, credibility, confirmability, and data dependability or reliability (Yin, 2003).

Despite the many advantages of a qualitative research method, testing its validity and reliability remains in doubt (Riege, 2003). In line with this, the instruments used for the interview should pass reliability and validity tests before being considered as a reliable tool in the study. such quality of the interview data can be checked and be improved at the interview protocol development stage (Yeong *et al.*, 2018; Jacob and Furgerson, 2015). Accordingly, the interview questions used in the study were aligned with the research questions and it was designed based on the researcher's understanding of the subject matter. The second step used for fine-tuning the interview protocol was to receive feedback from experts and piloting the interview protocol (to receive feedbacks from actual respondents). The questions were piloted with the researcher's work colleagues who are familiar with the tendering process, just to make sure that the questions are clear.

[69] SPSS is selected since it's by far the most common statistical data analysis software package, it's also quite user-friendly and does everything we need it to do (Muijs, 2004).

One way of adding rigor to qualitative research is to use the software in the data analysis process. Since carrying out the analysis process electronically yields more reliable results than doing it manually simply because human errors are ruled out (Welsh, 2002). Due to this reason, the interview analysis was conducted using NVivo.

The following table summarizes the quality tests used for the quantitative (questionnaire) research design along with several tactics for dealing with each test.

Table 3. 1 Tailored quality assurance techniques for survey research design

Source: Adapted from (Heale and Twycross, 2015; Muijs, 2004)

Tests	Corresponding design test (concepts related)	Survey tactics & research phase which the tactic occurs	The study's approach followed to comply with the quality requirement
Construct validity	The extent to which a research instrument (or a tool) measures the intended construct	***Tactic:*** A statistical method was used, a broad review of literature ***Research phase:*** Data analysis	A statistical method was used i.e., *Factor analysis*[70] to tell whether each item measures the subscale it is supposed to measure and not any other. Results/scores were checked if they were similar to theoretical propositions. Different sources of information were examined to recognize & discuss all the aspects associated with the research issues
Content validity	The extent to which the instruments accurately measure all aspects of a construct	***Tactic:*** Extensive literature review & a pilot study was conducted before the survey questionnaire was distributed ***Research phase:*** Data collection	An extensive literature review was done to know the subject under study and to understand how the concepts used are theoretically defined. Respondents were also asked how the instrument i.e.; the questionnaire looks valid to them. The experts' reflections & feedbacks were incorporated in the data collection instrument.
Criterion[71]	The extent to which a	***Tactic:*** A good knowledge of a	Good knowledge of literature relating to challenges of

[70] Factor analysis, as per Plucker (2003), is the most widely used analytical tool to provide evidence of construct validity for an instrument. Plucker (2003) asserts that, a factor analysis basically investigates the correlations among scores on several variables in an attempt to see how the variable scores "clump together". Factor analysis, as per Henson and Roberts (2006), is used to explain a larger set of measured variables or indicators via a smaller set of latent constructs or factors. Factor Analysis (FA) can be thought of as 'a variable reduction procedure, in which many variables are replaced by a few factors that summarizes the relations among the variables' (Goldberg and Velicer, 2006). Factor analysis, as per Kumar (2012), attempts to determine which sets of observed variables share common variance-covariance characteristics that define theoretical constructs or factors (latent variables)'.

Tests	Corresponding design test (concepts related)	Survey tactics & research phase which the tactic occurs	The study's approach followed to comply with the quality requirement
validity	research tool is related to other instruments that measure the same variables	theory relating to the concept under study is developed and statistical measurement was used. ***Research phase:*** Desk research (literature review) and data analysis	paper-based tendering, CSFs & barriers of e-tendering, and advantages/values of e-tendering was developed so that a decision was made upon which variable to measure. A correlation coefficient[72] was used to measure whether there was a relationship between the measures & the factors.
Reliability	The extent to which a research instrument is consistent	***Tactic:*** A statistical measure was used to determine the internal consistency of an instrument ***Research design:*** Data analysis	*Cronbach's α* was used to measure the homogeneity of an instrument i.e., questionnaire in this case.

[71] Criterion is any instrument that measures the same variable (Heale and Twycross, 2015).

[72] Correlation coefficient is a method used to analyze the relationship between two variables (Muijs, 2004). Accordingly, it looks at whether or not a high score on one variable is associated with a high score on the other.

3.3 e-tendering conceptual framework development and its validation

The study formulated an e-tendering implementation framework for road construction projects. The formulation and development of the conceptual framework were based on the public procurement core principles & objectives, e-tendering workflow process, previously developed models and/or frameworks, the result gained after the exploration of the current tendering practice & its challenges, and the potential factors (identified through a survey) affecting e-tendering implementation were also taken into consideration.

The developed framework was validated via a focus group discussion involving four experts from the consultant representative and using an informal interview with four and three experts from the client and contractor's representative respectively. The sampling design used for framework validation was similar to the data collection i.e., purposive sampling involving professionals working for Employers, Contractors, and Consultants involved in the tendering process of ERA's road construction projects for a minimum of six years. Based on the comments & suggestions forwarded during the discussion, some amendments were made accordingly. In addition to this, the developed framework was rated among participants for its clarity, comprehensiveness, simplicity, relevance, and future applicability. Based on the result of the same, the developed framework for e-tendering implementation was found to be clear and simple to understand.

3.4 Summary

This chapter was all about presenting the research methodology adopted for the study. It was intended to establish the appropriate research design along with the data collection mechanism, source of data, data collection instrument, sampling technique, data analysis, and interpretation techniques as well as presents the different quality assurance techniques employed for the study.

Table 3. 2 Research questions Vs Research methodologies

Research Questions	Research Methodologies to adopt
What is the current practice & gaps in the procurement of Ethiopian federal road construction projects?	**Study design:** Survey i.e., a questionnaire & interview survey
	Source of data: Primary & secondary
	Data collection instrument: Literature review, semi-structured interview, document review & questionnaire survey
Which of those challenges/gaps could be improved through e-tendering?	**Study design:** Survey i.e., questionnaire & interview survey
	Source of data: Primary & secondary
	Data collection instrument: Literature review, semi-structured interview, questionnaire survey & document review
What are the critical success factors (CSFs) and barriers of Ethiopia in implementing e-tendering for the procurement of federal road construction projects?	**Study design:** Survey i.e., survey questionnaire & interview
	Source of data: Primary & secondary
	Data collection instrument: Document review, semi-structured interview & questionnaire survey
How best can e-tendering be intervened or introduced for the procurement of Ethiopian federal road construction projects?	**Study design:** Survey i.e., a questionnaire & interview survey,
	Source of data: Primary & secondary
	Data collection instrument: Document review, semi-structured interview, questionnaire survey & Literature review, and a focus group discussion

Chapter Four: Analysis and Discussion

4.1 Introduction

This chapter presents the analysis of the data collected for this study via a document review, a questionnaire & an interview survey. The analysis includes thirteen parts, excluding the introductory section (4.1), section (4.2) presents the descriptive analysis of the questionnaire and interview data, sections (4.3 to 4.7) discuss the analysis of the five basic constructs raised as a research question; including the current practice of road construction tendering practice, its challenges along with the potential advantages of e-tendering and the basic CSFs and barriers affecting the implementation of e-tendering are discussed in detail.

The trends of the respondents' opinions obtained from their answers are ranked using the Relative Importance Index (RII). In the remaining sections (4.8, 4.9, 4.10, and 4.11), the data were tested for reliability, and validity was checked by several statistical measures. The results and findings from the questionnaire were triangulated with the findings from an interview and document review. The current status of e-tendering implementation in Ethiopia is presented under section 4.12. In the last section (4.13) conceptual framework developed and its validity check is presented.

4.2 Descriptive analysis

4.2.1 Questionnaire response rate

This section provides background information about the respondents in the questionnaire survey in terms of their position in the company, professional experience, & educational background. A total of 86 respondents have responded to the questionnaires. Of the total 86 respondents, 61.6% (53 respondents) gave their responses via the online google form or submitted electronically and the remaining 38.4% (34 respondents) via the printed questionnaire. Out of the forty-five (45) printed questionnaires distributed, thirteen (13) were distributed to employer's representatives, eighteen (18) to consultants' representatives, and the

remaining fourteen (14) to contractors' representatives. Of these questionnaires, thirty-three (73.3%) were returned, which was a valid response rate[73] and a high percentage from the total paper-based questionnaire distributed.

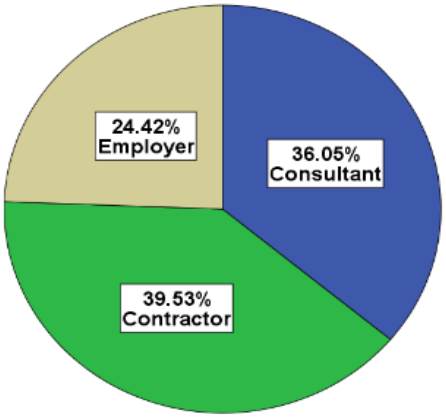
Table 4. 1 Questionnaire response rate

Respondents' category	**Number of questionnaires distributed**[74]	**Number of questionnaires returned**	**The average percentage of response rate (%)**
	Online		
Consultant	24	16	66.67
Contractor	32	25	78.13
Employer	27	12	44.44[75]
Total	**83**	**53**	**63.86**
	Printed		
Consultant	18	15	83.33
Contractor	14	9	64.29
Employer	13	9	69.23
Total	**45**	**33**	**73.33**

[73] Response rate is the portion of participants who agreed to complete a survey among all individuals who were asked to complete the survey (Curtis, 2004). The typical minimum threshold of response rate, as per Curtis (2004) to surveys in most published research is 50%. However, online survey may have a lower response rate (Fincham, 2008).

[74] This figure, for online forms, refers to the average number of questionnaires distributed via online that the author can trace. The figure cannot be exact, it may vary from the one stated here.

[75] Evenif this figure is below the minimun threshold set for response rate i.e., 50%, due to its proximity to the said threshold, it was accepted as it is. In addition to this, the intent of the survey was to assess the current trend of tendering along with its problem, and to address the perception of experts regarding e-tendering rather than generalizing and projecting the results of the survey onto a population. Generalization was made to a theory rather that to the whole population.



The pie chart below shows the proportion of the respondents. From the total 86 questionnaires used for analysis, 31 (36.05%) belong to Consultants, 34 (39.53%) work for Contractors, and the remaining 21 (24.42%) belong to the employer side.

Figure 4. 1 Area of operation of respondents

4.2.2 Background information of respondents

The categories of respondents with general information about their education and professional experience are presented in the underneath tables.

Table 4. 2 Educational background of questionnaire participants

Highest level of education;	Frequency	Percent	Cumulative Percent
Bachelor Degree	66	76.7	76.7
Master's Degree & above	20	23.3	100.0
Total	**86**	**100.0**	

The finding from Table 4.2 indicated that more than half of the respondents (76.7%) were Bachelor's Degree holders and the remaining 23.3% had a Graduate degree in Civil Engineering or Construction Technology Management or any other related Engineering field of study.

Table 4. 3 Current positions[76] in the company

[76] Since the scope of the research is only limited to the tendering phase of a procurement, the selection criteria set for the survey is mainly focused on these experts engaged in the tendering phase of Federal road construction projects. This was mainly due to the fact that these professionals would have a rich experience in relation to tendering and their understanding of the subject was perceived to have an impact on the research findings.

Current position in the company	Frequency	Percent (%)	Cumulative Percent (%)
Contract Administrator	27	31.4	31.4
Contract Engineer/Claims Expert	22	25.6	57.0
Procurement Team Leader	3	3.5	60.5
Project Engineer	27	31.4	91.9
Other	7	8.1	100.0
Total	**86**	**100.0**	

Due to the scope of the research, participants were professionals and experts working and/or have worked in the tendering phase of road construction projects. Therefore, table 4.3 indicated that 31.4% of the respondents were Contract Administrators & Project Engineers, 25.6% were Contract Engineers / Claim Experts, 3.5% were Procurement Team Leaders, and the remaining 8.1% of the respondents belong to other groups of careers, but still engaged in the tendering process of road construction projects.

Figure 4.2 below depicts that more than half of the respondents (62.8%) worked from five years to seven in the tendering phase of federal road construction projects. On average 23.3% worked for seven years to ten years in a similar area. whereas the rest 12.8% have over ten years of experience. Therefore, in general, it's assumed that the respondents of the questionnaire survey, had attained the necessary education and professional experience to understand the basic concept and logic of e-tendering.

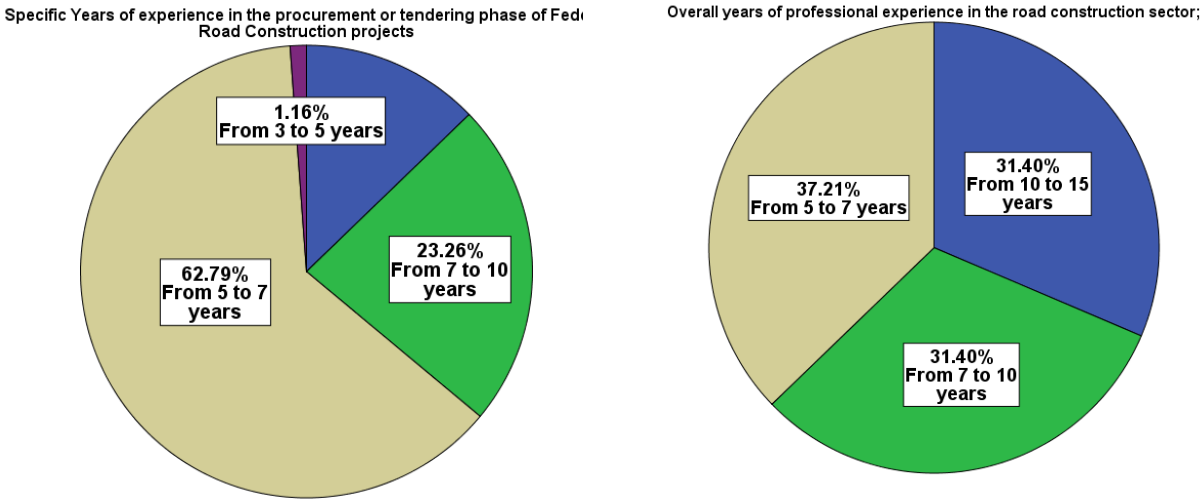


Figure 4. 2 Specific & overall experience of respondents

Source: Own survey, February 2021

4.2.3 Interview analysis

The analysis of the interview transcripts was computed using the most widely used qualitative data analysis program, QSR NUD*IST (Non-numerical Unstructured Data Indexing Searching and Theorizing) Vivo 10, also called NVivo[77]. The screenshot used in this paper is from NVivo version 10. The transcribed interview data was transferred and converted from word format (.doc extension) into a rich text file format (.rtf extensions) to process them as NVivo document files.

4.2.3.1 Background of respondents to the interview

The interview was conducted among selected target professionals[78] involved in road construction project tendering and those who practiced e-tendering for construction projects. Initially, it was planned to interview at least 20 professionals;

[77] NVivo is a retrieve, code, and theory building tool, that helps researchers to replicate all of the abilities of the 'paper and pen' system into the software (Jones, 2007).

[78] Selection criteria used for interview survey is explained in detail under section 3.2.7 of this study i.e., area of operation of experts and number of years of specific experience.

six from the client's representatives, six from the consultants' & contractors' representatives, five from e-tendering practitioners, and three from pilot organizations selected for EP implementation. However, a formal interview was conducted with 17 key professionals[79] (7 from ERA's procurement experts & professionals, 5 from contractors', and consultants' representatives, 2 from e-tendering practitioners, and 3 (MiNT, MoFEC, PPAA) from pilot organizations selected for EP implementation).

As per the current construction tendering practice, e-tendering is not yet practiced in Ethiopia for public procurement. Due to this, finding e-tendering practitioners was not an easy job for the researcher, however, after a lot of trials some United Nations (UN) companies operating in Ethiopia were approached for a brief interview to share their experience regarding e-tendering implementation for construction projects. However, due to the current pandemic (COVID-19), almost all employees of the said organizations were working from their homes, and conducting a face-to-face interview was not possible at all.

Table 4. 4 Background of interview participants

Educational background			
Highest level of education;	**Frequency**	**Percent (%)**	**Cumulative Percent (%)**
Bachelor Degree	10	58.8	58.8
Master's Degree & above	7	41.2	100.0
Total	**17**	**100.0**	
Specific experience			
Years of experience;	**Frequency**	**Percent (%)**	**Cumulative Percent (%)**
From 3 - 5	1	5.9	5.9
From 5 - 7	4	23.5	29.4

[79] The number of interviews conducted (17) were less that the initially planned number (20). This was mainly due to the fact that accessing e-tendering practitioners was difficult due to the pandemic i.e., COVID. Thus, only two practitioners were interviewed.

From 7 - 10	5	29.4	58.8
From 10 - 15	4	23.5	82.3
Above 15	3	17.7	100.0
Total	**17**	**100.0**	

Hence, an interview with only two responsive respondents from the World Food Programme (WFP) and United Nations Development Programme (UNDP) of the UN, Ethiopia office was conducted, one over a phone and the other was through e-mail.

All the 17 interviews were conducted in Amharic, to eliminate the difficulty in communication & overcome language barriers (except one which was conducted in English), and lasted from 24 min to an hour. Six principal themes were identified across the interview: Current road construction tendering practice, challenges of paper-based tendering, potential advantages of e-tendering, CSFs & barriers to e-tendering implementation, and a general understanding/perception of e-tendering. Rigorous help was taken from NVivo for finding the results of the study. the queries like Word tree, text searching, word frequency, word cloud, and nodes modeling were applied to analyze the data.

Figure 4.3 below shows the word cloud which was generated by word frequency query in NVivo 10. Word frequency query was used to list the most frequently used concepts or words by the respondents during the interview. The cloud tag in the figure underneath displayed the 200 most frequently occurring words in varying font sizes, where frequently occurring words (like tendering, procurement, evaluation, implementation, economic, efficiency, corruption, transparency…) were in large fonts. This helps to capture the whole view of responses in a single sight. Accordingly, the word *'tendering'* had the highest frequency (about 3.42%) from the first two hundred words analyzed.

Figure 4. 3 Word Frequency Query: Word Cloud

Source: QSR NVivo.10 output

4.2.4 Ethical consideration

Ethical consideration surrounding the use of any survey instrument that involves the use of human subjects is an essential part of ensuring that the research is conducted in a way that protects these subjects from any harmful consequences. Thus, the survey participants understood the voluntary nature of the survey, and the cover page of each questionnaire survey contained information regarding privacy protections & informed consent. The survey did not ask for any data that could be used to identify the subject.

Confidentiality was also guaranteed to interview participants. Their organizations didn't have access to the data and all identifiable information was removed in the write-up of the thesis. Recordings and transcripts were kept on a password-protected computer. All interviewees were asked for their consent before recording the interview.

4.3 Current construction tendering practice assessment

As mentioned in section 2.1 of this study, a good procurement system or practice should be guided by the basic principles of public procurement and should be able to achieve the core objectives of the same. Accordingly, respondents (including clients, contractors, and consultants) were asked via a questionnaire & interview survey about the extent to which the current construction tendering practice promotes the basic objectives or core principles of public procurement that were identified through a literature review.

A five-point Likert scale was used for the questionnaire to measure their agreement regarding the significance of the current road tendering practice for promoting the core principles or objectives of public procurement. Where; 1= Strongly disagree, 2=Disagree, 3=Neither agree nor disagree, 4=Agree, and 5=Strongly Agree.

Relative Importance Index (RII) was calculated on respondents' perception regarding the significance of the current road construction tendering practice for promoting the core principles of public procurement. The calculation for RII[80] determines the relative ranking of factors and indicates how much the top-ranked is more important than the next and so on.

Appendix 5.1 shows the rank of each of the tabulated objectives or core principles of public procurement after a relative importance index has been carried out on the data. The overall RII analysis showed (transparency & openness) and (accountability of professionals for decisions made) were the two most significant principles/objectives of public procurement that the current road construction tendering practice promotes or encourages. (equality & fairness) was ranked as the third principle whereas (public confidence in the procurement procedures) comes in fourth.

[80] It is calculated as follows; RII=T/(H*N); Where T= The total of the rankings of all participants, N= No. of respondents, and H= The highest possible ranking.

Encourages transparency & openness: was ranked first, with an RII of .674. The concept of transparency is related to constructing the criteria used for making decisions in public procurement as transparent and as clear as possible ((Federal Negarit Gazeta), 2009). Concerning this, the term openness ensures that all qualified and interested parties are included in the procurement procedures.

The figure below (figure 4.4) is a screenshot from NVivo 10 showing the parent node 'current construction tendering practice' along with the references it's been coded at. The second section of the screenshot shows the different sources along with the number or frequency the child node 'encourages transparency & openness' has been coded at.

The current procurement practice of the Ethiopian road construction projects is believed to be as transparent and as open as possible by the majority of respondents. According to the matrix coding query from the interview (as shown in Figure 4.4 above), the first most frequent item coded in the sources was 'encourages transparency and openness' that was referenced 23 times at 12 different sources.

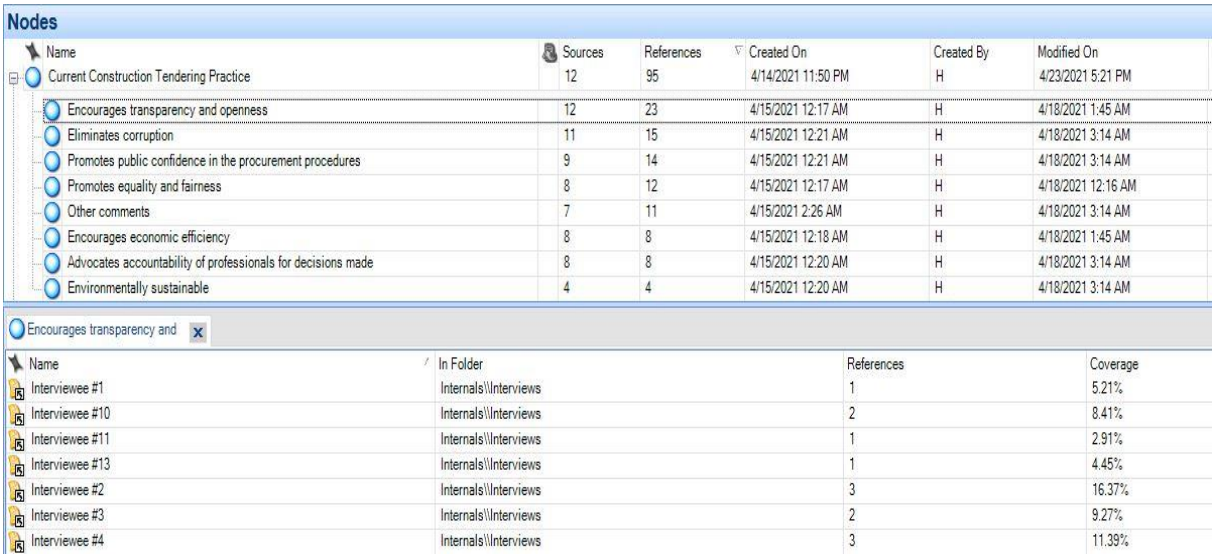


Figure 4. 4 Matrix Coding Query for 'current construction tendering practice'

The following are some parts of the verbatim transcripts taken from the interview;

" ERA notifies all its tender via a newspaper which has a sufficient media coverage like Ethiopian Herald (to make sure it reaches all interested bidders), using ERA's website than through PPA's website." Team Leader from Engineering Procurement Directorate, Client's representative.

"As per my experience, almost all tenders for federal road construction projects are open and any interested and eligible bidders can participate. The procedures to follow for each tendering stage is also clear and very transparent…." Contract, Legal, and Tendering Team Leader from Consultant's representative.

As one informant recounted;

"Openness is all about disclosing 'the rules of the game' or competing criteria to all parties and making it clear. So, all bidders should know the evaluating criteria to be used…even bidders can confidently predict their score before bidding using the stipulated evaluation criteria set under the respective bid document." Right of Way Management Directorate Director from Client's representative.

About promoting transparency, the Client uses a lot of initiatives during tender notification, like using its website in addition to the local newspaper to advertise tenders.

Advocates accountability of professionals for decisions made: was ranked second on the questionnaire survey with an RII of .644. Accountability is related to making public officials responsible for their decisions about the procurement process.

The summary of the query matrix (Figure 4.4 above) showed that 'advocates accountability of professionals for decisions made' comes in fifth place along with 'encourages economic efficiency'. These principles were referenced 8 times at 8 different sources or interview transcripts.

Some parts of verbatim transcripts taken from interview witnessing the accountability of professionals for decisions made is presented as follows;

"With this regard, every employee takes full responsibility for the decisions they make at every tendering stage, for example during tender evaluation evaluators confirm their decision by signing on every document they endorse & approve. If any deceitful or fraudulent practice is detected, ERA takes its measure, it may even go up to dismissal from the company…" Senior Project Engineer from Client's representative.

"It is obvious that employees take full responsibility for the actions and decisions they make, so yes it promotes accountability among professionals." Contract, Legal, and Tendering Team Leader from Consultant's representative.

4.3.1 Level of automation of the current road construction tendering practice

On the other hand, participants from the three categories were also asked about the nature or automation level of the current road construction tendering practice in monitoring and administering tenders. The table below (Table 4.6) shows the level of automation of the current road construction tendering as per the participants' experience.

Table 4. 5 Automation level of the current road construction tendering

Can you say the current road construction tendering is computerized or automated in terms of monitoring & administering the tendering process?		**Frequency**	**Percent (%)**
N/N [81]	Yes	12	14
	No	70	81.4
	Not sure	4	4.7
	Total	**86**	**100**

[81] To show that there is no missing value, all are valid responses. Where 'N' represents the total number of questionnaire respondents i.e., 86. Accordingly, 86 valid responses were given from the total 86 number of respondents.

Those who said the tendering system was automated, identified which process is automated and which is not. The table below summarizes the same.

Table 4. 6 Identification of each tendering process regarding its automation

Tender process	Character	Frequency	Percent (%)
Tender notification/advertisement	Automated	12	14
	Non-automated	-	-
Clarification to queries & addendum	Automated	1	1.2
	Non-automated	11	12.8
Tender submission	Automated	-	-
	Non-automated	12	14
Bid opening	Automated	-	-
	Non-automated	12	14
Bid evaluation	Automated	1	1.2
	Non-automated	11	12.8
Contract award & formation	Automated	2	2.3
	Non-automated	10	11.6
Documentation/archiving tender document	Automated	-	-
	Non-automated	12	14

4.4 Challenges of paper-based tendering

Several challenges of paper-based tendering were identified through extensive literature reviews as clearly shown under section 2.7 of this research. Similarly, the respondents to the questionnaire were asked to rank the identified challenges of paper-based tendering practice on a scale of 1 (Strongly disagree) to 5 (strongly agree). Similarly, RII was used to rank these challenges using the above formula. Appendix 5.2 shows the basic challenges of paper-based road construction tendering practice as per the participants' perception and experience.

(Time-consuming & slow process due to manual procedures) and (demands a huge storage space & difficult documentation) were considered to be the most challenging aspects of the current paper-based construction tendering practice as per the above overall RII analysis of the questionnaire survey. Some works of literature, (Elias *et al.*, 2005; Patil *et al.*, 2016; Ren and Kamarudin, 2016; Tindsley and Stephenson, 2008), regarding the application of e-tendering in the construction industry, agree with these results, confirming that the paper-based construction tendering demands a huge storage space and it is time taking and slow process due to manual procedures.

(High procession cost) and (highly dependent on geographical location of bidders) were ranked equally by respondents as the third most occurring challenge of paper-based construction tendering practice in the road sector. Whereas, (highly prone to human errors) was ranked fifth. Due to the volumuos documents prepared during tendering, human error might occur during printing, copying, and posting tender documents and respective proposals as well. Previous researches regarding e-tendering implementation in construction assert that the conventional or paper-based tendering practice is costly and has restricted mobility (Amarapathy *et al.,* 2013; Elias *et al.,* 2005; Patil *et al.*, 2016).

The figure below is a screenshot from NVivo 10 showing the summary of the matrix codding for the node ‘challenges of paper-based road construction tendering’ along with the references it’s been coded at. Accordingly, (time-consuming & slow process) comes first with 22 references followed by (high processing cost) with 15 references at 10 different sources, and (difficult documentation and requires huge storage space) being on the third with 8 references at 6 different sources. The second section of the screenshot shows the texts which they have been referenced at.

