Assess the Improvement of Collaboration among Integrated Infrastructure in Adama city

Adane Muniye Gelaw

A Thesis Submitted to the department of Civil Engineering, School of Civil Engineering and Architecture

Presented in Partial Fulfillment of the Requirement for the Degree of Masters of Science in Civil Engineering (Specialized in Construction Engineering and Management)

Office of Graduate Studies

Adama Science and Technology University

June, 2021

Adama, Ethiopia

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Declaration

I hereby declare that this Master Thesis entitled “Assess the improvement of collaboration among integrated infrastructure in Adama city” is my original work. That is, it has not been submitted for the award of any academic degree, diploma or certificate in any other university. All sources of materials that are used for this thesis have been duly acknowledged through citation.

_____	_____	_____
Name of the student	Signature	Date

Recommendation

I, the advisor of this thesis, hereby certify that I have read the revised version of the thesis entitled “Assess the improvement of collaboration among integrated infrastructure in Adama city” prepared under my guidance by Adane Muniye Gelaw submitted in partial fulfillment of the requirements for the degree of Mater’s of Science in Civil Engineering (Specialized in Construction Engineering and Management).

Therefore, I recommend the submission of revised version of the thesis to the department following the applicable procedures.

_____	_____	_____
Major Advisor	Signature	Date

Approval Sheet

I, the advisor of the thesis entitled “Assess the improvement of collaboration among integrated infrastructure in Adama city” and developed by Adane Muniye Gelaw, hereby certify that the recommendation and suggestions made by the board of examiners are appropriately incorporated into the final version of the thesis.

_____	_____	_____
Name of Advisor	Signature	Date

We, the undersigned, members of the Board of Examiners of the thesis by Adane Muniye Gelaw have read and evaluated the thesis entitled “Assess the improvement of collaboration among integrated infrastructure in Adama city” and examined the candidate during open defense. This is, therefore, to certify that the thesis is accepted for partial fulfillment of the requirement of the degree of Master of Science in Civil Engineering (Specialized by Construction Engineering and Management).

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Finally, approval and acceptance of the thesis is contingent upon submission of its final copy to the Office of Postgraduate Studies (OPGS) through the Department Graduate Council (DGC) and School Graduate Committee (SGC).

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ACKNOWLEDGEMENT

I would like to express deepest appreciation to my advisor Meseret Getnet (PhD) at ASTU, School of Civil Engineering and Architecture, department of Civil Engineering for his valuable advice, continuous encouragement and professional support and guidance. I also deeply thanks the staff of Civil engineering department for their academic and scientific supervision through-out my study at ASTU.

I would like to sincerely thank employees of ETCU, EEU, ACWSA, ACIDA and ACCOPCA for providing me the necessary information for the inputs of this thesis work.

I am grateful to my friend Ato Asrat Worku for making me keep pushing in the academic research path.

Last but not least, I would like to thank my wife Worike Tegegn for her overwhelming love and support which gave me the energy to fulfill the requirements for final thesis and my children; Kirubel Adane, Natanem Adane and Yeabsira Adane for their understanding when I could not spend quality of time with them. Finally, to all the people who participated in the research process, your involvement has contributed to the success of this thesis and for that I am grateful.

Table of Contents

Contents **Page**

List of Tables

List of Figures

List of Charts

List of Acronyms

AACRA	Addis Ababa City Road Authority
AAWSA	Addis Abeba water and sewerage authority
ACCOPCA	Adama City construction offices permit and control authority
ACIDA	Adama City infrastructure development authority
ACRA	Adama city Road authority
ACWSA	Adama city Water and Sewage authority
CFS	Common factors' scores
CS	Comprehensive scores
EEPCO	Ethiopian electric power corporation
EEU	Ethiopian Electric Utility
ETC	Ethiopian Telecommunication Corporation
ETCU	Ethiopian Telecommunication Utility
FGD	Focus group discussion
FIIDCA	Federal Integrated Infrastructure Development Control Authority
GDP	Growth domestic product
GHG	Greenhouse gas
GIS	Geographical information systems
ICT	Information communication technology
IUISP	Integrated Urban Infrastructure and Service Plan
IUISDP	Integrated urban infrastructure and service development plan
KMO	Kaiser-Meyer-Olkin
LDP	Local Development Plan
MIP	Municipal infrastructure program
RII	Relative importance index
SPSS	Statistical Package for the Social Sciences

Abstract

Infrastructure is the backbone of economic capacity, but it also impacts directly on human development, social inclusion and environmental sustainability and so the development of infrastructure is a fundamental concern of both governments and citizens. Cross Sectoral linkage in collaboration among integrated infrastructure and service provision plays an important role in determining the urban economic and physical development and has indispensible role in efficiency and effectiveness of service providers as well as development of the nation at large. This research aims to assesses the practices and provide a framework to improve the collaboration among integrated infrastructure in Adama city basic utility service sectors with a special emphasis on Adama city road authority, Adama city water & sewerage authority, Ethiopia Telecommunication utility and Ethiopia Electric utility. The study used both qualitative and quantitative approaches to address the research objective. Primary and secondary data were used using self-administered questionnaire & focus group discussion, and document reviews, respectively. 56 randomly selected respondents from the target sectors & six experts participated in the survey. Results revealed that there was inadequate collaboration among integrated infrastructure among selected sectors. The major practice level point collaboration among integrated infrastructure have been identified and ranked by relative important index technique. A factor analysis approach identified the most important factors that affect collaboration among integrated infrastructure to be loose communication both during design preparation and implementation of database, lack of central database system for data and information exchange, planning and decision making as well as lack of communication and coordination between the service providers, and lack of common standards & guidelines. The existing poor collaboration among the sectors negatively impacts lost time, repetition works, possible loss of product, revenue reduction, wastage of scarce resource, property damages, high cost of compensation and sewage backing up. The proposed conceptual framework (what to do → how to do → output) in addition to the sectors could be used by policy makers, city municipalities & other stakeholder to improve collaboration among integrated infrastructure in Adama city.

Keywords: Collaboration; integration; infrastructure; integrated infrastructure.

CHAPTER ONE
INTRODUCTION

1.1. Background of the Study

Most cities of the developing countries are faced with various problems of which high incidences of poverty and unemployment, poorly developed infrastructure, inadequate public services, acute and ever worsening shelter deficits and accelerated environmental deterioration tend to be significant (Mathewos, 2006). It is obvious that all these problems are resulted from the mismatch of demand and supply, and lack of good planning and governances. The supply of infrastructure and service is lagging behind the fast population growth rate (Mulugeta, 2011).

Infrastructure is the set of fundamental facilities and systems that support the sustainable functionality of households and firms. Integration is the act of bringing together small components into a single system that functions as one. These links usually are established between the components of the process and control layer of each system to promote the free flow of data across systems (Hinge & Goyal, 2020). Urban areas are perhaps the most part of a nation their image is highly dependent on infrastructural facilities and infrastructure development plan plays important role to effectively guide and promote urban development (Lombeso, 2018).

Urban infrastructure is invariably linked with productivity of urban economies and macro-economic development. That is why upgrading urban infrastructure has received increasing attention over the past few years (Mathewos, 2006). The focus on urban infrastructure is particularly visible among developing countries, which are making serious efforts to enhance the productivity of their economies through improved provision of infrastructure. However, urban infrastructure in the developing world is often subjected to haphazard planning, disjointed implementation and poor post installation management (Mulugeta, 2011; Lombeso, 2018). Usually inadequate attention is given to the interdependencies between infrastructure systems, the urban functions to be served and to the sustainability of the facilities (Mahlet, 2014). The outcome is poor facility functions, early deterioration and unwanted settlement development, implying wasteful use of scarce resources (United Nations Human Settlements Programme, 2003). Likewise, in the case of Ethiopia the supply of infrastructure and services is continually lagging behind the population growth rate (Mathewos, 2006). Ethiopian Urban centers are characterized by,

among others, lack/shortage of basic urban infrastructure and services (Mahlet, 2014). It is also vividly observed that the existing scanty infrastructure and services in the urban centers are deteriorating mainly as a result of poor design and installation practices and due to lack of timely maintenance (Mathewos, 2006). On top of this, lack of coordinated and integrated infrastructure & services planning and implementation has exacerbated the problems observed in the infrastructure development effort of the country (Kitila, 2015).

Integrated urban infrastructure is better coordinated across silos, enabling cheaper deployment and maintenance of infrastructure, more efficient roads and buildings, meeting our climate change obligations and more efficient land use planning processes (Addis Ababa City Structure Plan, 2017; Vaggione, 2014; Council, 2008). Integrated infrastructure planning is an input required for a society and its economy to function well (United Nations Environment programme, 2019). One way to do this is to integrate infrastructure like roads, telecommunication lines, Water and Sewage systems & electric power Utility sectors as effective & integrated infrastructure policies are necessary to foster integrated economic development (Mahlet, 2014). Effective collaboration among integrated infrastructure plays a pivotal role in sustaining societal & economic development of a country. Collaborative activities have strongly increased resulting in different forms of integrated infrastructure between sectors or civil society organizations (Merkel & Seidel, 2018). Many countries are now contemplating integrated infrastructure collaboration as an arrangement between sectors to finance, design, build, operate & maintain public infrastructure, community facilities and related services (Adetola et al., 2011).

Collaboration is the linking or sharing of information, resources, activities and capabilities by organizations to achieve jointly an outcome that could not be achieved by the organizations separately (Castañer, 2020). Recent calls for sustainable integrated infrastructure planning emphasize a need for collaborative, systems-based approaches across organizational boundaries (Paul et al., 2016). Collaborative development of infrastructure systems aims at integrating the business and engineering processes between different stakeholders and across various projects to assure consistency in design, coordinated construction, consideration of sustainability, and better handling of infrastructure interdependency (Kazi & Charoenngam, 2003; Chinowsky & Rojas, 2003; Wilson et al., 2001). Collaboration for integrated infrastructure development could provide useful services such as providing content-based information browsing, assuring timely

input from relevant parties, disseminating the right information to the right party, and capturing corporate/team memory throughout the life cycle of the collaboration (El-diraby, 2014). Collaboration requires coordination and communication between the partners in a virtual organization (Castañer, 2020).

The absence of full-fledged urban infrastructure, delivery policy and regulatory body may play significant role for the disjoint and unparalleled activities of the road and utilities. Currently the regulatory body is being established under the city administration, but it cannot bring the whole stakeholders together and avoid the problem of integration as expected. According to the cities good governance package (2007), every sector should work with regard to the master plan in an integrated manner. It is also mentioned in (Lombeso, 2018; Mulugeta, 2011 and Tesfaye, 2001), the conflict between different utility lines should be minimized, service provision is attained comparatively with chipper price, and the necessary space should be reserved during planning and design of roads in particular and towns in general. However, there were no strategies, policies, rules and regulations that direct the provision of infrastructure integration up until today. Hence, the research aims to assesses practices of collaboration among integrated infrastructure and provide a framework to improve the collaboration among integrated infrastructure in Adama city.

1.2. Statement of the Problem

Adama city is one of rift valley city of oromia region, east Shea zone and, the city's population growth has radically increased and becoming much more dependent on major utilities infrastructure. The government of Ethiopia has properly designed policy framework for urban infrastructure development and due emphasis has been given in urban development packages to create better urban centers that can contribute to the growth of national economy as well as improve welfare of their residents. There are improvements in the coverage of infrastructure in urban centers. The urban centers have been give different status in the governance system and are supposed to be self-reliant in most aspects. Hence, there is competition among urban centers to perform better than ever.

As Seife (2019), recently disclosed, splashing billions of Birr and crafting development oriented policies, but lack of integration among different utility providers resulting in project delays and capital inflation besides creating chaos on the day to day activities. "Utility services provider and other organization behind construction usually get each

other's throats criticizing for damage caused dismantling each other's' facilities while working on their respective projects" .

As Mulugeta (2011), despite the regulatory agency role is crucial and significant in reducing economic and engineering damage caused by lack of integration; as well as preparing ahead plan to new road and utilities to avoid further damages, but there is still frequent damages on road and utilities infrastructure. Some previous studies such as (Mahlet, 2014; Yirsaw Zegeye, 2012) reveal the existing practiced infrastructure integration management system is very poor; municipalities are facing unprecedented challenges in the management of infrastructure assets due to the increasing number of aging infrastructure assets, the ever-increasing demand and sustainability requirements, increasing maintenance deficit, and declining or static maintenance budgets in relation to City infrastructure development projects.

According to Fillat (2018), the level of coordination among the sectors been found weak and the effort to ensure community participation in providing infrastructure was found limited. This study has identified the major challenges include lack of infrastructure finance, limited technical capacity, shortage of adequate sources of supply, topographic challenges, fairness, transparency and accountability problems, limitation on following the master plan of the town, uncontrolled expansion of the town size and increased demand for infrastructure due to increased complexity of the economic and social services in the town. The prospects analysis indicates that the water subsector would remain to be more challenging in the near future. The power subsector was under expansion but was found very sluggish in the process. The road sector was found dependent on external financial sources and need to mobilize infrastructure finance through community participation, improved transparency and accountability.

According to Mahlet (2014), lack of communication during design preparations and common standards and guide lines to all service providers is also identified as one of the root causes. It was also realized that, the reactive nature of the legal procedures and lack of clearly stated rules and regulations which suggest coordination among service providers along with weak enforcement has greatly contributed to the problem under review. Moreover, findings also confirmed that there is still loose communication during implementation due to poor utility database, lack of institutions capacity, interest and commitment, absence of responsible body to do the job and lack of long term plan. It is

also identified the major economic, social and environmental effects of poor sectoral coordination on local residents, service providers and the nation at large.

According to Zegeye (2012), the lack of integrated urban utility infrastructure policy and common standards, lack of strong link between the land use development and utility infrastructure provision, shortage of institutional coordination and less use of digital mapping technologies are resulted in sub-standardization of the city utility infrastructure. Thus the issue is branded as economic, social and environmental effects.

Therefore, this study intends to assess practice of collaboration among integrated infrastructure and service providers, and forward conceptual framework for improvement of collaboration among integrated infrastructure in Adama city mainly emphasizing on: Adama city Road authority, Adama city Water and Sewage authority, Ethio-Telecommunication Utility South East Region District Adama Office and Ethio-Electric Utility South East Region District Adama Office sectors.

1.3. Research Questions

In relation to the research questions, this study seeks to answer the following questions:

- How does collaboration among integrated infrastructure practice in Adama city?
- Which factors is most significant affect collaboration among integrated infrastructure in Adama city?
- What are the effects of poor collaboration among integrated infrastructure in Adama city?
- How can improve the collaboration among integrated infrastructure in Adama city?

1.4. Objective of the Study

1.4.1. General Objective of the Study

The general objective of this study is to assess the improvement of collaboration among integrated infrastructure in Adama city.

1.4.2. Specific Objectives of the Study

The specific objectives of this study are: -

- To assess practice of collaboration among integrated infrastructure in Adama city.
- To identify the main factors that affecting collaboration among integrated infrastructure in Adama city.

- To assess the impact of poor collaboration among integrated infrastructure in Adama city.
- To develop conceptual framework to improve the collaboration among integrated infrastructure in Adama city.

1.5. Scope of the Study

This research focuses on collaboration among integrated infrastructure in Adama city. The study mainly deals with ways to improve collaboration among integrated infrastructure and their impact on the success of integrated infrastructure in the case of Adama city. Among these broad infrastructure divisions, this study focuses on integrated infrastructure with special emphasis on the basic utility services; Adama city Road authority sector, Adama city Water and Sewage authority sector, Ethio-Telecommunication Utility South East Region District Adama Office sector and Ethio-Electrical Utility South East Region District Adama Office sector.

1.6. Significance of the Study

This study could provide an important study results for policy makers, municipalities & infrastructure providing authorities as well as professionals in Adama city. The study will have advantages for all practitioners by providing useful information about the improvement of collaboration among integrated infrastructure for Adama city municipal. At the same time the study could believe to promote institutional coordination among urban infrastructure providers for the provision of an integrated and sustained urban infrastructure. Moreover; municipalities, urban infrastructure providing authorities, policy makers and professionals could use the document as an input for further discussion, application and investigation.