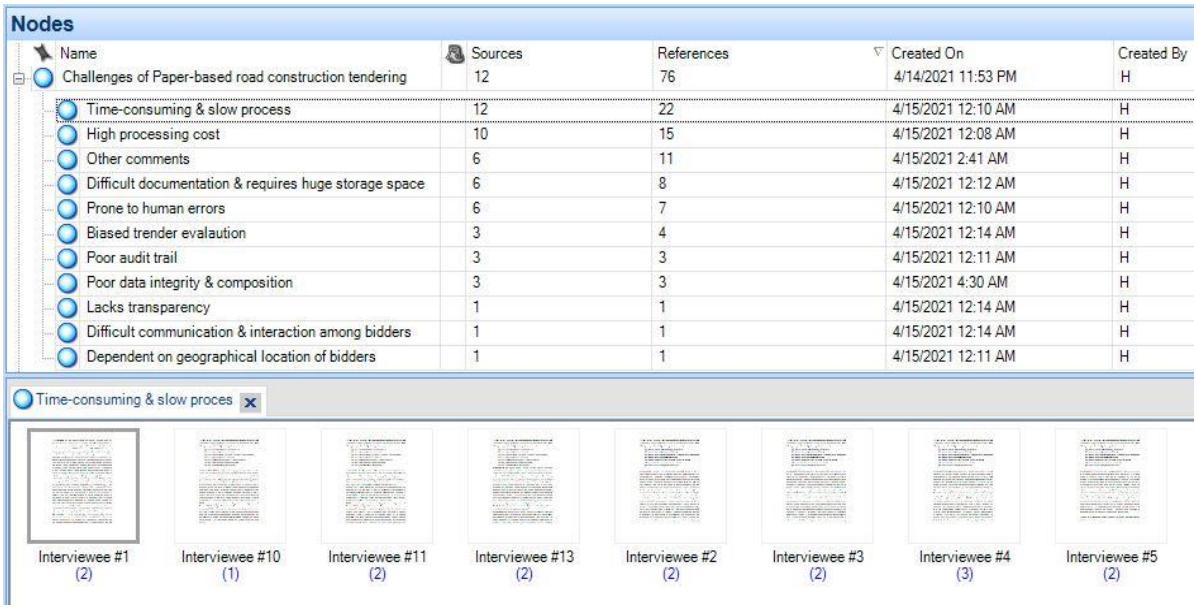


Figure 4. 5 Matrix Coding Query for 'challenges of paper-based road construction tendering'

Time-consuming & slow process: was ranked first with an RII of .888 in the questionnaire survey. It was referenced at 12 different sources 22 times during the interview. The following word tree (figure 4.6) is taken from NVivo to show the response of participants about the time-consuming nature of the paper-based tendering;

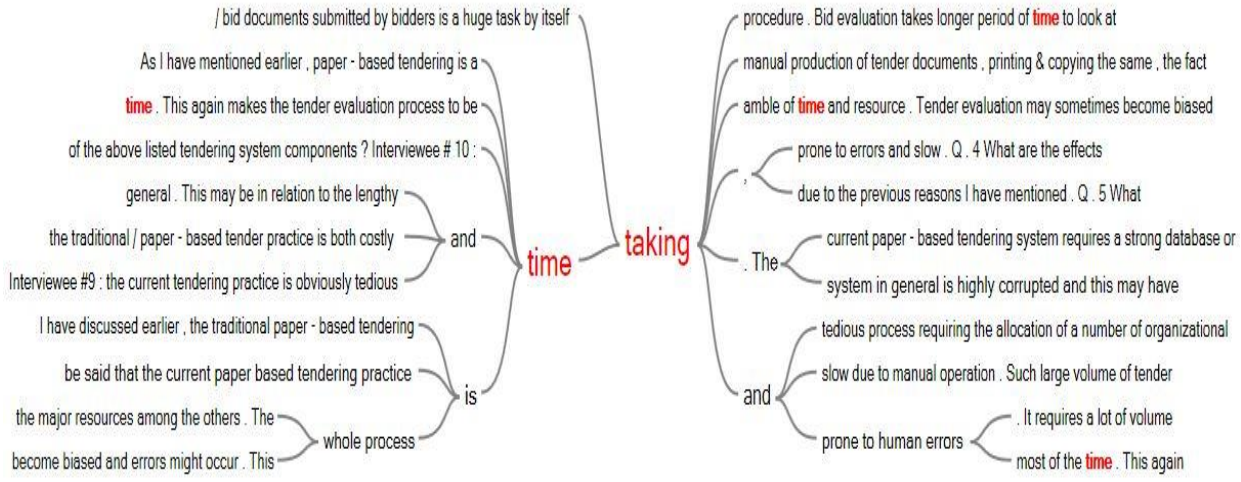


Figure 4. 6 Text search: Word Tree for 'Time-taking'

Demands a huge storage space & difficult documentation: was ranked second, during the questionnaire survey, with an RII of .871. This child node, during the interview analysis, came in third as per the matrix coding of the parent node i.e., challenges of paper-based road construction tendering. Accordingly, due to the tones of papers to prepare and submit at different points in time, storage space is becoming an issue and it's creating an administrative burden.

As per the interview, ERA faces a problem regarding record keeping of all the tender documents submitted and needs a huge storage space. A lot of tenders, on average 250 tenders are floated annually, and each tender document (including original & number of copies, on average 4 copies per tender per bidder) submitted needs to be stored and kept properly. Due to this, Proper management and file handling are really difficult. Some verbatim of the interview transcript is presented as follows;

"Archiving and document retaining are difficult to manage and consume a lot of space, as you can see here..." Team Leader from Engineering Procurement Directorate from ERA, Client's representative.

As one informant put it succinctly;

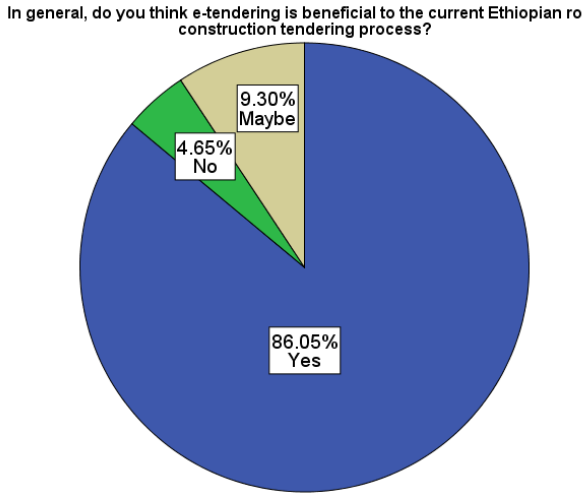
"The current paper-based tendering system requires a strong database or documentation practice and of course requires a large storage space." Contract, Legal, and Tendering Team Leader from Transport Construction Design and Supervision sector, Consultant's representative.

High processing cost: this came in second and third place with 15 references and an RII value of .830 during an interview and questionnaire survey respectively. Several kinds of research agree with this result and assert a paper-based tendering has high processing cost like cost about printing cost or paper cost, copying & postage, associated staff time, and related overhead costs (Amarapathy *et al.*, 2013; Asplund *et al.*, no date; Costa *et al.*, 2013; Gürbilek, 2013; Lavelle and

Bardon, 2009; Tindsley and Stephenson, 2008; RICS, 2010; Patil *et al.*, 2016). However, one informant during the interview noted that the cost related to paper and printing is not high as compared to the project cost.

4.5 Advantages of e-tendering

Respondents were asked about their perception regarding the possible advantages or values that could be obtained from e-tendering implementation via an interview & questionnaire survey. A formal interview was also conducted with e-tendering practitioners to assess the benefits/advantages gained through the same. The questionnaire survey regarding the benefit of e-tendering, as per the overall analysis of the questionnaire, is presented in the pie chart below.



The majority of the respondents (86.05%) or 74 of them thought that e-tendering is beneficial to the current road construction tendering practice. Whereas 4 or (4.65%) of the respondents believe it is not and the remaining 8 (9.3%) doubt the benefits gained. No valid response was obtained for justifying their reasons for saying e-tendering is not beneficial.

Figure 4. 7 Benefit of e-tendering

Before interviewing respondents about the potential advantages of e-tendering, their general understanding of the concept was assessed. Figure 4.8 below shows the word tree which was generated by a text search query for the word “e-tendering” in the ‘e-tendering understanding’ theme or node created. When respondents were asked their understanding of e-tendering, they replied with various comments.

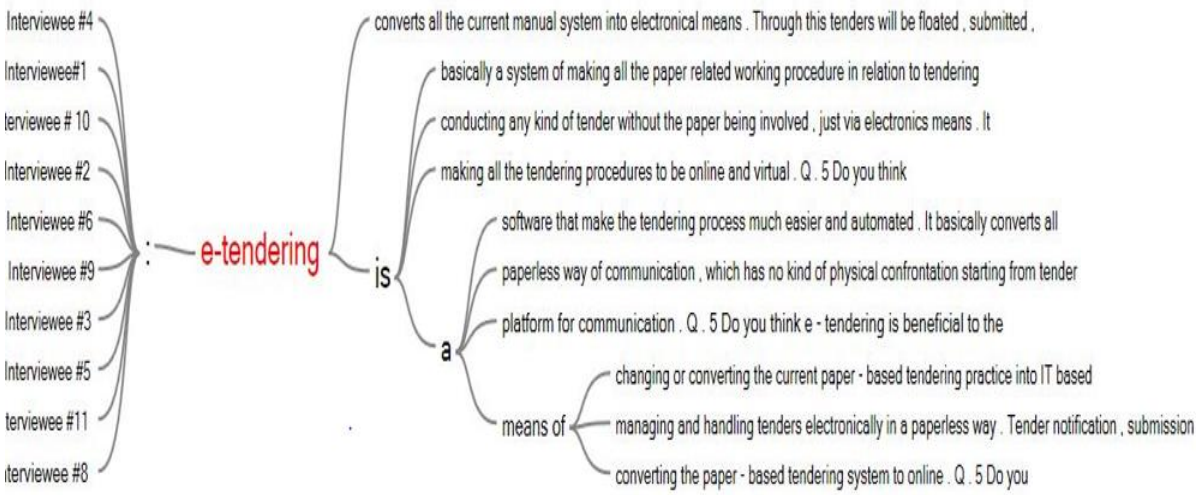


Figure 4. 8 Text Search Query: Word Tree for ‘e-tendering’

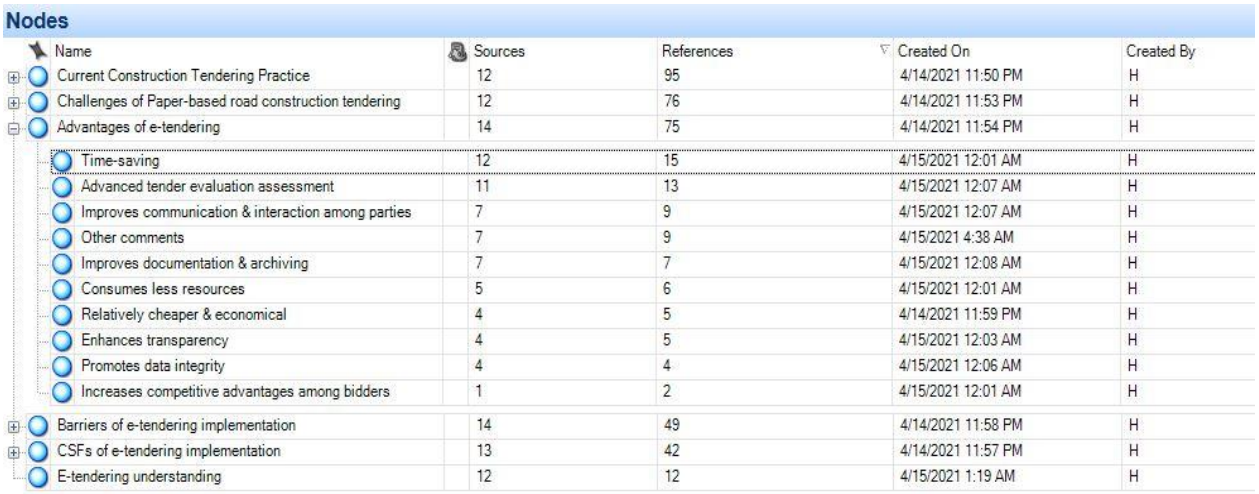
The questionnaire listed the possible advantages of e-tendering, gleaned from various publications as clearly depicted under section 2.8 of this document. The listed advantages identified via a literature review are in a close parallel to the list used in the questionnaire survey. Participants were asked to rank the identified advantages and values of e-tendering (as per their perception and understanding) on a scale of 1(Strongly disagree) to 5 (strongly agree).

Accordingly, Appendix 5.3 shows the rank of the values/advantages of e-tendering adaption as per the respondents' perception and understanding of the concept. The result from the questionnaire revealed that (improves documentation & archiving) and (time-saving) is considered to be the most advantages associated with e-tendering in the road construction sector. (More sustainable tender process) and (Consumes less resource) were ranked as the third & fourth most important advantages that e-tendering could bring in the road construction tendering respectively. Similarly, a study affirmed that as companies and individuals become more aware and are under more pressure to act in an environmentally friendly manner, sustainability was being an issue and it was ranked as the third most important advantage to gain through e-tendering (Lavelle and Bardon, 2009). The fact that e-tendering decreases the production of multiple copies of paper-based information, can lead to a less environmentally demanding and more sustainable tender process i.e., making the process more environmentally friendly (Patil *et al.*, 2016; RICS, 2010).

The overall RII analysis asserts that (improving communication & interaction among parties), (promoting data integration & fighting corruption), and (increasing competitive advantages among bidders) were the least perceived advantages to gain as compared with the other discussed values of e-tendering. However, this contradicts the findings of research conducted in Northern Ireland's construction industry by Eadie *et al.*, (2007), whereby *improving communication* was ranked first as the benefit or advantages to gain from e-tendering. The findings of Eadie *et al.* (2010), that was conducted to identify e-

procurement barriers and drivers in the UK construction organizations confirmed gaining competitive advantage was one of the verified drivers to e-tendering.

All interview participants felt that e-tendering would add value to the current construction paper-based tendering practice. The screenshot below is from NVivo 10's result preview showing the summary of the matrix coding for the node 'advantages of e-tendering' along with the references it's been coded at.



Nodes

Name	Sources	References	Created On	Created By
Current Construction Tendering Practice	12	95	4/14/2021 11:50 PM	H
Challenges of Paper-based road construction tendering	12	76	4/14/2021 11:53 PM	H
Advantages of e-tendering	14	75	4/14/2021 11:54 PM	H
Time-saving	12	15	4/15/2021 12:01 AM	H
Advanced tender evaluation assessment	11	13	4/15/2021 12:07 AM	H
Improves communication & interaction among parties	7	9	4/15/2021 12:07 AM	H
Other comments	7	9	4/15/2021 4:38 AM	H
Improves documentation & archiving	7	7	4/15/2021 12:08 AM	H
Consumes less resources	5	6	4/15/2021 12:01 AM	H
Relatively cheaper & economical	4	5	4/14/2021 11:59 PM	H
Enhances transparency	4	5	4/15/2021 12:03 AM	H
Promotes data integrity	4	4	4/15/2021 12:06 AM	H
Increases competitive advantages among bidders	1	2	4/15/2021 12:01 AM	H
Barriers of e-tendering implementation	14	49	4/14/2021 11:58 PM	H
CSFs of e-tendering implementation	13	42	4/14/2021 11:57 PM	H
E-tendering understanding	12	12	4/15/2021 1:19 AM	H

Figure 4. 9 Matrix Coding Query for 'advantages of e-tendering'

Accordingly, (time-saving) was the most coded advantage with 15 references followed by (advanced tender evaluation assessment) with 13 references at 11 different sources, and (improves communication & interaction among parties) being on the third with 9 references at 7 different sources. (Improves documentation and archiving) comes in fourth place based on the references it's been coded at.

Improved documentation & archiving: was ranked first (during the questionnaire survey) with an RII of .930 among the above listed possible advantages of e-tendering. Similarly, Contractors' representatives ranked this factor first, whereas Consultants' and Clients' representatives ranked it second. The construction tendering process requires the production of various documents which makes the process to be paper-intensive.

During tendering, it is important to keep all related documents and this requires large storage space.

This item was referenced 7 times at 7 different sources during the interview. e-tendering practitioners during the interview also mentioned that e-tendering makes archiving and documenting bid documents much easier. This way the audit trail process was also facilitated. This was emphasized by one informant from the e-tendering practitioners' group;

"Since documents are stored online, no physical storage space is needed. This makes document archiving much easier." Supply Chain Procurement Officer from WFP of the UN Ethiopia office, e-tendering practitioners' representative.

Some verbatim transcripts of interviewees regarding the possible advantages of e-tendering (as per their perception) towards documentation are presented as follows;

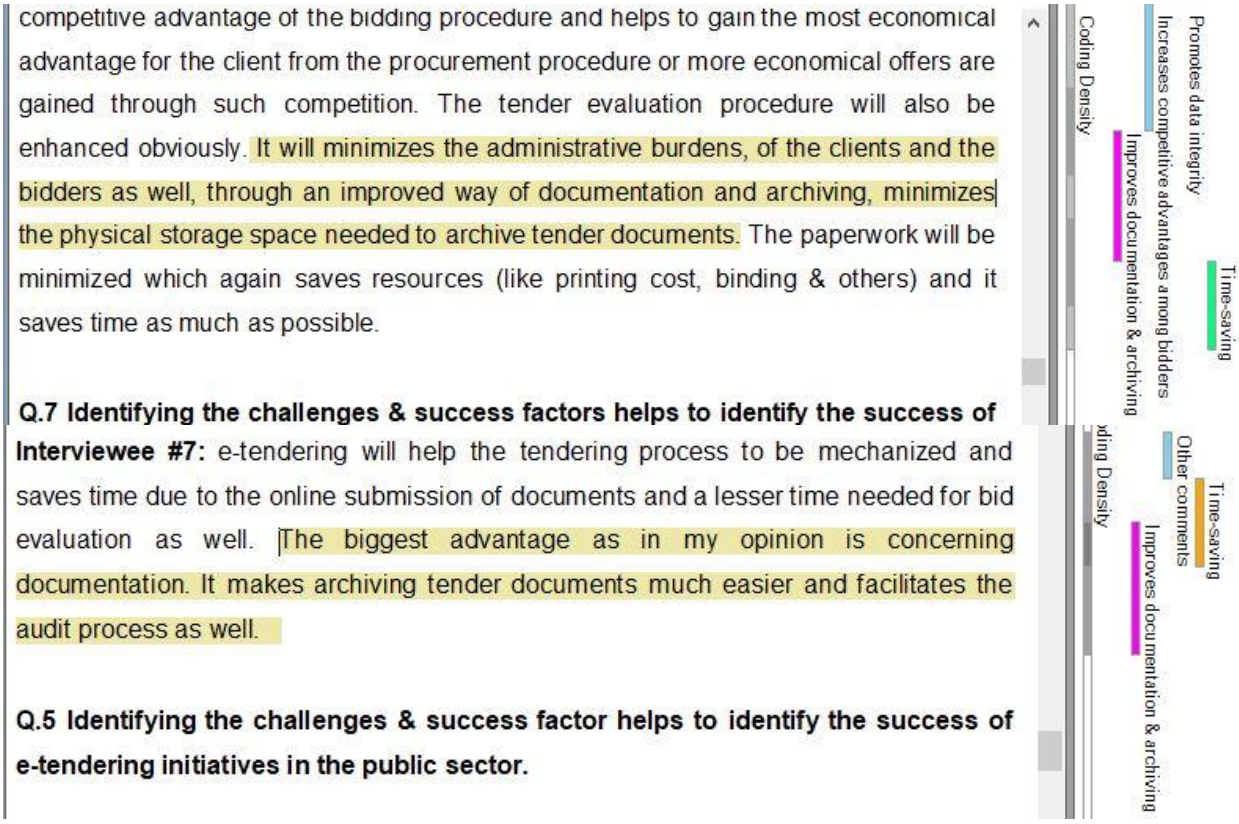


Figure 4. 10 Sample interview transcript for ‘improved documentation & archiving’ along with a coding stripe

Sample transcript was taken from Team Leader at ERA’s Engineering Procurement Directorate Director, Client’s representative, and Senior Contract Administrator, Contractor’s representative. Similarly, saving in storage space was also ranked first among other factors which influenced Malaysian construction companies’ willingness to participate in e-tendering (Ren and Kamarudin, 2016).

Time-saving: was ranked second with an RII of .911. Lavelle and Bardon (2009) agreed with these results, confirming that ‘reduced time’ to be the first ranked advantage to gain from e-tendering in the construction industry. The finding is also consistent with a study conducted by Nawi *et al.* (2016), asserting that time saving, along with others, is one of the basic advantages e-tendering has brought to the government. Tindsley and Stephenson (2008) were also in agreement with the efficiency of the e-tendering process in the UK construction industry to the overall efficiencies of the system, which includes cost, time, and other resource savings. Due to faster communication among bidders and the principal and due to reduced tender life cycle, e-tendering is agreed to save time to a great extent (Nesan Lenin, 2011; Eadie et al., 2007; Ezanee *et al.*, 2005; Gürbilek, 2013; Minahan and Degan; Patil *et al.*, 2016; Tindsley and Stephenson, 2008).

This can also be cross-checked by some verbatim transcripts taken from interviewees;
“: e-tendering will help the tendering process to be mechanized and saves time due to the online submission of documents and a lesser time needed for bid evaluation as well.” Design Directorate Director from ERA, Client’s representative.
“…among some of the possible advantages of e-tendering, procurement cycles or the time needed to procure goods, works or services will diminish to a great extent, and with this regard, procurement decisions will be made faster. Excessive delay in tender evaluation & subsequent phases will no longer be an issue.” Senior Claims Expert at Transport Construction Design & Supervision Sector, Consultant’s representative.

This was emphasized by another informant from the e-tendering practitioners' representative:

"….it saves time in a way that large volumes of tender documents are produced online in a short time" Supply Chain Procurement Officer at the WFP Ethiopia office of the UN, e-tendering practitioners' representative.

Another informant also shared his experience as follows:

"…it saves time & decreases the duration for the whole process. The minimum average duration for devising a procurement plan (including need assessment) was 15-20 days. But now, the system consolidates the whole process & minimizes the duration to 2-3 days and a maximum of 3-5 days to communicate different department which has not submitted their need yet. This makes the communication channel to be easier & faster." Procurement & Property Management Directorate Director at MiNT, from EP pilot procuring entity.

Making the bidding procedure more transparent to the participating entities and easing the communication among the client and bidders were other benefits mentioned by e-tendering practitioners at the UNDP and WFP during the interview.

Regardless of the perspective, it's taken from, a study conducted by Tindsley and Stephenson (2008) contradicts these findings and claims EP to be a time-consuming process as seen from sub-contractors' point of view. The journal also asserts that unless the whole supply chain system is moved to a completely paperless system, tendering costs are just transferred to the Contractors and subcontractors, and they also claimed it is going to be a time-taking process. With this regard, the researcher believed that due to the small volume of work sub-contractors would engage in, implementing e-tendering may not be beneficial from their point of view.

The node model below shows pictorial representations of the perceived advantages or values of e-tendering implementation in the study area. NVivo generated this node model (figure 4.11) automatically by linking the advantages mentioned and discussed during the interview.

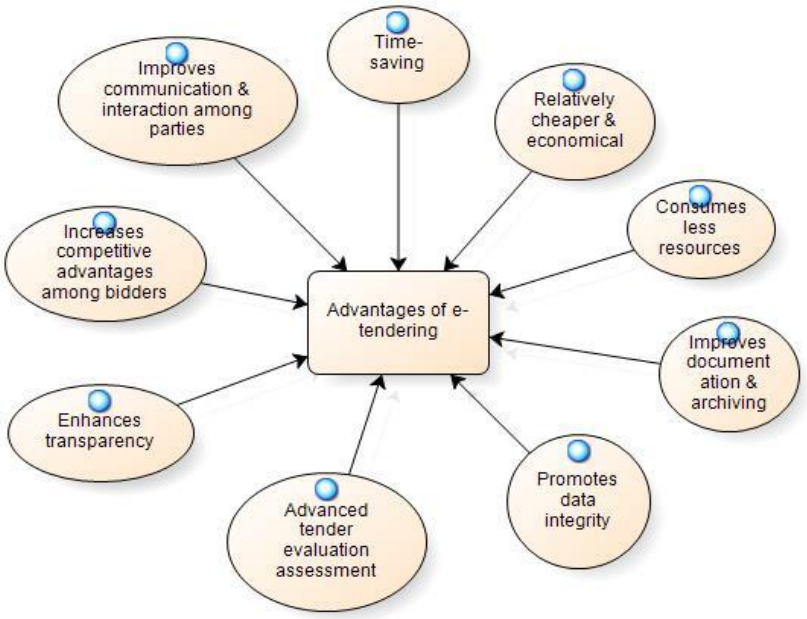


Figure 4. 11 Advantage Model: Relationship among Nodes

4.6 CSFs for e-tendering implementation

A literature review was conducted to identify the CSFs for e-tendering implementation, as a result of which twenty-one (21) factors[82] were identified. The study asked respondents (including clients, contractors, and consultants) to rank the factors based on their opinion on the relative contribution of the factors to the successful implementation of e-tendering. Based on the result of the survey, the top ten (10) contributing factors out of the total twenty-one (21) CSFs available are indicated under *Appendix 5.4*, of which the top three factors are discussed afterward.

Consistency of internet connection was ranked first, with an RII value of .967. As per the questionnaire survey's findings, it was the most important perceived CSF to consider while implementing or adopting e-tendering in the Ethiopian constriction industry. Research conducted by Tebeka and Yessuf (2019), asserted that consistency

[82] These 21 factors under the CSF construct were extracted from existing works of literature i.e., Tebeka and Yessuf (2019) during the study conducted on the challenges and CSFs of EP adoption in Ethiopia. The same is presented under section 2.10 of this study.

of internet connection is a crucial component for the full implementation of EP system for public procurement. The study also mentioned the concerns of many interviewees from the pilot organizations in Ethiopia selected for e-procurement implementation regarding the impact of the power outage and the slow internet connection system of the country. The slow internet connection does contribute a lot to the bad performance of the system and it can even be a hindering factor in the future implementation process too (Tebeka and Yessuf, 2019). Nesan Lenin (2011) also claimed the reliability of internet-based communication to be one of the CSFs for successful implementation as it is one of the causes and concerns of bidders.

A result from the interview also showed the strength of internet connection along with the consistency of the country's power supply is one of the basic factors to consider during implementation. As one informant noted;

"The strength and consistency of power supply and internet connection is very crucial for the successful implementation of e-tendering." Deputy General Manager at Crafts Construction plc, Contractors' representative.

"As a country, I think, the power supply, strength, and consistency of the internet connection is another indicator for successful implementation of the system." Senior Project Engineer at ERA, Client's representative.

For a better understanding of the importance of internet connection, another text search query was run with the word "internet". Figure 4.12 shows the result of this query. In this word tree, respondents explained how the internet connection is critical for the success of e-tendering implementation in the study area or at a national level. Respondents from e-tendering practitioners witnessed the importance of the internet connection for the success of e-tendering implementation.

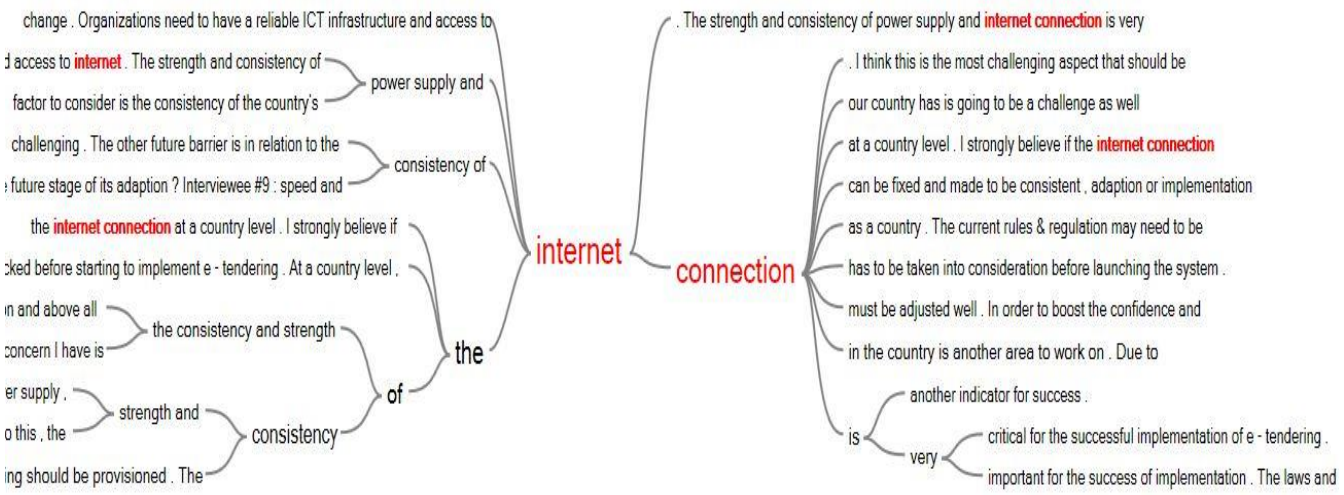


Figure 4. 12 Text Search Query: Word tree for 'Internet'

The following quote illustrates their experience;

"It is pretty obvious that Ethiopia's current access to the internet is very poor and unreliable. Bidders cannot rely on the system if the current networking is not fixed. This again costs the purchaser, since a competitive bid may not be obtained." Supply Chain Procurement Officer at WFP Ethiopia office, e-tendering practitioners' representative.

Another informant from the e-tendering practitioners also noted;

"The network strength should be considered as well before implementing e-tendering" Senior Procurement Officer at UNDP Ethiopia office, e-tendering practitioners' representative.

Availability of reliable ICT infrastructure within an organization (RII=0.949): is the reliability of information technology and infrastructure-related factor, which ranked second according to the questionnaire survey result. According to respondents' responses during an interview, the lack of a reliable ICT infrastructure in an organization can be a challenging factor while implementing e-tendering.

As informants recounted;

" …organizations need to have a reliable ICT infrastructure and access to the internet."

Deputy General Manager at Crafts Construction plc, Contractors' representative.
"… well-developed ICT infrastructure and facilities for organizations implementing e-tendering are very important." Senior Procurement Officer, UNDP Ethiopia office, from e-tendering practitioners' representative.

Provision of material was mentioned as one of the five categories described by Boonstra (2013) where top management support is provided for the success of any information system project success. Thus, ICT infrastructure within an organization falls under this category. Naveed Sarwar, 2017 (cited in Tebeka and Yessuf (2019)) found the availability of ICT infrastructures to be one of the top three CSFs for EP adoption in Pakistan public organizations. Nesan Lenin (2011) agrees with the importance of a structured business process and/or ICT structure/system for the successful implementation of the system.

Staff training (RII=0.947): was the third-rated CSF. The finding is consistent with research conducted by Islam and Zhu (2012) whereby adequate training of employees to enable them to take advantage of the new system is one of the three CSFs identified in the study. similarly, Becker (2018) claims awareness-raising actions and extensive training programs to be the basic success factors for Estonia's[83] e-government system.

As some informants noted;
"To boost the confidence and efficiency of users, a capacity-building program needs to be provided." Senior Contract Administrator, Contractors' representative.
"…continuous training must be given to users (both for the suppliers and employers)." Senior Procurement Officer from UNDP, e-tendering practitioners' representative.
In relation to making staffs aware of the system, another informant from e-tendering practitioners iterated:

[83] Estonia is a country frequently referred to as a best practice in EU, as per Becker (2018).

"…. a clear operation manual or kind of guideline has to be made available for users at any level." Supply Chain Procurement Officer, WFP of the UN Ethiopia office, e-tendering practitioners.

The node model below shows pictorial representations of the CSFs affecting the success of e-tendering implementation. NVivo generated this node model automatically by identifying various nodes (relating to CSFs affecting e-tendering implementation) in the interview responses.

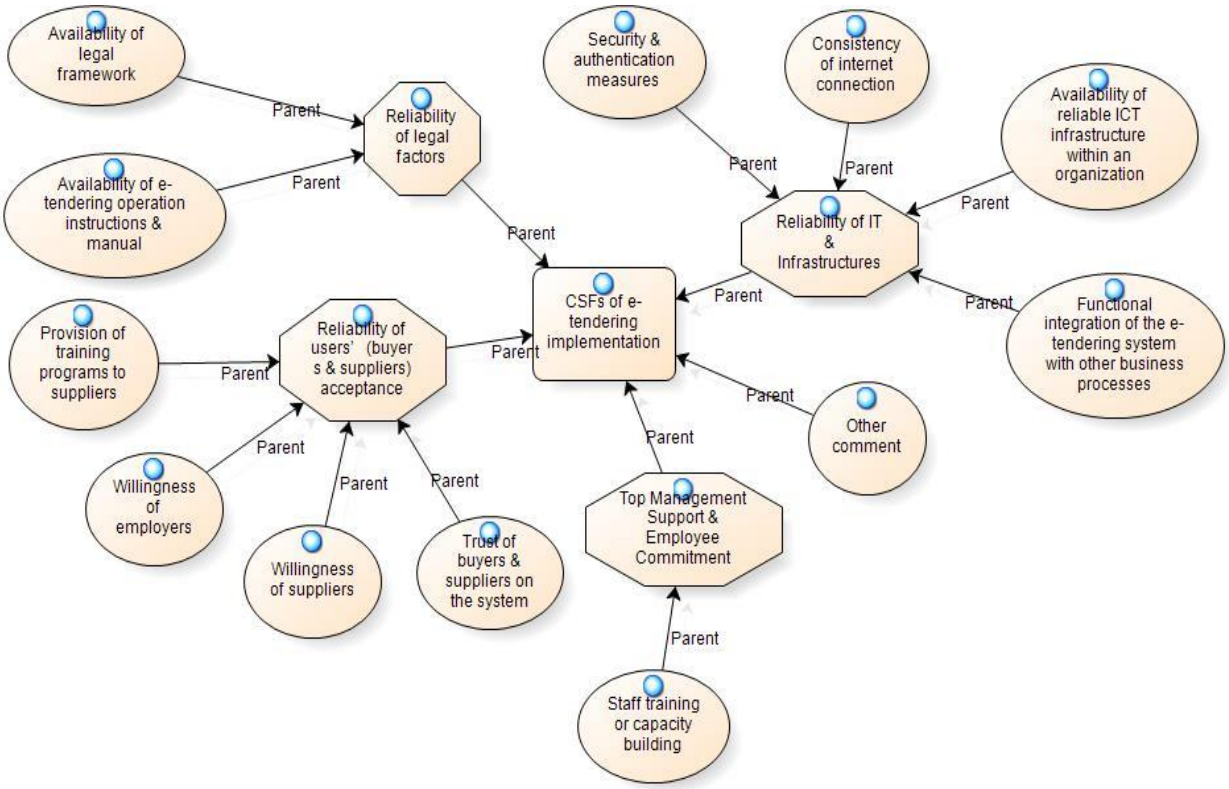


Figure 4. 13 CSFs Node Model: Relationship among Nodes

4.7 Barriers/challenges of e-tendering implementation

Similarly, a literature review was conducted to identify the barriers/challenges of e-tendering implementation in construction tendering, as a result of which sixteen[84] (16) factors under four basic categories or groups were identified as barriers & challenges. Respondents (including clients, consultants, and contractors) were asked to rank the factors based on their opinion and perception of the concept. Based on the result of the survey, the top ten (10) barriers/challenges are indicated under Appendix 5.5. Thus, the ranking of factors is determined according to their relative importance to the proper adaption of e-tendering in the study area.

Accordingly, the most challenging factor or barrier of e-tendering implementation as per respondents' perception (lack of system integration) with a RII=.895 and followed by (lack of training/capacity building programs) with RII= .879, while (lack of common technology standard) comes to a third-place with RII=.865. The overall RII analysis shows the (lack of an effective legal & regulation system) under the environmental barrier group is the fourth rated barrier among participants.

Lack of system integration was ranked first among respondents. Interviewees mentioned that the system needs to be checked before launch. The finding was consistent with a study conducted by Nesan Lenin (2011), whereby a lack of integration of new tools with the already existing process is one of the concerns and uncertainties why contractors became too reluctant to experience e-tendering. such lack of system integration standardization and compatibility issues are mentioned as a challenge to EP

[84] The sixteen (16) factors under the barriers construct were extracted from the number of literatures (Costa *et al.*, 2013; Davila *et al.*, 2003; Eadie *et al.*, 2007; Rankin *et al.*, 2006; Stewart *et al.*, 2003; Zou and Seo, 2005). The four categories were as per the classification of barriers of EP implementation in the CI of developing countries used by (Tran *et al.* (2011). The same is covered under section 2.9 of this paper.

implementation in the CI by several authors; (Costa *et al.*, 2013; Davila *et al.*, 2003; Rankin *et al.*, 2006; Zou and Seo, 2005).

An informant emphasized that system integration became an issue during the procurement of goods and consultancy services using the EP system.

"What happened was that the system kept failing while suppliers tried to upload & send their documents online. They were complaining that they could not upload their document (due to different reasons like capacity of documents, lack of system integration, etc.) and due to this they missed the did closing date & time and the company was forced to re-bid." Procurement and Property Management Directorate Director from MiNT, pilot EP procuring entity's representative.

Challenge in shifting the mindset of users: Figure 4.14 below showed the screenshot taken from NVivo 10, to show the notation of informants' perception about the possible key factors that may hinder the successful implementation of e-tendering in the study area. Accordingly, the most frequently referenced barrier by participants was the challenge in shifting the mindset of users. It was clear from the interview that changing or shifting the mindset of users is going to be an issue. As one informant related;

"As per my opinion, awareness creation is going to be the hardest challenge of all. Since all governmental institutions, suppliers, financers & all are going to be part of the system, changing the mindset of all these and bringing them together takes a lot of time and energy. Training them is going to be lengthy and this is also another challenge to consider." Team Leader from Engineering Procurement Directorate, Client's representative.

Nodes

Name	Sources	References	Created On
Barriers of e-tendering implementation	14	49	4/14/2021 11:58 PM
Organizational barriers	10	17	4/15/2021 12:39 AM
Challenge in shifting the mindset of users	10	10	4/15/2021 12:39 AM
Limited resources	5	6	4/15/2021 12:39 AM
Company access to the internet	1	1	4/15/2021 12:39 AM
Other comments	7	11	4/15/2021 2:54 AM
Technological Barriers	8	9	4/15/2021 12:36 AM
Security of transaction & uncertainty	5	5	4/15/2021 12:36 AM
Lack of system integration	3	3	4/15/2021 12:36 AM
Lack of common technology standard	1	1	4/15/2021 12:37 AM
Management Barriers	4	6	4/15/2021 12:37 AM
Lack of training	3	3	4/15/2021 12:38 AM
Lack of skilled personnel & technical expertise	2	2	4/15/2021 12:37 AM
Resistance to change (at managerial level)	1	1	4/15/2021 12:38 AM
Environmental barriers	6	6	4/15/2021 12:40 AM
Inadequate technological infrastructure	4	4	4/15/2021 12:40 AM
Lack of an effective legal & regulation system	1	1	4/15/2021 12:41 AM
Lack of suppliers' readiness	1	1	4/15/2021 12:41 AM

Figure 4. 14 Matrix Coding Query for 'Barriers of e-tendering implementation'

For better clarification, another text search query was run with the word 'mindset'. Figure 4.15 showed the result of such a query. In this word tree, respondents explained that changing the mindset of users is probably going to be the most challenging task during the future implementation of e-tendering in the study area.

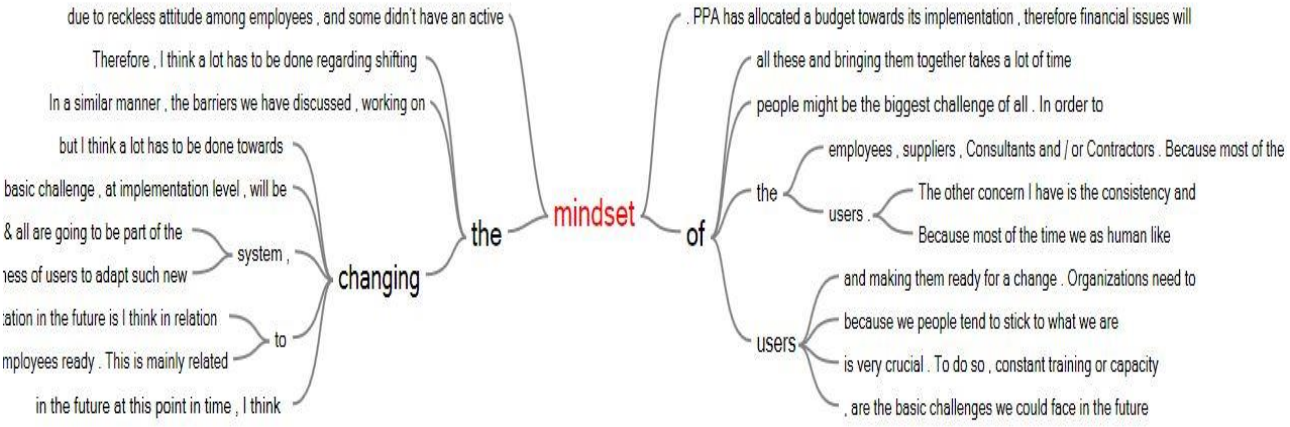


Figure 4. 15 Text Search Query: Word Tree for 'mindset'

Considering the “newness” of e-tendering practice among users, it turns out some users may be refrained from implementing it. With this regard, practitioners of the system put it as follows;

“I think the biggest challenge while implementing e-tendering is raising the awareness of users, and suppliers as well. Since suppliers are not familiar with the system, they feel insecure and think that confidentiality issue is compromised.” Supply Chain Procurement Officer from WFP Ethiopia office, e-tendering practitioner.

As one informant cautioned;
“The other biggest challenge is the knowledge gap among users, because workers who used to work manually using the paper and pen system may not be flexible enough to entertain such change. So, awareness creation is very important for the successful implementation.” Right of Way Management Directorate Director, Client’s representative.

Amarapathy *et al.* (2013) approved that resistance to change was one of the top listed barriers of e-tendering implementation in the construction industry for Sri Lanka. The findings of the research were also consistent with a study conducted by (Costa *et al.*, 2013; Davila *et al.*, 2003).

Lack of training/ capacity-building programs (RII=0.879): was ranked second during the questionnaire survey. As one informant advised;

“….users don’t know how to use the portal, so training them is a must before trying to implement the system.” Senior Procurement Officer from UNDP of the UN, Ethiopia office, e-tendering practitioners’ representative.

Due to a lack of inadequate insight into how e-tendering works, users usually hesitate to use e-tendering. Another informant reiterated;

“In a similar manner, the barriers we have discussed, working on the mindset of users is very crucial. To do so, constant training or capacity building program must be given to users.” Team Leader Engineering Procurement Directorate, Client’s representative.

The node model below shows pictorial representations of the perceived barriers or challenges affecting the success of e-tendering implementation. NVivo generated this node model automatically by identifying various nodes (related to barriers affecting e-tendering implementation) in the interview responses.

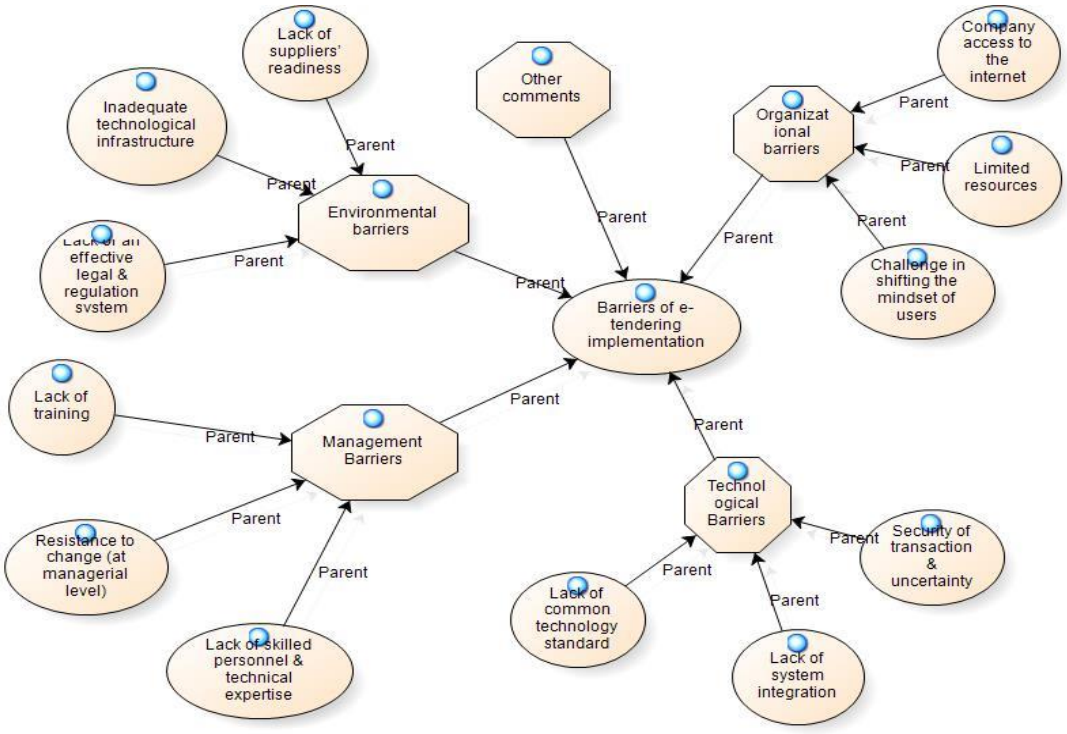


Figure 4. 16 Barriers Node Model: Relationship among nodes

4.8 Content validity: Face validity

Eventually, a pilot test was carried out with a participation of a suitable number of volunteers to get feedback on the questions’ content in the questionnaire for further amendments. Therefore, the instrument or the questionnaire’s clarity, completeness, and applicability were confirmed. Similarly, the interview questions were piloted with professionals working in road construction projects with tender preparation.

4.9 Criterion validity: Spearman's rho

To finish understanding all the variables, in addition to the above descriptive analysis, the correlation matrix should be analyzed. A correlation coefficient is used to analyze the relationship i.e. both the strength and direction of a relationship between two variables (Muijs, 2004). Values for Correlation coefficients vary between –1 and +1; –1 indicates a perfect negative relationship and +1 a perfect positive relationship and 0 means no relationship (Muijs, 2004). Accordingly, since all the variables i.e., 65 variables are ordinal, *Spearman's rho (Spearman rank correlation)* was used & it was computed using SPSS version 25.0. Table 4.7 shows the correlation matrix[85] for the first eight variables (CCTPA1 to CCTPA8) as an example.

From the correlation matrix output, for instance, it can be concluded that there was a significant positive[86] correlation between participants' ratings of CCTPA1 (encouraging transparency) and CCTPA2 (promoting fair competition & preventing discrimination), r_s[87] (84) =0.66, p[88] <0.001. A similar step can be followed to present the correlation between any of the two variables. All correlation values along the diagonal are equal to one (1) due to the perfect relation or correlation between two identical variables and the values above and below the diagonal are similar.

---

85 The output of SPSS about the correlation matrix for all the 65 variables can be provided on further request.

86 Positive relation between two variables indicates that both variables tend to rank similarly i.e., increasing the rank of one variable tends to be related to increasing the value of the other variable too, but the increase is not regular.

87 Correlation is presented as $r_s(n-2)$, where n refers the sample taken.

88 It refers to the significance level or P-value i.e., statistical significance measure of the relationship. Low value indicates a low probability of us finding a relationship between these two variables in our sample if there was none in the population. Significance level is given as 0.000. This does not mean that the significance level is exactly zero (no p-value will have 100 per cent certainty), but it does indicate a very small value, smaller than 0.001, and well below the 0.05 cut-off value (Muijs, 2004).

Table 4. 7 SPSS output for Spearman's rho of variables CCTPA1 to CCTPA8

Correlations

			CCTPA1	CCTPA2	CCTPA3	CCTPA4	CCTPA5	CCTPA6	CCTPA7	CCTPA8
Spearman's rho	CCTPA1	Correlation Coefficient	1.000	.658**	.543**	.633**	.630**	.630**	.550**	.767**
		Sig. (2-tailed)		.000	.000	.000	.000	.000	.000	.000
		N	86	86	86	86	86	86	86	86
	CCTPA2	Correlation Coefficient	.658**	1.000	.450**	.576**	.572**	.512**	.364**	.503**
		Sig. (2-tailed)	.000		.000	.000	.000	.000	.001	.000
		N	86	86	86	86	86	86	86	86
	CCTPA3	Correlation Coefficient	.543**	.450**	1.000	.320**	.565**	.453**	.561**	.472**
		Sig. (2-tailed)	.000	.000		.003	.000	.000	.000	.000
		N	86	86	86	86	86	86	86	86
	CCTPA4	Correlation Coefficient	.633**	.576**	.320**	1.000	.601**	.562**	.481**	.568**
		Sig. (2-tailed)	.000	.000	.003		.000	.000	.000	.000
		N	86	86	86	86	86	86	86	86
	CCTPA5	Correlation Coefficient	.630**	.572**	.565**	.601**	1.000	.623**	.634**	.556**
		Sig. (2-tailed)	.000	.000	.000	.000		.000	.000	.000
		N	86	86	86	86	86	86	86	86
	CCTPA6	Correlation Coefficient	.630**	.512**	.453**	.562**	.623**	1.000	.670**	.644**
		Sig. (2-tailed)	.000	.000	.000	.000	.000		.000	.000
		N	86	86	86	86	86	86	86	86
	CCTPA7	Correlation Coefficient	.550**	.364**	.561**	.481**	.634**	.670**	1.000	.578**
		Sig. (2-tailed)	.000	.001	.000	.000	.000	.000		.000
		N	86	86	86	86	86	86	86	86
	CCTPA8	Correlation Coefficient	.767**	.503**	.472**	.568**	.556**	.644**	.578**	1.000
		Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	
		N	86	86	86	86	86	86	86	86

4.10 Scale reliability: Cronbach's alpha

A reliability test is carried out 'to check the internal consistency[89] among items of one factor' (Nguyen *et al.*, 2019). For calculating the internal consistency of items on a scale a formula[90] developed by *Lee Cronbach (in 1951)* which is called *Cronbach's alpha or α* is used in this study. It's a scaling coefficient and predictor of test reliability for the questionnaire.

While it's good to know the above formula behind the concept, for this study SPSS 25.0 was used to compute the alpha for all of the factors and items listed in the questionnaire i.e., current practice and challenges of paper-based tendering, advantages of e-tendering, CSFs & barriers of adapting e-tendering.

Cronbach's alpha and Cronbach's alpha if item deleted was calculated. Although many states 0.7 to be the minimum value for Cronbach's alpha, a commonly accepted rule of thumb i.e., an alpha of 0.6 - 0.7 is also acceptable. With this, when deleting[91] one item, the new Cronbach's alpha must be smaller than the original value before this item is deleted.

The following table (see table 4.8) depicts a summary of Cronbach's alpha value for each scale used in the questionnaire and the item-deleted Cronbach's *α* of each item. Cronbach's alpha values for the current construction tendering practice, challenges of paper-based tendering, advantages of e-tendering, CSFs (inclusive of five sub-factors), and barriers (inclusive of four sub-factors) of e-tendering implementation are calculated at .899, .844, .804, (.841, .882, .732, .820, .674) and (.557, .799, .697, .794)

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89 Internal consistency is a concept related to the degree to which items on the instrument or test are consistent or measuring the same thing (Simelane-Mnisi and Andile, 2017). According to Kassem *et al.* (2020), the logic behind checking the reliability of a research instrument is to assess if identical results can be obtained if respondents used it twice.

90 The formula used to compute *Cronbach's alpha* as per Kassem *et al.*, (2020) is; ***α=NC/(V+(N-1)*C)*** Where; N=number of items, v=the average variance, and C=the average inter-item covariance.

91 An item needs to be deleted when its Cronbach's value falls below the minimum threshold, otherwise deleting an item is not a necessary. Its value ranges from 0 to 1, with values of .60 to .70 deemed the lower level of acceptability (J *et al.*, 2010; Shakya, 2015).

respectively and all the figures are much closer to and/or higher than the minimum acceptable threshold i.e., .6.

Cronbach's alpha .899 for current construction tendering practice, for example, means 89.9% of the variance in the score is reliable, i.e., only 10.1% is error variance. Therefore, it can be concluded that internal consistency among items of a factor is satisfied except item Bar 1 with Cronbach's alpha value a bit less than the minimum threshold, but with a much closer figure. This ensures the reliability of the instrument designed for the survey. It confirms that the tests were designed with high quality and the data received were reliable.

4.11 Factor analysis

Factor analysis (FA) is a statistical method used to determine the relationship between components of a dataset (Kapoor, 2020). It is an interdependence technique whose primary function, as quoted under J *et al.* (2010) is to define the underlying structure among the variables in the analysis.

Even though the questionnaire used in the study was the same for all respondents, it was not the same instrument for the researcher, since a separate FA has to be established for each instrument. Sixty-five (65) separate items were used in the questionnaire to measure the five constructs or dimensions i.e., 'current construction tendering practice' & 'challenges of the paper-based tendering', 'the potential advantages of e-tendering', 'CSFs & barriers of e-tendering implementation', a separate FA was done for the five dimensions to check if the initial group from other works of literature or the factors derived from existing questionnaires holds for the data set. Since data reduction was not the aim of this research, a separate FA can be considered for each construct. The researcher would also like to test the construct validity of a 65-item instrument that measures the above five constructs.

Table 4. 8 Reliability statistics

Source: Own survey, February 2021

No	Construct (latent variable) measurement scale	Code	Number of items	Valid number of cases	Item deleted	Cronbach's alpha (α)
1	Current construction tendering practice	CCTPA	8	86	None	0.899
2	Challenges of paper-based	CPBT	10	86	None	0.844*
3	Advantages of e-tendering	AET	10	74	None	0.804*
4	Top management support & employee commitment	CSF1	5	86	None	0.841*
5	Reliability of Information & Technology	CSF2	5	86	None	0.882*
6	Reliability of legal factors	CSF3	3	86	None	0.732
7	Reliability of users' (buyers & suppliers) acceptance	CSF4	4	86	None	0.820*
8	Reliability of monitoring & evaluation system	CSF5	4	86	None	0.632*
9	Technological barriers	Bar 1	4	86	None	0.550
10	Management barriers	Bar 2	4	86	None	0.799
11	Organizational barriers	Bar 3	4	86	None	0.670
12	Environmental barriers	Bar 4	4	86	None	0.794
	All construct measurement scale		**65**			

N.B: Items with '*' mark on their reliability value indicated that their original reliability value can be improved to some extent if an item is deleted for that perspective construct. Hence all values under table 4.8 are above the minimum threshold, no item was deleted at this level.

Accordingly, Exploratory Factor Analysis (EFA) has been applied to explore or determine the most effective factors/construct on e-tendering implementation and the group of measured variables based on the data, so that some meaningful pattern can be brought out of it.

Before starting the factor analysis, a reliability test and intercorrelation (criterion validity) were done. Where table 4.8 shows the value of the Cronbach's Alpha test for each item, which indicates an acceptable internal consistency of data and its validity for factor analysis. Similarly, an analysis of Spearman's correlations demonstrated low-to-high associations between almost all items, ranging from -.894 to .980. In summary, the magnitude of the correlations among the items was sufficient to warrant factor analysis i.e., at least two factors exist in EFA.

4.11.1 EFA for 'current road construction tendering practice'

To conduct an EFA, it started with the application of two methods; the Bartlett Sphericity test[92] and Kaiser-Meyer-Olkin (KMO)[93] measure to evaluate the factorability (Costa and Rui, 2019, Kim *et al.*, 2016). The KMO was used to measure the sampling adequacy & Bartlett's test of sphericity was used to test the null hypothesis that the variables in the population matrix were uncorrelated.

The KMO test for the 'current road construction tendering practice' had a value of .882, which is higher than the acceptable value of .5, and the value of Bartlett's test of sphericity is estimated at 363 and the p-value is .00, which is highly significant, this indicates that its probability is less than 0.05 which implies that the correlation matrix produced by this data is not an identity matrix and therefore is appropriate for factor

[92] Bartlett test is used to check if several samples have equal variances. It is used to test the hypothesis the correlation matrix is an identity matrix (a matrix in which all the diagonal elements are 1 and all off diagonal elements are 0). It is a statistical test for the overall significance of all correlations within a correlation matrix (J *et al.*, 2010).

[93] KMO measure tests the sampling adequacy for each variable in the model (Costa and Rui, 2019). KMO value less than 0.5 is unacceptable (Costa and Rui, 2019; Moh, 2013; Samuels, 2016).

analysis. The obtained findings from KMO and Bartlett's test of this construct confirm that EFA can be used for the data set of 86 respondents.

The analysis of principal components (factors) for the dimension 'current construction tendering practice' using a scree plot resulted in one factor that explained 59.16% of the total variance[94] with eigenvalues greater than 1 (4.73). Appendix 6.1 presents the result of the EFA analysis using the Principal Component Analysis extraction method for all communalities & total variance explained values.

4.11.2 EFA analysis for 'challenges of paper-based road construction tendering'

The KMO measure and Bartlett's test for the 'challenges of paper-based road construction tendering construct showed further FA was possible for this construct. The KMO measure was .815 much above the minimum .5 required for sampling adequacy, whereas the significance level resulting .000 of Bartlett's test of sphericity showed the 'challenges of paper-based road construction tendering' construct could be seen as a correlation matrix, indicating that further factor analysis would be possible. For this construct, using the Principal Component Analysis factor extraction method and examining total variance explained, component matrix, and communalities tables (as shown under Appendix 6.2) provided the basis for deciding that all the questions in this construct could be correlated to the first three factors. The total variance explained indicated that 70.26% of the total variance could be explained by the first three factors of the construct, as the Eigenvalue is greater than 1. Finally, the communalities values showed the extracted values for each item in the construct are well over the required level of .40.

From the EFA result (Appendix 6.2), it can be seen only two items were included under factor 3. Unless a strong theoretical and practical reason exists, on average three to five

[94] As a general rule the proportion of the total variance explained by the retained factors should be at least 50% (Samuels, 2016).

items should exist under each factor (J *et al.*, 2010; Raubenheimer, 2004). Since latent variables having two items are likely to have low reliability[95] , deletion of factor three or items under this factor (CPBT 4 and/or CPBT 5) was recommended. Due to this, instead of deleting both items, only item CPBT 5 was deleted. This was because the reliability of the construct showed a better result when item CPBT 5 was deleted than item CPBT 4. On top of that, the analysis result from the questionnaire showed that item CPBT 5 was ranked 7th, whereas item CPBT 4 was ranked 3rd.

The rotated component matrix of the second model (after item CPBT 5 was deleted) is shown under Appendix 6.2 model 2. As per the second model, the items are structured into two factors. Accordingly, Item 'CPBT6' has a significant loading on both factors, but instead of deleting the item based on rigid statistics because of the true meaning that the variable is carrying, it can be explained as having an impact on both factors. Since it has a higher loading on the second factor, it was grouped under factor 2.

These 2 factors explain 63% of the variability in the challenges of paper-based tendering practice, with the first factor explaining 38% and the second factor explaining 25%. Even if the total variance explained by the factors in the second model (63%) is not better than the first model (70%), it can be accepted due to the construct's higher reliability result and better factor structure. Table 4.9 below shows the significant components of each factor.

Table 4. 9 Components of factor 1 & 2 under 'challenges of paper-based construction tendering'

Code	Items under Factor 1: Process related challenges
CPBT3	Prone to human errors
CPBT4	Dependent on geographical location of bidders
CPBT7	A tender evaluation may become biased & unfair

[95] As per the initial reliability result under Table 4.8, the Cronbach's alpha value for 'challenges of paper-based tendering' construct is 0.844 (which is beyond the minimum threshold .6). But, the Cronbach's Alpha if item deleted column of the reliability analysis result showed that, the reliability can increase to .845 and .853 if item CPBT 4 & CPBT 5 are deleted. This shows an increase in the overall reliability of the construct due to deletion of these items.