1.7. Limitation of the Study

This study is carried out under the limitations including very few previous researches which shorten empirical findings. Few recent studies are published in local context and the project complexity with multi-stakeholder and actors. Unavailability of some experts from the target institutions to participate in the focus group discussion, consequently the smaller size of key informants participated in the FGD for having tight schedules, as well as the limited factors identified to associate with collaborative integrated infrastructures, and limited access and availability of historical data in the case city could possibly limits the generalizability and robustness of the findings. However, the adoption of sound statistical

procedures and methodologies significantly help to fairly and wisely make inferences and conclusions to similar scenarios.

1.8. Organization of the Thesis

This thesis will be organized with the preliminary pages of the thesis document consisted of the title page, approval sheet; acknowledgment, abstract, table of content; list of figures, list of tables and acronyms. The body part accounted five chapters, within each chapter there is different but interrelated subtopics. The first chapter contains the introduction part which comprised the background information, problem statement, objectives, Research questions, significance, scope, limitation and organization. The second chapter consisted of the literature review part. The third chapter is the research methodology which covers the Setting/Study Area, Research design, Population and Sampling Techniques, Data Collection Method, Data analysis Method, Validity & Reliability and Ethical consideration. The fourth chapter is the results and discussion part of the study which concerned about data presentation and discussions. This documented the analysis of the primary and secondary facts with the mixed research approach. The last chapter provided the conclusion and recommendation of the study.

CHAPTER TWO
RELATED LITERATURE REVIEW

The purpose of this literature analysis is to identify the existing knowledge base and debates and consequently develop a meaningful and relevant research project. The purpose of this chapter is to present the research, theory, concepts and ideology that exist with regard to the theoretical and practical issue of collaboration among integrated infrastructure and urban utility infrastructure provision.

2.1.The Concept of Infrastructure

Infrastructure is the structural foundation or supporting system for economic and social activities. In more detail it is the network or services in a society which are essential/or its cohesion and/or the efficient functioning of the economy (Mulugeta, 2011). Infrastructure is basic physical and organizational structures needed for the operation of a society or enterprise, or the services and facilities necessary for an economy to function. It can be generally defined as the set of interconnected structural elements that provide framework supporting an entire structure of development (Mathewos, 2006). It is an important term for judging a country or region's development. The term typically refers to the technical structures that support a society, such as roads, water supply, sewers, electrical grids, telecommunications, and so forth, and can be defined as "the physical components of interrelated systems providing commodities and services essential to enable, sustain, or enhance societal living conditions (Zegeye, 2012).

Infrastructure is often categorized as 'hard' to refer to physical and built structures such as transport, water, energy and telecommunications services or 'soft', which includes human and community services such as education, health, policing and emergency services/facilities (Mahlet, 2014).

2.2.The need for infrastructure

All development is about change, but not all changes take place at the same rate; different time clocks seem to apply to different phenomena. Energy and environment are related to slow or transition processes, including construction and infrastructure investment and are related more to technological breakthrough and long waves that to rapid economic, social and institutional response (Belew, 2001). Adequate quantity, quality and reliability of infrastructure are necessary preconditions for rapid economic growth. The state of the infrastructure also has a direct correlation to internal production, international

competitiveness, flow of direct foreign investment, and export dynamism (Mahlet, 2014). The importance of infrastructure in the economic and social system of a nation has been recognized. It is a key element in the generation of economic growth and development and the main driver of urban activities. The efficiency of economic and social systems is to a large extent dependent on the efficiency of infrastructure (Nwuba, 2010). For a nation to experience sustainable economic development and growth it must have developed an efficient infrastructure system. This is essential for efficient and proper functioning of urban economic and social activities (Mahlet, 2014).

2.3.Importance of infrastructure in cites

Cities simply defined, as concentration of people, resources, information, and activities. Clever and skilled people in close proximity with each other generate benefits due to the diversity of interactions of people and ideas and potential for economies of scale and scope from agglomeration. Where interaction is fluid, dense and diverse, there emerges potential for innovation and creativity (Belew, 2001). Although we realize that people and ideas are fundamental to successful cities, these people and the process they put in motion need support from urban infrastructure to ensure that cities remain healthy, safe, and accessible and to support cultural, economic, and social systems. Efficient, effective urban infrastructure does not lead in itself to competitive, innovative cities, but the lack of it would strongly impede their development or sustainability (Mahlet, 2014).

2.4.The Concept of Integration

Integration means to look at all circumstances that might affect the plan or project in a holistic manner (Geyer, 2006). Integration is the highest level which brings the planning, financing, implementation and management of different sectors into a formalized decision making system and procedures. Since this is the most challenging level, the other lower levels should work smoothly, effectively and efficiently prior to application of full integration (Soyinka et al., 2016). There are two types of integration and they are both essential success factors, particularly in a multi-project program environment. They are vertical and horizontal integration (Bruce, 2006). Vertical integration looks inside and up and down into the business, program, project, and product service components. This kind of integration targets the program, project, and product, and builds a product or service with integrity. It looks downstream in the project process to product performance and customer satisfaction (Gebremeskel, 2020). Horizontal integration looks outside and around to the external, the environmental, and the organizational assets that support the

project. It focuses on outside forces that create risk and opportunity, market forces that will shape the product or service (Seife, 2019).

2.5.Mechanism of Integration

Infrastructure management systems can be integrated in different ways. Integrated systems are the integration of separate management systems. Which does not necessarily mean combining everything into one grand "lump-sum" system; rather the integration should be carried out by using a common platform. Data sharing which employs geographical information systems (GIS) is one mechanism which offers great promise and existing integration mechanisms. According to Seife (2019), though primitive manual data sharing was the simplest, flexible method, manual data sharing uses diskettes or tape drives as the medium to exchange data and information. On the other hand automatic data sharing which uses medium of data transfer primarily network wires is more efficient for frequent data sharing. Another level of integration can be achieved by standardizing data items, definitions, collection procedures, quality, and updating schedules using central database (Zhang & Hudson, 1998). Standardization of analysis procedures is also important for integrated system as some analyses may require certain inputs that are output from prior analyses. Policy and decision-making integration help administrators to develop coordinated policies and to make comprehensive decisions to the best use of available resources (Mahlet, 2014; Steenmans & Engineering, 2017).

2.6.Integrating Institutions

To support integration between different project phases and sectors of infrastructure, a restructuring of institutional arrangements is necessary. Government bodies responsible for different infrastructure sectors must be integrated horizontally across sectors, as well as vertically, so that national-level policy can be effectively translated into regional and local-level implementation. These institutions can constitute commissions, councils, ministries, or boards, and should focus on the upstream institutional context, including policies, plans, regulations and legislation (Inter-American Development Bank, 2018). This top-down approach to infrastructure is essential for a strategic assessment of long-term economic infrastructure needs across sectors (International Transport Forum, OECD & UK National Infrastructure Commission, 2017). Laying down a foundational policy framework that links national-level planning with local level implementing institutions ensures that subsequent projects are in line with national priorities, through incentivizing and regulating good corporate governance and transparency (Inter-American Development

Bank, 2018). At the local level, factors such as budget constraints, poor implementation capacity and absence of maintenance systems should be addressed to avoid service deficiencies that undermine the effectiveness of service delivery (United Nations Environment programme, 2019). Integrating infrastructure systems and sectors are to deliver services most effectively, efficiently and sustainably, the many sectors of infrastructure must be considered as interconnected systems. This is because the degree of sustainability of certain infrastructure systems can have direct and indirect impacts on others (Thacker et al., 2018). Access to reliable and sustainable energy is also critical to ensuring the sustainability of infrastructure in other sectors, such as transport, water, agriculture, or buildings (Gebremeskel, 2020). At the same time, infrastructure built in those sectors can have crossover impacts on energy infrastructure. For example, technological advances in the transport sector (e.g. increased fuel efficiency, electrification) can affect the demand for energy and the related infrastructure (United Nations Environment programme, 2019).

It is important to adopt integrated approaches at the local, regional, national, and transnational levels. However, the challenges and opportunities of doing so at the urban level, where there is a high density of closely linked infrastructure systems, are particularly pronounced (IRP, 2018). Transportation and building infrastructure, for example, must be considered together during land-use planning. Compact and dense cities present an opportunity to develop more economically viable transportation systems, particularly in the shift in modality from vehicles to more active transport options such as cycling and walking (Zegeye, 2012). Public investment in the extension of cycling infrastructure within metropolitan areas, for instance, not only reduces transport-related GHG emissions, but also has positive consequences for local air quality and traffic congestion, thereby improving community and individual health and quality of life (Gebremeskel, 2020; United Nations Environment programme, 2019).

2.7.Cross-Sectoral Approach for Infrastructure Collaboration

Given the scale of the township urban management challenge relative to municipal urban management capacity, approaches based on a traditional ‘control and command- based’ mode (where the public sector commands and other sectors passively wait for state delivery) are likely to fail. Instead the mobilization of the capacity and of groups outside government is needed and this requires the adoption of ‘negotiated ways of enforcing bylaws and partnership-based approaches’ (Kitila, 2015). A shift in management style is

required to bring about effective governance of public places in townships. This shift requires that urban management goes beyond the classic notion of participatory urban planning. It involves joint actions with end users of public amenities and services. Most importantly it includes them in their effective involvement in the implementation, operation and maintenance of public facilities (Roberts & Addison, 2015). The development of urban infrastructure and municipal services is of paramount importance for economic growth and for the improvement of the quality of life in the cities of the developing countries(Soyinka et al., 2016). However, the development and improvement of infrastructure and services requires appropriate investment decisions and effective utilization of scarce municipal resources (Mahlet, 2014). To this end, integrated infrastructure development planning plays crucial role to effectively guide and promote urban development as well as to significantly increase the gross national product of developing countries (Mathewos, 2006). Therefore, Sectoral planning approach is dominantly practicing among the urban sectors of the city. They have invited each other mainly during planning phase, however, it not during implementation, evaluation and monitoring phases. Thus their performance status, when evaluated vis-à-vis what has been planned is poor (Mathewos, 2006). This was mainly because their service giving institutions, which are found at different levels of development, do not have integration, are extremely bureaucratic and very much lacking as regards access to and the use of a qualified workforce and the state of the art technology. It was reported that cross sectoral approach is very crucial to ensure effective and efficient urban management than sectoral planning approach, hence, it allow the sectors to plan, implement, evaluate and monitor jointly. Consequently, it will minimize the cost, energy, time invested to maintain urban infrastructural lines (Kitila, 2015).

2.7.1. Understanding Cross-Sector Collaboration

Cross-sector collaboration is now increasingly both necessary and desirable as a strategy for addressing many of society's most complex public challenges. Collaboration is the linking or sharing of information, resources, activities and capabilities by organizations to achieve jointly an outcome that could not be achieved by the organizations separately. Note that, by this definition, the power sharing in collaboration does not imply equal power nor does it necessarily imply much in the way of shared interests and goals. Indeed, in our experience, collaboration typically involves uneven power and mixed motives (Kitila, 2015). Cross-sector collaboration occurs for many reasons. The first is simply that

we live in a shared-power world in which many groups and organizations are involved in, affected by, or have some partial responsibility to act on public challenges (Castañer, 2020). Beyond that, in the United States, advocates of power sharing across sectors are often responding to a long-standing critique of the effectiveness of government when it acts on its own (United Nations Environment programme, 2019).

At the same time, cross-sector collaborations do not solve all of the problems they tackle. Indeed, some are solved badly, and some solutions have created more of the problems they were meant to solve (Kitila, 2015). Collaboration especially cross-sector collaboration is no panacea. This is partly because of the interconnectedness of things, such that changes anywhere reverberate unexpectedly and sometimes even dangerously throughout the system. Complex feedback effects abound. How to respond collaboratively and effectively to problems that are so interconnected and encompassing is a major challenge (Brandon, 2011).

2.7.2. The Need for Cross-Sectoral Approach of Infrastructure Collaboration

In the process of urbanization, policies and programmes for the sustainable development of human settlements in both rural and urban areas require strong subnational governmental institutions working in partnership with all interested parties. Such institutions are still weak in many countries, and their effectiveness is threatened by increasing problems of political regionalism and ethnic strife (Kitila, 2015). All these concerns and demands require a regional and cross-sectoral approach to human settlements planning, which places emphasis on rural/urban linkages and treats villages and cities as two ends of a human settlements continuum in a common ecosystem (Pernegger, 2008). Participatory planning has proven to be an essential element for developing sustainable and inclusive services. Working with relevant stakeholders from all the sectors being analyzed, together with city officials and civil society living in the defined area(s), helps generate new ideas and understanding of the problem (Kitila, 2015). If these ideas become incorporated into a proposed project, greater commitment results, as does enhanced responsibility for achieving the full objectives (Castañer, 2020).

2.8.Cooperation and Coordination of Infrastructure

A cooperation and coordination level in infrastructure and service delivery is a stepping-stone for the highest level of integration to work. The foundation for full level of integration should be laid through cooperation and coordination. (Bruce, 2006) effective

cross sectoral coordination and linkage requires compatible system in two domains (technological, competitive, and legal) (Mathewos, 2006). Development sectors have traditionally been institutionalized and addressed through separate government line functions. For operational purposes, each department has been allocated separate budgets and has been given responsibility for developing and implementing different legislation, policy and programs. For municipal planning and delivery to be integrated, vertical and horizontal coordination or alignment needs to take place between and within the spheres of government (Seife, 2019).

2.9.The Concept of Integrated Infrastructure

Integration is a combination and coordination of separate and diverse elements or units into a more complete or harmonious whole. It is unified control of a number successor of similar economic processes formerly carried on independently. It requires both cooperation and coordination in order to work, it also calls for the existence of a single formalized decision making system and the procedures that facilitate the existence of such a system. Integration potentially allows for more effective and efficient use of resources in order to achieve a given set of objectives (Zegeye, 2012). Integration may take three forms, which are (Mathewos, 2006):

Integration within an infrastructure sector/entity (intra-sectoral integration): for example integration within road sector between Road Authority (arterial and sub arterial road) and local government and community initiatives (local and collector road).

Integration between infrastructure entities (inter-sectoral integration): integration between different sectors/infrastructure entities.

Integration of infrastructure with other urban development sectors housing, business, industrial areas etc. (which is also inter-sectoral integration). Integrated infrastructure planning is a tool for implementing housing, business and industrial development.

Integrated Infrastructure denotes a state of affairs whereby different infrastructure interventions are planned and implemented in a balanced manner relative to one another and to the urban functions they are supposed to serve (Lombeso, 2018).

2.10. Key Principles of Integrated Infrastructure and Service Planning

As indicated in the integrated urban infrastructure and services planning manual prepared by Mathewos (2006), there are basic principles to integrated infrastructure development and service planning explained as follows:

- Participatory approach which is integrated planning of infrastructure and services require a foundation of shared interests, visions and common objectives of stakeholders in a structured and directed manner (Roberts & Addison, 2015; Seife, 2019).
- Decentralized decision making process which is integrated urban infrastructure and service development plan requires decentralization and empowerment of local governments as key actors in investment decision of infrastructure and service development (Mahlet, 2014).
- Setting clear and common objectives for common benefits which is applying integrated infrastructure and services development planning requires clear and common objectives of all concerned parties (Planning & Bureau, 2012).
- Precautions should be made prior to initializing which is integrated urban infrastructure and services planning inappropriate attempts might cause adverse effect (Mathewos, 2006).
- Developing cooperation and coordination level in infrastructure and service delivery which is a stepping-stone for the highest level of integration to work (Mahlet, 2014).
- Integration should link the institutional, regulatory, spatial, environmental, & economical elements across sectors that are all elements should be interlinked while preparing integrated infrastructure & service planning (Mulugeta, 2011).
- Follow incremental proceeding in order to be pragmatic to specific local conditions and to build on existing capacities (Mahlet, 2014).