Code	Items under Factor 1: Process related challenges
CPBT8	Difficult communication & interaction among parties
CPBT9	Lacks transparency
CPBT10	Poor information safety & availability
Code	**Items under Factor 2: Resource related challenges**
CPBT1	High processing cost (in relation to transportation, paper usage, & printing)
CPBT2	Time-consuming & slow process due to manual procedures
CPBT6	Demands a huge storage space & difficult documentation

4.11.3 EFA analysis for 'advantages of e-tendering'

The KMO measure and Bartlett's test for the 'advantages of e-tendering' construct showed further FA was possible for this construct. The KMO measure was .774 much above the minimum .5 required for sampling adequacy, whereas the significance level resulting .000 of Bartlett's test of sphericity showed the construct could be seen as a correlation matrix, indicating that further factor analysis would be possible.

For this construct, using the Principal Component Analysis factor extraction method and examining total variance explained, component matrix, and communalities tables (as shown under (Appendix 6.3) provided the basis for deciding that all the questions in this construct could be correlated to the first three factors. The total variance explained indicated that 63% of the total variance could be explained by the first three factors of the construct, as the Eigenvalue is greater than 1. Finally, the communalities values showed the extracted values for each item in the construct are well over the required level of .40.

Regarding the EFA analysis output of SPSS (under Appendix 6.3), the rotated component matrix result showed that three factors can be extracted by Principal Component Analysis.

However, similar items came under three different factors and some factors did not adequately converge into expected factors. This in turn made naming the factors difficult.
In addition to this, factor 3 consisted of only one item (AET10: Improves documentation & archiving). Even if, a single item under a latent variable is not recommended for a better model building and explanation as per J *et al.* (2010), based on the researcher's empirical and conceptual knowledge/experience some problematic variables may be ignored and solution may be interpreted as it is. Therefore, item AET10 was not deleted based on rigid statistics due to the true meaning that the item was carrying.

Hence naming our factors is only for the purpose of communicating, all items under these dimensions were kept as they were initially (under one factor) and the fact that the researcher addressed the smaller sample size or data set taken for the study i.e., 86 may have attributed for such deviation.

4.11.4 EFA analysis for 'CSFs of e-tendering implementation'

The KMO measure and Bartlett's test for the 'advantages of e-tendering' construct showed further FA was possible for this construct. The KMO measure was .685 above the minimum .5 required for sampling adequacy, whereas the significance level resulting .000 of Bartlett's test of sphericity showed the construct could be seen as a correlation matrix, indicating that further factor analysis would be possible.

The first round of FA (under Appendix 6.4) produced 21 items. The analysis of the principal component using scree plot test and Kaiser criterion for the CSFs construct resulted in 6 factors that explained 70.7% of the total variance, in the data while each factor presented eigenvalues greater than 1 (3.49, 3.19, 2.76, 2.24, 1.97, and 1.22) after rotation and explained (16.62%, 15.17%, 13.13%, 10.64%, 9.37%, and 5.80%) of the scale's variance, respectively.

However, while looking at the rotated component matrix, factor 6 only consisted of two items (CSF 4.1 & CSF 5.1) and item CSF4.1 seems to cross-load on two components/factors i.e., factor loading value of .539 and .588 on factors 3 and 6 respectively. Among the options available to eliminate cross-loading[96] , which is to look at their commonalities (values less than 0.4 are viewed insufficient), employ alternative rotation (to define a simpler structure), and/or to consider possible deletion of that particular item. Even if, the commonality of item CSF4.1 is .688 i.e., above the minimum threshold and other alternative rotations have been applied to define a better structure, a cross-loading of the item persists. Therefore, the item was deleted and the second model was developed with a better factor structure and cross-loading was no longer an issue. The second model of the dimension CSFs for e-tendering implementation is presented under Appendix 6.4 (Model 2).

The second round of FA for CSFs dimension, as shown in the scree plot, produced 20 factors. However, only 5 of the components could have the most impact on e-tendering implementation and are extracted with initial eigenvalues of more than 1.0 and the % of variance explained by these components is higher than 50% i.e., 67.6%.

The rotated component matrix of the second model showed that the first one of these four factors is composed of the variables relating to 'reliability of information communication & technology' and it explains 17.46% of the variability in e-tendering implementation, therefore it's the most effective factors. The significant components or individual variables that formed this factor are related to the following.

[96] Cross-loading is when one variable has a moderate-size loading on a several factors at a time, all of which are significant. Loadings are considered significant over a certain threshold depending on the sample size needed for significance i.e. for this study between 0.5 and 0.6 for a sample size of 85-100 (J *et al.*, 2010). On the other hand, Samuels (2016) argues that, an items which load less than 0.4 on any factor to be removed. Loadings should at least be >0.3 to get a minimum variance of 10% explained by an item. For this study 0.4 is taken as a cut off value for a minimum loading of a factor. Cross-loading makes it troublesome to label all factors which are sharing the same variable and thus hard for factors to be distinct and represent separate concepts.

Table 4. 10 Components of factor 1 under CSFs of e-tendering implementation dimension

Code	Items under factor 1: Reliability of information communication & technology
CSF2.1	Consistency of internet connection
CSF2.2	Availability of reliable ICT infrastructure within an organization
CSF2.3	Compatibility of existing hardware & software with the e-tendering implementation system
CSF2.4	Functional integration of the e-tendering system with other business processes
CSF2.5	Security & authentication measures

The second factor is composed of variables relating to 'top management support & employee commitment' which explains 15.85% of the variability of e-tendering implementation. The significant components of individual variables that formed this factor are tabulated underneath.

Table 4. 11 Components of Factor 2 under CSFs of e-tendering implementation dimension

Code	Items under Factor 2: Top management support & employee commitment
CSF1.1	Staff training/capacity building
CSF1.2	Provision of adequate resources
CSF1.3	Employee's commitment
CSF1.4	The skill of procurement employees with IT perspective
CSF1.5	E-tendering implementation strategy

The third factor relates to 'reliability of users (buyers & suppliers) acceptance' and explains 12.68% of the variability of e-tendering implementation. Table 4.21 depicts the significant components that form this factor.

Table 4. 12 Components of Factor 3 under CSFs of e-tendering implementation dimension

Code	Items under Factor 3: Reliability of users' acceptance
CSF4.2	The willingness of employers to use e-tendering
CSF4.3	The willingness of suppliers to adopt e-tendering
CSF4.4	Provision of training programs to suppliers

Similarly, the fourth factor relates to 'reliability of legal factors' and explains 11.422% of the variability of e-tendering implementation. Table 4.22 depicts the significant components that form this factor.

Table 4. 13 Components of factor 4 under CSFs of e-tendering implementation dimension

Code	Items under Factor 4: Reliability of legal factors
CSF3.1	Availability of e-tendering operation instructions & manual
CSF3.2	Availability of legal & administrative procedures
CSF3.3	Availability of legal framework

The last factor i.e., Factor 5 explaining the remaining 10.14% of the variability of e-tendering implementation has the following significant components.

Table 4. 14 Components of Factor s under CSFs of e-tendering implementation dimension

Code	Items under Factor 5: Reliability of monitoring & evaluation system
CSF5.1	Existence of a project management team to monitor & evaluate the progress of its implementation
CSF5.2	Continuous evaluation & feedback
CSF5.3	Compliance with rules & regulations is ensured
CSF5.4	Checking procurement guidelines are practices & monitored

4.11.5 EFA analysis for 'barriers of e-tendering implementation'

The KMO measure and Bartlett's test for the 'barriers of e-tendering implementation' construct showed further FA was possible for this construct. The KMO measure was .54 above the minimum .5 required for sampling adequacy, whereas the significance level resulting .000 of Bartlett's test of sphericity showed the construct could be seen as a correlation matrix, indicating that further factor analysis would be possible.

The first round of FA (under Appendix 6.5) produced 16 factors. The analysis of the principal component using scree plot test and Kaiser criterion for the CSFs construct resulted in 5 factors that explained 71.68% of the total variance, in the data while each factor presented eigenvalues greater than 1 (2.71, 2.67, 2.35, 2.14, and 1.59) after rotation and explained (16.96%, 16.69%, %, 14.69%, 13.37%, and 9.95%) of the scale's variance, respectively.

However, while looking at the rotated component matrix, factor 4 only consisted of two items (Bar 3.3 & Bar 1.2), and item Bar 1.2 seems to cross-load on two components/factors i.e., factor loading value of .628 and .400 on factors 4 and 5 respectively.

Since latent variables having two items are likely to have low reliability[97] , deletion of factor four or items under this factor was recommended. Due to this, instead of deleting both items, only item 'Bar 3.3' was deleted. This was because the original reliability of the respective construct showed a better result when item Bar 3.3 was deleted than item Bar 1.2. On top of that, the analysis result from the questionnaire showed that item Bar 1.2 was ranked on the top ten challenging factors, whereas item Bar 3.3 was not. This can be taken as an empirical evidence to keep the item i.e., Bar 1.2.

[97] As per the initial reliability result under Table 4.8, the Cronbach's alpha value for 'Bar 3: Organizational barriers' construct was .67 (which is beyond the minimum threshold .6). But, the Cronbach's Alpha if item deleted column of the reliability analysis result showed that, the reliability can increase to .77 if item 'Bar 3.3' was deleted. Whereas, the original reliability value for 'Bar 1: Technological barriers' was .55 (almost closer to the minimum threshold .6). However, the reliability of the construct could not be improved due to deletion of any item under it. This shows deleting item 'Bar 1.2' would cause the reliability of the respective factor to drop or decrease.

The rotated component matrix of the second model (Appendix 6.5, Model 2) showed that the first one of these four factors is composed of the variables relating to 'Environmental barriers' and it explains 20.67% of the variability in e-tendering implementation, therefore it's the most effective factors. The significant components or individual variables that formed this factor are related to the following;

Table 4. 15 Components of factor 1 under 'barriers of e-tendering implementation' dimension

Code	Items under factor 1: Environmental barriers
Bar4.1	Inadequate technological infrastructure
Bar4.2	Lack of national IT policy relating to EP issues
Bar4.3	Lack of an effective legal & regulation system
Bar4.4	Lack of suppliers' readiness

The second factor is composed of variables relating to 'Management barriers' which explains 17.94% of the variability of e-tendering implementation. The significant components of individual variables that formed this factor are tabulated underneath.

Table 4. 16 Components of Factor 2 under 'barriers of e-tendering implementation' dimension

Code	Items under Factor 2: Managerial barriers
Bar2.1	Lack of skilled personnel & technical expertise
Bar2.3	Resistance to change (at managerial level)
Bar2.4	Lack of leadership/upper management support

The third factor relates to 'Organizational barriers' and explains 17.13% of the variability of e-tendering implementation. Table 4.17 depicts the significant components that form this factor.

Table 4. 17 Components of Factor 3 under 'barriers of e-tendering implementation' dimension

Code	Items under Factor 3: Organizational barriers
Bar3.1	Staff turnover

Code	Items under Factor 3: Organizational barriers
Bar3.2	Limited resources i.e., financial resource & time
Bar3.4	Challenge in shifting the mindset of users

Similarly, the fourth factor relates to 'Technological barriers' and explains 15.00% of the variability of e-tendering implementation. Table 4.30 depicts the significant components that form this factor.

Table 4. 18 Components of factor 4 under 'barriers of e-tendering implementation' dimension

Code	Items under Factor 4: Technological barriers
Bar1.1	Lack of system integration i.e., interoperability & compatibility with other systems
Bar1.2	Insufficient assessment of systems before installation
Bar2.2	Lack of training/capacity building programs

Item 'Bar 2.2' has loaded on both factor 2 (managerial barriers) and factor 4 (technological barriers). This can be explained that lack of training can be considered as a managerial barrier and a lack of training about technological aspects of e-tendering can be seen as a technological barrier. Since the loading on factor 4 was more significant than the loading on factor 2, the item fell under factor 4 as per the data set.

4.12 Current status of E-tendering implementation in Ethiopia

The introduction of the E-GP[98] system is part of the broader Ethiopian government objectives of e-government. The responsible party to lead the introduction of the use of electronic means in the procurement of goods, services, and works is the FPPA ((Federal Public Procurement and Property Administration Agency), 2018). Hence a strategy document and a road map has been developed (as of 2018) as the first step in a long journey through E-GP implementation.

[98] Since the initiatives of EP implementation in Ethiopia is under the control of the Ethiopian government i.e., under FPPA, the name has changed to 'E-GP'.

As FPPA being the mandated authority to lead the E-GP initiative in the country, it's currently working in coordination with MoFEC and the Ministry of Communication and Information Technology (MCIT), and other stakeholders as well. A formal interview was conducted with three pilot procuring entities i.e., FPPPAA, MiNT & MoFEC to have an insight into the general progress of its implementation nationwide.

Concerning this, regarding the current status of e-tendering implementation and the challenges faced so far, a formal face-to-face interview had been conducted with the E-GP Manager of the FPPA. The following paragraphs narrate the information gathered from the interview (with pilot procuring entities) and document review regarding the current status of Ethiopia in E-GP implementation.

- **EP readiness assessment:** regarding this, an EP readiness assessment was carried out on 19 institutions (14 from public entities & 5 from the bidding community) via a survey questionnaire in March 2018 to view the readiness of procuring entities, private sectors, and other relevant stakeholders. Nine components were identified by Multilateral Development Bank (MDB) to assess Ethiopia's EP readiness and the result revealed that the Level of Readiness (LoR) on nine components was found to be moderately satisfactory i.e., with the score of 2.97 out of 4.
- **Draft e-procurement strategy & action plan development:** the first task undertaken was to develop a draft EP strategy & action plan (from 2018-2023), then institutional structure had been established. The E-GP Manager noted that on the government side the e-Procurement Project Steering Committee (e-PPSC), e-Procurement Project Management Unit (e-PMU), and e-Procurement Working Group (e-PWG) has been established. These project tasks were accomplished within the timeline stated under the strategy and road map developed by the FPPAA i.e., until the end of 2018.

- **Development of EP proclamation & regulation:** at the policy level, the government has made decisions on the introduction of EP in the country and the Ethiopian e-Government Strategic Implementation Plan 2020 incorporates the implementation of the same. As the E-GP Manager illustrated:

  "*As per the procurement proclamation, a new proclamation is at the draft stage. Thus, it's already been submitted to the FDRE House of People's Representatives, mandated authority to endorse the proclamation and it is expected to be issued soon."*

- **EP system implementation:** Then, there comes the procurement process of the E-GP software itself. Before procuring such a system, a strategic decision was made; whether to go for the home-grown software or to use other internationally developed systems. So, a decision to adopt a home-grown system was made as of December 2018. It is noted that two systems already exist in the country- one developed by MiNT, and another by BDU. After an assessment was done from the two home-grown software, MiNT's developed system was found better for customization and to use at a national level. Thus, a contract was signed with the public organization in July 2019.

  The informant at the E-GP center noted that software development (customization) and piloting (implementation) was supposed to begin on February 2020 and February 2021 respectively. But, by then the system was not completely developed. There is still some equipment that needs to be procured for the whole data center to be established. This is supposed to be finalized until July 2021.

- **Capacity building:** regarding capacity building, a benchmark study visit had been made by the institution (FPPA) to countries like Bangladesh, Armenia, South Korea, and Rwanda where EP is implemented. The informant also illustrated the situation by the following quote:

"We have developed a communication & change management strategy and a capacity-building strategy. Regarding the capacity building strategy, many trainings were identified (a total of 9 modules) are prepared so far. Almost all modules have been trained to FPPA staff and other pilot procuring entities[99] *(8 in number including FPPA)." E-GP Manager, e-tendering pilot procuring entity's representative.*

Another informant from the e-tendering pilot procuring entity witnessed that virtual training was given to the organization's procurement staff on the 7 training modules.

"Regarding EP's implementation, a virtual training was given to the procurement staff members of our company with the help of PPA. Due to the workload that other staffs have here at the office, only 2 or 3 employees of MiNT have taken training at Debrezeith & Nazireth regarding EP. Though, the training only lasted for few months due to the pandemic i.e., COVID." Procurement & Property Management Directorate Director, EP pilot procuring entities' representative.

- **General status:** currently, the system development has been substantially completed but piloting (implementation) has not started yet. As the E-GP informant put it succinctly:

  "Our target is to start piloting by the 7th of July, 2021. Regarding integration of the system, Preliminary activities have started like with IFMIS, MoT (Ministry of Trade). And with MoR, we are just in the process of starting, just the engagement process)."

Many reasons underlie for lagging behind schedule, the pandemic (Covid-19) being the major one.

[99] List of 8 pilot procuring entities: Ethiopian Pharmaceuticals Fund and Supply Agency (EPSA), Public Procurement and Property Disposal Service (PPDS), Addis Ababa University (AAU), Ethiopian Roads Authority (ERA), Ministry of Innovative and Technology (MiNT) or former MCIT, Ministry of Revenue (MoR), Ministry of Finance (MoF) and Federal Public Procurement and Property Administration Agency (FPPPAA).

"I think the major one was COVID and that took away a lot of man-hours from both our end and the developers' end. We were also very ambitious and we were not realistic when we initially set the timelines in the strategy…. We also had the issues of payment delay like delayed payment to the developers and this made the development process lag behind schedule." E-GP Manager at FPPPAA.

High staff turnover, low perception/understanding among stakeholders & bidding communities, and the country's access to the internet were the basic barriers mentioned by the pilot procuring entities during the system development. The informant from the E-GP team at FPPA also noted the importance of leadership as a key success factor for E-GP implementation:

"The implementation process, in general, requires very strong leadership at a high-level people who should believe in the system must be there. For me, I think it's leadership, leadership, and leadership!! Of course, others like proper planning and assessment of the environment before implementing E-GP is also crucial, but the top is leadership."

4.13 Framework development

Following the analysis of the transcripts, document review[100] , and questionnaire survey, this section presents a framework that organizes the aspects identified (Figure 4.17) and addresses the fourth objective of this research.

This study was an attempt to advance the body of knowledge on e-tendering implementation in the Ethiopian construction industry specifically in the road sector. This was done so by exploring the basic features/processes of e-tendering (identified through literature and document review), potential advantages, perceived barriers or challenges, and key success factors of its implementation at an organization level in the

[100] Documents reviewed includes: e-tendering Bidders Training Guide of UNDP, Clean E-GP Strategy & Action Plan of Ethiopia (Final version), Ethiopia maturity assessment of MCIT E-GP system, E-GP Training & Engagement Report (October 2019), Training Modules for E-GP implementation, and Draft PPPAA Proclamation (2013 E.C edition).

study area. To the best of the researcher's knowledge, it is the first local study done in the construction industry to address all these four aspects together during e-tendering implementation. The findings provide both theoretical and managerial implications useful to researchers and practitioners respectively.

The current practice of road construction tendering and its challenges were assessed thoroughly in the previous sections. As noted earlier, it is argued that e-tendering provides various favorable outcomes in other countries that justify its implementation in the public procurement process for the construction industry as well. Thus, this study sought to identify the potential or possible advantages to gain from e-tendering in the Ethiopian construction industry specifically in the road sector. Since the introduction of the system by the GoE is still at its elementary level, benefits to gain from the system and factors affecting its adoption/implementation are considered by taking the perception of experts into account.

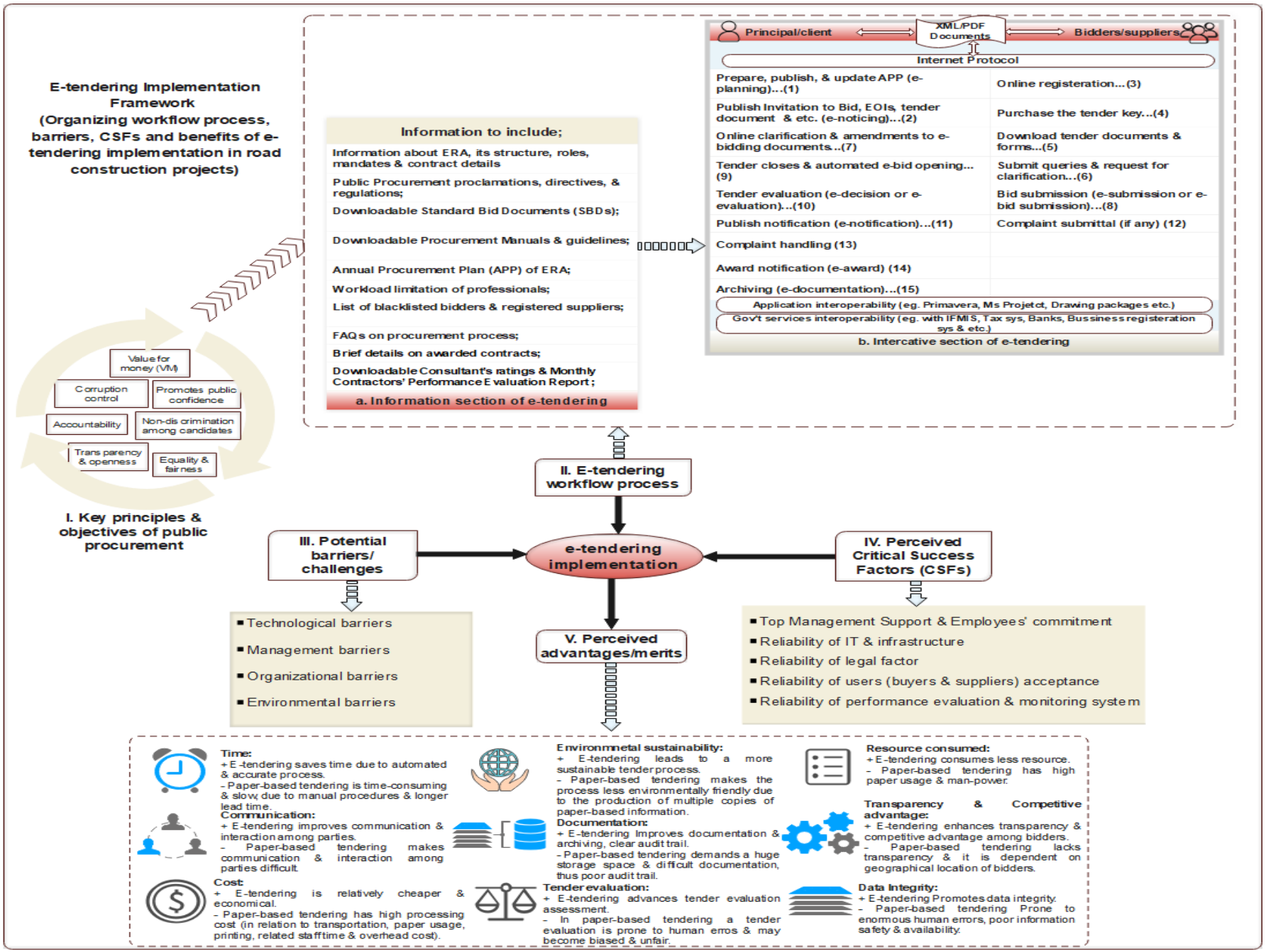
The findings of this study revealed contingent factors for successful e-tendering implementation, identified as CSFs. In other words, these factors were perceived to be essential for achieving desired outcomes in the implementation. Along with the CSFs, pitfalls/challenges in implementing e-tendering were identified. These are factors that are likely to prevent organizations from achieving desirable outcomes during e-tendering implementation.

The framework (figure 4.17), as signified by the arrows, suggests that before implementing e-tendering, its processes and features along with the principles & objectives of public procurement must be identified properly. Accordingly, the implementation of the system must ensure that the basic principles[101] & core objectives of public procurement are entertained or promoted in the first place. Then, the detailed process or components of e-tendering should be identified. Similarly, the successful

[101] Public procurement principles including accountability, VM, corruption control, transparency & openness, equality & fairness, promoting public confidence, and non-discrimination among candidates.

implementation of the system relies on the existence of the CSFs on one hand and the absence of barriers on the other. Accordingly, five and four groups of CSFs and barriers as identified in the previous sections had been included in the framework. The detailed explication of the identified factors follows after the framework.

Figure 4. 17 E-tendering implementation framework for road construction projects


E-tendering Implementation Framework
(Organizing workflow process, barriers, CSFs and benefits of e-tendering implementation in road construction projects)
Information to include;
Information about ERA, its structure, roles, mandates & contract details
Public Procurement proclamations, directives, & regulations;
Downloadable Standard Bid Documents (SBDs);
Downloadable Procurement Manuals & guidelines;
Annual Procurement Plan (APP) of ERA;
Workload limitation of professionals;
List of blacklisted bidders & registered suppliers;
FAQs on procurement process;
Brief details on awarded contracts;
Downloadable Consultant's ratings & Monthly Contractors' Performance Evaluation Report;
a. Information section of e-tendering
Principal/client
XML/PDF Documents
Bidders/suppliers
Internet Protocol
Prepare, publish, & update APP (e-planning)...(1)
Online registeration...(3)
Publish Invitation to Bid, EOIs, tender document & etc. (e-noticing)...(2)
Purchase the tender key...(4)
Online clarification & amendments to e-bidding documents...(7)
Download tender documents & forms...(5)
Tender closes & automated e-bid opening...(9)
Submit queries & request for clarification...(6)
Tender evaluation (e-decision or e-evaluation)...(10)
Bid submission (e-submission or e-bid submission)...(8)
Publish notification (e-notification)...(11)
Complaint submittal (if any) (12)
Complaint handling (13)
Award notification (e-award) (14)
Archiving (e-documentation)...(15)
Application interoperability (eg. Primavera, Ms Projetct, Drawing packages etc.)
Gov't services interoperability (eg. with IFMIS, Tax sys, Banks, Bussiness registeration sys & etc.)
b. Intercative section of e-tendering
Value for money (VM)
Promotes public confidence
Non-dis crimination among candidates
Equality & fairness
Trans parency & openness
Accountability
Corruption control
I. Key principles & objectives of public procurement
II. E-tendering workflow process
III. Potential barriers/ challenges
e-tendering implementation
IV. Perceived Critical Success Factors (CSFs)
V. Perceived advantages/merits
Technological barriers
Management barriers
Organizational barriers
Environmental barriers
Top Management Support & Employees' commitment
Reliability of IT & infrastructure
Reliability of legal factor
Reliability of users (buyers & suppliers) acceptance
Reliability of performance evaluation & monitoring system
Time:
+ E-tendering saves time due to automated & accurate process.
- Paper-based tendering is time-consuming & slow, due to manual procedures & longer lead time.
Communication:
+ E-tendering improves communication & interaction among parties.
- Paper-based tendering makes communication & interaction among parties difficult.
Cost:
+ E-tendering is relatively cheaper & economical.
- Paper-based tendering has high processing cost (in relation to transportation, paper usage, printing, related stafftime & overhead cost).
Environmnetal sustainability:
+ E-tendering leads to a more sustainable tender process.
- Paper-based tendering makes the process less environmentally friendly due to the production of multiple copies of paper-based information.
Documentation:
+ E-tendering Improves documentation & archiving, clear audit trail.
- Paper-based tendering demands a huge storage space & difficult documentation, thus poor audit trail.
Tender evaluation:
+ E-tendering advances tender evaluation assessment.
- In paper-based tendering a tender evaluation is prone to human erros & may become biased & unfair.
Resource consumed:
+ E-tendering consumes less resource.
- Paper-based tendering has high paper usage & man-power.
Transparency & Competitive advantage:
+ E-tendering enhances transparency & competitive advantage among bidders.
- Paper-based tendering lacks transparency & it is dependent on geographical location of bidders.
Data Integrity:
+ E-tendering Promotes data integrity.
- Paper-based tendering Prone to enormous human errors, poor information safety & availability.

A. Core principles & objectives of public procurement

For successful tendering practice, first, the underlying principles & objectives of a public procurement system should be understood. Hence, the e-tendering system should target many of the fundamental procurement values. Some of the basic principles to incorporate in the implementation framework are;

- **Value for money (VM)**: is related to ensuring the economic efficiency of the procedures. VM is defined as 'the effective, efficient, and economic use or resources, which requires an evaluation of relevant costs and benefits along with an assessment of risks, nonprice attributes, and/or total cost of ownership as appropriate' ((Asian Development Bank, 2018). This can be achieved through buying or procuring the works, goods, or services needed to be procured from the lowest qualified supplier possible.
- **Corruption control:** This objective aims to ensure that all are given a chance to participate fairly without having to be locked out unfairly.
- **Accountability** is related to making public officials responsible for their decisions about the procurement process. To do so, clear lines of responsibility in decision-making should be established. As per Komakech (2016), accountability is defined as the 'quality or state of being accountable, especially an obligation or willingness to accept responsibility or to account for one's actions'.
- **Transparency & openness:** This is to ensure that the function of public procurement is done openly and transparently. It ensures that all qualified and interested parties are included in the procurement procedures. Not only this, but it also makes sure that all procurement information is duly communicated to all members of the public, with clear guidelines on how the process will be conducted.
- **Equality & fairness:** This principle is aimed generally to ensure public funds are not used to favor specific individuals or groups or companies. It seeks to give all an equal chance to participate in the procurement process. The term

fairness can be used interchangeably with equal treatment. It is tied to the concept of giving all participants an equal chance to compete by avoiding discrimination among potential bidders (Berhanu, 2019).

- **Promotes public confidence in procurement procedures:** the bidding community or participants of the public procurement must be confident enough in the procurement procedures. Therefore, by delivering positive results, a proper procurement process should be able to restore bidders' confidence.
- **Non-discrimination among candidates:** refers to the condition that any bidder, who wanted to participate in public procurement, should not be excluded or disposed of on the following basis: nationality, race, religion, gender, or any other criteria not related to qualification, except the objective of discrimination is justified (Komakech, 2016).

B. E-tendering workflow process

The e-tendering module must be designed to facilitate collaboration between buyers and suppliers of goods, services, and/or works. Thus, after understanding the underlying principles & values of public procurement, identifying the basic process of the system is very crucial. As per (Asian Development Bank, (2018); (Federal Public Procurement and Property Administration Agency), (2018), a simple EP system should consist of information and an interactive section.

i) **Information section:** accordingly, the information section of the e-tendering system for the road sector should provide the following information for the bidders & other relevant stakeholders:
    - Information about the principal i.e., ERA, its structure, roles, mandates & contract details;
    - Downloadable public procurement proclamations, directives, & regulations;
    - Downloadable Standard Bidding Documents (SBDs) for the procurement of works & services;

- Downloadable procurement guidelines & manuals;
- Annual Procurement Plans (APP) of ERA;
- Workload limitation of professionals;
- List of blacklisted bidders (contractors, consultants, and/or suppliers);
- List of registered suppliers;
- Brief details on awarded contracts;
- Frequently Asked Questions (FAQs) on procurement processes;
- Downloadable Consultant's ratings & Monthly Contractors' Performance Evaluation Report etc.

ii) **Interactive section:** in a similar manner this section would generally include;

- Bidders' registration;
- Publication of APPs;
- Publication and amendment of invitation to bid, Expression of Interest (EOI), Tender documents, etc.;
- E-tender analysis or evaluation;
- Access to complaint lodgment;
- Publication of the least evaluated bidder & Contract Award Notice & etc.

C. Potential barriers/challenges of e-tendering implementation

Despite the positive roles played by CSFs of e-tendering implementation, several factors were revealed as barriers/challenges that hinder organizations from implementing e-tendering. These factors are mainly categorized into the following four groups;

i) **Technological barriers:** includes lack of system integration i.e., interoperability & compatibility with other systems, insufficient assessment of systems before installation, and lack of training/capacity-building programs.

ii) **Management barriers:** includes lack of skilled personnel & technical expertise, resistance to change (at managerial level), and lack of leadership/upper management support.

iii) **Organizational barriers:** includes staff turnover, limited resources i.e., financial resources & time, and challenge in shifting the mindset of users.

iv) **Environmental barriers:** includes inadequate technological infrastructure, lack of national IT policy relating to EP issues, lack of an effective legal & regulation system, and lack of suppliers' readiness.

D. Perceived CSFs of e-tendering implementation

As no public sector organizations engaged in construction have started implementing e-tendering in Ethiopia, the study sought to determine the perception of experts regarding the factors that triggered other countries to implement e-tendering in the construction and other sectors as well. As shown in figure 4.17, five main factors were identified. The sub-factors included under each factor are clearly shown underneath;

i) **Reliability of information communication & technology:** includes consistency of internet connection, availability of reliable ICT infrastructure within an organization, compatibility of existing hardware & software with the e-tendering implementation system, functional integration of the e-tendering system with other business processes, and security & authentication measures.

ii) **Top management support & employee commitment:** includes staff training/capacity building, provision of adequate resources, employee's commitment, the skill of procurement employees with IT perspective, and e-tendering implementation strategy.

iii) **Reliability of users' acceptance:** includes the willingness of employers to use e-tendering, the willingness of suppliers to adopt e-tendering, and the provision of training programs to suppliers.

iv) **Reliability of legal factors:** includes the availability of e-tendering operation instructions & manual, availability of legal & administrative procedures, and availability of legal framework.

v) **Reliability of monitoring & evaluation system:** includes the existence of a project management team to monitor & evaluate the progress of its implementation, continuous evaluation & feedback, compliance with rules & regulations is ensured, and checking procurement guidelines are practices & monitored.

E. Perceived advantages/benefits of e-tendering

The study sought to identify the benefits to gain from e-tendering implementation in the construction industry specifically in the road sector. A list of potential advantages was obtained from literature reviews. Experts in the study area had the perception that engaging in e-tendering may lead to substantial benefit & gain, which would not be achieved via a traditional/paper-based tendering approach. List of potential advantages to gain through e-tendering implementation includes; cost-saving, time-saving, increased competitive advantage, enhanced transparency, improved documentation & archiving, better communication & interaction, advanced tender evaluation &, etc.

4.13.1 Result validation

As discussed in the methodology the developed e-tendering implementation framework was validated using a focus group discussion involving four experts from the consultant representative. An individual interview and discussion were made with four experts from the client-side and three from the contractor side. The developed conceptual framework was emailed and/or distributed for participants to let them get time to review and comment on the same. A 15-minute-long debriefing about the framework was made before the focus group discussion and the interview. Some adjustments were made based on the comments and feedback of experts accordingly.

In addition to this, a five-point Likert scaled questionnaire (see Appendix 3) was used to rate the clarity, comprehensiveness, simplicity, relevance, and future applicability of the developed framework. The result of the same is shown in table 4.19 below.

- **Framework clarity:** the RII analysis result (table 4.19) showed that all the 11 experts who participated in the validation process strongly agree that the framework developed is clear and easy to comprehend.
- **Framework simplicity:** the RII value for framework simplicity is 98%. 91% of the respondents strongly agree with the framework's simplicity while the remaining 9% agree that the framework is simple. Thus, it can be noted from the finding that the developed conceptual framework for e-tendering implementation is simple to understand.

Table 4. 19 E-tendering implementation conceptual framework validation

	Strongly Agree	**Agree**	**Neither Agree nor Disagree**	**Disagree**	**Strongly Disagree**	**RII (%)**
The Framework is clear	11	0	0	0	0	**100.0**
The Framework is simple	10	1	0	0	0	**98.2**
The Framework is comprehensive	2	9	0	0	0	**83.6**
The Framework is relevant	7	4	0	0	0	**92.7**
Future applicability	1	8	2	0	0	**78.2**

- **Framework comprehensiveness:** based on their understanding and perception of the concept, participants believed the implementation framework is comprehensive and contained the basic issues that need to be included. According to the result shown in table 1.19, 18% of the respondents strongly agree the framework is comprehensive, while the remaining 82% agree with the comprehensiveness of the framework.

- **Framework relevance:** the RII value for framework relevance is 93%. Accordingly, 64% of the respondents strongly agree with the framework's relevance and value, while the remaining 36% agree that the framework is relevant.
- **Framework future applicability:** as shown in table 1.19 the RII of the framework's future applicability is 78%. Only 9% of the respondents strongly agree with the framework's future applicability and 73% of the participants agree that the framework is applicable in the future. Whereas, the remaining 18% remained neutral regarding the future applicability of the developed framework.

Chapter Five: Conclusion and Recommendation

This research was made to survey the current practice & challenges of paper-based tendering and proposing a conceptual framework for the implementation of e-tendering in the Ethiopian construction sector specifically for federal road construction projects. Following the detailed analysis and findings of the survey and document review presented and discussed in the previous section of this study, the following chapter presents the conclusion that conforms to the research objectives. Recommendations were also forwarded and topics for future study were highlighted.

5.1 Conclusion

The study was undertaken to develop a framework or an intervention mechanism for the implementation of e-tendering in the procurement of Ethiopian Federal Road Construction projects. The conceptual framework was designed after assessing the current practice of tendering in the study area along with its challenges, potential advantages, CSFs & barriers of e-tendering implementation. The basic workflow process of e-tendering obtained from literature review and document review was also incorporated in the conceptual framework developed.

The current practice was assessed based on the principles and values of procurement in general. Based on the findings derived from the first aim of this study, it can be concluded that the current practice of tendering in the Ethiopian road sector, promotes most of the values and principles of procurement. These include; transparency & openness, accountability of professionals, equality & fairness, public confidence in the procurement procedures, ensuring economic efficiency, etc. Similarly, many challenges of a paper-based tendering practice were extracted from extant literature reviews and a questionnaire survey was conducted to express the level of professionals' agreement on the identified challenges. An interview was also conducted to assess the same. Accordingly, time-consuming & slow processes due to manual procedures, difficult

documentation & demanding huge storage space, dependent on geographical location of bidders, and high processing cost were the top four ranked challenges of the paper-based tendering system in road construction projects during the questionnaire survey analysis. The factor analysis result on the other hand categorized the challenges used in the survey under two major factors; process-related & resource-related challenges. Prone to human errors, poor data integrity & composition, poor audit trail, biased tender evaluation, and difficult communication & interaction among bidders were also mentioned during the interview conducted with professionals engaged in the tendering phase of the study area.

As a result of examining the second aim of this study, it can be generalized that e-tendering is perceived to be advantageous and would be able to improve most of the challenges of paper-based tendering discussed above. In line with this, the survey analysis of the participants' perception regarding the potential advantages to gain from e-tendering has shown that improved documentation & archiving, time-saving, a more sustainable tender process, and less consumption of resources were the top four ranked advantages of e-tendering.

During the factor analysis, all the identified advantages came under three different factors. However, similar sub-factors merged into different factors and this made the naming process difficult. Since the process of naming and retaining factors is highly subjective, the researcher decided not to delete any item from the advantages listed due to the true meaning each item was carrying and kept all the 10 items under a single factor i.e., simply under a factor named 'advantages of e-tendering'. An interview conducted with the system's practitioners also proved the advantages of e-tendering in construction projects.

Based on the findings derived from the third aim of this study, it can be concluded that certain factors affect the implementation of e-tendering both in a positive & negative way. Hence the other components of the framework developed were the CSFs &

barriers of e-tendering implementation that were identified from the literature review. A similar procedure was followed for these dimensions. Since the introduction of the system by the GoE is still at its elementary level, factors affecting its adoption/implementation were considered by taking the perception of experts in the study area into account. The experience of e-tendering practitioners in the construction sector was also assessed. Accordingly, using factor analysis several CSFs were categorized into five groups based on the response of participants; Reliability of information communication & technology, top management support & employee commitment, reliability of users' acceptance, reliability of legal factors, and reliability of monitoring & evaluation system.

Concerning this, factors negatively affecting the implementation of the system were categorized under four groups; Environmental barriers, managerial barriers, organizational barriers, and technological barriers.

The developed framework was validated via a focus group discussion involving four experts from the consultant representative and using an informal interview with four experts from the client's side and three from the contractor's representative respectively. Accordingly, based on the comments & suggestions forwarded during the discussion, some amendments were made. In addition to this, the developed framework was rated among participants for its clarity, comprehensiveness, simplicity, relevance, and future applicability. Based on the result of the same, the developed framework for e-tendering implementation was found to be clear and simple to understand.

5.2 Recommendation

The study generally showed that the implementation of e-tendering is at its elementary level and from the interview conducted, as well as from the findings of (Federal Public Procurement and Property Administration Agency), (2018) it was noted that less concern was given among public bodies and procuring entities regarding EP

implementation in Ethiopia, thus it is highly recommended that training or capacity building programs need to be setup. Frequent and/or regular seminars about the system should be held at the nation and/or organization level to increase users' awareness and future adoption. EP implementing agencies should make sure processes are efficient before applying automated solutions.

In line with the above, the following recommendations are made for future study;

- The scope of the study was only limited to public procurement thus, it is advisable if future studies could also include the detailed implementation of e-tendering for the private sector.
- Once e-tendering becomes practical, it will be advantageous if the practical implementation of the system is studied in detail, the actual benefits gained, implementation difficulties &, etc.
- This study only covered the practice of tendering and the adoption of e-tendering in the road sector, hence it will be valuable if other sectors of the industry (like the water & building sector) are covered in future work & study.
- The EFA conducted in this study resulted in different factor structures under each construct, each of which was discussed in detail in the previous sections. In EFA the statistical result from the study assigned variables to factors. However, it is appreciated if further FA i.e., a Confirmatory Factor Analysis (CFA) is conducted to test the extent to which the study's findings of factors loadings on prespecified constructs represent the actual data.
- Due to the pandemic, it was not possible to reach out to the real e-tendering practitioners in the construction sector and share their experiences in detail. The researcher believed their practical experience would have been a great input for the research. Hence, by considering this, further study can be conducted incorporating the same.
- The findings of this research were only limited to framework development for e-tendering implementation in road construction projects. Based on this,

developing a web-based prototype to simulate the system can be developed in future researches.

- The scope of this study was only limited to address the potential means of implementing e-tendering in road construction projects. however, future studies could be carried out to assess the implementation of e-procurement (EP) as a whole.

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APPENDICES

Appendix 1: Publishable Manuscript

E-tendering Applicability for the Procurement of Ethiopian Federal Road Construction Projects

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ABSTRACT

Construction procurement is considered to be the most critical stage throughout the lifecycle of construction projects. However, bidding practice is identified as one of the major short coming of the Ethiopian construction industry. The fact that the current Ethiopian construction tendering system is paper-based has a number of drawbacks like human errors in document production, incomplete information or tender document, possible mix up of documents, insufficient copies, possible leakage of restricted information, problems in issuing of addendums and voluminous tender documents being the major ones.

This paper analyses the current practice of paper-based tendering in road construction projects along with its challenges and how it can be improved vide e-tendering implementation. To answer these questions, the perception and experience of tendering professionals involved in the road construction projects was assessed via a questionnaire and interview survey respectively. Few e-tendering practitioners were also interviewed about their experience while implementing the system. Accordingly, the result showed that e-tendering was perceived to be advantageous and would improve the time, cost, communication, documentation, tender evaluation, data integrity, resource consumption, and transparency of the tendering process in general. However, the result also revealed a number of factors related to management, organization, environment, and technology may hinder the implementation of the system. Thus, due to the potential benefits of e-tendering highlighted in this paper, it requires more attention from the government and the procuring entities for its greater expansion and adoption to ultimately contribute to the growth of the country's economy.

Accordingly, findings from the literature review, survey, and document review were finally incorporated in the conceptual framework developed for e-tendering implementation in the study area. General principles & values of procurement, work flow process of e-tendering, potential advantages, and factors affecting implementation of the system were the major components of the developed framework. The conceptual framework was validated using a focus group discussion and a semi-structured interview with tendering professionals engaged in the study area and amendments were made accordingly. Clarity, comprehensiveness, relevance, simplicity, and future applicability of the framework was also assured via the questionnaires developed.

Key words: procurement; tendering; construction; e-tendering; road construction projects; e-procurement (EP)

INTRODUCTION

According to Vee and Skitmore (2003), construction procurement is considered to be the most critical stage throughout the lifecycle of construction projects. The fact that the current Ethiopian construction tendering system is paper-based has a number of drawbacks. Often problems arise when tender documents are ready to be distributed to interested bidders after the preparation is completed (Lou and Alshawi, 2009). Accordingly, 'human errors in document production, incomplete information or tender document, possible mix up of documents, insufficient copies, possible leakage of restricted information, problems in issuing of addendums and voluminous tender documents' are some of the problems that occur (Egan, 2003).

Governments all around the world have tried to provide their citizens easy access to government services as well as making their operation more efficient & transparent by incorporating ICT, specifically the Internet, as a means to update public sector processes (Elias, Ezanee, Mahidin and Shiratuddin, 2005). Accordingly, electronic-procurement, which is also called e-procurement or EP afterward comes into the picture by integrating ICT with the procurement process. For this paper, EP is defined as 'The use of the Internet/ICT by the public body to purchase goods, works and services they require in an effective, efficient and transparent manner' (Komakech, 2016). Similarly, e-tendering for this study is defined as the process of entering and conducting a tendering process electronically, where bidders undertake the whole tendering process through electronic media (Ren and Kamarudin, 2016).

Public procurement principles

To achieve sound procurement practice and preserve public trust and public interest, procurement principles must be applied ((Minstry of Finance and Economic Development), 2013). Accordingly, as per (Federal Negarit Gazeta) (2009) and (Minstry of Finance and Economic Development) (2013), the following are the core principles: to ensure value for money (VM) in the use of the public fund for procurement;

nondiscrimination among candidates on grounds of nationality or any other criteria not having to do with their qualification, except in cases of preference specifically provided for in the Proclamation; transparency and fairness of the criteria based on which decisions are given in public procurement as well as of decisions in each procurement; accountability for decisions made and measures taken concerning public procurement and property administration; and careful handling and proper use of the public property. Such principles should be used to guide and make the right decisions about procurement practices.

Comparison between traditional/conventional Tendering and e-tendering

The following sub-section represents the different outlooks of numerous authors and scholars regarding the comparison made between conventional or paper-based tendering and e-tendering. The same is presented in the following table:

Table 1. 1 Comparison between traditional tendering and e-tendering

Perspective/ Area	Traditional tendering	e-tendering	Source(s)
Cost	Higher processing cost	Relatively cheaper and economical (as printing & transporting is reduced)	(Amarapathy, Jayasena, and Ranadewa, 2013; Elias, Ezanee, Mahidin and Shiratuddin, 2005; Patil, Waghmare and Gawande, 2016)
Time	Time-consuming & slow	Automated & accurate process allows a dramatic reduction in the timeframe of the tender period	(Elias, Ezanee, Mahidin and Shiratuddin, 2005; Patil, Waghmare and Gawande, 2016; Ren and Kamarudin, 2016; Tindsley and Stephenson, 2008)
Accessibility or mobility	Restricted mobility[102]	Higher accessibility[103]	(Patil, Waghmare and Gawande, 2016; Ren and Kamarudin, 2016)
Resource consumed	High paper usage and storage	e- documentation (No physical storage space is needed)	(Ezanee, Norlila and Norshuhada, 2005; Patil, Waghmare and Gawande, 2016; Ren and Kamarudin,

[102] As paper-based tendering requires tenderers to physically come to collect the documents, the process is highly dependent on the geographical location of bidders.

[103] E-tendering allows tender documents to be viewed & downloaded anytime, anywhere with the internet.

Perspective/ Area	Traditional tendering	e-tendering	Source(s)
			2016)
Audit trail	Poor audit trail	Clear, systematic, & accurate audit trail.	(Ezanee, Norlila and Norshuhada, 2005; Ren and Kamarudin, 2016)
Information safety & availability	Poor information safety & availability	Information safety[104] & availability is guaranteed	(Elias, Ezanee, Mahidin and Shiratuddin, 2005; Patil, Waghmare and Gawande, 2016; Ren and Kamarudin, 2016)
Accuracy	Prone to human errors	Automated and accurate	(Becker, 2018; Costa, Arantes and Valadares Tavares, 2013; Neupane, 2014; Patil, Waghmare and Gawande, 2016)
Transparency	Direct human interaction[105]	Less human interaction, promotes sufficient publicity & process transparency	

Barriers & challenges of e-tendering implementation in the construction industry

Even though there are indeed positive outcomes from the introduction of e-tendering, barriers also exist to its successful adoption. The implementation process of EP is very complex; and it is due to this complex nature of its implementation that the main benefit of EP can be achieved only in the long term (Sitar, 2011). Thus (Shukla, Khan and Shah, 2016; Sitar, 2011) categorizes the different barriers from many works of literature into four; Management barriers, organizational barriers, IT barriers, and users' barriers. According to Eadie *et al.* (2007), the first piece of research to investigate drivers and barriers of EP in the construction industry was Rankin, Chen and Christian (2006) in Canada. Accordingly, the study confirmed that the list of drivers and barriers identified from the procurement of goods and services in other industries could also be applied to the construction industry. However, Eadie *et al.* (2007) assert that with the greater complexity and nature of the construction industry, the barriers to construction EP could be performing differently to those in the general goods and services industry. This study adopted the four classification of Tran *et al.* (2011) for barriers and challenges of EP implementation in the construction industry; technology, management, organization, and environment.

CSFs of e-tendering implementation in the construction industry

[104] Since all tender documents are stored online and backed up via remote servers.

[105] The direct human interaction of procuring entities with suppliers/bidders may lead the procurement officials to get bribed or use their power for personal enrichment in this way a corruption-free process may not become possible. Changing the quoted rates or prices is also possible.

This section presents the Critical Success Factors (CSFs) that are likely to influence the success of e-tendering initiatives in the public sector, especially in the construction tendering process. Accordingly, Becker (2018) listed business process re-engineering, digital end-to-end /system integration, end-user uptake and training, top management support, security & authentication, and suppliers' adoption as a factor in assisting public authorities or entities involved in the e-tendering implementation process. In relation to this, Vaidya, Sajeev and Callender (2006) considered performance measurement, change management program, EP implementation strategy, and communication standard to be the major CSFs during EP implementation. Hence to avoid redundancy of the different CSFs considered by different researchers, the study used the following four factors identified by Tebeka and Yessuf (2019) extracted from existing works of literature. These being; top management support & employee commitment, reliability of information technology & infrastructure, reliability of legal factors, reliability of users' (buyers & suppliers) acceptance, and reliability of monitoring and evaluation system for e-tendering adoption.

PROBLEM STATEMENT

Even if the objectives of public procurement in the construction sector can be achieved through the traditional paper-based tendering, it has many inherent limitations (Emiru, 2015). To this, Elias, Ezanee, Mahidin and Shiratuddin (2005) assert the following points as some of the drawbacks of the conventional or the current construction paper-based procurement/tendering system; high processing cost, time-consuming and slow process due to human errors & manual procedures, high paper usage and storage, restricted mobility or highly dependent on geographical location of bidders. Such an over-extended procurement procedure highly affects the speed of most government-owned projects' implementation (Berhanu, 2019). The tender evaluation may become biased, unfair, and dishonest due to unprofessional or unethical procurement committees (Indah Kusumarukmi and Joko Wahyu Adi, 2019). Similarly, the leak of the lowest bid price is another problem to be considered in paper-based procurement or tendering. Corruption is a major issue in the public procurement system of developing countries and it's estimated that countries annually lose 20%-25% through their public spending through malfunction of officials and Ethiopia is no exception to this statement (Telgen and Ambaw, 2017).

A summary of the borrower's project completion report was prepared for the World Bank financed Road Sector Development Stage III projects (Adaptable Program Lending; APL 3) in 2015 and it assert that, delays in some of the assessed Ethiopian Roads Authority's (ERA's) projects implementation has occurred due to procurement related factors. Accordingly, factors including poor quality of bidding documents and designs leading to inadequate technical information are mentioned. Even if the procurement staffs at the ERA are considered to have been fully trained and capable to conduct the procurement process adequately, delays in projects were caused mainly by internal

coordination to finalize complete bidding documents ((Transport and ICT Global Practice Country department AFCE3), 2015). The report also claimed delays were attributed to the inadequate technical information, requiring several rounds of clarifications requested by bidders, thus making the process lengthy.

Tindsley and Stephenson (2008) assumed e-tendering in the construction sector to be more cost-effective and time-saving than the current, traditional method of tendering and generally claimed EP to benefit the construction industry as a whole if fully implemented. Streamlined document handling, reduced paperwork, clear audit trail, easier incorporation of later changes to be made in the tender document, and efficiency savings are some of the benefits discussed under the study. Moreover, another study shows that adopting e-tendering, especially in developing countries, helps to fight corruption that resides in the current public procurement practice by increasing transparency, increasing competition among bidders, and making information to be accessed easily during tendering (Neupane *et al.*, 2012). To this effect, the study will focus mainly on the implementation of e-tendering, in the procurement of Ethiopian federal road construction projects.

Objectives of the Study

This research aims to investigate the suitability/applicability of e-tendering in the procurement of Ethiopian federal road construction projects.

Specific Objectives

1. To assess the current practice and gaps in the procurement of Ethiopian federal road construction projects.
2. To identify the gaps that could be improved through e-tendering.
3. To identify the CSFs and barriers of e-tendering implementation in the procurement of federal road construction projects in Ethiopia.
4. To develop a framework or intervention mechanism for the implementation of e-tendering in the procurement of Ethiopian federal road construction projects.

SCOPE

Due to the limited resources & time that the researcher has, the scope of the research is limited only to the public procurement of Ethiopian federal road construction projects. The procurement cycle is limited to the tendering phase; other phases in the procurement cycle like contract management will not be covered under this study.

SIGNIFICANCE

Since public procurement is a key tool towards achieving development goals of a country, improvement in this area will enhance the performance of the industry as a whole. The study first accessed the current practice & identified the loopholes in the existing works & service procurement of Ethiopian federal road construction projects. The researcher believed that the study mainly contributes to improve the knowledge on

the values/advantages of e-tendering, its basic features, and the perceived factors affecting its implementation in the road construction sector.

Based on the findings of the research, the study came up with recommendations for improved procurement performance of the road sector and proposed e-tendering as a means to enhance the performance of the Procurement in the road sector. Thus, the value of this study lies in developing an implementation framework or a simple intervention mechanism for the adoption of e-tendering in the study area or for academic purpose as well.

METHODOLOGICAL APPROACH

A research methodology is a generic term used for the process of defining problems, gathering facts or data, analyzing data, and accomplishing objectives (Patel, 2017). It is a systematic way of solving a problem (Kothari, 2004).

Research approach: due to the nature of the research topic area, both a quantitative and qualitative research methodological approach was adopted. Accordingly, a questionnaire survey and an interview were conducted with professionals engaged in the tendering phase of the study area to assess the current practice & challenges of tendering practice, the challenges that could be improved via e-tendering, and factors affecting e-tendering adoption.

Source of data: both primary and secondary data sources were used for this particular study. The primary data was predominantly collected through a semi-structured interview and questionnaire survey. The exhaustive literature reviewed on the subject area was the major secondary source of data. Sources of literature were books, journal articles, conference proceedings, academic reports, etc.

Data source selection/sampling design: for the survey research design used, a non-probabilistic type of sampling was adopted. Since, public procurement is done at a company level, organizations were the unit of population in the study. The bounding criteria used for this study were professionals' area of operation (working for employer, contractors & consultants involved in road construction), behavior (who participated in the tendering phase of the Ethiopian Roads Authority (ERA) for a minimum of five & six years for questionnaire & interview survey respectively), educational background of professionals (people holding Bachelor of Science Degree & above in Civil Engineering or Construction Technology Management or any other related Engineering field). Based on the above-defined population, the best way of getting access to professionals involved in the tendering process of Ethiopia's Federal road construction projects was by using the concept of snowball sampling[106].

[106] Snowball sampling also known as chain referral method. It's a well-known non-probability method of survey sample selection that's commonly used to locate hidden or hard to find population and useful to approach dispersed/small population. It's commonly considered as a purposeful method of data collection in qualitative study (Naderifar, Goli and Ghaljaei, 2017).

Data source size: the concept of data saturation[107] was used to determine the appropriate sample size. Data was mainly collected through a semi-structured or partially-open ended items questionnaire survey, a semi-structured interview, and document review.

Data analysis: For this study, both content analysis & thematic analysis were used to analyze the data obtained either through interviews or document reviews. The analysis of textual data or the interview transcripts was computed using the most widely used qualitative data analysis program, QSR NUD*IST (Non-numerical Unstructured Data Indexing Searching and Theorizing) Vivo 10, also called NVivo. To analyze the data obtained from a survey questionnaire, the most widely used statistical analysis software package i.e., *Statistical Package for Social Science (SPSS)* was used. SPSS 25.0 software was used to conduct the descriptive statistics, reliability test, and to check the validity of the instrument. In addition to this, Relative Importance Index (RII) was calculated on respondents' perception during the questionnaire survey regarding the current road construction tendering practice & its challenges, potential advantages of e-tendering, and factors affecting its implementation in the study area. The calculation for RII determines the relative ranking of factors and indicates how much the top-ranked is more important than the next and so on.

RESULT AND DISCUSSION

The finding from the study indicated that more than half of the respondents (76.7% and 58.8%) from the questionnaire & interview survey respectively were Bachelor's Degree holders and 23.3% & 41.2% of the respondents from the questionnaire & interview survey respectively had a Graduate Degree. For the purpose of making the results more understandable, a query was run in NVivo i.e., word frequency query (see figure 1.2). The cloud tag in the figure underneath displayed the 200 most frequently occurring words in varying font sizes, where frequently occurring words (like tendering, procurement, evaluation, implementation, economic, efficiency, corruption, transparency…) were in large fonts. This helps to capture the whole view of responses in a single sight.

[107] Data saturation can be defined as the point in which new data tend to be redundant of data already collected. It's used in qualitative research as a criterion for discontinuing data collection and/or analysis. When similar instances or themes are seen over and over again, the researcher can be confident that a category is saturated (Baker, Waterfield and Bartlam, 2018).

Figure 1. 1 Word Frequency Query: Word Cloud *(Source: QSR NVivo.10 output)*

Current practice of paper-based construction tendering

A good procurement system or practice should be guided by the basic principles of public procurement and should be able to achieve the core objectives of the same. Accordingly, respondents (including clients, contractors, and consultants) were asked via a questionnaire & interview survey about the extent to which the current construction tendering practice promotes the basic objectives or core principles of public procurement that were identified through a literature review.

The overall RII analysis showed (transparency & openness) and (accountability of professionals for decisions made) were the two most significant principles/objectives of public procurement that the current road construction tendering practice promotes or encourages. The concept of transparency is related to constructing the criteria used for making decisions in public procurement as transparent and as clear as possible ((Federal Negarit Gazeta), 2009). Concerning this, the term openness ensures that all qualified and interested parties are included in the procurement procedures. Majority of the interviewees also witnessed that the current procurement practice is believed to be as transparent and as open as possible. (Equality & fairness) was ranked as the third principle whereas (public confidence in the procurement procedures) comes in fourth. Ensuring economic efficiency, controlling corruption, and environmentally sustainable procurement performance were the other principles and objectives of public procurement that are promoted in the current practice of tendering in the study area.

Challenges of paper-based construction tendering

Similarly, the respondents to the questionnaire were asked to rank the number of identified challenges of paper-based tendering practice on a scale of 1 (Strongly disagree) to 5 (strongly agree).

Accordingly, (Time-consuming & slow process due to manual procedures) and (demands a huge storage space & difficult documentation) were considered to be the most challenging aspects of the current paper-based construction tendering practice as per the overall RII analysis of the questionnaire survey. Some works of literature, (Elias, Ezanee, Mahidin and Shiratuddin, 2005; Patil, Waghmare and Gawande, 2016; Ren

and Kamarudin, 2016; Tindsley and Stephenson, 2008), regarding the application of e-tendering in the construction industry, agree with these results, confirming that the paper-based construction tendering demands a huge storage space and it is time taking and slow process due to manual procedures.