2.11. The Complex Relationship of Infrastructural Integration

The problem of infrastructure development by integrating technical, economic and operational aspects, as well as the interactions between the entities that jointly carries out the project. As mentioned by Aterina (2015), the complex relationship between the sequential actions of players and the time-dependent behavior of a physical system is explored using a hybrid agent-based simulation model. The model is illustrated with several examples that show the versatility of the approach and its ability to accommodate the different decision strategies of the players (i.e., principal, agent) and the model of a physical infrastructure system (Seife, 2019).

2.12. Collaboration among Integrated Infrastructure Practice

According to Dikbas et al. (2000), the current Practice of inter sectoral level integrated infrastructure projects management system of constitute intuitional current capacity which

incorporates the organizational structure, project planning; communication and information technology in supporting decision making on budget and plan, central data base and information exchange and the City's infrastructure integration, construction, permit and control authority with respect to its capacity to enforce the law and coordinate all project stakeholder during new project development and maintenance stage. The current institutional capacity gap impinge with organizational structure almost all institutions do not have primarily concerned department for utilities infrastructure project implementation and maintenance and rehabilitation management .In addition, they have no clear project participants roles and responsibilities. These factors create inconsistency of utilities project administration and become a challenge for effective and integrated projects management inter and across the sector (Seife, 2019).

According to Mahlet (2014), the current level of integration between service providers, the current status of integration among service providers is said to be low. The current institutions technological capacity does not fit the current complex and interdependent of the city infrastructure project nature. Thus, it is found to be substantial the technological advancement which is compatible, cost effective and flexible and could be adopted contextually to create effective and efficient integrated infrastructure project management system (Dias, 2001). Though, it requires a considerable time resource and cost, regarding the city's regulatory authority the research finding reveals that the regulatory authority's current institutional capacity lack organizational structure and also has no technological support and facilitate for decision making, planning and coordination (Larsson, 2020). Thus, the finding clearly indicates that the regulatory authority needs institutional capacity building to achieve its establishment mission and objective. Unless, the regulatory authority enforce the law and project compliance during project development and each project execution stage, the utilities institutions' poor awareness of integration and coordination, lack of top management commitment become a serious challenge for integrated infrastructure project implementation (Seife, 2019).

2.13. Factors that affect Collaboration among Infrastructure Integration

According to Mahlet (2014), the current level of integration between service providers, the current status of integration among service providers is said to be low. However, there were an efforts made to introduce an integrated approach but were not successful due to various reasons: such as lack of clearly stated rules or regulations or any legal conditions which suggest coordination among service providers were also found to be causes for the

lack of strong integration between stakeholders. It is still loose communication during implementation due to lack of accurate information about the location, size and type of utility lines and negligence and carelessness of service providers to communicate. In general lack of strong legal enforcement, lack of capacity, lack of interest and commitment of service providers, absence of responsible body to do the job and lack of long term plan were identified as the root causes for the absence of inter sectoral integration.

According to Mulugeta (2011), the current status of integration could be said low or poor among service providing institutions. The major reasons for the poor level of integration at inter sectoral level are: lack of adequate professionals, lack of integrity and working together, shortage of budget, absence of responsible body, absence of policy, plan year and change of plan, infrastructural policy, legal ground of sectors and presence of formal committee and regular meeting.

According to Kitila (2015), studied the major factors that have contributed to the less likely performance level of the urban sectors are: weak institutional arrangements; lack of budget and monitoring by the concerned parties; poor coordination among the sectors in all phases of urban management stages; lack of budget to organize various trainings, workshops and regular meetings to aware the officials working; absence of clear cut policy frameworks on which approach is to be adopted and exercised; lack of commitment and responsibility towards the new approach; lack of political will and biasness towards the traditional approach; lack of coordination within and in between sectors, unwillingness of some individuals and uncoordinated or lack of integrity within and in between the urban service sectors (Lombeso, 2018; Zegeye, 2012).

2.14. Impacts of Poor Collaboration among Integrated Infrastructure

According to Mahlet (2014), studied the effects of poor/absence of inter sectoral integration are: the economic effects on service providers are characterized by property damages, high cost of compensation, cost of carrying out repairs and relocations, cost for· any temporary service arrangements necessary, and the possible loss of "product" and revenue reduction during service interruptions. Effects on utility customers include, frequent service interruptions, business may be stopped and data lost, and for industrial properties production may be halted and machinery damaged, low productivity, decrease in number of customers, low profit etc. The social effect which can be characterized as lost time, business opportunities and additional fuel consumption, spoiling of food because of

refrigeration failure, injuries and traffic accidents, traffic congestion, safety hazards and lack of transportation access. The environmental effect which can be characterized as hygiene problems may arise because of water supplies being contaminated, sewage backing up, flooding and storm water inundation, noise pollution, air pollution, and dust induced lung diseases are identified by the study.

According to Mulugeta (2011), the major negative effects of poor/absence of infrastructure integration could be said economical (repetition of works and wastage of scarce resources), social traffic accident and congestion. Moreover, negative mentality of people as well as environmental and health issues. The socio economic impact of the absence or low level of integration was repetition of works, traffic accident, death of significant number of people and loss of huge amount of resources are the major backlogs resulted from the absence of integration. Since excavation usually is done on the peak hours and done with traditional methods it will have considerable effect on both economic and social aspects.

According to Kitila (2015), the major effects are economic, social, and administrative. Economically, when the allocation of huge cost to maintain the destroyed line, labor cost, purchasing of the materials and time and energy cost. Socially, when utility line is destroyed the service will be disconnected and the community is going to suffer from long lasting loss of services. Because the time interval since the destruction of utility line to the maintenances becomes longer, hence, the bureaucracy, to identify the responsible body for the breakage of the line, takes time. Finally, the problems related to administrative aspects are the potential rise of conflicts, disagreements and unnecessary dialogues among various sector officials. Thus it will contaminate the working environment and dwindle the spirit of jointly working to rise the performance of the sector.

2.15. Cross-Sector conceptual framework

It is a general fact that integration is a process of bringing different sectors in to one harmonized system which seems very difficult and impractical. Integration involves different sectors of works and every single work should be harmonized one another to bring effective and efficient system an attempt has been made to demonstrate that there is a correlation between integration and infrastructure projects and the social, environmental and economic developments of a country. Such a broad view is commonly considered to be an essential aspect of sustainability. The idea of sustainable development as an explicit

concept can be traced back to 1987 when the World Commission on Environment and Development defined it as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". The most common general assessment framework is based on the three pillars of sustainability: Environmental, Economic and Social (Gebremeskel, 2020).

2.16. Legal &Regulatory Framework of Collaboration among Integrated Infrastructure

The need for a comprehensive legal and regulatory framework which is clear, transparent and predictable for efficient, effective and fair bidding procedures has been emphasized. The legal environment where projects operate often influences to a large extent the willingness of the private sector to collaborate in infrastructure project development. Therefore, in order to attract private sector participation, the government has to develop adequate legal and regulatory framework, as well as a financial environment, congenial to investment and attractive to foreign investors (Hinge & Goyal, 2020). It has been argued that the success of public private collaboration revolves around availing an adequate and enabling legal and regulatory framework that critically analyses services, partners and a "value for money" procurement strategy. This is necessary, since disputes are likely to occur and service delivery delayed and/or impaired. The existence of a functioning legal and regulatory framework reduces opportunistic tendencies, aligns the interest of partners and also provides confidence to the private partners as it acts as a buffer against political interference from government agencies. PPC requires a regulatory and institutional framework which clearly discourages criminal tendencies. The laws and regulations that govern all economic activities must empower appropriate government agencies/institutions to promptly detect and adequately penalize corrupt practices and illicit transactions (Lombeso, 2018).

2.17. Emphasis of the City Master plan for Utility Providers

It is a fact that any work in any city should comply with the master plan either directly or indirectly. Hence, any work has to refer the city master plan. Similarly, the preparation of this master plan needs quiet participation and need to involve every stakeholder, because this master plan is a general frame work that enables every actor to entertain within it. However, the preparation of master plan in some cities may execute without the consultation of every stakeholder. In this regard the survey attempts to elicit idea whether the city master plan gave enough attention for utilities or not. The Planning perspective,

the plan year of every sector is not uniform among infrastructure providing institutions. Moreover, every utility provider except the road authority does not refer the city master plan in most of their activities. Since the plan year is short and there is frequent plan change the integration process challenging and from bad to worse. The level of integration is loose in the planning and design stage, the implication expected to be the same on the implementation and follow up too. Coordinating these sectors already began by regulatory office but, the current status of integration in all stages said to be low (i.e on planning, design, budget and financing, implementation and follow-up) at both intra and inter sectoral level. The absence of integration caused and resulted with a number of consequences and it is still loose in spatial aspects. The emphasis of city master plan for utilities has still significant effect (Mulugeta, 2011).

2.18. Sectoral Coordination in Urban Infrastructure Development & Service Provision

According to Mahlet (2014), focus area on the four main infrastructure sectors of Addis Ababa; Water and sewerage, Electricity, Telecommunication, and Road sectors, the institutional, regulatory and financial arrangements, were mentioned as major factors to have strong relationships and significant influence on the process of infrastructure development and service provision as well as level of inter-sectoral coordination indicating an urge and need for the current governance arrangement to be made more effective and compatible for the existing infrastructure needs and requirements, to uncoordinated planning and design and weak institutional arrangements redoing faulty designs and rebuilding utility lines have wasted a significant resource.

2.19. Summary of the Literature Review and Research Gap

Key to this research is improvement of collaboration among integrated infrastructure in Adama city. Looking back at the review there are instances of successful cooperation between different sectors in integrated infrastructure environments that promote greater efficiencies of systems. The provision of infrastructure services is a critical factor for economic growth and contribution to GDP. For example infrastructure, is the capital stock that provides public goods and services, the provision of which acts as a formal conduit for leveraging economic and market drivers. Several key concepts emerge from this review literature:

Infrastructure is the backbone of economic capacity, but it also impacts directly on human development, social inclusion and environmental sustainability and so the development of infrastructure is a fundamental concern of both governments and citizens. It is basic physical and organizational structures needed for the operation of a society or enterprise, or the services and facilities necessary for an economy to function. It can be generally defined as the set of interconnected structural elements that provide framework supporting an entire structure of development (Zegeye, 2012).

Integration is the highest level which brings the planning, financing, implementation and management of different sectors into a formalized decision making system and procedures. Since this is the most challenging level, the other lower levels should work smoothly, effectively and efficiently prior to application of full integration (Soyinka et al., 2016). Integrating institutions is to support integration between different project phases and sectors of infrastructure, a restructuring of institutional arrangements is necessary. Government bodies responsible for different infrastructure sectors must be integrated horizontally across sectors, as well as vertically, so that national-level policy can be effectively translated into regional and local-level implementation (Gebremeskel, 2020; United Nations Environment programme, 2019).

Cross-sector collaboration is now increasingly both necessary and desirable as a strategy for addressing many of society's most complex public challenges. Collaboration is the linking or sharing of information, resources, activities and capabilities by organizations to achieve jointly an outcome that could not be achieved by the organizations separately (Castañer, 2020).

Several Current practice exist when collaboration among integrated infrastructure are: the strategic alliances and relationships among road authority, regulatory authority and other utilities, the institution plans/designs in line with the master plan of the city, the aware of the other institutions/organization plans, the organization communicates its plan with the other institutions/organizations, the efforts made to introduce integrated approach for infrastructure collaboration between institutions/organization, the organization has established relationships with stakeholder in solving the root causes of problems of the integrated infrastructure implementation, the organization efficiently possesses project communication plan, information sharing, and dissemination strategies to inform, accelerated decision making, the organization routinely shared the information about

current or planned utilities services and results with project beneficiary and other stakeholders, the organization collaborates with other utility service providers (actors) to design and implement projects with complementary services, the efficient collaboration across utilities institution, road authority and regulatory agencies system in Planning, implementing and data exchange, the effective organizational information technology system for integrated infrastructure for human resources, budgets and data storage/archiving, current legal instruments and the established Adama city's regulatory authority are capable of creating collaboration in integrated infrastructure (Dikbas et al., 2000; Larsson, 2020; Mahlet, 2014; Seife, 2019).

Several factors that affect exist when implementing collaboration among integrated infrastructure. The major factors that affect collaboration among integrated infrastructure are: lack of cooperation & coordination across sectors, poor integrated infrastructure between sectors, limitation institutional capability in terms of system, technology & strategies, lack of effective decision support tools to enable strategic analysis & planning, shortage of professionals, lack of integrity and working together between sectors, budget constraints, absence of responsible body to do the job, current status of integration among infrastructure providing institutions, lack of communication during design preparation, loose communication during implementation due to poor utility database, lack of communication and coordination between the service providers, lack of central database system for data and information exchange, planning and decision making, lack of strong legal enforcement, lack of common standards and guidelines to all service providers, lack of clearly stated rules and regulations among integrated infrastructure, lack of policy and legal ground of infrastructure integration, lack of policy, manuals, procedures, standards and regulations integrated infrastructure, lack of interest and commitment of service providers, level of commitment for coordination between sectors, level of presence of formal committee and regular meeting between sectors, emphasis of the city master plan for utility providers and lack of long and short term plan among integrated infrastructure (Mulugeta, 2011; Mahlet, 2014; Kitila, 2015).

Several impacts exist when the result of poor collaboration among integrated infrastructure on sustainability. The major social impacts are lost time, business opportunities and additional fuel consumption, spoiling of food because of refrigeration failure, injuries and traffic accidents, traffic congestion, safety hazards, lack of transportation access, service interruption and handicap people faces many challenges were identified. The major

economic impacts are property damages, high cost of compensation, cost for any temporary service arrangements necessary, cost of carrying out repairs and relocations, possible loss of product and revenue reduction during service interruptions, wastage of scarce resource, repetition works/overlap and reduction of the asphalt service year were identified. The major environmental impacts are hygiene problems may arise because of water supplies being contaminated; sewage backing up, flooring and storm water inundation, noise pollution, air pollution and dust induced lung diseases were identified. (Mulugeta, 2011; Mahlet, 2014; Kitila, 2015).

An important gap here is, although the common factors that affect collaboration among integrated infrastructure are evidenced from theoretical and empirical findings, there is no specific framework for improvement of collaboration among integrated infrastructure in the case of Adama city. Sustainability of collaboration among integrated infrastructure can be measured on the impact that could be seen on economic, social and environmental developments of a country. Adama city is suffering from lack of proper management of its infrastructural and utility services as it is witnessed by regular conflict between sectors, increased cost of maintenance of infrastructure, dalliance of projects and coordination. These are management, communication and legal & policy issues frequently arise in the city sectors. In this respect, extant literature is now highlighting the importance of embracing new collaborative among integrated infrastructure approaches to effectively share and manage risks and rewards. There is a gap in the literature with reference to integrated infrastructure systems within the municipal context. The research must address this issue and answer the following questions:

- How does collaboration among integrated infrastructure practice in Adama city?
- Which factors is most significant affect collaboration among integrated infrastructure in Adama city?
- What are the social, economic and environmental impacts of poor collaboration among integrated infrastructure in Adama city?
- How can improve collaboration among integrated infrastructure in Adama city?

The sectors are Adama City Road Authority (ACRA), Ethiopia Telecommunication Utility (ETCU), Adama City Water and Sewerage Authority (ACWSA), Ethiopia Electric Utility (EEU) and the role of Adama City infrastructure development authority (ACIDA) and Adama City construction office permit and control authority (ACCOPCA); controllers and implementers. The dependent variable would be improving collaboration among

integrated infrastructure that was observed on the factors: economic, social, environmental and technological developments. As illustrated in figure 2.1 below as follow: (Gebremeskel, 2020).