(High procession cost) and (highly dependent on geographical location of bidders) were ranked equally by respondents as the third most occurring challenge of paper-based construction tendering practice in the road sector. Whereas, (highly prone to human errors) was ranked fifth. Previous researches regarding e-tendering implementation in construction assert that the conventional or paper-based tendering practice is costly and has restricted mobility (Amarapathy, Jayasena and Ranadewa, 2013; Elias, Ezanee, Mahidin and Shiratuddin, 2005; Patil, Waghmare and Gawande, 2016).

Advantages of e-tendering in construction road projects

Respondents were asked about their perception regarding the possible advantages or values that could be obtained from e-tendering implementation via an interview & questionnaire survey. A formal interview was also conducted with e-tendering practitioners to assess the benefits/advantages gained through the same. Before the interview, the general understanding of the concept among participants was assessed. Figure 1.3 below shows the word tree which was generated by a text search query for the word “e-tendering” in the ‘e-tendering understanding’ theme or node created. When respondents were asked their understanding of e-tendering, they replied with various comments.

The result from the questionnaire revealed that (improves documentation & archiving) and (time-saving) are considered to be the most advantages associated with e-tendering in the road construction sector. (More sustainable tender process) and (less resource consumption) were ranked as the third & fourth most important advantages that e-tendering could bring in the road construction tendering respectively. Similarly, a study affirmed that as companies and individuals become more aware and are under more pressure to act in an environmentally friendly manner, sustainability was being an issue and it was ranked as the third most important advantage to gain through e-tendering (Lavelle and Bardon, 2009).

The overall RII analysis asserts that (improving communication & interaction among parties), (promoting data integration & fighting corruption), and (increasing competitive advantages among bidders) were the least perceived advantages to gain as compared with the other discussed values of e-tendering. However, this contradicts the findings of research conducted in Northern Ireland’s construction industry by Eadie *et al.*, (2007), whereby improving communication was ranked first as the benefit or advantages to gain from e-tendering. The findings of Eadie, Perera and Heaney, (2010), that was conducted to identify e-procurement barriers and drivers in the UK construction organizations confirmed gaining competitive advantage was one of the verified drivers to e-tendering. Making the bidding procedure more transparent to the participating

entities and easing the communication among the client and bidders were other benefits mentioned by e-tendering practitioners at the UNDP and WFP during the interview.

CSFs of e-tendering implementation

A literature review was conducted to identify the CSFs for e-tendering implementation, as a result of which twenty-one (21) factors were identified. The study asked respondents (including clients, contractors, and consultants) to rank the factors based on their opinion on the relative contribution of the factors to the successful implementation of e-tendering.

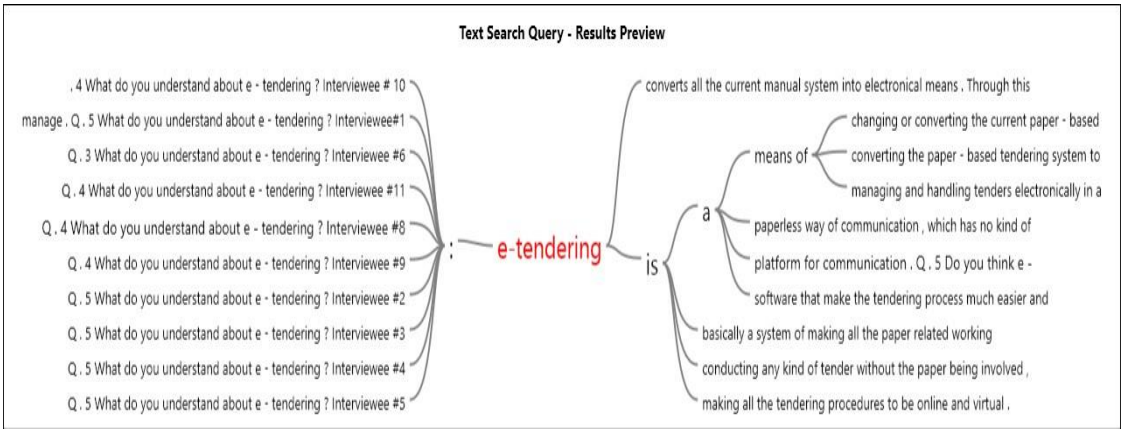

Figure 1. 2 Text Search Query: Word Tree for ‘e-tendering’

Accordingly; consistency of internet connection, availability of ICT infrastructure within an organization, compatibility of existing hardware & software with e-tendering implementation system, staff training, availability of legal & administrative procedures, provision of adequate resources, availability of legal framework, and others are the top ranked list of CSFs identified in this study during the survey. Of which the top three factors are discussed afterwards.

- **Consistency of internet connection:** was ranked first, with an RII value of .967 during the questionnaire survey. Research conducted by Tebeka and Yessuf (2019), asserted that consistency of internet connection is a crucial component for the full implementation of EP system for public procurement. The study also mentioned the concerns of many interviewees from the pilot organizations in Ethiopia selected for e-procurement implementation regarding the impact of the power outage and the slow internet connection system of the country.
- **Availability of reliable ICT infrastructure within an organization** (RII=0.949) is the reliability of information technology and infrastructure-related factor, which ranked second according to the questionnaire survey result. According to respondents’ responses during an interview, the lack of a reliable ICT infrastructure in an organization can be a challenging factor while implementing e-tendering. Provision of material was mentioned as one of the five categories

described by Boonstra (2013) where top management support is provided for the success of any information system project success. Thus, ICT infrastructure within an organization falls under this category. Naveed Sarwar, 2017 (cited in Tebeka and Yessuf (2019)) found the availability of ICT infrastructures to be one of the top three CSFs for EP adoption in Pakistan public organizations.

- **Staff training (RII=0.947):** was the third-rated CSF. The finding is consistent with research conducted by Islam and Zhu (2012) whereby adequate training of employees to enable them to take advantage of the new system is one of the three CSFs identified in the study. Similarly, Becker (2018) claims awareness-raising actions and extensive training programs to be the basic success factors for Estonia's e-government system.

NVivo generated this node model automatically by identifying various nodes (relating to CSFs affecting e-tendering implementation) in the interview responses (see figure 1.4).

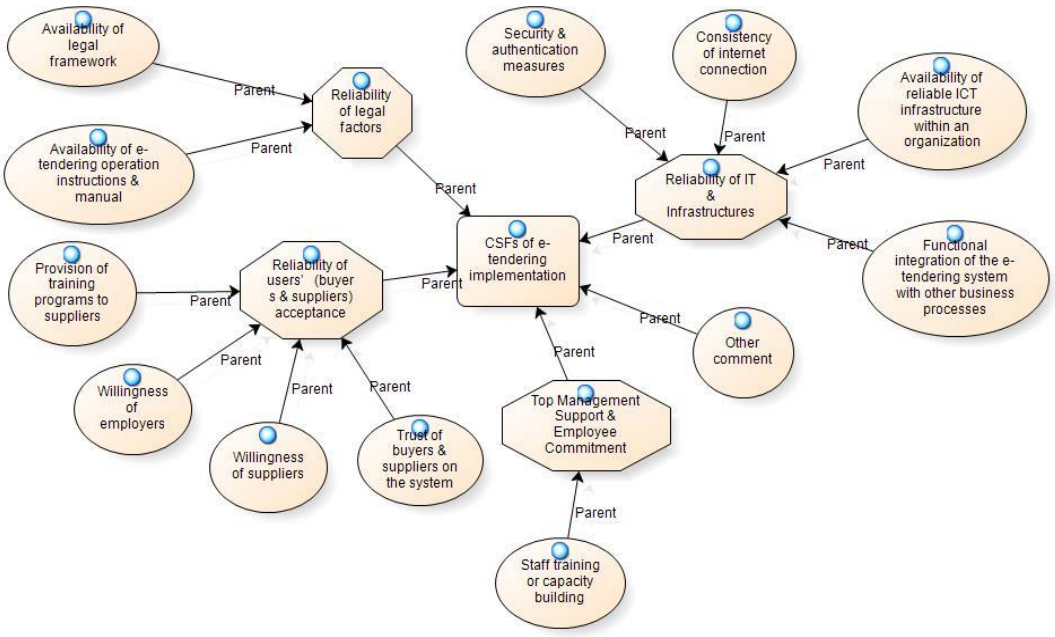

Figure 1. 3 CSFs Node Model: Relationship among Nodes

Barriers of e-tendering implementation

Sixteen (16) factors under four basic categories or groups were identified as barriers & challenges from a literature review. Respondents ranked these factors based on their understanding and perception of the concept. Accordingly, the top three ranked barriers are discussed underneath;

- **Lack of system integration (RII=.895):** was ranked first during the questionnaire survey. Interviewees also mentioned that the system needs to be checked before launching.
- **Lack of training/ capacity-building programs (RII=0.879)**: was ranked second during the questionnaire survey. As one informant advised;

"….users don't know how to use the portal, so training them is a must before trying to implement the system." Senior Procurement Officer from UNDP of the UN, Ethiopia office, e-tendering practitioners' representative.

Due to a lack of inadequate insight into how e-tendering works, users usually hesitate to use e-tendering. Another informant reiterated;

"In a similar manner, the barriers we have discussed, working on the mindset of users is very crucial. To do so, constant training or capacity building program must be given to users." Team Leader Engineering Procurement Directorate from ERA, Client's representative.

- **Challenge in shifting the mindset of users:** was one of the most frequently referenced barriers during the interview. Considering the "newness" of e-tendering practice among users, it turns out some users may be refrained from implementing it. With this regard, one practitioner of the system put it as follows;

"I think the biggest challenge while implementing e-tendering is raising the awareness of users, and suppliers as well. Since suppliers are not familiar with the system, they feel insecure and think that confidentiality issue is compromised." Supply Chain Procurement Officer from WFP Ethiopia office, e-tendering practitioner.

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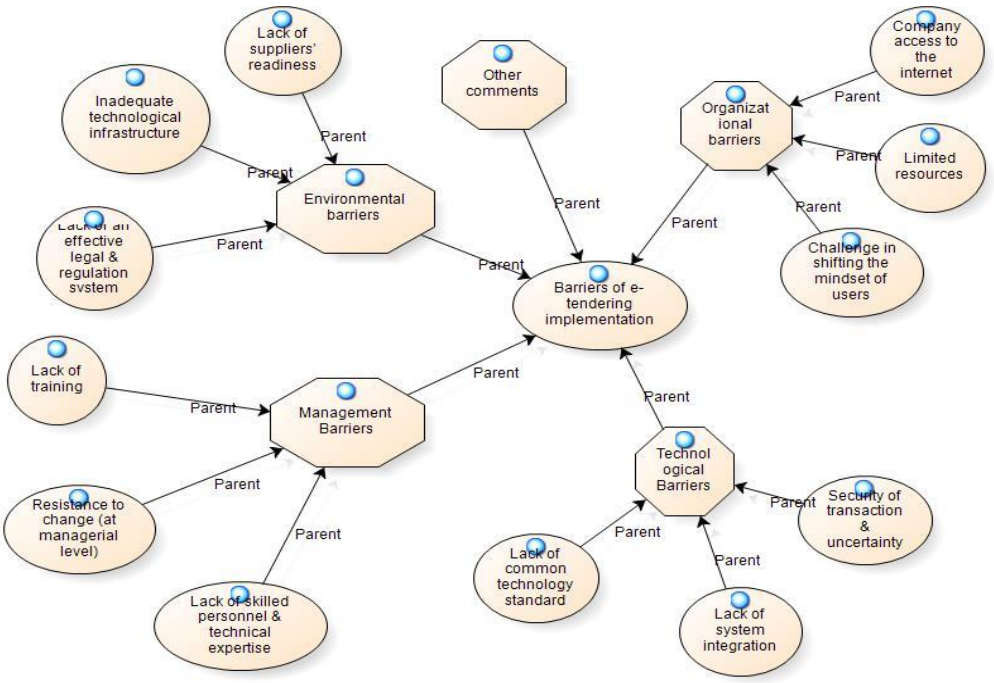


Figure 1. 4 Barriers Node Model: Relationship among nodes

Research validity & reliability check

- **Content validity: Face validity**

Eventually, a pilot test was carried out with a participation of a suitable number of volunteers to get feedback on the questions' content in the questionnaire for further amendments. Therefore, the instrument or the questionnaire's clarity, completeness, and applicability were confirmed. Similarly, the interview questions were piloted with professionals working in road construction projects with tender preparation.

- **Scale reliability: Cronbach's alpha**

A reliability test is carried out 'to check the internal consistency[108] among items of one factor' (Nguyen *et al.*, 2019). For calculating the internal consistency of items on a scale a formula[109] developed by *Lee Cronbach (in 1951)* which is called *Cronbach's alpha or α* is used in this study. While it's good to know the above formula behind the concept, for this study SPSS 25.0 was used to compute the alpha for all of the factors and items listed in the questionnaire i.e., current practice and challenges of paper-based tendering, advantages of e-tendering, CSFs & barriers of adapting e-tendering.

[108] Internal consistency is a concept related to the degree to which items on the instrument or test are consistent or measuring the same thing (Simelane-Mnisi and Mji, 2017). According to Kassem, Khoiry and Hamzah (2020), the logic behind checking the reliability of a research instrument is to assess if identical results can be obtained if respondents used it twice.

[109] The formula used to compute *Cronbach's alpha* as per Kassem, Khoiry and Hamzah (2020) is; ***α=NC/(V+(N-1)*C)*** Where; N=number of items, v=the average variance, and C=the average inter-item covariance.

Accordingly, Cronbach's alpha values for the current construction tendering practice, challenges of paper-based tendering, advantages of e-tendering, CSFs (inclusive of five sub-factors), and barriers (inclusive of four sub-factors) of e-tendering implementation are calculated at .899, .844, .804, (.841, .882, .732, .820, .674) and (.557, .799, .697, .794) respectively and all the figures are much closer to and/or higher than the minimum acceptable threshold i.e., .6.

- **Scale validity: Factor analysis**

Factor analysis (FA) is a statistical method used to determine the relationship between components of a dataset (Kapoor, 2020). Even though the questionnaire used in the study was the same for all respondents, it was not the same instrument for the researcher, since a separate FA has to be established for each instrument. Sixty-five (65) separate items were used in the questionnaire to measure five constructs or dimensions i.e., 'current construction tendering practice' & 'challenges of the paper-based tendering', 'the potential advantages of e-tendering', 'CSFs & barriers of e-tendering implementation', a separate FA was done for the five dimensions to check if the initial group from other works of literature or the factors derived from existing questionnaires holds for the data set. The researcher tested the construct validity of a 65-item instrument that measures the above five constructs.

Accordingly, Exploratory Factor Analysis (EFA) has been applied to explore or determine the most effective factors/construct on e-tendering implementation and the group of measured variables based on the data, so that some meaningful pattern can be brought out of it.

Before starting the factor analysis, a reliability test and inter correlation (criterion validity) were done. Where Cronbach's Alpha test for each item indicated an acceptable internal consistency of data and its validity for factor analysis. Similarly, an analysis of Spearman's correlations demonstrated low-to-high associations between almost all items, ranging from -.894 to .980. In summary, the magnitude of the correlations among the items was sufficient to warrant factor analysis i.e., at least two factors exist in EFA.

As the data from the questionnaire was to be used in a further analysis, it was decided to carry out an EFA using the Principal Component Analysis (PCA) factoring technique, using the most widely used Orthogonal rotation kind i.e., Varimax rotation. A Spearman's rho correlation of all the items was carried out in SPSS 25.0. From the number of rules that can be used to retain factors, Kaiser criterion or Eigen value > 1 rule & the scree plot were adopted for this study. Finally, an EFA was run on all the five dimensions separately. Accordingly;

- **Current practice of road construction tendering:** the KMO test for the 'current road construction tendering practice' had a value of .882, which is higher than acceptable value of .5 and the value of Bartlett's test of sphericity is estimated at 363 and p-value is .00, which is highly significant. Accordingly, the analysis of principal components (factors) for this dimension using a scree plot resulted in

one factor that explained 59.16% of the total variance[110] with eigenvalues greater than 1 (4.73).

- **Challenges of paper-based road construction tendering:** the KMO measure was .815 much above the minimum .5 required for sampling adequacy, whereas the significance level resulting .000 of the Bartlett's test of sphericity showed this construct could be seen as a correlation matrix, indicating that further factor analysis would be possible**.**

The total variance explained indicated that 70.26% of the total variance could be explained by the first three factors of the construct, as the Eigen value is greater than 1. Finally, the communalities values showed the extracted values for each item in the construct are well over the required level of .40. However, only two items were included under factor three. Unless a strong theoretical and practical reason exists, on average three to five items should exist under each factor (J *et al.*, 2010; Raubenheimer, 2004). Since latent variable having two items are likely to have low reliability, deletion of factor three or items under this factor (CPBT 4[111] and/or CPBT 5[112]) was recommended. Due to this, instead of deleting both items, only item CPBT 5 was deleted. This was because the reliability of the construct showed a better result when item CPBT 5 was deleted than item CPBT 4.

An EFA was re-run on the remaining 9 items and as per the second model, the items were structured into two factors i.e., process related challenges and resource related challenges. These 2 factors explain 63% of the variability in the challenges of paper-based tendering practice, with the first factor explaining 38% and the second factor explaining 25%.

- **Advantages of e-tendering:** the KMO measure was .774 much above the minimum .5 required for sampling adequacy, whereas the significance level resulting .000 of the Bartlett's test of sphericity showed the construct could be seen as a correlation matrix, indicating that further factor analysis would be possible**.** When an EFA was run, similar items came under three different factors and some factors did not adequately converge into expected factors. This in turn made naming the factors difficult.

In addition to this, factor 3 consisted only one item AET10[113]. Even if, a single item under a latent variable is not recommended for a better model building and explanation as per J et al. (2010), based on the researcher's empirical and conceptual knowledge/experience some problematic variables maybe ignored

[110] As a general rule the proportion of the total variance explained by the retained factors should be at least 50% (Samuels, 2016).
[111] CPBT4: (Dependent on geographical location of bidders).
[112] CPBT5: (Poor audit trail).
[113] AET10: (Improves documentation & archiving).

and solution may be interpreted as it is. Therefore, item AET10 was not deleted based on rigid statistics due to the true meaning that the item was carrying.

Hence naming our factors is only for the purpose of communicating, all items under these dimensions were kept as they were initially (under one factor) and the fact that the researcher addressed the smaller sample size or data set taken for the study i.e., 86 may have attributed for such deviation.

- **CSFs of e-tendering implementation:** the KMO measure (.685) and Bartlett's test for this construct showed conducting further FA was possible. Accordingly, the first round of FA produced 21 items under 6 different factors that explained 70.7% of the total variance, in the data while each factor presented eigenvalues greater than 1 (3.49, 3.19, 2.76, 2.24, 1.97, and 1.22) after rotation and explained (16.62%, 15.17%, 13.13%, 10.64%, 9.37%, and 5.80%) of the scale's variance, respectively.

However, while looking at the rotated component matrix, factor 6 only consisted of two items (CSF 4.1[114] & CSF 5.1[115]) and item CSF4.1 seems to cross-load on two components/factors i.e., factor loading value of .539 and .588 on factors 3 and 6 respectively. Among the options available to eliminate cross-loading, which is to look at their commonalities (values less than 0.4 are viewed insufficient), employ alternative rotation (to define a simpler structure), and/or to consider possible deletion of that particular item. Even if, the commonality of item CSF4.1 is .688 i.e., above the minimum threshold and other alternative rotations have been applied to define a better structure, a cross-loading of the item persists. Therefore, the item was deleted and the second model was developed with a better factor structure and cross-loading was no longer an issue.

The second round of EFA produced 20 items under 5 factors that have the most impact on e-tendering implementation and are extracted with initial eigenvalues of more than 1.0 and the % of variance explained by these components is higher than 50% i.e., 67.6%. These five factors as per the analysis are; Reliability of information communication & technology; Top management support & employee commitment; Reliability of users' acceptance; Reliability of legal factor; and Reliability of monitoring & evaluation system.

- **Barriers of e-tendering implementation:** the KMO measure (.54) and Bartlett's test for this construct showed conducting further FA was possible. The first round of FA produced 16 factors. The analysis of the principal component using scree plot test and Kaiser criterion for the CSFs construct resulted in 5 factors that explained 71.68% of the total variance, in the data while each factor presented

[114] CSF 4.1: (Trust of buyers & suppliers on the system)
[115] CSF 5.1: (Existence of a project management team to monitor & evaluate the progress of its implementation)

eigenvalues greater than 1 (2.71, 2.67, 2.35, 2.14, and 1.59) after rotation and explained (16.96%, 16.69%, %, 14.69%, 13.37%, and 9.95%) of the scale's variance, respectively.

However, while looking at the rotated component matrix, factor 4 only consisted of two items (Bar 3.3[116] & Bar 1.2[117]) and item Bar 1.2 seems to cross-load on two components/factors. Since latent variable having two items are likely to have low reliability, deletion of factor four or items under this factor was recommended. Due to this, instead of deleting both items, only item 'Bar 3.3' was deleted. This was because the original reliability of the respective construct showed a better result when item Bar 3.3 was deleted than item Bar 1.2. On top of that, the analysis result from the questionnaire showed that item Bar 1.2 was ranked on the top ten challenging factors, whereas item Bar 3.3 was not. This can be taken as an empirical evidence to keep the item i.e., Bar 1.2. as EFA was re-run after deletion of an item and the second model came up with four factors i.e., Environmental barriers; Managerial barriers; organizational barriers; and technological barriers.

Framework development & validation

Following the analysis of the transcripts, document review, and the questionnaire survey, this section presents a framework (see Figure 1.7) that organizes the aspects identified and addressed the fourth objective of this research. The developed framework was validated via a focus group discussion involving four experts from the consultant representative and using an informal interview with four and three experts from the client and contractor's representative respectively. Based on the comments & suggestions forwarded during the discussion, some amendments were made accordingly. In addition to this, the developed framework was rated among participants for its clarity, comprehensiveness, simplicity, relevance, and future applicability. Based on the result of the same, the developed framework for e-tendering implementation was found to be clear and simple to understand.

CONCLUSION

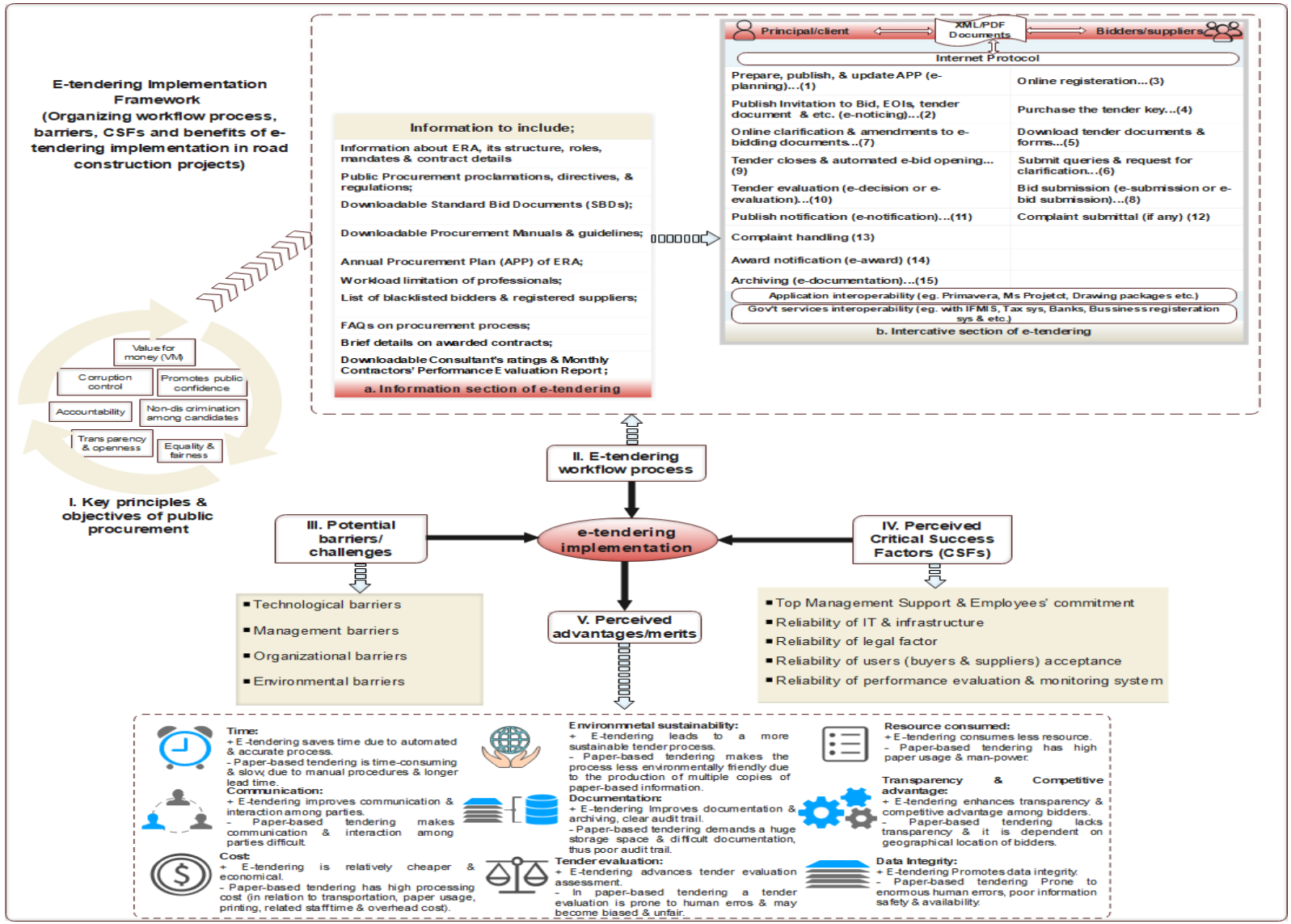
From the survey conducted it can be concluded that most of the public procurement principles & values like; transparency & openness, accountability of professionals, equality & fairness, public confidence in the procurement procedures, ensuring economic efficiency are promoted by the current tendering practice of road construction projects. However, a number of challenges occur in the paper-based road construction tendering process. Based on the data obtained from the interview & questionnaire survey, the research indicated that time consuming & slow process due to manual

[116] Bar3.3: (Company access to the internet)
[117] Bar 1.2: (Insufficient assessment of systems before installation)

procedures, difficult documentation & demanding huge storage space, dependent on geographical location of bidders, high processing cost, poor data integrity & composition, poor audit trail, and difficult communication & interaction were the most frequently mentioned challenges of the paper-based tendering practice in the study area.

As a result of examining the second aim of this study, it can be generalized that e-tendering was perceived to be advantageous and would be able to improve most of the challenges of paper-based tendering discussed above. In line with this, the survey analysis of the participants' perception regarding the potential advantages to gain from e-tendering has shown that improved documentation & archiving, time-saving, a more sustainable tender process, less consumption of resources, relatively cheaper & economical were some of the top ranked advantages of e-tendering. An interview conducted with the system's practitioners also proved the advantages of e-tendering in construction projects. Even though e-tendering was perceived to be advantageous among participants, its success in implementation depends on a number of factors. Since the introduction of the system by the GoE is still at its elementary level, factors affecting its future implementation were considered by taking the perception of experts in the study area into account. Similarly, FA categorized 16 barriers of e-tendering implementation that were identified from the literature review, under four groups; Environmental, managerial, organizational, and technological barriers. Based on the findings derived from the last aim of the study, the developed framework was validated using a focus group discussion and an informal interview with professionals and experts. Accordingly, based on the discussion and comments, some adjustments were made and later incorporated in the implementation framework.

Figure 1. 5 E-tendering implementation framework for road construction projects



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Appendix 2: Survey questionnaire

Ethiopian Institute of Architecture, Building Construction, and City Development, (EiABC), Addis Ababa University

Department of Construction Management (School of Graduates)

Dear participants,

I am undertaking research titled ***"Innovative Tendering Practice: E-tendering Applicability for the Procurement of Federal Road Construction Projects"*** as partial fulfillment of my M.Sc study in Construction Management at Addis Ababa University.

The questionnaire is developed to assess the current practice of construction tendering in the road sector along with its challenges, to identify the Critical Success Factors (CSFs) & barriers of *e-tendering* adaption in the construction industry as per the respondents' perception.

Filling out the questionnaire will take approximately 8 (Eight) minutes. I would like to assure you that your responses will be kept confidential and will be used for academic and research purposes only.

Thank you for your invaluable time & cooperation!

Kind Regards,

Hilina Belachew/Researcher

General direction

Please consider each question in terms of your organization's experience and/or your professional experience in general. Please indicate your responses by ***ticking (X or √) mark*** *at the appropriate box/es or by filling the blank spaces provided.*

Section I: Respondents' professional & educational background assessment

This section surveys the professional background of the respondents.

1. Area of operation of the company you are working in;

   Consultant ☐ Contractor ☐ Employer ☐ If other (specify)___

2. Your highest level of education *(in Civil Engineering or Construction Technology Management or other related Engineering field of study);*

   Certificate/Diploma ☐ Bachelor Degree ☐ Master's Degree and above ☐

3. Your current position in the company;

   Contract Administrator ☐ Contract Engineer or Claims Expert ☐

   Procurement Team Leader ☐ Project Engineer ☐

   If other (specify)_____

4. Years of experience working in the procurement or tendering phase of Federal Road Construction projects;

   ≥ 10 - <15 (From 10 to 15 years) ☐ ≥ 7 - <10 (From 7 to 10 years) ☐

   ≥5 - <7 (From 5 to 7 years) ☐ ≥3 - <5 (From 3 to 5 years) ☐

   If other (specify)_____

5. Overall professional experience in the road construction sector;

   ≥ 10 - <15 (From 10 to 15 years) ☐ ≥ 7 - <10 (From 7 to 10 years) ☐

   ≥5 - <7 (From 5 to 7 years) ☐ ≥3 - <5 (From 3 to 5 years) ☐

   If other (specify)_____

Section II: Current road construction tendering practice assessment

1. To what extent do you think the current construction tendering practice in the road sector promotes the following core principles or objectives of public procurement;

*The rating system ranges from **1 (Strongly Disagree)** to **5 (Strongly Agree)** to gauge the significance of the current road construction tendering system for promoting the core principles or objectives of public procurement.*

	Current road construction tendering practice (CCTPA)	**Strongly Agree**	**Agree**	**Neither Agree nor Disagree**	**Disagree**	**Strongly Disagree**
1.	Encourages *transparency & openness*					
2.	Promotes *equality & fairness*					
3.	Ensures *economic efficiency* or value for money					
4.	Promotes *confidentiality & accuracy* of information					
5.	Advocates *accountability* of professionals for decisions made					
6.	*Environmentally sustainable* procurement performance					
7.	Promotes public confidence in the procurement procedures					
8.	Controls *corruption*					

2. What are the challenges of the paper-based (traditional) road construction tendering practice?

	Challenges of paper-based road construction tendering (CPBT)	**Strongly Agree**	**Agree**	**Neither Agree nor Disagree**	**Disagree**	**Strongly Disagree**
1.	High processing cost (in relation to transportation, paper usage, & printing)					
2.	Time-consuming & slow process due to manual procedures					
3.	Prone to enormous human errors					
4.	Dependent on the geographical location of bidders					
5.	Poor audit trail					

	Challenges of paper-based road construction tendering (CPBT)	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
6.	Demands a huge storage space & difficult documentation					
7.	A tender evaluation may become biased & unfair					
8.	Difficult communication & interaction among parties					
9.	Lacks transparency					
10.	Poor information safety & availability					

3. Can you say the current road construction tendering practice is computerized or automated in terms of monitoring & administering the tendering process?

   Yes ☐ No ☐ Maybe ☐

4. If your answer is '*yes*' to the previous question, which of the following tendering process is automated;

   Tender notification/advertisement ☐ Clarification to queries & addendum ☐

   Tender submission ☐ Bid opening ☐

   Bid evaluation ☐ Contract award & formation ☐

   Documentation/archiving tender documents & proposals ☐

Section III: Values of e-tendering in the Ethiopia construction industry

e-tendering is the process of entering and conducting a tendering process electronically, where bidders undertake the whole tendering process through electronic media (Ren and Kamarudin, 2016).

1. In general, do you think e-tendering is beneficial to the current Ethiopian federal road construction procurement process?

   Yes ☐ No ☐ Maybe ☐

2. If your answer is '*Yes*', rate its importance in the construction industry to your perception of the concept. Tick in the box.

	Advantages of e-tendering (AET)	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
1.	Relatively *cheaper & economical*					
2.	Leads to a more *sustainable* tender process					
3.	*Time-saving*					
4.	Increases *competitive advantage* among bidders					
5.	Consumes *less resource*					
6.	Enhances *transparency*					
7.	Promotes *data integrity*					
8.	*Advanced tender evaluation assessment*					
9.	I*mproves communication* & interaction among parties					
10.	Improves documentation & archiving					

3. If your answer is *'No'* to question no.1, then state your basic reasons for saying so;

Section IV: Critical Success Factor (CSFs) & barriers of adapting e-tendering in the Ethiopian Construction industry

This section ranks the CSFs (Critical Success Factors) & barriers of e-tendering adaption in the construction sector as per the respondents' perception.

CSFs *are defined as areas or functions where events & actions must occur to ensure the successful adoption of e-tendering.* ***Barriers*** *are determinant factors that hinder the successful adoption or implementation of e-tendering.*

I.	Critical Success Factors (CSFs) of e-tendering adaption	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
CSF 1.	**Top management support & employee commitment**					
1.1	Staff training/capacity building					
1.2	Provision of adequate resources					
1.3	Employee's commitment					
1.4	The skill of procurement employees with IT perspective					
1.5	E-tendering implementation strategy					
CSF 2.	**Reliability of Information Technology & infrastructure**					
2.1	Consistency of internet connection					
2.2	Availability of reliable ICT infrastructure within an organization					
2.3	Compatibility of existing hardware & software with the e-tendering implementation system					
2.4	Functional integration of the e-tendering system with other business processes					
2.5	Security & authentication measures					
CSF 3.	**Reliability of legal factors**					
3.1	Availability of e-tendering operation instructions & manual					
3.2	Availability of legal & administrative procedures					
3.3	Availability of legal framework					
CSF 4.	**Reliability of users' (buyers & suppliers) acceptance**					
4.1	Trust of buyers & suppliers on the system					
4.2	The willingness of employers to use e-tendering					
4.3	The willingness of suppliers to adopt e-tendering					
4.4	Provision of training programs to suppliers					
CSF 5.	**Reliability of monitoring & evaluation system**					

I.	Critical Success Factors (CSFs) of e-tendering adaption	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
5.1	Existence of a project management team to monitor & evaluate the progress of its implementation					
5.2	Continuous performance evaluation & feedback					
5.3	Compliance with rules & regulations is ensured					
5.4	Checking procurement guidelines are practiced & monitored					

II.	Challenges & barriers of e-tendering adaption	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
Bar 1.	**Technological barriers**					
1.1	Lack of system integration i.e., interoperability & compatibility with other systems					
1.2	Insufficient assessment of systems before installation					
1.3	Security of transaction & uncertainty (confidentiality violation)					
1.4	Lack of common technology standard					
Bar 2.	**Management barriers**					
2.1	Lack of skilled personnel & technical expertise					
2.2	Lack of training/capacity building programs					
2.3	Resistance to change (at managerial level)					
2.4	Lack of leadership/upper management support					
Bar 3.	**Organizational barriers**					
3.1	Staff turnover					
3.2	Limited resources i.e. financial resource & time					
3.3	Company access to the internet					
3.4	Challenge in shifting the mindset of users					
Bar 4.	**Environmental barriers**					

II.	Challenges & barriers of e-tendering adaption	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
4.1	Inadequate technological infrastructure					
4.2	Lack of national IT policy relating to EP issues					
4.3	Lack of an effective legal & regulation system					
4.4	Lack of suppliers' readiness					

Please kindly check no points are skipped, Thank You!

Appendix 3: Interview questions

The interview questions are prepared based on the literature review. The questions are carefully designed to encourage interviewees to reveal accurate and detailed information as much as possible.

Appendix 3.1: For Employer (For ERA's Procurement Team Leader/Top Level Management)

1. Tell me about the current construction tendering practice in the road sector, as per your professional experience and observation, in terms of the following core principles & objectives of public procurement;
    e) In terms of encouraging openness & transparency b) In terms of promoting economic efficiency c) In terms of promoting public confidence in the procurement procedures d) In terms of promoting equality and fairness
    f) In terms of eliminating corruption in the public procurement
    g) In terms of keeping the environment sustainable g) In terms of accountability for decisions made
2. Tell me the procedures for the following tendering system components;
    a) To advertise tender b)To respond to queries from bidders

c) For a bid evaluation d) For a bid opening e) To award tender

f) For archiving tender documents

3. Tell me about the flaws/problems of the overall paper-based tendering practice, in terms of the above-listed tendering system components.
4. What do you think are the effects of these problems on your organization? For example in terms of cost, time, resource, transparency of the system, accountability, economic efficiency &, etc.
5. Tell me your understanding about 'e-tendering'.
6. How do you think e-tendering would benefit the parties involved in tendering or the construction industry in general? For instance, in terms of improving the above-raised problems of the current paper-based tendering process.
7. Identifying the challenges & success factors helps to identify the success of e-tendering initiatives in the public sector.
    - Accordingly, in your opinion, tell me what the most important CSFs are to facilitate the success of e-tendering implementation.
    - Tell me your perception about the main barriers faced so far or predicted to exist in the future stage of its implementation.

Appendix 3.2: For Bidders (Consultants & Contractors)

1. What is your say about the current construction tendering practice in the road sector, as per your professional experience and observation, in terms of the following core principles & objectives of public procurement;

    a) In terms of encouraging openness & transparency b) In terms of promoting economic efficiency c) In terms of promoting public confidence in the procurement procedures d) In terms of promoting equality and fairness

    e) In terms of eliminating corruption in the public procurement f) In terms of keeping the environment sustainable g) In terms of accountability for decisions made
2. Tell me the flows/problems of the overall paper-based tendering, in terms of the above-listed tendering system components.

3. What do you think are the effects of these problems on your organization? For example in terms of cost, time, resource, transparency of the system, accountability, economic efficiency &, etc.
4. Tell me your understanding about 'e-tendering'.
5. Do you think e-tendering is beneficial to the current tendering practice in the road sector?
6. If *'Yes',* tell me how you think e-tendering would benefit the parties involved in tendering phase or the construction industry in general. For instance, in terms of improving the above raise problems of the current paper-based tendering process.
7. If *'No',* tell me your reason for saying so?
8. Identifying the challenges & success factors helps to identify the success of e-tendering initiatives in the public sector.
    - Accordingly, in your opinion, tell me what the most important CSFs are to facilitate the success of e-tendering implementation.
    - Tell me your perception about the main barriers faced so far or predicted to exist in the future stage of its implementation.

Appendix 3.3: For EP Pilot organizations and/or e-tendering practitioners

1. To what extent has your company started implementing e-procurement?
2. What are the main **barriers or challenges** faced so far during its implementation? It might be about **legal issues** (if there is any legal framework developed or planned to adapt), **organization** (organizational structure, change in shifting the mindset of people, company's consistent access to the internet, program compatibility issues), **management** (provision of financial, human resources & materials, change management programs, developed implementation framework) &, etc.
3. What measures were taken to overcome these challenges?
4. Tell me what you think are the most important success factors for e-tendering implementation.

5. Which e-procurement platforms are being implemented first? Does the implementation includes the whole package all at once or is it progressive?
6. How did your company benefit from e-tendering adaption or the possible advantages you could get in the future? In terms of cost, time, resource, transparency of the system, and with regard to promoting the principles & objectives of public procurement (if applicable to your company).

Appendix 3.4: For E-GP center at FPPPAA

1. What has been done so far regarding e-GP's implementation? Tell me the current status.
2. How do you rate your progress relative to the implementation timeline stated under the strategy & action plan?
3. Which country's e-GP system is planned to adopt or use as a benchmark (international best practice), along with Ethiopia's context?
4. Tell me the main barriers faced so far or predicted to exist in the future stage of its adaption/implementation.
5. What measures were taken or planned to overcome these barriers & challenges?
6. If you've to state or rate the most important CSF for e-GP's implementation in Ethiopia as per your observation & experience, what could it be?

Appendix 4: Framework validation questionnaire

Ethiopian Institute of Architecture, Building Construction, and City Development, (EiABC), Addis Ababa University

Department of Construction Management (School of Graduates)

Subject: Requesting your sincere assistance in participating as key respondents to validate the framework indicated below

Research title: Innovative Tendering Practice: E-tendering Applicability for the Procurement of Federal Road Construction Projects

Dear Sir/ Madam;

This MSc research work aims to develop a **conceptual e-tendering implementation framework** for federal road construction projects by critically assessing the current paper-based tendering practices along with its challenges, potential advantages of e-tendering, and factors affecting e-tendering implementation in the study area. The researcher strongly believes that the study output will contribute not only to academic purposes but also to practical applications in the proper implementation of the system in the construction sector.

With this brief background, we kindly request your participation in responding to the survey to validate the framework, which will be highly valuable and necessary for the attainment of the research objectives. I strongly believe your rich experiences and professional analysis will significantly contribute to the quality of the research output. Your response will be treated in strict confidence and will be used solely for the study. The detailed content of the questionnaire is attached to this letter. I would like to thank you in advance for your valuable time and for sharing your rich experiences in the sector.

Sincerely,

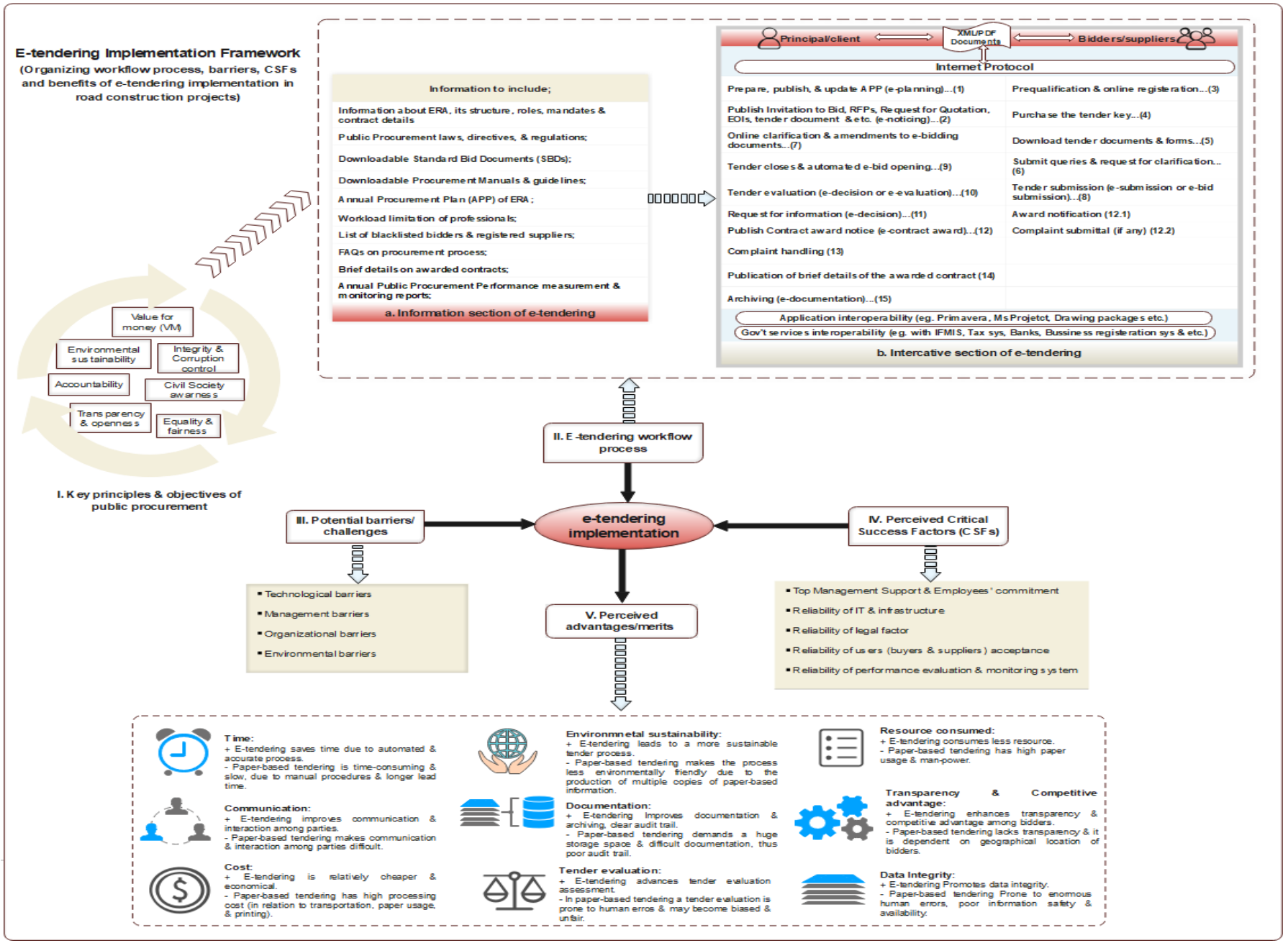
Hilina Belachew (Researcher)

Framework validation

From the developed framework for e-tendering implementation in the road sector and its brief description provided on the next pages, please state your level of agreement with the framework using the themes and the options in each case below.

*The rating system ranges from **1 (Strongly Disagree)** to **5 (Strongly Agree)**. Please indicate your responses by **ticking (X or √) mark** at the appropriate box/es.*

	Strongly Agree	**Agree**	**Neither Agree nor Disagree**	**Disagree**	**Strongly Disagree**
The Framework is clear					
The Framework is simple					
The Framework is comprehensive					
The Framework is relevant					
Future applicability					


E-tendering Implementation Framework
(Organizing workflow process, barriers, CSFs and benefits of e-tendering implementation in road construction projects)
Information to include;
Information about ERA, its structure, roles, mandates & contract details
Public Procurement laws, directives, & regulations;
Downloadable Standard Bid Documents (SBDs);
Downloadable Procurement Manuals & guidelines;
Annual Procurement Plan (APP) of ERA;
Workload limitation of professionals;
List of blacklisted bidders & registered suppliers;
FAQs on procurement process;
Brief details on awarded contracts;
Annual Public Procurement Performance measurement & monitoring reports;
a. Information section of e-tendering
Principal/client
XML/PDF Documents
Bidders/suppliers
Internet Protocol
Prepare, publish, & update APP (e-planning)...(1)
Publish Invitation to Bid, RFPs, Request for Quotation, EOIs, tender document &etc. (e-noticing)...(2)
Online clarification & amendments to e-bidding documents...(7)
Tender closes & automated e-bid opening...(9)
Tender evaluation (e-decision or e-evaluation)...(10)
Request for information (e-decision)...(11)
Publish Contract award notice (e-contract award)...(12)
Complaint handling (13)
Publication of brief details of the awarded contract (14)
Archiving (e-documentation)...(15)
Prequalification & online registeration...(3)
Purchase the tender key...(4)
Download tender documents & forms...(5)
Submit queries & request for clarification...(6)
Tender submission (e-submission or e-bid submission)...(8)
Award notification (12.1)
Complaint submittal (if any) (12.2)
Application interoperability (eg. Primavera, Ms Projetct, Drawing packages etc.)
Gov't services interoperability (eg. with IFMIS, Tax sys, Banks, Bussiness registeration sys & etc.)
b. Intercative section of e-tendering
Value for money (VM)
Environmental sustainability
Integrity & Corruption control
Accountability
Civil Society awarness
Transparency & openness
Equality & fairness
I. Key principles & objectives of public procurement
II. E-tendering workflow process
III. Potential barriers/ challenges
e-tendering implementation
IV. Perceived Critical Success Factors (CSFs)
Technological barriers
Management barriers
Organizational barriers
Environmental barriers
V. Perceived advantages/merits
Top Management Support & Employees' commitment
Reliability of IT & infrastructure
Reliability of legal factor
Reliability of users (buyers & suppliers) acceptance
Reliability of performance evaluation & monitoring system
Time:
+ E-tendering saves time due to automated & accurate process.
- Paper-based tendering is time-consuming & slow, due to manual procedures & longer lead time.
Communication:
+ E-tendering improves communication & interaction among parties.
- Paper-based tendering makes communication & interaction among parties difficult.
Cost:
+ E-tendering is relatively cheaper & economical.
- Paper-based tendering has high processing cost (in relation to transportation, paper usage, & printing).
Environmnetal sustainability:
+ E-tendering leads to a more sustainable tender process.
- Paper-based tendering makes the process less environmentally friendly due to the production of multiple copies of paper-based information.
Documentation:
+ E-tendering Improves documentation & archiving, clear audit trail.
- Paper-based tendering demands a huge storage space & difficult documentation, thus poor audit trail.
Tender evaluation:
+ E-tendering advances tender evaluation assessment.
- In paper-based tendering a tender evaluation is prone to human erros & may become biased & unfair.
Resource consumed:
+ E-tendering consumes less resource.
- Paper-based tendering has high paper usage & man-power.
Transparency & Competitive advantage:
+ E-tendering enhances transparency & competitive advantage among bidders.
- Paper-based tendering lacks transparency & it is dependent on geographical location of bidders.
Data Integrity:
+ E-tendering Promotes data integrity.
- Paper-based tendering Prone to enormous human errors, poor information safety & availability.

Appendix 5: Codes used for observed variables

Codes		Description of observed variable
CCTPA: Current construction tendering practice assessment	CCTPA1	Encourages transparency
	CCTPA2	Promotes fair competition & prevents discrimination
	CCTPA3	Encourages economic efficiency
	CCTPA4	Promotes confidentiality & accuracy of information
	CCTPA5	Advocates accountability of public sectors spending
	CCTPA6	Environmentally sustainable procurement performance
	CCTPA7	Ensures value for money
	CCTPA8	Controls corruption
CPBT: Challenger of paper-based construction tendering	CPBT1	High processing cost (in relation to transportation, paper usage & printing)
	CPBT2	Time-consuming & slow process due to manual procedures
	CPBT3	Prone to human errors
	CPBT4	Dependent on geographical location of bidders
	CPBT5	Poor audit trail
	CPBT6	Demands a huge storage space & difficult documentation
	CPBT7	Tender evaluation may become biased & unfair
	CPBT8	Difficult communication & interaction among parties
	CPBT9	Lacks transparency
	CPBT10	Poor information safety and availability
AET: Advantages of e-tendering	AET1	Relatively cheaper & economical
	AET2	Leads to a more sustainable tender process
	AET3	Time-saving
	AET4	Increases competitive advantage among bidders
	AET5	Consumes less resource
	AET6	Enhances transparency
	AET7	Promotes data integrity & fights corruption
	AET8	Advanced tender evaluation assessment
	AET9	Improves communication & interaction among parties
	AET10	Improves documentation & archiving
CSF1: Top Management	CSF1.1	Staff training/capacity building
	CSF1.2	Provision of adequate resources

Codes		Description of observed variable
support & employee commitment	CSF1.3	Employee's commitment
	CSF1.4	The skill of procurement employees with IT perspective
	CSF1.5	E-tendering implementation strategy
CSF2: Reliability of Information Technology & infrastructure	CSF2.1	Consistency of internet connection
	CSF2.2	Availability of reliable ICT infrastructure within an organization
	CSF2.3	Compatibility of existing hardware & software with the e-tendering implementation system
	CSF2.4	Functional integration of the e-tendering system with other business processes
	CSF2.5	Security & authentication measures
CSF3: Reliability of legal factor	CSF3.1	Availability of e-tendering operation instructions & manual
	CSF3.2	Availability of legal & administrative procedures
	CSF3.3	Availability of legal framework
CSF4: Reliability of users' (buyers & suppliers) acceptance	CSF4.1	Trust of buyers & suppliers on the system
	CSF4.2	The willingness of employers to use e-tendering
	CSF4.3	The willingness of suppliers to adopt e-tendering
	CSF4.4	Provision of training programs to suppliers
CSF5: Reliability of monitoring & evaluation system	CSF5.1	Existence of a project management team to monitor & evaluate the progress of its implementation
	CSF5.2	Continuous evaluation & feedback
	CSF5.3	Compliance with rules & regulations is ensured
	CSF5.4	Checking procurement guidelines are practices & monitored
Bar1: Technological barriers	Bar1.1	Lack of system integration i.e. interoperability & compatibility with other systems
	Bar1.2	Insufficient assessment of systems before installation
	Bar1.3	Security of transaction & uncertainty (confidentiality violation)
	Bar1.4	Lack of common technology standard
Bar2: Management barriers	Bar2.1	Lack of skilled personnel & technical expertise
	Bar2.2	Lack of training/capacity building programs
	Bar2.3	Resistance to change (at managerial level)
	Bar2.4	Lack of leadership/upper management support

Codes		Description of observed variable
Bar3: Organizational barriers	Bar3.1	Staff turnover
	Bar3.2	Limited resources i.e., financial resource & time
	Bar3.3	Company access to the internet
	Bar3.4	Challenge in shifting the mindset of users
Bar4: Environmental barriers	Bar4.1	Inadequate technological infrastructure
	Bar4.2	Lack of national IT policy relating to EP issues
	Bar4.3	Lack of an effective legal & regulation system
	Bar4.4	Lack of suppliers' readiness

Appendix 6: Ranking of factors using RII

Appendix 6.1: Ranking of current road construction tendering practice

No.	Current road construction tendering practice	Consultant			Contractor			Client			Overall		
		Total ranked	RII	Rank	Total ranked score	RII	Rank	Total ranked score	RII	Rank	Total ranked score	RII	Rank
1	Encourages *transparency & openness*	109	0.70	1	108	0.64	4	73	0.695	2	**290**	**0.67**	**1**
2	Promotes *equality & fairness*	95	0.61	6	104	0.61	5	75	0.714	1	**274**	**0.64**	**3**
3	Ensures *economic efficiency*	98	0.63	5	109	0.64	3	62	0.590	5	269	0.63	5
4	Promotes *confidentiality & accuracy* of information	104	0.67	2	97	0.57	6	66	0.628	3	267	0.62	6
5	Advocates *accountability* of professionals for decisions made	99	0.64	4	113	0.66	1	65	0.619	4	**277**	**0.64**	**2**
6	*Environmentally sustainable* procurement performance	91	0.59	7	95	0.56	7	59	0.561	7	245	0.57	7
7	Promotes public confidence in the procurement procedures	102	0.66	3	110	0.65	2	60	0.571	6	272	0.63	4
8	Controls *corruption*	86	0.55	8	77	0.45	8	57	0.542	8	220	0.51	8

Appendix 6.2: Ranking of challenges of paper-based road construction tendering

No.	Challenges of paper-based tendering	Consultant			Contractor			Client			Overall		
		Total rank	RII	Rank	Total ranked score	RII	Rank	Total ranked score	RII	Rank	Total ranked score	RII	Rank
1	High processing cost (in relation to transportation, paper usage, and printing)	101	0.65	10	140	0.823	6	89	0.85	3	**357**	**0.83**	**3**
2	Time-consuming & slow process due to manual procedures	136	0.88	2	153	0.900	1	93	0.89	2	**382**	**0.89**	**1**
3	Highly prone to enormous human errors	131	0.85	4	148	0.870	3	71	0.68	7	350	0.81	5
4	Dependent on the geographical location of bidders	141	0.91	1	133	0.782	7	83	0.79	4	**357**	**0.83**	**3**
5	Demands a huge storage space & difficult documentation	135	0.87	3	147	0.864	4	97	0.92	1	**379**	**0.81**	**2**
6	Poor audit trail	126	0.81	5	132	0.776	8	76	0.72	5	334	0.76	7
7	A tender evaluation may become biased & unfair	121	0.78	6	150	0.882	2	74	0.70	6	345	0.78	6
8	Difficult communication & interaction among parties	108	0.70	9	120	0.705	10	64	0.61	9	292	0.68	9
9	Lacks transparency	112	0.72	7	127	0.747	9	51	0.48	10	290	0.67	10
10	Poor information safety & availability	111	0.72	8	143	0.841	5	70	0.67	8	324	0.75	8

Appendix 6.3: Ranking of Perceived advantages of e-tendering

No.	Advantages of e-tendering	Consultant			Contractor			Client			Overall		
		Total ranked score	RII	Rank	Total ranked score	RII	Rank	Total ranked score	RII	Rank	Total ranked score	RII	Rank
1	Relatively *cheaper & economical*	127	0.85	6	119	0.882	3	74	0.871	6	320	0.865	5
2	Leads to a more *sustainable* tender process	128	0.85	5	122	0.904	2	76	0.894	4	326	0.881	**3**
3	*Time-saving*	140	0.93	1	15	0.852	5	82	0.965	1	337	0.911	**2**
4	Increases *competitive advantage* among bidders	130	0.866	3	11	0.822	7	68	0.800	9	309	0.835	8
5	Consumes *less resource*	125	0.83	7	19	0.882	3	120	0.889	5	321	0.868	**4**
6	Enhances *transparency*	129	0.86	4	11	0.822	7	73	0.859	7	313	0.846	7
7	Promotes *data integrity & fights corruption*	121	0.81	9	11	0.822	7	72	0.847	8	304	0.822	9
8	*Advanced tender evaluation assessment*	122	0.81	8	115	0.852	5	77	0.905	3	314	0.849	6
9	I*mproves communication &* interaction among parties	119	0.79	10	110	0.815	10	64	0.753	10	293	0.792	10
10	Improves documentation & archiving	139	0.93	2	124	0.919	1	80	0.941	2	344	0.930	**1**

Appendix 6.4: Ranking of the CSFs affecting e-tendering implementation

No.	Factors (CSFs) & Groups of factors	Consultant			Contractor			Client			Overall		
		Total ranked score	RII	Rank	Total ranked score	RII	Rank	Total ranked score	RII	Rank	Total ranked score	RII	Rank
1	CSF2: Consistency of internet connection	146	0.94	3	166	0.977	1	104	0.99	1	**416**	**0.98**	**1**
2	CSF2: Availability of reliable ICT infrastructure within an organization	149	0.96	1	158	0.929	7	101	0.96	2	**408**	**0.95**	**2**
3	CSF2: Compatibility of existing hardware & software with e-tendering implementation system	148	0.96	2	160	0.941	4	99	0.94	4	**407**	**0.95**	**3**
4	CSF1: Staff training	145	0.93	4	163	0.959	2	99	0.94	4	**407**	**0.95**	**3**
5	CSF3: Availability of legal & administrative procedures	143	0.92	5	162	0.953	3	96	0.91	8	402	0.94	5
6	CFS1: Provision of adequate resources	143	0.92	5	156	0.918	9	101	0.96	2	400	0.93	6
7	CSF3: Availability of legal framework	139	0.89	10	160	0.941	4	99	0.94	4	399	0.93	7
8	CSF3: Availability of e-tendering operation instructions & manual	141	0.91	8	155	0.912	11	95	0.91	9	391	0.91	8
9	CSF1: Employee's commitment	141	0.91	8	157	0.924	8	92	0.87	11	390	0.91	9
10	CSF5: Continuous evaluation & feedback	128	0.83	18	152	0.894	13	98	0.93	7	390	0.91	9