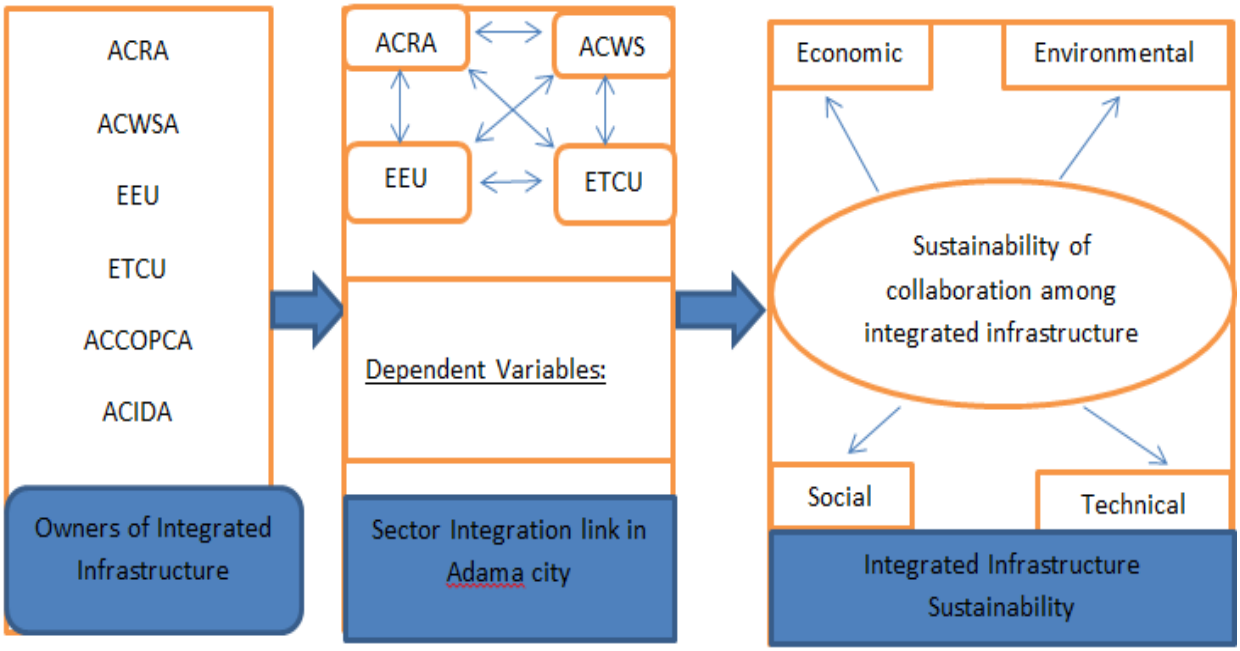

Figure 2.1: Conceptual Framework to improve the collaboration among integrated infrastructure

Source: researcher's own conceptualization

CHAPTER THREE
RESEARCH METHODOLOGY

3.1.Introduction

The focus of this research is assessing collaboration among integrated infrastructure and develop conceptual framework to improve the collaboration among integrated infrastructure in Adama city. This chapter explains the method and design that was used to conduct the research. This section includes the methodology used in this thesis work and provides an overview of research approach adopted in the study which is the information about the research area, research design, population & sampling frame, sample size determination, sampling techniques, data collection method, the process of data analysis techniques, and tests of reliability and validity of questionnaire and the ethical consideration. A mixed research method is preferred as an appropriate research strategy to this study.

3.2.Study Area

The study area of this research is Adama city. The rationale behind this is that the city's population size is growing fast and much more infrastructural utilities are demanded that ever before. The urban infrastructure of the four service rendering institutions: which are Adama city Road Authority, Adama city Water and Sewage Authority, Ethio-Telecommunication Utility South East Region District Adama Office and Ethio-Electric Utility South East Region District Adama Office are targets. The spatial description of the study area graphically is presented in the Figure 3.1, as shown below within the context of the Adama metropolis.

Figure 3.1: Map of Adama metropolis

Source: Adama city Municipal

3.3.Research Design

The research design adopted qualitative and quantitative research approach which is a mixed research approach aimed at increasing reliability of information, thereby making qualitative information to complement the quantitative information. The data were collected from primary and secondary data source through use either of the two a combination of close ended and open ended questionnaire, and published & unpublished documents, respectively. In addition, a review of related literature helped to explore concepts and adopt approaches to the current study of collaboration among integrated infrastructure practice and the associated challenges.

According to Kumar (2011), a research design as a procedural plan that is adopted by the researcher to answer questions validly, objectively, accurately and economically.
The general approach followed to this research is summarized in the Figure 3.2, as shown below.

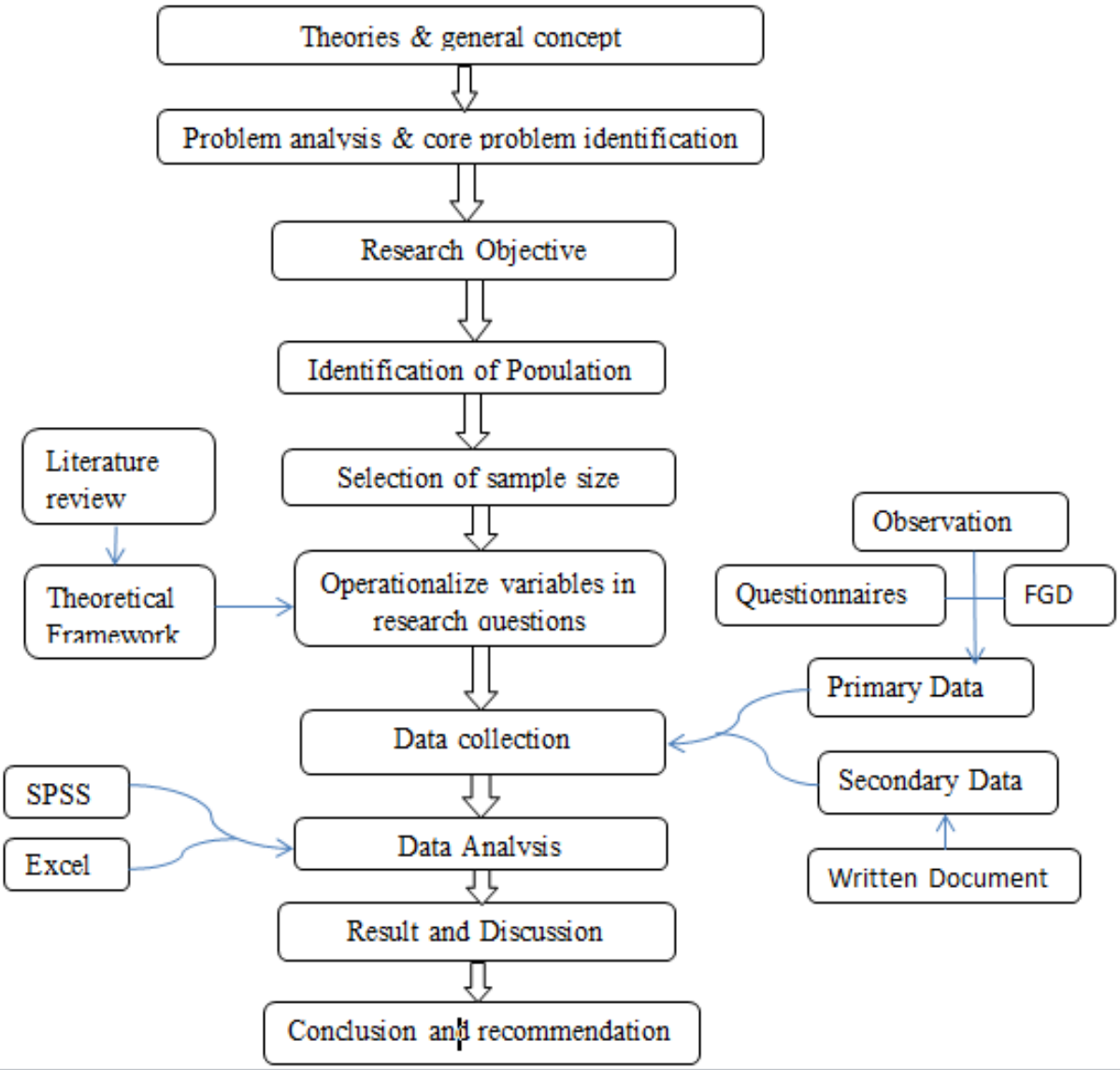

Figure 3.2: General approach followed to the research

Source: researcher's own research design

3.4.Population and Sampling Frame

This study has intent to assessing the improvement of collaboration among integrated infrastructure in Adama city. To do this, the methods employed are survey design. Survey research usually conducted through self-report using questionnaires and focus group discussion which is also adopted by this research.

The target populations of this study are the four sectors located in Adama city namely: Adama City Road Authority, Adama City Water and Sewage Authority, Ethio-Telecommunication Utility South East Region District Adama Office and Ethio-Electric Utility South East Region District Adama Office. The sectors professional employees, experts and different managers working were respondents for the questionnaire. The rationale behind the selection of these four sectorial offices was their major public utility service provision and being governmental owned sector that highly affects the societal development of the city. Respondents from the target population were selected using a probability sampling technique.

3.5.Sample Size Determination

Sample size determination is the act of choosing the number of observations or replicates to include in a statistical sample. The sample size is an important feature of any empirical study in which the goal is to make inferences about a population from a sample. In this research, the size of target population frame consists of a total of 1020 professional workers, experts, managers and directors i.e. for EEU = 252, for ETCU =287, for ACWSA = 248, for ACCOPCA = 126 and for ACIDA = 107 are considered to be in the population frame.

The sample size of each sector from the total sampling frame was drawn to make the required number of respondents (representatives). The data gathered through this technique shall be more representative and reliable. Therefore, this research paper considers these respondents as sample representative; the following equation 3.1 is used to determine the sample size (Lombeso, 2018):

$$n = \frac{NZ^{2}Pq}{e^{2}(N-1)+Z^{2}Pq} \quad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots \quad 3.1$$

Where; n is the desired sample size, N is the size of target population, Z is the standard normal deviate usually set at 1.645 for 90% confidence level, P is a proportion of target population have a specific characteristics (if no estimate available set at 50%), q is one minus P and e is acceptable sample error.

To calculate the sample size of respondents using equation 3.1, as shown below:

$$n = \frac{NZ^{2}Pq}{e^{2}(N-1)+Z^{2}pq} = \frac{1020(1.645)^{2}(0.5)(0.5)}{(0.1)^{2}(1020-1)+(1{,}645)^{2}(0.5)(0.5)} = 63.5 \approx 64$$

$$n \approx 64$$

Hence, the sample size of 64 *is accepted for respondents selection.*

To ensure good representation of each sector, the following was done:

EEU professional employees = 252

$$n\ for\ EEU = \frac{64 \times 252}{1020} = 16\ respondents$$

ETCU professional employees = 287

$$n\ for\ ETCU = \frac{64 \times 287}{1020} = 18\ respondents$$

ACIDA professional employees = 107

$$n\ for\ ACIDA = \frac{64 \times 107}{1020} = 7\ respondents$$

ACWSA professional employees = 248

$$n\ for\ ACWSA = \frac{64 \times 248}{1020} = 15\ respondents$$

ACCOPCA professional employees = 126

$$n\ for\ ACCOPCA = \frac{64 \times 126}{1020} = 8\ respondents$$

The sample respondent frame consists of a total of 64 professional workers, experts, managers and directors i.e. from Adama city Water and Sewage Authority sector 15 respondents, from Ethio-Telecommunication Utility sector 18 respondents, from Ethio-Electric Utility sector 16 respondents, from Adama city construction office permit and control authority sector 8 respondents and from Adama city infrastructure development authority sector 7 respondents are considered to be in the sampling frame.

3.6.Sampling Techniques

Sampling is a method that allows researchers to infer information about a population based on results from a subset of the population, without having to investigate every individual. In probability (random) sampling, you start with a complete sampling frame of all eligible individuals from which you select your sample. In this study probability sampling technique was used as this research followed a mixed method strategy. Of the different types of probability sampling techniques, simple random sampling is taken as the most appropriate sampling technique to select the required sample size for the study (Kumar, 2011).

Simple random Sampling is one in which each element of the population has an equal and independent chance of being included in the sample i.e. a sample selected by randomization method. It is the process of selecting sample by taking subject that is not

based on the level or area, but it is taken based on the specific purpose. Simple random sampling is a method used to cull a smaller sample size from a larger population and use it to research and make generalizations about the larger group**.**

3.7.Data Collection Methods

This research has been conducted by employing various methods of data collection. Both primary as well as secondary data has been collected. The researcher himself collects the primary data from the respondents using self-administered structured questionnaire and focus group discussion during the meeting carried out in the open place with key informants and industry practitioners.

The secondary data types were gathering information from published and unpublished documents, maps, plans, standard documents, statistical information and other related material collected from different sources.

The following instruments have been used to collect data for this study:

3.7.1. Questionnaire Survey

It was planned to use questionnaire which is a tool for collecting and recording information about a particular issue of interest with clear instructions and choices and space for answers. The closed questionnaire was adopted in such a way to have quantitative data which are related to the objectives of the research.

The questionnaire has three parts. The first part of questionnaire is gathering information about the respondents' background. The second part of the questionnaire is gathering information about the collaboration among integrated infrastructure practices. The third part of questionnaire is gathers information about the factors that affect collaboration among integrated infrastructure and the impacts of poor collaboration among integrated infrastructure on sustainability in Adama city.

The sample respondents of the questionnaire were selected using simple random sample techniques which include managers, experts and directors level are summarized in Table 3.1, shown below:

Table 3. 1: Distribution of sample respondents from each Organization/Sectors

Target sample group	Number of Respondent
Adama city Water and Sewerage authority sector	18
Ethio-Telecommunication Utility sector	22
Ethio-Electric Utility sector	19
Adama city construction office permit and control authority sector	10
Adama city infrastructure development authority sectors	9

Source: researcher's own sample respondents

3.7.2. Focus Group Discussion

Focus group discussion is frequently used as a qualitative approach to obtain data as part of fulfilling information on the town's infrastructure status (Lombeso, 2018). A focus group organized by the researcher use 8 important questions during the discussion. For the focus group discussion 6 purposively selected key informants one from ETCU sector managers, from EEU sector managers, from ACWSA sector managers, from ACCOPCA sector managers, from ACIDA sector managers and from city municipal were invited in FGD to discuss about issue regarding collaboration among integrated infrastructure on sustainability in Adama city.

Focus group discussion is frequently used as a qualitative approach to gain an in-depth understanding of social issues. It has been used in areas such as management, marketing, decision and information systems, among others. Its general characteristics stand out: the homogeneity of the group, the sequence of the sessions, the obtaining of qualitative data, and focus on a topic. The method aims to obtain data from a purposely selected group of individuals rather than from a statistically representative sample of a broader population. Focus group discussion (FGD) is a research tools that is a good way to gather together people from similar backgrounds or experiences to discuss a specific topic of interest.

The following questions were presented for the FGD (See Appendix B):

- What do you think about factors that affect collaboration among integrated infrastructure service in Adama city?
- What is your attitude towards the poor collaboration among integrated infrastructure effects on sustainability in Adama city?
- What do you think about the aims of having cities master plan practice in infrastructure service integration in Adama city?

- Why do you think that the sectors should collaborate in order to manage integrated infrastructure in Adama city?
- Do you have communication on infrastructure service integration with stakeholders? How?
- What would you say are the most important issues of collaboration among integrated infrastructure service in Adama city?
- What changes do you think might improve the current process of collaboration among integrated infrastructure service in Adama city?
- Do you have comments/suggestions regarding any area that needs to be improving collaboration among integrated infrastructure service in Adama city?

3.8.Data Analysis Techniques

In order to achieve the above objectives, the study employed descriptive analysis technique using frequency and relative importance index to fairly describe demographic information of respondents, and practices & impacts of challenges regarding collaborative among integrated infrastructure, respectively. Exploratory factor analysis was also used to identify critical factors that affect collaboration among integrated infrastructure. Narrative approach was also an addition to summarize the major points obtained during the focus group discussion. The data collected through review of documents, focus group discussion and questionnaires is analyzed within the framework of the study objectives. Data collected through questionnaires are screened, coded, and analyzed. Qualitative data is used to enrich, illustrate, and elaborate on the quantitative findings. Both the qualitative and quantitative analysis focuses on answering the study questions.

Data collected from the first part of the questionnaire (respondent's profile) that are respondents institution name, educational background, work experience, current position and area of the work were analyzed descriptively using frequency, charts and percentages.

3.8.1. Relative Importance Index (RII) Technique

Data collected from the Current Practice of collaboration among integrated infrastructure of the questionnaire is analyzed by relative importance index technique was used to determine the relative importance of the Current Level of collaboration among integrated infrastructure Practice in Adama city using the following five likert scale: Strongly Agree (SA) = 5, Agree (A) = 4, moderately Agree (MA) = 3, Disagree (D) = 2 and Strongly Disagree (SD) = 1 (See Appendix A). The researcher believes that a 5 point scale fairly

represents the respondents' perception reliably and instead of multiple redundant scales for their time.

Data collected from the impacts of poor collaboration among integrated infrastructure on sustainability of the questionnaire is also analyzed by relative importance index technique was used to determine the relative importance of the impacts as a result of poor collaboration among integrated infrastructure on sustainability in Adama city using the following five likert scale: Very high impact (VHI) = 5, High impact (HI) = 4, Medium impact (MI) = 3, Low impact (LI) = 2 and Very low impact (VLI) = 1 (See Appendix A).

Data analysis technique by RII, the equation 3.2 is used to determine the relative importance index as shown below (Joro, 2015):

$$RII = \frac{\sum W_i f_{xi}}{AN} = \frac{5n_5 + 4n_4 + 3n_3 + 2n_2 + 1n_1}{AN} \quad \dots \dots \dots \dots \dots \dots \quad 3.2$$

Where W_i is weight given to i^{th} response; i = 1, 2, 3, 4 and 5, f_{xi} is the responses frequency, N is total number of responses, RII is relative importance indices, A is the highest weight (i.e. 5 in this case), n_5 is number of despondence for value 5, n_4 is number of despondence for value 4, n_3 is number of despondence for value 3, n_2 is number of despondence for value 2 and n_1 is number of despondence for value 1.

The relative importance indices value had a range from 0 to 1. If a relative importance index value is near to 0, it is not inclusive and if relative importance index value is higher value (near to 1), it is more significant.

3.8.2. Factor Analysis Technique

Data collected from the factors that affect collaboration among integrated infrastructure of the questionnaire is analyzed by factor analysis that is the factors that affect collaboration among integrated infrastructure in Adama city using the following five likert scale: Very high (VH) = 5, High (H) = 4, Medium (M) = 3, Low (L) = 2 and Very low (VL) = 1 (See Appendix A).

Factor analysis is a statistical technique that is used to choose and ranks the significant variables. This technique extracts maximum common variance from all variables and puts them into a common score. Factor analysis type using Principal component analysis method which is provides a unique solution, so that the original data can be reconstructed from the results. It looks at the total variance among the variables, so the solution

generated will include as many factors as there are variables, although it is unlikely that they will all meet the criteria for retention (Shrestha, 2021).

The result of data analysis is chooses and rank the more significant factors that affect collaboration among integrated infrastructure using factor analysis technique to determine a comprehensive score steps are as follows:

3.8.2.1.KMO check for adequacy of data

A Kaiser-Meyer-Olkin (KMO) test is used in research to determine the sampling adequacy of data that are to be used for factor analysis (often use to ensure the variables they have used to measure a particular concept are measuring the concept intended). The KMO test allows us to ensure that the data we have are suitable to run a factor analysis and therefore determine whether or not we have in fact measured what we intended to measure. The statistic that is computed is a measure of 0 to 1. Interpreting the statistic is relatively straightforward. It is closer to 1, the better. Kaiser states we should interpret the statistic by recognizing the range to which it falls in (Reserved et al., 2019):

- Values between 0.8 and 1 would deem the sample adequate.
- Values below 0.6 would deem the sample not adequate and remedial action should be taken.
- Values below 0.49 are unacceptable, and we should conclude that the data are not suitable for Factor Analysis.

In SPSS, we conduct a KMO test by using Factor Analysis. The KMO test is used along with Bartlett's test of Sphericity, a different test that examines whether the data are normally distributed. The two tests together examine the distribution of the data and the sampling adequacy of each variable in the model tested, along with the adequacy of the model as a whole (Reserved et al., 2019).

3.8.2.2.Correlation matrix

Producing a correlation matrix is an essential step in the process of conducting a factor analysis. A correlation matrix is a set of correlation coefficients among all the variables being considered in the study. Factoring is not worthwhile unless there are a substantial number of large correlations. Correlation coefficients are the relationship between a single variable and every other variable in the investigation. With respect to Correlation Matrix if any pair of variables has a value less than 0.5, consider dropping

one of them from the analysis (by repeating the factor analysis test in SPSS by removing variables whose value is less than 0.5) (Shrestha, 2021).

3.8.2.3. Extraction of initial factor

Factor extraction is the method of identifying the components that best characterize a set of variables. Three factor extraction methods are frequently used in factor analysis. They are principal-axis factoring, principal components analysis (PCA), and the maximum likelihood method. Of the methods, PCA is the most popular (Brandon, 2011).

Principal components analysis is intended to simply summarize many variables into a few components. The goal of PCA is data reduction, reducing a large number of variables to a smaller set of components that account for a large amount of observed variance. PCA is appropriate if the researcher's purpose is pure reduction of variables without interpreting the resulting variables in terms of latent constructs. PCA explains all the variance in any particular correlation matrix. PCA assumes that there is as much variance to be analyzed as the number of achieved variables and all the variance can be explained by extracted components (Brandon, 2011). In factor analysis, the remarkable factors having eigenvalue greater than one are retained using SPSS software (Shrestha, 2021).

3.8.2.4.Factor rotation

Factor rotation is a process of turning the two reference axes of the factor. These rotations permit a virtual infinity of different solutions. Each rotation of a factor into a new position changes the position relative to the other factors and each new position would give new loadings. Factor loading is basically the correlation coefficient for the variable and factor. Factors obtained in the initial extraction phase are often difficult to interpret because of significant cross loadings in which many factors are correlated with many variables. There are two main approaches to factor rotation; orthogonal (uncorrelated) or oblique (correlated) factor solutions using SPSS software (Shrestha, 2021).

3.8.2.5.Standardized values of original factors

The aim of this step is to standardize the range of the continuous initial variables so that each one of them contributes equally to the analysis. More specifically, the reason why it is critical to perform standardization prior to Principal Component Analysis is that the latter is quite sensitive regarding the variances of the initial variables using SPSS and excels software. Mathematically, calculate Standardized values can be done by subtracting

the mean and dividing by the standard deviation for each value of each variable using equation 3.3, as follows (Brandon, 2011):

$$S\tan dardizedValue\,(Z) = \frac{Value - meean}{S\tan dard\ deviation} \quad \cdots\ \cdots\ \cdots\ \cdots\ \cdots\ \cdots\ \cdots \quad 3.3$$

3.8.2.6.Factor Score Coefficient Matrix

Factor score coefficient matrix is the factor weight matrix and is used to compute the factor scores analyzed by SPSS software (Bai et al., 2015).

3.8.2.7.Common factor Score

Every common factor score of factors that affect collaboration among integrated infrastructure in Adama city analyzed by SPSS and Excel software can be calculate using the following equation 3.4, as shown below (Bai et al., 2015):

$$F_i = \sum_{n=1}^{m} C_n V_n \quad \cdots\ \cdots\ \cdots\ \cdots\ \cdots\ \cdots\ \cdots\ \cdots\ \cdots\ \cdots\ \cdots\ \cdots\ \cdots\ \cdots\ \cdots \quad 3.4$$

Where; F_i is the i^{th} common factor score, i is number of common factor, m is number of variables, C_n is n^{th} factor score coefficient matrix and V_n is n^{th} standardized values of original factors.

3.8.2.8.Comprehensive scores and rank

The comprehensive scores are calculating and rank analyzed by SPSS and Excel software using the following equation 3.5, as shown below which is Comprehensive evaluation score (Bai et al., 2015):

$$Comprehensive\ Score = \frac{\sum_{i=1}^{m} f_i}{\sum_{j=1}^{p}\left(\sum_{i=1}^{m} Sf_i\right)_j} \quad \cdots\ \cdots\ \cdots\ \cdots\ \cdots\ \cdots\ \cdots\ \cdots\ \cdots\ \cdots\ \cdots \quad 3.5$$

Where; f_i is common factor score $i = 1,2,3,\cdots$, S is number of variables, P is total variable and m is number of common factors.

Therefore, the interpretation of factor analysis technique if comprehensive score is higher value, it is more significant factors that affect collaboration among integrated infrastructure in Adama city.

3.9.Validity and Reliability

As mentioned by Stilwell & Hoskins (2013), reliability and validity are two main criteria for determining data quality where validity presumes reliability, that is, if a measure is not reliable, it cannot be valid.

3.9.1. Validity of the research method

Validity is the degree to which a test measures what it purports to measure and the validity of the questionnaire data depends in a crucial way on the ability and willingness of the respondents to provide the information requested. The questionnaire employed was adapted from reviewed literatures and similar study instruments and were made suit for the existing research environment. In addition, industry practitioners' comment on the appropriateness of the elements included in the questionnaire helps to well validate the approaches in obtaining the intended data. Furthermore the questionnaires adapted were pilot tested by advisors, professionals from the area and experts to be validated in the three parts of the questionnaires. Validity means that correct procedures have been applied to find answers to a question.

In this regard the study was designed to clearly and correctly address the intended objective (research question). The instrument's similarity with other collaboration among integrated infrastructure measurement scales, detailed reviewed literatures of the constructs/concepts identified by the variables in the three parts of the questionnaires, advisor's review, university instructors comment and subsequent steps in the process that follow formal statistical/scientific approach in answering the research questions ensured that the study approach and the measurement instrument fulfill all of the construct, face and content validity of the research.

3.9.2. Reliability of Questionnaire

Reliable measurement is the repetition of any measurement that produces the same result. In order to maintain reliability in the study, the researcher administered the same type of questionnaire to all the subjects, that is, all four selected utility services members who participated in this research were given the same type of questions with the same type of wording thus carrying the same meaning to all. The assumption here is that all the respondents will have the same interpretation of the questions; however, the researcher made sure that all the questions were constructed in the English language so as to be easily

read and understood by all subjects. Reliability refers to the quality of a measurement procedure that provides repeatability and accuracy.

Data collected from the respondent's profile of the questionnaire reliability is test participants personal characteristics regarding the test environment and condition of the participants can contribute to whether or not a test is effectively reliable. Simple random method is that the researcher exercises lottery method for equal chance of target population selection on the informant's reliability and competency. This is a relevant concern especially regarding key informants on whom much of the data quality rest.
Data collected from the Current Practice Level of collaboration among integrated infrastructure of the questionnaires, internal consistency reliability is tested by Cronbach's alpha coefficient in rated on a five point likert the response scale which included Strongly Agree (SA) = 5, Agree (A) = 4, moderately Agree (MA) = 3, Disagree (D) = 2 and Strongly Disagree (SD) = 1.

Data collected from the factors that affect collaboration among integrated infrastructure of the questionnaires, internal consistency reliability is tested by Cronbach's alpha coefficient in rated on a five point likert the response scale which included Very high (VH) = 5, High (H) = 4, Medium (M) = 3, Low (L) = 2 and Very low (VL) = 1 and from the impacts as a result of poor collaboration among integrated infrastructure on sustainability of the questionnaires, internal consistency reliability is also tested by Cronbach's alpha coefficient in rated on a five point likert the response scale which included Very high impact (VHI) = 5, High impact (HI) = 4, Medium impact (MI) = 3, Low impact (LI) = 2 and Very low impact (VLI) = 1. Reliability tested using Cronbach's alpha values for the items in each construct. Cronbach's alpha requires only a single test administration to provide a unique estimate of the reliability.

The test of reliability, the equation 3.6 is used to determine the Cronbach's alpha as shown below (Namdeo & Rout, 2016):

$$\alpha = \left(\frac{k}{k-1}\right)\left(\frac{{S_T}^2 - \sum {S_i}^2}{{S_T}^2}\right) \quad \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \quad 3.6$$

Where; α is the cronbach alpha coefficient, K is the number of items, S_i^2 is the variance of i^{th} item and S_i^2 is the variance of total score formed by summing items.

The interpretation of Cronbach's alpha is the range of Cronbach's alpha normally is between 0 and 1. Guide line provided by them to assess the reliability of any data as shown in Table 3.2.

Table 3. 2: Guideline for assessing reliability results

S. No	Range	Reliability
1	0.9 and above	Excellent
2	0.7 – 0.9	High
3	0.5 - 0.7	Moderate
4	0.5 and below	Low

Source: (Perry R. Hinton & Brownlow, 2014)

3.10. Ethical Consideration

This study was subject to certain ethical issues. As it was mentioned earlier, all the research participants included in this study is appropriately informed about the purpose of the research and their willingness and consent is secured before the commencement of distributing the survey questionnaire and asking them to give their responses to the focus group discussion.

The research does not specify any participant's name and Confidentiality of information was guaranteed. The other ethical consideration of this research is in keeping the findings not to be disadvantageous to participants. The author shall not intentionally misreport findings which would be disadvantageous to the participants.

CHAPTER FOUR
RESULTS AND DISCUSSIONS

4.1. Introduction

The results and discussion is the most important part of the study. This chapter is structured according to research objective and presents the findings. The important finding results were directly linked to the improvement of collaboration among integrated infrastructure in Adama city. The information collected through field observation, survey questionnaires and focus group discussion are analyzed within the framework of the study objectives. The analysis was carried out using factor analysis method and RII method; focusing on collaboration among integrated infrastructure practices, factors that affect collaboration among integrated infrastructure and effects of poor collaboration among integrated infrastructure on sustainability in Adama city. Accordingly, interpretations and discussions were presented on the basis of the findings. Hence, this chapter seeks to discuss the implications of the findings in relation to the research objectives that were set out in the introduction and the results are presented concurrently according to the three key topics listed below.

- General information about the respondents
- Integrated infrastructure practice in Adama City
- Existing Integrated infrastructure in Adama City

A total of 78 questionnaires which dealt with practices, factors that affect and effects of poor collaboration among integrated infrastructure in Adama city were distributed to the respondents. However, only 64 questionnaires were collected and had usable responses (82% response rate), focus group discussion and relevant documents have been also reviewed. Considering the difficulty of collecting data in infrastructure sectors, an 82% response rate was reasonably very good.

4.2. Respondent's Profile

4.2.1. Questionnaire Response Rates

The questionnaire form was distributed to 78 respondents (18 for ACWSA, 22 for ETCU, 19 for EEU, 10 for ACCOPCA and 9 for ACIDA) out of which 64 respondents returned completed forms, representing an 82% response rate. The response rate for respondents is 82%, the response rate for ACCOPCA is 80%, the response rate for ACWSA is 83.33%, the response rate for ETCU is 81.82%, the response rate for ACIDA is 77.78% and the

response rate for EEU is 84.21% are very good when compared to the other response rate, which is show in Table 4.1 below.

Table 4. 1: Frequency distribution of sample respondent's rate

Response Distribution	No of distributed questionnaire	No of returned Responses	% of returned Responses
ETCU	22	18	81.82%
EEU	19	16	84.21%
ACWSA	18	15	83.33%
ACCOPCA	10	8	80%
ACIDA	9	7	77.78%
Total	78	64	82%

Source: Own survey data analysis

4.2.2. Classification of respondents sample size

Frequency Table 4.2 shows that the characteristics of the respondents sample size rate among the groups of the selected sectors/institution in Adama city. The sample consists of 18 respondents from ETCU (28.1%), 16 respondents from EEU (25%), 15 respondents from ACWSA (23.4%), 8 respondents from ACCOPCA (12.5%) and 7 respondents from ACIDA (10.9%). The distribution respondents sample size can be seen in the Table 4.2 as follows.

Table 4. 2: Classification of respondents sample size

Name of institution/sectors		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	ETCU	18	28.1%	28.1%	28.1%
	EEU	16	25%	25%	53.1%
	ACWSA	15	23.4%	23.4%	76.6%
	ACCOPCA	8	12.5%	12.5%	89.1%
	ACIDA	7	10.9%	10.9%	100%
	Total	64	100%	100%	

Source: Own survey data analysis

4.2.3. Respondents level of qualification/Educational Background

Education as one of man's cultural needs is the most important factor to bring forth all round development. Moreover, it is a key to enhance the level of capability working together with others, which can also influence the process of integration at certain level.