Appendix 6.5: Ranking of barriers affecting e-tendering implementation

No.	Factors (barriers) & Groups of factors	Consultant			Contractor			Client			Overall		
		Total ranked score	RII	Rank	Total ranked score	RII	Rank	Total ranked score	RII	Rank	Total ranked score	RII	Rank
1	Bar1: Lack of system integration	140	0.90	3	151	0.89	1	94	0.895	2	**385**	**0.895**	**1**
2	Bar2: Lack of training/capacity building programs	145	0.94	1	151	0.89	1	82	0.781	11	**378**	**0.879**	**2**
3	Bar1: Lack of common technology standard	132	0.85	7	143	0.84	9	97	0.924	1	**372**	**0.865**	**3**
4	Bar4: Lack of an effective legal & regulation system	129	0.83	11	149	0.88	4	93	0.886	3	371	0.863	4
5	Bar2: Lack of skilled personnel & technical expertise	141	0.91	2	149	0.88	4	80	0.762	13	370	0.861	5
6	Bar1: Security of transaction & uncertainty (confidential violation)	137	0.88	4	146	0.86	6	85	0.810	8	368	0.856	6
7	Bar2: Resistance to change	133	0.86	5	143	0.84	9	90	0.857	4	366	0.851	7
8	Bar2: Lack of leadership/upper management support	132	0.85	7	145	0.85	8	88	0.838	6	365	0.849	8
9	Bar4: Inadequate technological infrastructure	126	0.81	13	150	0.88	3	88	0.838	6	364	0.847	9
10	Bar1: Insufficient assessment of systems before installation	133	0.86	5	140	0.82	12	89	0.848	5	362	0.842	10

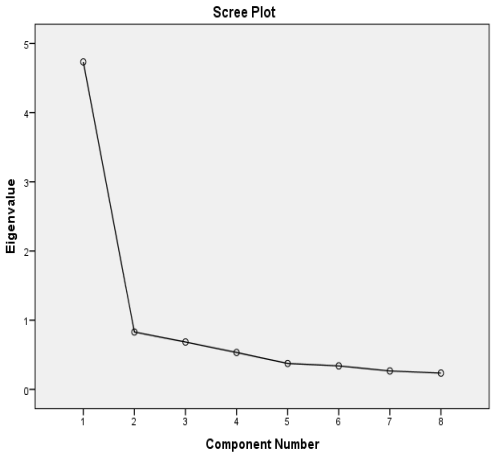
Appendix 7: Factor analysis output

Appendix 7.1: Current road construction tendering practice

```
FACTOR
  /VARIABLES CCTPA1 CCTPA2 CCTPA3 CCTPA4 CCTPA5 CCTPA6 CCTPA7 CCTPA8
  /PRINT INITIAL CORRELATION SIG DET KMO EXTRACTION ROTATION
  /FORMAT SORT BLANK(0.4)      /PLOT EIGEN    /CRITERIA MINEIGEN(1) ITERATE(25)
  /EXTRACTION PC    /CRITERIA ITERATE(25) /ROTATION VARIMAX  /METHOD=CORRELATION.
```

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.882
Bartlett's Test of Sphericity	Approx. Chi-Square	363.632
	df	28
	Sig.	.000



Communalities		
CCTPA1	Initial	Extraction
CCTPA2	1.000	.710
CCTPA3	1.000	.500
CCTPA4	1.000	.463
CCTPA5	1.000	.546
CCTPA6	1.000	.658
CCTPA7	1.000	.621
CCTPA8	1.000	.621
	1.000	.614

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.733	59.163	59.163	4.733	59.163	59.163
2	.830	10.370	69.533			
3	.685	8.567	78.100			
4	.534	6.672	84.773			
5	.376	4.695	89.468			
6	.340	4.249	93.716			
7	.267	3.334	97.051			
8	.236	2.949	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix			
	Component		Component
	1		1
CCTPA1	.842	CCTPA8	.783
CCTPA5	.811	CCTPA4	.739
CCTPA7	.788	CCTPA2	.707
CCTPA6	.788	CCTPA3	.681

Appendix 7.2: Challenges of road construction tendering practice

(Model 1)

```
FACTOR
  /VARIABLES CPBT1 CPBT2 CPBT3 CPBT4 CPBT5 CPBT6 CPBT7 CPBT8 CPBT9 CPBT10
  /PRINT INITIAL CORRELATION SIG DET KMO EXTRACTION ROTATION
  /FORMAT SORT BLANK(0.4)  /PLOT EIGEN /CRITERIA MINEIGEN(1) ITERATE(25)
  /EXTRACTION PC
  /CRITERIA ITERATE(25)    /ROTATION VARIMAX      /METHOD=CORRELATION.
```

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.815
Bartlett's Test of Sphericity	Approx. Chi-Square	371.849
	df	45
	Sig.	.000

Communalities

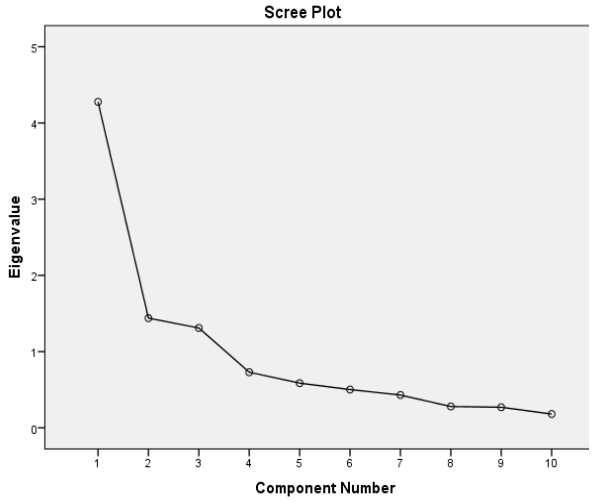
	Initial	Extraction
CPBT1	1.000	.786
CPBT2	1.000	.757
CPBT3	1.000	.405
CPBT7	1.000	.762
CPBT8	1.000	.732
CPBT9	1.000	.714
CPBT10	1.000	.790
CPBT4	1.000	.662
CPBT5	1.000	.692
CPBT6	1.000	.726

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.277	42.766	42.766	4.277	42.766	42.766	3.292	32.921	32.921
2	1.439	14.393	57.159	1.439	14.393	57.159	2.191	21.914	54.836
3	1.310	13.097	70.256	1.310	13.097	70.256	1.542	15.420	70.256
4	.729	7.293	77.549						
5	.586	5.858	83.407						
6	.501	5.011	88.418						
7	.429	4.293	92.711						
8	.279	2.789	95.500						
9	.270	2.696	98.196						
10	.180	1.804	100.000						

Extraction Method: Principal Component Analysis.



Rotated Component Matrix

	Component		
	1	2	3
CPBT7	.871		
CPBT9	.845		
CPBT10	.801		
CPBT8	.705		
CPBT3	.606		
CPBT1		.862	
CPBT2		.858	
CPBT6	.478	.633	
CPBT5			.827
CPBT4			.774

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 4 iterations.

(Model 2: Item CPBT 5 deleted)

```
FACTOR
  /VARIABLES CPBT1 CPBT2 CPBT3 CPBT4 CPBT6 CPBT7 CPBT8 CPBT9 CPBT10
  /PRINT INITIAL CORRELATION SIG DET KMO EXTRACTION ROTATION
  /FORMAT SORT BLANK(0.4)  /PLOT EIGEN /CRITERIA MINEIGEN(1) ITERATE(25)
  /EXTRACTION PC
  /CRITERIA ITERATE(25)    /ROTATION VARIMAX      /METHOD=CORRELATION.
```

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.818
Bartlett's Test of Sphericity	Approx. Chi-Square	357.834
	df	36

Sig.	.000

Communalities

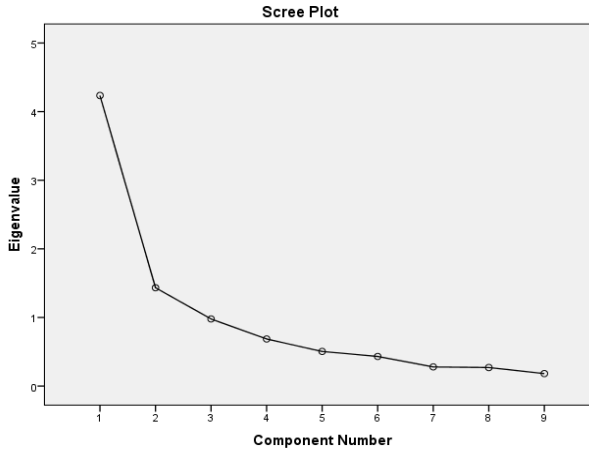
	Initial	Extraction
CPBT1	1.000	.786
CPBT2	1.000	.711
CPBT6	1.000	.710
CPBT7	1.000	.730
CPBT8	1.000	.722
CPBT9	1.000	.687
CPBT10	1.000	.730
CPBT4	1.000	.188
CPBT3	1.000	.404

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.235	47.057	47.057	4.235	47.057	47.057	3.425	38.054	38.054
2	1.433	15.924	62.981	1.433	15.924	62.981	2.243	24.927	62.981
3	.978	10.867	73.849						
4	.686	7.625	81.474						
5	.505	5.606	87.079						
6	.432	4.799	91.878						
7	.279	3.099	94.976						
8	.270	3.000	97.977						
9	.182	2.023	100.000						

Extraction Method: Principal Component Analysis.



	Component	
	1	2
CPBT7	.852	
CPBT9	.829	
CPBT10	.766	
CPBT8	.750	
CPBT3	.623	
CPBT4	.421	
CPBT1		.875
CPBT2		.842
CPBT6	.524	.660

Appendix 7.3: Advantages of e-tendering

```
FACTOR /VARIABLES AET1 AET2 AET3 AET4  AET5  AET6  AET7  AET8  AET9 AET10
/PRINT  INITIAL  CORRELATION  SIG  DET  KMO  EXTRACTION  ROTATION     /FORMAT  SORT
BLANK(.40)  /PLOT  EIGEN  /CRITERIA  MINEIGEN(1)  ITERATE(25)  /EXTRACTION  PC
/CRITERIA ITERATE(25)/ROTATION VARIMAX    /METHOD=CORRELATION.
```

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.774
Bartlett's Test of Sphericity	Approx. Chi-Square	232.564
	df	45
	Sig.	.000

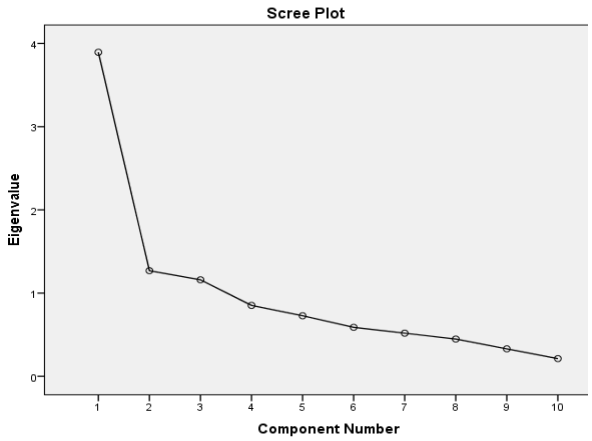
Communalities

	Initial	Extraction		Initial	Extraction
AET1	1.000	.733	AET6	1.000	.670
AET2	1.000	.430	AET7	1.000	.598
AET3	1.000	.592	AET8	1.000	.566
AET4	1.000	.639	AET9	1.000	.558
AET5	1.000	.739	AET10	1.000	.797

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.894	38.939	38.939	3.894	38.939	38.939	2.589	25.886	25.886
2	1.269	12.691	51.631	1.269	12.691	51.631	2.551	25.512	51.399
3	1.160	11.600	63.230	1.160	11.600	63.230	1.183	11.831	63.230
4	.852	8.518	71.748						
5	.727	7.274	79.023						
6	.589	5.887	84.910						
7	.518	5.184	90.094						
8	.448	4.479	94.573						
9	.330	3.299	97.871						
10	.213	2.129	100.000						



Rotated Component Matrix[a]

	Component		
	1	2	3
AET1	.832		
AET8	.734		
AET2	.652		
AET5	.604	.517	
AET6		.761	
AET4		.755	
AET7	.442	.623	
AET3		.603	.453
AET9	.465	.574	
AET10			.883

Appendix 7.4 CSFs for e-tendering implementation

(Model 1)

```
FACTOR
/VARIABLES CSF1.1   CSF1.2 CSF1.3 CSF1.4 CSF1.5 CSF2.1 CSF2.2 CSF2.3 CSF2.4 CSF2.5
CSF3.1 CSF3.2 CSF3.3 CSF4.2 CSF4.3 CSF4.4 CSF5.1 CSF5.2 CSF5.3 CSF5.4 CSF4.1
/PRINT  INITIAL  CORRELATION  SIG  DET  KMO  EXTRACTION  ROTATION     /FORMAT  SORT
BLANK(0.4) /PLOT EIGEN     /CRITERIA MINEIGEN(1) ITERATE(25)      /EXTRACTION PC
/CRITERIA ITERATE(25)     /ROTATION VARIMAX     /METHOD=CORRELATION.
```

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.685
Bartlett's Test of Sphericity	Approx. Chi-Square	890.792
	df	210
	Sig.	.000

Communalities

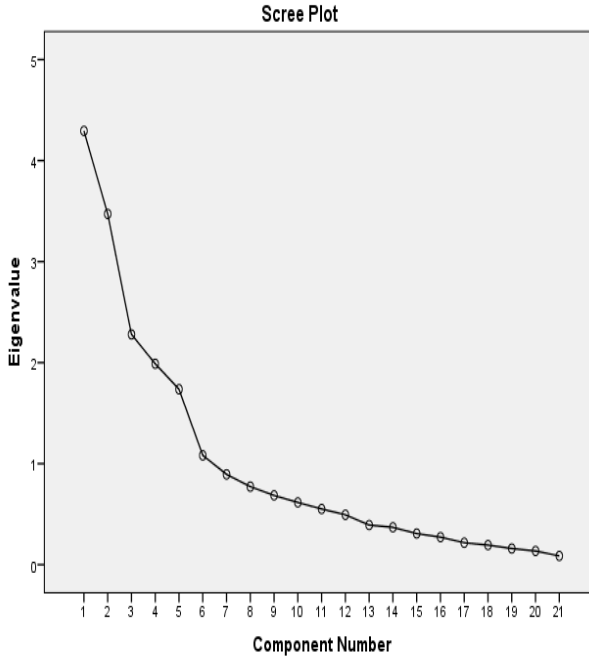
	Initial	Extraction		Initial	Extraction
CSF1.1	1.000	.443	CSF3.1	1.000	.596
CSF1.2	1.000	.851	CSF3.2	1.000	.590
CSF1.3	1.000	.781	CSF3.3	1.000	.825
CSF1.4	1.000	.686	CSF4.2	1.000	.772
CSF1.5	1.000	.603	CSF4.3	1.000	.773
CSF2.1	1.000	.596	CSF4.4	1.000	.808
CSF2.2	1.000	.890	CSF5.1	1.000	.710
CSF2.3	1.000	.791	CSF5.2	1.000	.695
CSF2.4	1.000	.711	CSF5.3	1.000	.679
CSF2.5	1.000	.744	CSF5.4	1.000	.621
			CSF4.1	1.000	.688

Extraction Method: Principal Component Analysis

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.294	20.447	20.447	4.294	20.447	20.447	3.490	16.618	16.618
2	3.472	16.532	36.979	3.472	16.532	36.979	3.185	15.169	31.787
3	2.279	10.854	47.833	2.279	10.854	47.833	2.757	13.127	44.914
4	1.988	9.468	57.301	1.988	9.468	57.301	2.235	10.641	55.555
5	1.737	8.269	65.570	1.737	8.269	65.570	1.967	9.368	64.923
6	1.082	5.152	70.722	1.082	5.152	70.722	1.218	5.799	70.722
7	.894	4.257	74.979						
8	.772	3.678	78.657						
9	.686	3.266	81.923						
10	.616	2.933	84.856						
11	.551	2.624	87.480						
12	.494	2.352	89.831						
13	.392	1.866	91.697						
14	.370	1.760	93.457						
15	.308	1.466	94.923						
16	.273	1.299	96.222						
17	.217	1.033	97.256						
18	.194	.923	98.179						
19	.160	.762	98.940						
20	.136	.648	99.588						
21	.086	.412	100.000						

Extraction Method: Principal Component Analysis.



	Component					
	1	2	3	4	5	6
CSF2.2	.935					
CSF2.3	.872					
CSF2.5	.843					
CSF2.1	.750					
CSF2.4	.704					
CSF1.2		.843				
CSF1.3		.836				
CSF1.4		.803				
CSF1.5		.747				
CSF1.1		.545				
CSF4.4			.869			
CSF4.3			.813			
CSF4.2			.807			
CSF3.3				.892		
CSF3.1				.729		
CSF3.2				.725		
CSF5.2					.792	
CSF5.3					.747	
CSF5.4					.746	
CSF5.1						.754
CSF4.1			.539			-.588

(Model 2- Item CSF 4.1 deleted)

```
FACTOR
  /VARIABLES CSF1.1 CSF1.2 CSF1.3 CSF1.4 CSF1.5 CSF2.1 CSF2.2 CSF2.3 CSF2.4 CSF2.5
CSF3.1 CSF3.2 CSF3.3 CSF4.2 CSF4.3 CSF4.4 CSF5.1 CSF5.2 CSF5.3     CSF5.4
  /PRINT  INITIAL  CORRELATION  SIG  DET  KMO  EXTRACTION  ROTATION    /FORMAT  SORT
BLANK(0.4) /PLOT EIGEN   /CRITERIA MINEIGEN(1) ITERATE(25)     /EXTRACTION PC
  /CRITERIA ITERATE(25)     /ROTATION VARIMAX         /METHOD=CORRELATION.
```

KMO and Bartlett's Test

	Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	.684
Bartlett's Test of Sphericity	Approx. Chi-Square	853.709
	df	190
	Sig.	.000

Communalities

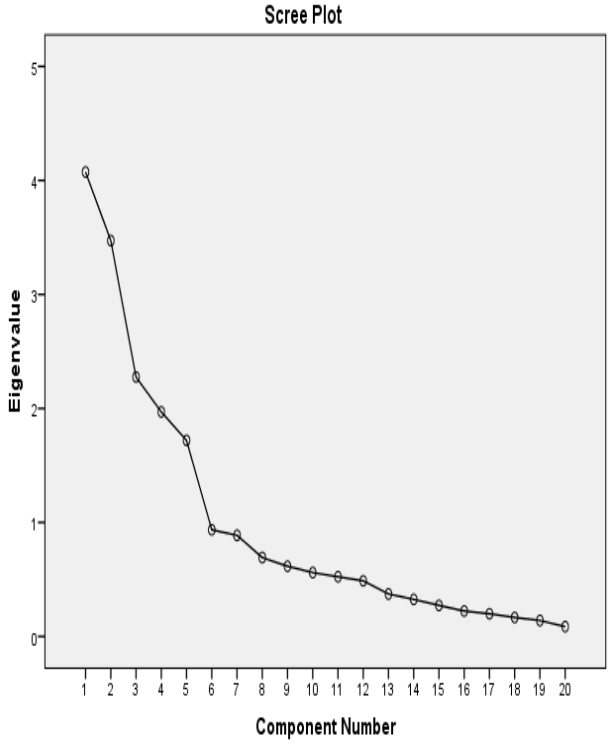
	Initial	Extraction		Initial	Extraction
CSF1.1	1.000	.396	CSF3.1	1.000	.605
CSF1.2	1.000	.850	CSF3.2	1.000	.596
CSF1.3	1.000	.781	CSF3.3	1.000	.773
CSF1.4	1.000	.672	CSF4.2	1.000	.775
CSF1.5	1.000	.573	CSF4.3	1.000	.771
CSF2.1	1.000	.584	CSF4.4	1.000	.815
CSF2.2	1.000	.880	CSF5.1	1.000	.394
CSF2.3	1.000	.790	CSF5.2	1.000	.685
CSF2.4	1.000	.605	CSF5.3	1.000	.635
CSF2.5	1.000	.721	CSF5.4	1.000	.610

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.074	20.369	20.369	4.074	20.369	20.369	3.491	17.457	17.457
2	3.472	17.358	37.727	3.472	17.358	37.727	3.170	15.851	33.308
3	2.275	11.377	49.103	2.275	11.377	49.103	2.537	12.684	45.992
4	1.970	9.848	58.951	1.970	9.848	58.951	2.284	11.422	57.414
5	1.720	8.600	67.551	1.720	8.600	67.551	2.027	10.137	67.551
6	.936	4.678	72.229						
7	.887	4.435	76.664						
8	.692	3.460	80.124						
9	.616	3.082	83.206						
10	.561	2.804	86.010						
11	.524	2.618	88.628						
12	.488	2.440	91.068						
13	.373	1.864	92.932						
14	.325	1.625	94.557						

15	.273	1.365	95.921						
16	.223	1.117	97.038						
17	.199	.993	98.031						
18	.167	.834	98.866						
19	.140	.701	99.567						
20	.087	.433	100.000						

Extraction Method: Principal Component Analysis.



	Rotated Component Matrix: Component				
	1	2	3	4	5
CSF2.2	.929				
CSF2.3	.878				
CSF2.5	.832				
CSF2.1	.745				
CSF2.4	.729				
CSF1.3		.841			
CSF1.2		.840			
CSF1.4		.792			
CSF1.5		.731			
CSF1.1		.587			
CSF4.4			.889		
CSF4.3			.803		
CSF4.2			.802		
CSF3.3				.864	
CSF3.1				.739	
CSF3.2				.732	
CSF5.2					.787
CSF5.3					.731
CSF5.4					.730
CSF5.1					.423

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 6 iterations.

Appendix 7.5: Barriers of e-tendering implementation (Model 1)

```
FACTOR
/VARIABLES Bar 1.1 Bar1.2 Bar1.3 Bar 1.4 Bar 2.1 Bar 2.2 Bar 2.3 Bar 2.4 Bar 3.1
Bar 3.2 Bar 3.3 Bar 3.4 Bar 4.1 Bar 4.2 Bar 4.3 Bar 4.4
/PRINT INITIAL CORRELATION SIG DET KMO EXTRACTION ROTATION FSCORE    /FORMAT SORT
BLANK(0.4)     /PLOT EIGEN
/CRITERIA MINEIGEN(1) ITERATE(25) /EXTRACTION PC
/CRITERIA ITERATE(25)  /ROTATION VARIMAX      /SAVE REG(ALL) /METHOD=CORRELATION.
```

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.540
Bartlett's Test of Sphericity	Approx. Chi-Square	659.635
	df	120
	Sig.	.000

Communalities

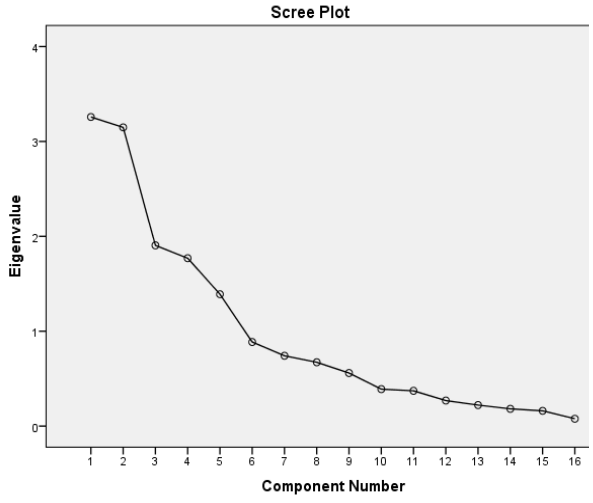
	Initial	Extraction		Initial	Extraction
Bar1.1	1.000	.672	Bar3.1	1.000	.555
Bar1.2	1.000	.637	Bar3.2	1.000	.812
Bar1.3	1.000	.405	Bar3.3	1.000	.786
Bar1.4	1.000	.807	Bar3.4	1.000	.773
Bar2.1	1.000	.774	Bar4.1	1.000	.805
Bar2.2	1.000	.683	Bar4.2	1.000	.773
Bar2.3	1.000	.712	Bar4.3	1.000	.805
Bar2.4	1.000	.804	Bar4.4	1.000	.666

Extraction Method: Principal Component Analysis

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.258	20.360	20.360	3.258	20.360	20.360	2.714	16.962	16.962
2	3.148	19.674	40.034	3.148	19.674	40.034	2.672	16.698	33.660
3	1.905	11.904	51.937	1.905	11.904	51.937	2.351	14.695	48.355
4	1.769	11.058	62.995	1.769	11.058	62.995	2.140	13.372	61.727
5	1.390	8.685	71.680	1.390	8.685	71.680	1.592	9.952	71.680
6	.886	5.538	77.218						
7	.741	4.633	81.851						
8	.673	4.204	86.055						
9	.559	3.496	89.550						
10	.390	2.435	91.985						
11	.372	2.323	94.308						
12	.269	1.682	95.991						
13	.221	1.383	97.374						
14	.182	1.135	98.509						
15	.161	1.005	99.514						
16	.078	.486	100.000						

Extraction Method: Principal Component Analysis.



	1	2	3	4	5
Bar4.2	.873				
Bar4.1	.859				
Bar4.4	.714				
Bar4.3	.593			-.486	.427
Bar2.4		.885			
Bar2.3		.794			
Bar2.1		.763		.409	
Bar2.2		.638			
Bar3.2			.834		
Bar3.4			.826		
Bar3.1			.735		
Bar3.3				.872	
Bar1.2				.628	.400
Bar1.4					.846

Bar1.1					.505
Bar1.3					.486

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

(Model 2-Item Bar 3.3 deleted)

```
FACTOR
/VARIABLES Bar 1.1 Bar1.2 Bar1.3 Bar 1.4 Bar 2.1 Bar 2.2 Bar 2.3 Bar 2.4 Bar 3.1
Bar 3.2 Bar 3.4 Bar 4.1 Bar 4.2 Bar 4.3 Bar 4.4
/PRINT INITIAL CORRELATION SIG DET KMO EXTRACTION ROTATION FSCORE    /FORMAT SORT
BLANK(0.4)     /PLOT EIGEN
/CRITERIA MINEIGEN(1) ITERATE(25)      /EXTRACTION PC
/CRITERIA  ITERATE(25)                 /ROTATION  VARIMAX          /SAVE  REG(ALL)
/METHOD=CORRELATION.
```

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.569
Bartlett's Test of Sphericity	Approx. Chi-Square	517.569
	df	78
	Sig.	.000

Communalities

	Initial	Extraction		Initial	Extraction
Bar1.1	1.000	.595	Bar3.2	1.000	.834
Bar2.1	1.000	.718	Bar3.4	1.000	.750
Bar2.2	1.000	.673	Bar4.1	1.000	.811
Bar2.3	1.000	.738	Bar4.2	1.000	.770
Bar2.4	1.000	.831	Bar4.3	1.000	.561
Bar3.1	1.000	.584	Bar4.4	1.000	.652
			Bar1.2	1.000	.678

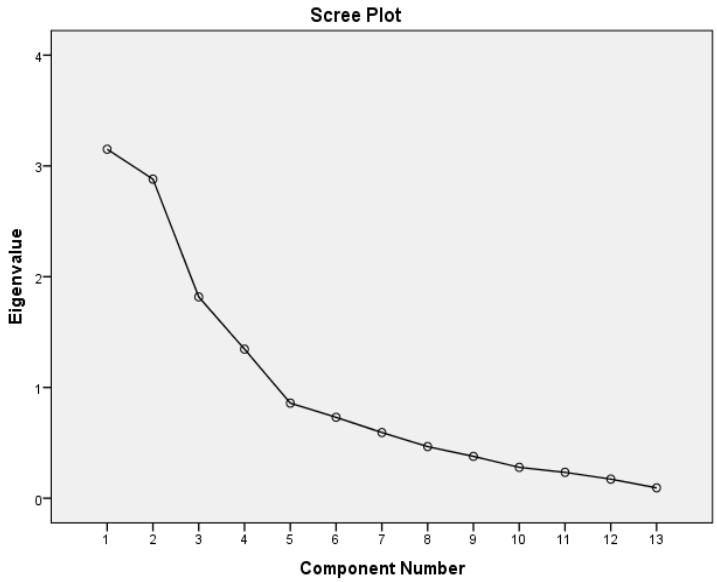
Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.151	24.241	24.241	3.151	24.241	24.241	2.686	20.665	20.665
2	2.881	22.160	46.402	2.881	22.160	46.402	2.332	17.935	38.600
3	1.818	13.982	60.384	1.818	13.982	60.384	2.227	17.131	55.731
4	1.346	10.351	70.735	1.346	10.351	70.735	1.951	15.004	70.735
5	.859	6.605	77.340						
6	.730	5.619	82.959						
7	.593	4.561	87.520						
8	.466	3.586	91.106						
9	.378	2.907	94.013						
10	.279	2.144	96.157						
11	.234	1.797	97.954						
12	.172	1.325	99.279						

13	.094	.721	100.000							

Extraction Method: Principal Component Analysis.



	Component			
	1	2	3	4
Bar2.3		.855		
Bar2.1		.623		.531
Bar3.2			.856	
Bar3.4			.815	
Bar3.1			.744	
Bar1.2				.815
Bar2.2		.461		.617
Bar1.1				.524

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

	Component			
	1	2	3	4
Bar4.1	.871			
Bar4.2	.871			
Bar4.3	.662			
Bar4.4	.630			.429
Bar2.4		.882		