Educational statuses of the sample of the respondents have been presented on following Table 4.3 and Chart 4.1, as shown below respectively.

Table 4. 3: Respondents Level of qualification/Educational Background

Educational Background	Response Distribution Sectors											
	ETCU		EEU		ACWSA		ACCOPCA		ACIDA		Total	
	Fr	%	Fr	%	Fr	%	Fr	%	Fr	%	Fr	%
PhD	-	-	-	-	-	-	-	-	-	-	-	-
MSc/MA	-	-	1	1.56%	1	1.56%	-	-	2	3.13%	4	6.2%
BSc/BA	13	20.3%	12	18.8%	10	15.6%	8	12.5%	5	7.8%	48	75.0%
Diploma	5	7.8%	3	4.69%	4	6.2%	-	-	-	-	12	18.8%
< Diploma	-	-	-	-	-	-	-	-	-	-	-	-
Total	18	28.1%	16	25.0%	15	23.4%	8	12.5%	7	10.9%	64	100%

Source: Own survey data analysis

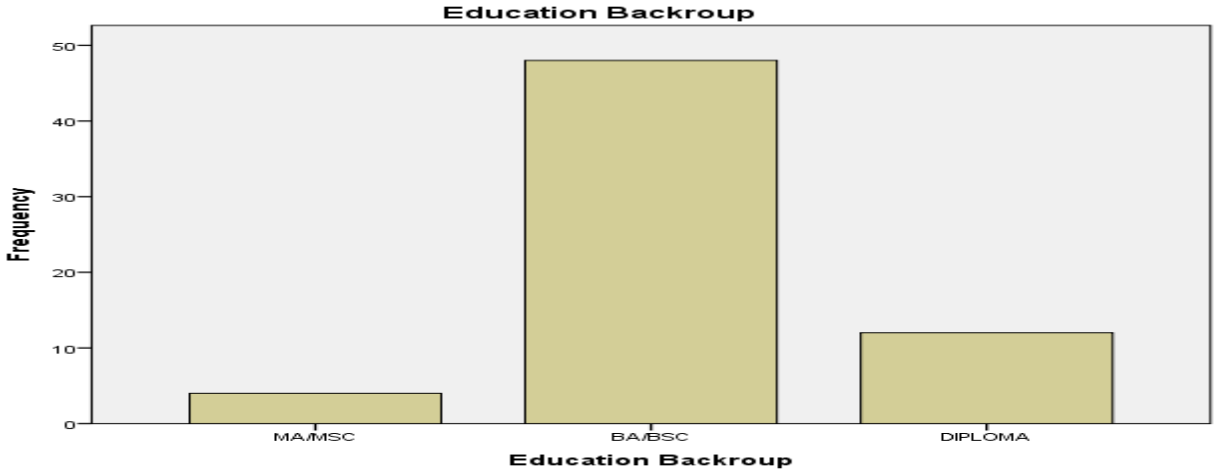

Chart 4.1: Respondents Level of qualification/Education Background

Source: Own survey data analysis

According to above analysis from frequency Table 4.3 and Chart 4.1, it was indicated that the highest educational level of the respondents ranges from diploma to the second degree. The majorities of the respondents 75% are first degree holders, the followed respondents 18.8% are Diploma holders and 6.2% of the respondents are second degree holders. This implied that highly educated people with high expertise and high knowledge of matters. This also helped the researcher to quickly collect data since the respondents were able to read, write and easily interpret the questionnaires. Therefore, high educated respondents were key role players in providing adequate and relevant data which determine the research result rationally and logically.

4.2.4. Respondents work Experience

The frequency Table 4.4 and Chart 4.2 shows that the respondents work experience less than 5 years have 20.3% from the total respondents, 34.4% from the total respondents have years of experience between 5 - 9 years, 21.9% from the total respondents have years of experience between 10 - 14 years and 23.4% from the total respondents have years of experience more than 14 years. The obtained results of respondent's year of work experience are given in the following Table 4.4 & Chart 4.2, as shown below respectively.

Table 4. 4: Respondents years of work experience

Work Experience	Response Distribution											
	ETCU		EEU		ACWSA		ACCOPCA		ACIDA		Total	
	Fr	%	Fr	%	Fr	%	Fr	%	Fr	%	fr	%
< 5 years	2	3.13%	5	8.93%	2	3.13%	2	3.13%	2	3.13%	13	20.3%
5 - 9 years	6	9.38%	4	6.25%	6	9.38%	4	6.25%	2	3.13%	22	34.4%
10 - 14 years	3	4.69%	3	4.69%	4	6.25%	2	3.13%	2	3.13%	14	21.9%
> 14 years	7	10.9%	4	6.25%	3	4.69%	-	-	1	1.56%	15	23.4%
Total	18	28.1%	16	25.0%	15	23.4%	8	12.5%	7	10.9%	64	100%

Source: Own survey data analysis

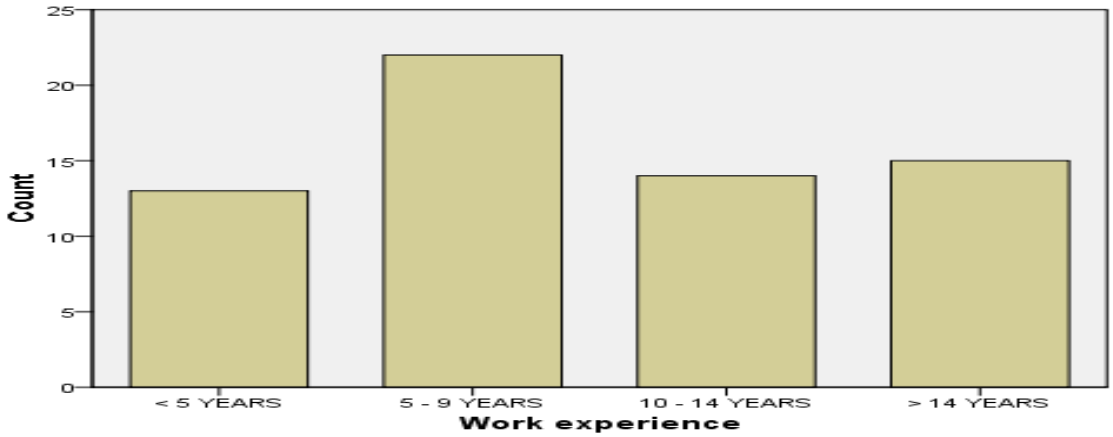

Chart 4.2: Respondents years of work experience

Source: Own survey data analysis

These results illustrate that, more than 79% of the respondents have experience more than 5 years' work experience. These results will also provide a level of good that the obtained data will reflect what it was designed for. Those respondents have good positions in their organizations to provide confidant and specific data. Therefore, high experienced respondents were key role players in providing adequate and relevant data which determine the research result rationally and logically.

4.2.5. Respondents position/responsibility

Table 4.5 & Chart 4.3 shows that the respondents current position/responsibility on the manager level have 43.8% from the total respondents, on the director level have 14.1% from the total respondents, on the experts level have 26.6% from the total respondents and on the supervisor level have 15.6% from the total respondents. The current position statuses of the sample of the respondents have been presented on following Table 4.5 & Chart 4.3, as shown below respectively.

Table 4. 5: Respondents current position/responsibility

Current position /responsibility	Response Distribution											
	ETCU		EEU		ACWSA		ACCOPCA		ACIDA		Total	
	Fr	%	Fr	%	Fr	%	Fr	%	Fr	%	Fr	%
Manager Level	10	15.6%	6	9.38%	8	12.5%	3	4.69%	1	1.56%	28	43.8%
Director Level	2	3.13%	3	4.69%	2	3.13%	1	1.56%	1	1.56%	9	14.1%
Experts Level	4	6.25%	5	7.81%	3	4.69%	2	3.13%	3	4.69%	17	26.6%
Supervisor Level	2	3.13%	2	3.13%	2	3.13%	2	3.13%	2	3.13%	10	15.6%
Total	18	28.1%	16	25.0%	15	23.4%	8	12.5%	7	10.9%	64	100%

Source: Own survey data analysis

Chart 4.3: Respondents current position/responsibility

Source: Own survey data analysis

Therefore, many of the respondents were on manager level positions which shows that the sample selection taking them as main actors to exploit what challenge they faced during integrated infrastructure. In addition, the experts in their respective organizations well distributed and hoped to share their significant experience. Similarly, Supervisors also made a significant contribution on the project implementation stage issue. However, the research agenda supposed to support the top management enabling them to make informed

decision making process and tools during the project planning and implementation and the director level of the respondents, made less effort to share their infrastructure integration experience and the critical challenge they faced. Moreover, the managers 28 and the experts' 17 respondents were key role players in providing adequate and relevant data which determine the research result rationally and logically

4.2.6. Respondents area of work

Frequency Table 4.6 & Chart 4.4 shows that the respondents primary area of work on the design have 17.2% from the total respondents, on the construction have 32.8% from the total respondents, on the Operations & Maintenance have 42.2% from the total respondents and on the other different works have 7.8% from the total respondents. The obtained results of respondent's area of work are given in the following Table 4.6 & Chart 4.4, as shown below respectively.

Table 4. 6: Respondents primary area of work

Area of Work	Response Distribution											
	ETCU		EEU		ACWSA		ACCOPCA		ACIDA		Total	
	fr	%	Fr	%	Fr	%	Fr	%	fr	%	fr	%
Design	2	3.13%	4	6.25%	3	4.69%	1	1.56%	1	1.56%	11	17.2%
Construction	2	3.13%	5	7.81%	4	6.25%	6	9.38%	4	6.25%	21	32.8%
Operations & Maintenance	13	20.31%	5	7.81%	6	9.38%	1	1.56%	2	3.13%	27	42.2%
Other	1	1.56%	2	3.13%	2	3.13%	-	-	-	-	5	7.8%
Total	18	28.1%	16	25.0%	15	23.4%	8	12.5%	7	10.9%	64	100%

Source: Own survey data analysis

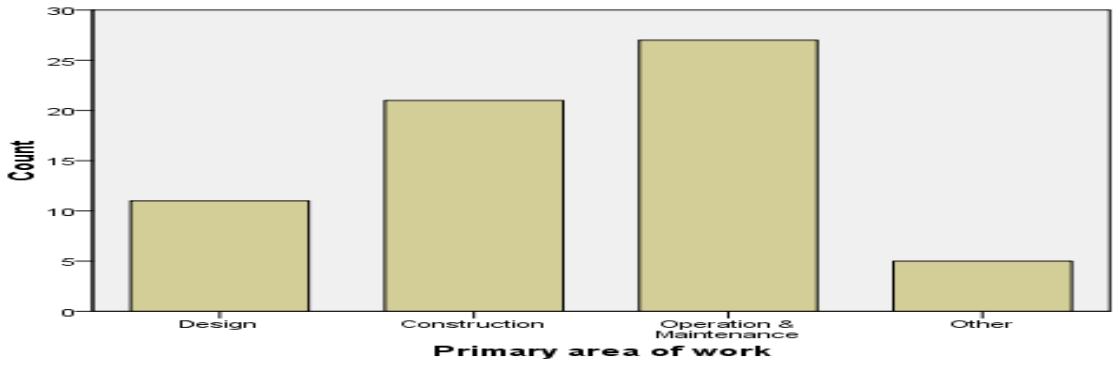

Chart 4.4: Respondents primary area of work

Source: Own survey data analysis

Therefore, from above frequency Table 4.6 & Chart 4.4 many of the respondents were on the operations & maintenance area of work which shows that the sample selection taking them as main actors to exploit what challenge they faced during infrastructure integration and followed on the construction area of work. Moreover, the area of work on construction and operations & maintenance respondents were key role players in providing adequate and relevant data which determine the research result rationally and logically.

From the respondents' demography, the researcher concluded that among the different demographic groups, a test on the variables assessed does not show significant difference. Moreover, 75% of the respondents have educational qualification of first degree, more than 79% of the respondents have work experience of more than 5 years, 43.8% of the respondents have position/responsibility at manager level and more than 74% of the respondents have area of work on construction, operations & maintenance. Therefore, adequate level of education, high work experience, manager level position and expertise area of work on construction and operations & maintenance, ensure that the respondents were key role players in providing adequate and relevant data which enhance the validity of the research results.

4.3. Results of Reliability Analysis

Before conducting an analysis based on the results obtained from the questionnaire, Cronbach analysis was carried out to ascertain the internal consistency of the questions using the Likert scale. The Cronbach Alpha test that shows the reliability of the questionnaire and the result of the reliability test that was conducted on the Current Practice of Collaboration among integrated infrastructure in Adama city is represented in the Table 4.7, as shown below.

Table 4. 7: Result of Reliability test

Reliability Statistics	Cronbach's Alpha
Current Practice of Collaboration among integrated Infrastructure	0.852

Source: Own survey data analysis

The result indicates that the 12 items in current practice of collaboration among integrated infrastructure in Adama are correlated. There is internal consistency between the items. Since the data collected was based on five Likert-scales; therefore to check reliability of the research Cronbach's Alpha method was used and all the components is high or close to 1. As a matter of fact the overall Cronbach Alpha value for the 12 items is 0.852 which

showed high reliability of the data. Therefore, the researchers conclude that the test and questions were reliable.

The Cronbach Alpha test that shows the reliability of the questionnaire and the result of the reliability test that was conducted on the factors that affect collaboration among integrated infrastructure in Adama city is represented in the Table 4.8, as shown below.

Table 4. 8: Result of Reliability test

Reliability Statistics	Cronbach's Alpha
Factors that affect collaboration among integrated infrastructure	0.926

Source: Own survey data analysis

The result indicates that the 22 items in factors that affect collaboration among integrated infrastructure in Adama are correlated. There is internal consistency between the items. Since the data collected was based on five Likert-scales; therefore to check reliability of the research Cronbach's Alpha method was used and all the components is excellent or close to 1. As a matter of fact the overall Cronbach Alpha value for the 22 items is 0.926 which showed excellent reliability of the data. Therefore, the researchers conclude that the test and questions were reliable.

The Cronbach Alpha test that shows the reliability of the questionnaire and the result of the reliability test that was conducted on the impacts of poor collaboration among integrated infrastructure on sustainability in Adama city is represented on the Table 4.9, as shown below.

Table 4. 9: Result of Reliability test

Reliability Statistics	Cronbach's Alpha
Social impacts of poor collaboration among integrated infrastructure	0.978
Economic impacts of poor collaboration among integrated infrastructure	0.982
Environmental impacts of poor collaboration among integrated infrastructure	0.970
Overall items	0.992

Source: Own survey data analysis

The result indicates that all items in the impacts of poor collaboration among integrated infrastructure on sustainability in Adama are correlated. There is internal consistency between the items. Since the data collected was based on five Likert-scales; therefore to check reliability of the research Cronbach's Alpha method was used and all the components is excellent or close to 1. As a matter of fact the overall Cronbach Alpha

value for the 23 items is 0.992 which showed excellent reliability of the data. Therefore, the researchers conclude that the test and questions were reliable.

4.4. Current Practice of Collaboration among Integrated Infrastructure

Assessment of current practice of collaboration among integrated infrastructure level of achievement for each selected major attributes. By considering the degree to which the current infrastructure integration effectively supports each of the attributes. This study is intended to analyzing the current collaboration among integrated infrastructure practice in the alignment of how challenge the effective integrated utility's' infrastructure and the approaches for each attribute where contribute utilities service providers to improve collaboration among integrated infrastructure in Adama city.

The overview evaluation was done by utilizing relative importance index strategy and respondents were asked to score which current practice level are considered to be collaboration among integrated infrastructure in Adama city. Ranking of the various current practice level according to their RII value and the interpretation of the RII values, RII is ranked from the highest to the lowest which is rankings of 12 common current practice level of collaboration among integrated infrastructure as per previous studies and practices were ranked. This means that all the twelve variables are considered as current practice of collaboration among integrated infrastructure in Adama city. The value analysis carried out on the data by relative important index is shown in the Table 4.10 as follow.

Table 4. 10: Result of RII analysis of Current Practice level and rank

R. No	Current Practice of Collaboration among Integrated Infrastructure	RII	Rank
1	Institution plans/designs in line with the master plan of the city.	0.6063	1
2	Organization collaborates with other utility service providers (actors) to design and implement projects with complementary services.	0.5969	2
3	Efficient collaboration across utilities institution, road authority and regulatory agencies system in planning, implementing and data exchange.	0.575	3
4	Organization efficiently possesses project communication plan, information sharing, and dissemination strategies to inform, accelerated decision making.	0.575	3
5	There is information technology support system for integrated infrastructure for human resources, budgets and data storage/archiving.	0.5719	5

6	Current legal instruments and the established Adama City's regulatory authority are capable of creating collaboration in integrated infrastructure.	0.5656	6
7	Organization has established relationships with stakeholder in solving the root causes of problems of the integrated infrastructure implementation.	0.5656	6
8	Strategic alliances and relationships among Road Authority, Regulatory Authority and other Utilities.	0.5594	8
9	Organization routinely shared the Information about current or planned utilities services and results with project beneficiary and other stakeholders.	0.55	9
10	Organization communicates its plan with the other institutions/organizations.	0.5406	10
11	Aware of the other institutions/organization plans.	0.5375	11
12	Efforts are made to introduce integrated approach for infrastructure collaboration between institutions/organization.	0.5281	12

Source: Own survey data analysis

Based on the RII obtained in Table 4.10, relatively the following points were practiced in chronological order. Thus, institution plans/designs in line with the master plan of the city was ranked first among twelve current practice points of collaboration among integrated infrastructure, with relative importance index of 0.6063. Organization collaborates with other utility service providers to design and implement projects with complementary services was ranked second, with relative importance index of 0.5969, Organization efficiently possesses project communication plan, information sharing, and dissemination strategies to inform, accelerated decision making and collaboration across utilities institution, road authority and regulatory agencies system in planning, implementing and data exchange both was ranked 3rd, with relative importance index value of 0.575, and information technology support system for integrated infrastructure for human resources, budgets and data storage/archiving was ranked 5th, with relative importance index value of 0.5719. These are the top five relatively more practiced points among all the 12 practice points regarding collaboration among integrated infrastructure. However from the RII values they are not well practiced in adequate manner. This signifies the need to improve these identified relatively important practices. From the FGD also experts revealed that even if all service providers and road authority are obliged to refer the master plan while planning, the application is not commonly practiced in Adama city mainly due to the less emphasis given to utilities in the master plan, what is depicted in the master plan and the

reality in the ground doesn't always match and there are places which are out of the master plan.

According to Seife (2019), who studied institutional capacity gap impinge with organizational structure, almost all institutions do not have primarily concerned department for utilities infrastructure project implementation and maintenance and rehabilitation management. In addition his study indicated that no clear project participants' roles and responsibilities. These factors create inconsistency of utilities project administration and become a challenge for effective and integrated projects management inter & across the sector & also the existing institutions technological capacity does not fit the current complex & interdependent of the city infrastructure.

The finding of Seife (2019) is inline and nearly supported in one or the other way by this study which is indicated by the poor practice (the highest RII which is 0.606 is far from 1) little institution plans/designs in line with the master plan of the city, currently no adequate organization collaborates with other utility service providers (actors) to design and implement projects with complementary services, rarely shared the information about current or planned utilities services and results with project beneficiary and other stakeholders, and no or little efforts are made to introduce integrated approach for infrastructure collaboration between institutions/organization. Thus, the results already indicate that current practice levels of collaboration among integrated infrastructure in Adama city are not well practiced in adequate manner. This signifies the need to improve these identified relatively important practices.

4.5. Factors that affect Collaboration among Integrated Infrastructure

This paper chooses the significant factors that affect collaboration among integrated infrastructure from dataset and applies factor analysis to make a comprehensive evaluation score of their factors that affect collaboration among integrated infrastructure use the SPSS software. As part of a factor analysis, SPSS calculates factor scores & comprehensive score them in the data file, where they are easily accessible for further analyses. This is a factor score matrix for samples of 64 participants on the 22 variables.

Before performing factor analysis need to evaluate and ensure the validity and reliability of the data. Reliability refers to the consistency degree of measurement results. Measure the reliability of the data using Cronbach coefficient α. Validity refers to the closeness of the measured values using KMO and Bartlett's test of Sphericity.

4.5.1. Kaiser-Meyer-Olkin (KMO) check for adequacy of data

Using SPSS software to analyze the data reliability and validity results in Table 4.15 shows that the result of KMO measure of sampling adequacy and Bartlett's test of sphericity of factors that affect collaboration among integrated infrastructure in Adama city which are the obtained results are given in the following Table 4.11, as shown below.

Table 4. 11: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.836
Bartlett's Test of Sphericity	Approx. Chi-Square	2484.208
	Df	231
	Sig.	0.000

Source: Own survey data analysis

Therefore, KMO statistic value is 0.836; indicating factor analysis is relatively suitable. Significance probability of Bartlett's test of Sphericity is 0.000 < 0.01, rejects the original hypothesis which indicates that the variables are related, so it is suitable for factor analysis

4.5.2. Correlation Matrix

From correlation matrix shown in Appendix C, it is analyzed that most variables have relatively strong correlation, so it is necessary to make a factor analysis.

4.5.3. Extraction of initial factor

Table 4.12 shows that the eigenvalues and contribution rate of variance of the correlation matrix using principal component analysis as common factors extraction method. There are three common factors and their cumulative variance proportion has reached 91.83%. So choose three common factors which represent the whole amount of information provided by raw data which is the obtained results are given in the following Table 4.12, as shown below.

Table 4. 12: 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	10.961	49.824	49.824	10.961	49.824	49.824	10.848	49.309	49.309
2	5.984	27.200	77.024	5.984	27.200	77.024	5.631	25.594	74.904
3	3.257	14.806	91.830	3.257	14.806	91.830	3.724	16.926	91.830
4	.886	4.028	95.858						

5	.318	1.444	97.303						
6	.218	.992	98.294						
7	.149	.675	98.970						
8	.099	.449	99.419						
9	.050	.227	99.646						
10	.035	.160	99.806						
11	.018	.080	99.886						
12	.011	.052	99.938						
13	.006	.028	99.966						
14	.005	.023	99.989						
15	.002	.010	99.999						
16	.000	.001	100.000						
17	2.855E-017	1.298E-016	100.000						
18	3.822E-018	1.737E-017	100.000						
19	2.579E-019	1.172E-018	100.000						
20	-4.994E-018	-2.270E-017	100.000						
21	-1.081E-017	-4.916E-017	100.000						
22	-5.729E-017	-2.604E-016	100.000						

Extraction Method: Principal Component Analysis.

Source: Own survey data analysis

The above Table 4.12 showed that SPSS software then extracts all factors with eigenvalues greater than 1, which leaves with three factors. Therefore, the factor analysis was run with three principal components is to be retained, because the eigenvalue of a factor is more than 1. If the eigenvalue of a factor is more than or equal to 1, then the factor is to be retained. Considering this criterion; the three common factors in collaboration among integrated infrastructure in Adama city are to be retained. Therefore, inferences based on the data analysis, it is inferred that all the factors considered have a significant factors that affect collaboration among integrated infrastructure in Adama city.

4.5.4. Factor Rotation Matrix

Determine the common factors as rotated component matrix if the basic structure of component matrix is not easily understandable, the typical descriptive parameters of common factors are not very remarkable, so that it is easy to explain the common factors. According to Kaiser Normalization for Eigen values, extract first 3 components which have the Eigenvalues greater than 1 which are the obtained results are given in the following Table 4.13, as shown below.

Table 4. 13: Rotated Component Matrix

Factors that affect collaboration among integrated infrastructure	Component		
	1	2	3
Lack of cooperation & coordination across sectors	0.937		
Limitation in institutional capability in terms of system, technology & strategies	0.940		
Lack of decision support tools to enable strategic analysis & planning	0.972		
Shortage of professionals (lack of adequate professionals)	0.976		
Lack of integrity and working together between sectors		0.704	0.550
Budget constraints (Shortage of budget)	0.972		
Absence of responsible body to do the job	0.815		
Current status of integration among infrastructure providing institutions	0.815		
Lack of communication during design preparation	-0.448		0.606
Loose communication during implementation due to poor utility database (due to lack of accurate information about the location)			0.977
Lack of communication and coordination between the service providers			0.968
Lack of central database system for data and information exchange, planning and decision making			0.972
Lack of strong legal enforcement		0.994	
Lack of common standards and guidelines to all service providers		0.994	
Lack of clearly stated rules and regulations among integrated infrastructure		0.992	
Lack of clear policy and legal ground of infrastructure integration		0.992	
Lack of policy, manuals, procedures, standards and regulations integrated infrastructure		0.994	
Lack of interest and commitment of service providers	0.966		
Lack of commitment for coordination between sectors	0.943		
Level of presence of formal committee and regular meeting between sectors	0.976		
Emphasis of the city master plan for utility providers	0.982		
Lack of long and short term plan among integrated infrastructure	0.970		

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

Rotation converged in 5 iterations.

Source: Own survey data analysis

From above Table 4.13 result that the implementation of rotation of component matrix, the goal of rotation is to place the axes close to as many points as possible. Some common factors all parameters have high loads, while in others smaller loads and use Varimax with Kaiser Normalization method to obtain Rotated Component Matrix. By default SPSS displays all loadings; however, factor loadings less than 0.4 have not been displayed because asked for these loadings to be suppressed. There are two main types of factor rotation which is oblique and orthogonal rotation. Oblique technique is used when there is an expectation that factors should be related to each other. Orthogonal rotation on the other hand, is used when expect factors should be unrelated to each other theoretically. Therefore this study used oblique rotation.

4.5.5. Standardized values of original factors

The result of Standardized values of original factors is calculated by excel software using equation 3.5 shown in Appendix D.

4.5.6. Component score coefficient matrix

Table 4.14 represents the Calculation of component score coefficient matrix of factors that affect collaboration among integrated infrastructure in Adama city using SPSS software and its results for factor analysis are shown in Table 4.14, as shown below.

Table 4. 14: Component Score Coefficient Matrix

Factors that affect Collaboration among integrated infrastructure	Component		
	1	2	3
Lack of cooperation & coordination across sectors	0.086	0.008	-0.012
Limitation in institutional capability in terms of system, technology & strategies	0.086	0.010	-0.039
Lack of decision support tools to enable strategic analysis & planning	0.090	0.000	-0.023
Shortage of professionals (lack of adequate professionals)	0.090	0.005	-0.018
Lack of integrity and working together between sectors	-0.004	0.104	0.119
Budget constraints (Shortage of budget)	0.090	-0.007	0.025
Absence of responsible body to do the job	0.076	-0.025	0.078
Current status of integration among infrastructure providing institutions	0.076	-0.025	0.078
Lack of communication during design preparation	-0.045	0.047	0.150
Loose communication during implementation due to poor utility database (due to lack of accurate information about the location)	0.007	-0.042	0.274
Lack of communication and coordination between the service providers	0.006	-0.041	0.271
Lack of central database system for data and information exchange, planning and decision making	0.008	-0.040	0.272
Lack of strong legal enforcement	-0.007	0.184	-0.037

Lack of common standards and guidelines to all service providers	-0.007	0.184	-0.037
Lack of clearly stated rules and regulations among integrated infrastructure	-0.006	0.184	-0.037
Lack of clear policy and legal ground of infrastructure integration	-0.006	0.184	-0.037
Lack of policy, manuals, procedures, standards and regulations integrated infrastructure	-0.007	0.184	-0.037
Lack of interest and commitment of service providers	0.090	-0.009	0.024
Lack of commitment for coordination between sectors	0.088	-0.012	-0.025
Level of presence of formal committee and regular meeting between sectors	0.090	0.005	-0.018
Emphasis of the city master plan for utility providers	0.091	-0.006	-0.007
Lack of long and short term plan among integrated infrastructure	0.089	0.007	-0.012

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

Source: Own survey data analysis

4.5.7. Common Factor Score and Comprehensive Scores

Every common factor score of factors that affect collaboration among integrated infrastructure in Adama city can be calculated using equation 3.4:

$$F_1 = 0.086V_1 + 0.086V_2 + 0.09V_3 + 0.09V_4 - 0.004V_5 + \cdots + 0.088V_{19} + 0.09V_{20} + 0.091V_{21} + 0.089V_{22}$$
$$F_2 = 0.008V_1 + 0.01V_2 + 0.000V_3 + 0.005V_4 + 0.104V_5 + \cdots + -0.012V_{19} + 0.005V_{20} - 0.006V_{21} + 0.007V_{22}$$
$$F_3 = -0.012V_1 - 0.039V_2 - 0.023V_3 - 0.018V_4 + 0.119V_5 + \cdots + -0.025V_{19} - 0.018V_{20} - 0.007V_{21} - 0.012V_{22}$$

Where V_1, V_2, V_3, . . . ,V_{20}, V_{21} and V_{22} respectively indicate 22 factors in the standardized values of original factors.

In order to evaluate 22 factors that affect collaboration among integrated infrastructure, calculate their comprehensive scores. The result of comprehensive scores is calculated and ranked using equation 3.5. Comprehensive evaluation score:

$$Comprehensive\ Score = \frac{\sum_{i=1}^{3} f_i}{\sum_{j=1}^{22}\left(\sum_{i=1}^{3} Sf_i\right)_j}$$

$$Where\ f_i = i^{th}\ common\ factor\ score\ i = 1,2,3$$
$$S = Number\ of\ \text{var}iables$$

Table 4.15 shown that the factor analysis result of common factors' scores, comprehensive scores and rank of influential factors of collaboration among integrated infrastructure in Adama city using SPSS and Excel software gives in Table 4.15, as shown below:

Table 4. 15: Common factors' scores, comprehensive scores and rank

Factors that affect collaboration among integrated infrastructure	CFS (f1)	CFS (f2)	CFS (f3)	CS	Rk
Lack of communication and coordination between the service providers	0.943	-6.398	42.783	0.001231	1
Lack of central database system for data and information exchange, planning and decision making	1.274	-6.101	41.988	0.001226	2
Loose communication during implementation due to poor utility database	1.086	-6.439	42.404	0.001222	3
Lack of communication during design preparation	-8.298	8.560	27.585	0.000919	4
Lack of integrity and working together between sectors	-0.519	12.908	14.816	0.000897	5
Absence of responsible body to do the job	13.827	-4.438	14.157	0.000777	6
Current status of integration among infrastructure providing institutions	13.827	-4.438	14.157	0.000777	6
Budget constraints (Shortage of budget)	18.107	-1.413	4.982	0.000715	8
Lack of interest and commitment of service providers	18.329	-1.742	4.823	0.000706	9
Lack of common standards and guidelines to all service providers	-1.039	27.596	-5.583	0.000692	10
Lack of strong legal enforcement	-1.039	27.596	-5.583	0.000692	10
Lack of policy, manuals, procedures, standards and regulations integrated infrastructure	-1.039	27.596	-5.583	0.000692	10
Lack of clearly stated rules and regulations among integrated infrastructure	-0.851	27.288	-5.477	0.000691	13
Lack of clear policy and legal ground of infrastructure integration	-0.851	27.288	-5.477	0.000691	13
Lack of cooperation & coordination across sectors	17.093	1.518	-2.383	0.000535	15
Lack of long and short term plan among integrated infrastructure	16.912	1.395	-2.256	0.000529	16
Emphasis of the city master plan for utility providers	18.399	-1.278	-1.410	0.000518	17
Level of presence of formal committee and regular meeting between sectors	16.923	0.997	-3.325	0.000481	18
Shortage of professionals (lack of adequate professionals)	16.923	0.997	-3.325	0.000481	18
Lack of decision support tools to enable strategic analysis	17.540	-0.005	-4.573	0.000428	20

& planning					
Limitation in institutional capability in terms of system, technology & strategies	17.246	1.942	-7.803	0.000376	21
Lack of commitment for coordination between sectors	18.016	-2.388	-5.105	0.000347	22

Source: Own survey data analysis

Therefore, inferences based on the data analysis, it is inferred that factor analysis is a statistical multivariate analysis technique to analyze common variances. It is used in the evaluation of factors that affect collaboration among integrated infrastructure in Adama city. In the process of significant factors affect evaluation, it is acceptable to classify and simplify parameters by factor analysis and extract number of common factors, and then calculate rank according to their scores evaluated by comprehensive score model. From the finding it can be concluded that the top ranked significant factors affecting collaboration among integrated infrastructure are: lack of communication and coordination between the service providers; lack of central database system for data and information exchange, planning and decision making; loose communication during implementation due to poor utility database; lack of communication during design preparation and lack of integrity and working together between sectors.

According to Mahlet (2014), in general lack of strong legal enforcement, lack of capacity, lack of interest and commitment of service providers, absence of responsible body to do the job and lack of long term plan were identified as the factors that affect collaboration among integrated infrastructure. Therefore, the finding of this study is also inline and complements with (Mahlet, 2014).

Mulugeta (2011) found that the major factors that affect collaboration among integrated infrastructure at inter sectoral level are: lack of adequate professionals, lack of integrity and working together, shortage of budget, absence of responsible body, absence of policy, plan year and change of plan, infrastructural policy, legal ground of sectors and presence of formal committee and regular meeting. Therefore, once again this study finding is also coincides with (Mulugeta, 2011).

Kitila (2015) on the other hand found the major factors that have contributed to the less likely performance level of the urban sectors are weak institutional arrangements, lack of budget and monitoring, poor coordination among the sectors, absence of clear cut policy frameworks, lack of commitment and responsibility, lack of political will and biasness

towards the traditional approach, lack of coordination within and in between sectors, unwillingness of some individuals and uncoordinated or lack of integrity within and in between the urban service sectors. Therefore, this study also more or less coincide with (Kitila, 2015).

Thus, the results already indicate that the significant factors that affect collaboration among integrated infrastructure are lack of communication and coordination between the service providers; lack of central database system for data and information exchange, planning and decision making; loose communication during implementation due to poor utility database; lack of communication during design preparation and lack of integrity and working together between sectors. So adopting and focusing on these most significant factors play important role in improving collaboration among integrated infrastructure in Adama city.

4.6. The Impacts of Poor Collaboration among Integrated Infrastructure

The contribution of each of the variables to overall impacts was examined and the ranking of the attributes in terms of their criticality as perceived by the respondents was done by use of RII five point likert-scale: (1-Very low impact it; 2–Low impact it; 3–Medium impact it; 4–High impact it and 5-Very high impact it) which was computed using equation and rankings of 23 common impacts of poor collaboration among integrated infrastructure on sustainability as per previous studies and impacts were categorized into three major groups and were ranked. The results show that all respondents agreed that the economic impacts of poor collaboration among integrated infrastructure were the highest impact with average RII value of 0.7363, Social impacts were considered the second most important impacts of poor collaboration among integrated infrastructure with average RII value of 0.7056 & the followed by environmental impact with average RII value of 0.689 which is the results of the analysis are presented in Tables 4.16, as shown below.

Table 4. 16: Results of the impacts of poor collaboration among integrated infrastructure

R. No	Impacts of poor collaboration among integrated infrastructure	RII	Rank
Social impacts			
1	Lost time	0.784375	1
2	Business opportunities and additional fuel consumption	0.746875	2
3	Service interruption	0.71875	3
4	Handicap people faces many challenges	0.71875	3

5	Lack of transportation access	0.7125	5
6	Traffic congestion	0.709375	6
7	Safety hazards	0.696875	7
8	Injuries and traffic accidents	0.653125	8
9	Spoiling of food because of refrigeration failure	0.609375	9
	Economic impacts		
1	Repetition works/overlap	0.771875	1
2	The possible loss of product and revenue reduction during service interruptions	0.75625	2
3	Wastage of scarce resource	0.75625	2
4	Cost of carrying out repairs and relocations	0.7375	4
5	Reduction of the asphalt service year	0.728125	5
6	Property damages	0.71875	6
7	High cost of compensation	0.71875	6
8	Cost for any temporary service arrangements necessary	0.703125	8
	Environmental impacts		
1	Sewage backing up	0.759375	1
2	Hygiene problems may arise because of water supplies being contaminated	0.684375	2
4	Dust induced lung diseases	0.684375	2
3	Air pollution	0.675	4
5	Flooring and storm water inundation	0.665625	5
6	Noise pollution	0.665625	5

Source: Own survey data analysis

Hence, it could be concluded from analysis of the responses that the dominant social impacts is lost time for poor collaboration among integrated infrastructure with RII value of 0.784375, Business opportunities and additional fuel consumption is the second social impact for poor collaboration among integrated infrastructure with RII value of 0.746875 and the third social impact of poor collaboration among integrated infrastructure are Service interruption and handicap people faces many challenges with RII value of 0.71875 in the process.

It could be concluded from analysis of the responses that the dominant economic impact is repetition works/overlap for poor collaboration among integrated infrastructure with RII

value of 0.771875, the possible loss of product and revenue reduction during service interruptions and wastage of scarce resource are the second economic impact for poor collaboration among integrated infrastructure with RII value of 0.75625 in the process.

It could be concluded from analysis of the responses that the dominant environmental impact is sewage backing up for poor collaboration among integrated infrastructure with RII value of 0.759375, the second environmental impact of poor collaboration among integrated infrastructure are the hygiene problems may arise because of water supplies being contaminated and dust induced lung diseases with RII value of 0.684375 in the process.

In generally the survey results are subjected to analysis, and the ranking the impacts of poor collaboration among integrated infrastructure on sustainability are calculated using (RII). The study showed that all the five sectors- ETCU, EEU, ACWSA, ACCOPCA and ACIDA employees of participants generally acquiesce that out of a total of 23 variables the top eight significant effect of poor collaboration among integrated infrastructure on sustainability arranged in descending order of RII are:

- Lost time with RII value of 0.784375
- Repetition works/overlap with RII value of 0.771875
- Sewage backing up with RII value of 0.759375
- The possible loss of product and revenue reduction during service interruptions with RII value of 0.75625
- Wastage of scarce resource with RII value of 0.75625
- Business opportunities and additional fuel consumption with RII value of 0.746875
- Cost of carrying out repairs and relocations with RII value of 0.7375
- Reduction of the asphalt service year with RII value of 0.728125

According to Mahlet (2014), the impacts of poor inter sectoral integration are: the economic impacts on service providers are characterized by property damages, high cost of compensation, cost of carrying out repairs and relocations, cost for· any temporary service arrangements necessary, and the possible loss of "product" and revenue reduction during service interruptions. The social impacts which can be characterized as lost time, business opportunities and additional fuel consumption, spoiling of food because of refrigeration failure, injuries and traffic accidents, traffic congestion, safety hazards and lack of transportation access. The environmental impacts which can be characterized as

Hygiene problems may arise because of water supplies being contaminated, sewage backing up, flooding and storm water inundation, noise pollution, air pollution, and dust induced lung diseases are identified by the study. Therefore, this study's finding is clearly coinciding with Mahlet (2014).

According to Mulugeta (2011), the major negative impacts of poor infrastructure integration could be said economical (repetition of works and wastage of scarce resources), social traffic accident and congestion. Moreover, negative mentality of people as well as Environmental and health issues. The socio economic impact of the absence or low level of integration was repetition of works, traffic accident, death of significant number of people and loss of huge amount of resources are the major backlogs resulted from the absence of integration. Since excavation usually is done on the peak hours and done with traditional methods it will have considerable effect on both economic and social aspects. Therefore, this study finding is inline and complements the study by Mulugeta (2011).

According to Kitila (2015), the major effects are economic, social, and administrative. Economically, when the allocation of huge cost to maintain the destroyed line, labor cost, purchasing of the materials and time and energy cost. Socially, when utility line is destroyed the service will be disconnected and the community is going to suffer from long lasting loss of services. Because the time interval since the destruction of utility line to the maintenances becomes longer, hence, the bureaucracy, to identify the responsible body for the breakage of the line, takes time. Finally, the problems related to administrative aspects are the potential rise of conflicts, disagreements and unnecessary dialogues among various sector officials. Thus it will contaminate the working environment and dwindle the spirit of jointly working to raise the performance of the sector. Again, this study's finding is inline and complements Kitila (2015).

Thus, the results indicate that integrated infrastructure in Adama city is usually negatively impacted by poor collaboration among integrated infrastructure. Mitigating or tackling the challenges that negatively impact the collaboration among integrated infrastructure should be given due attention to improve collaboration among integrated infrastructure.

4.7. Focus Group Discussion

Focus group discussion is a qualitative data collection method and used in this study to support and fill gaps that otherwise not addressed by the quantitative part. It has been used

in areas such as management, marketing, decision and information systems, among others. Its general characteristics stand out: the homogeneity of the group, the sequence of the sessions, the obtaining of qualitative data, and focus on a topic.

As part fulfilling information on the Adama City infrastructure status a focus group was organized by the researcher guided by 8 important questions designed for the discussion. The members of the group invited consists of representatives of different sectors groups such as senior ETCU sector managers, senior EEU sector managers, senior ACWSA sector managers, senior ACCOPCA sector managers and senior ACIDA sector managers. The attendance list for 6 member discussion group, the guiding questions for the discussion chaired by the researcher are also attached at the end of the report. Summary of the discussion is indicated under the four sector headings below and relevant conclusions were drawn from the discussions.

The discussion is opened by researcher the questions posed the current factor affecting of collaboration among integrated infrastructure service in Adama city was discussed and it was identified significant factors that affecting collaboration among integrated infrastructure. The findings from focus group discussion most, not all focus group participants identified the following factors as the primary issues that significant factors that affect collaboration among integrated infrastructure in Adama city are lack of integrity and working together between sectors, lack of communication during design preparation, lack of cooperation & coordination across sectors, Absence of responsible body to do the job, Lack of strong legal enforcement, weak institutional arrangements, lack of budget and monitoring by the concerned parties.

The poor collaboration among integrated infrastructure effects on sustainability in Adama city was discussed in the focus group and it was identified the major economic, social and environmental effects of poor collaboration among integrated infrastructure. The findings from focus group discussion all focus group participants agree the major social effects are Service interruption, lost time, Lack of transportation access etc. major economic effects are property damages, high cost of compensation, cost for· any temporary service arrangements necessary etc. and major environmental effects are water supplies being contaminated, noise pollution, air pollution, and dust induced lung diseases.

The cities master plan practice in infrastructure service integration in Adama city was discussed and it was shown that the result/findings from focus group discussion all

participants indicate that the emphasis of master plan for utilities has still significant effect on integrated infrastructure practice.

The sectors should collaborate in order to manage integrated infrastructure in Adama city was discussed and the following issues were raised the level of management by Regulatory Authority sector collaboration among integrated infrastructure was poor and the relationships among Road Authority, Regulatory Authority and other basic Utilities for collaborate in order to manage integrated infrastructure was found weak. This is one of the major areas that basic need improvement in the overall collaboration among integrated infrastructure in Adama city.

The communication on infrastructure service integration with stakeholders was discussed and the following issues were raised the level of communication among sectors for integrated infrastructure provision was found weak. This is one of the major areas that need improvement in the overall collaboration among integrated infrastructure in Adama city. In general terms, an effective integrated communications system will provide the information and data necessary to optimize the reliability, asset management, maintenance, and operations required.

Almost all of the respondents in the FGDs on the most important issues of collaboration among integrated infrastructure in Adama city include cross-sectoral planning approach to be adopted and exercised by the urban sectors to plan, organize, implement, monitor and re-plan jointly to minimize costs, energy and time in maintaining infrastructural lines.

The finding from focus group discussion, all focus group participants was discussed and the following issues were raised in the area that basic needs to be improving collaboration among integrated infrastructure service in Adama city includes increasing level of communication, coordination, controlling , adequate professionals, strong legal enforcement, central database system for data and information exchange, planning and decision making and clearly stated rules and regulations among integrated infrastructure.

Major suggestions from the FGD indicated that the need for increased collaboration of sectors effort, Strict follow up of city master plan, good governance, transparency, accountability, fairness in the improving collaboration among integrated infrastructure in Adama city. Technical capacity building, Maintenance of the existing infrastructure system, increased community mobilization effort, critical mobilization of finance

strengthening institutional capacity of the service providers for improving collaboration among integrated infrastructure service in Adama city.

From the results obtained from the questionnaire and FGD, the researcher concluded that the major factors that affect collaboration among integrated infrastructure are commonly lack of communication and coordination between the service providers; lack of central database system for data and information exchange, planning and decision making; loose communication during implementation due to poor utility database; lack of communication during design preparation and lack of integrity and working together between sectors; and the impacts of poor collaboration among integrated infrastructure are commonly again lost time, repetition works/overlap, sewage backing up, possible loss of product and revenue reduction during service interruptions, wastage of scarce resource, business opportunities and additional fuel consumption, cost of carrying out repairs and relocations; and reduction of the asphalt service year.

4.8. Conceptual Framework to Improve the Collaboration among Integrated Infrastructure

The conceptual framework proposed is emphasizes how principles could be applied to effective infrastructure integration in Adama city. The objectives of the framework are to help enhances and improves effective cross-sector integration to: Identify what could be done to tackle or counter-balance these challenges (what to do), Identify how to address these challenges (how to do it) and Realize the possible outcome (results) which is improving collaboration among integrated infrastructure. Information obtained from above factor analysis, the respondents identifies the major factors affect collaboration among integrated infrastructure in Adama city and its framework to improve collaboration among integrated infrastructure which is the obtained results are given in the Table 4.17, as shown below.

Table 4. 17: Conceptual frameworks (Adopted from Joro, 2015) to improve collaboration among integrated infrastructure

Factors affect collaboration among integrated infrastructure	What to do to improving collaboration among integrated infrastructure	How to do it	Result
Lack of communication	Prepare good communication and	• Improve communication and coordination among sectors.	

and coordination between the service providers.	coordination between the service providers.	• Promote common standards, policy and guidelines. • Good government enforcement to common standards, policy and guidelines.	Improvement of collaboration among integrated infrastructure in Adama city
Lack of central database system for data and information exchange, planning and decision making.	Prepare effective central database system for data and information exchange, planning and decision making.	• Shared decision making. • Improve ICT infrastructure • Use computerized and ICT based decision support systems. • Improve or recruit skilled manpower	
Loose communication during implementation due to poor utility database.	Prepare/maintain good communication channel and databases during implementation.	• Timely delivery accurate information about the location. • Improve communication among sectors. • Sharing vision among sectors.	
Lack of communication during design preparation.	Prepare good communication during design preparation.	• Improve communication among sectors. • Government should be embark on applicable polices. • Involvement of all stakeholders during planning and design.	

Source: Own survey data analysis

Adopting and incorporating the conceptual framework is very important for the institution/sector and community to have improved collaboration among integrated infrastructure in Adama city. Among the institutional benefits of cross sectoral integration; firstly it will enhance the performance level of the sector by minimizing the huge cost that will be allocated for maintaining the utility line destroyed by other sectors. In short it will save the time, energy and resources invested by the sectors to repair infrastructures and re-design. On the other hand, the community is beneficial in that it gets improved urban infrastructure service distribution, accessibility and quality. Explicitly, when infrastructure service sectors plan, monitor and implement jointly it could be easier to address the very need of the community when, where, how and why to locate infrastructures. Thus, it can be possible to satisfy the community's need by addressing the problems identified and reducing the frequency of utility line destruction using the proposed conceptual frameworks.

CHAPTER FIVE
CONCLUSIONS AND RECOMMENDATIONS

5.1.Conclusion

The overall objective of this research was to assess the improvement of collaboration among integrated infrastructure in Adama city. The specific objectives of this research was to assess practice of collaboration among integrated infrastructure, to identify the main factors that affect collaboration among integrated infrastructure, to assess the impact of poor collaboration among integrated infrastructure on sustainability and to develop the conceptual framework to improve collaboration among integrated infrastructure in Adama city. With this in mind, the conclusion specifically presents the major findings obtained based on the data analyzed. Therefore, the researcher has drawn the conclusion as follows:

- The top relatively more practices regarding collaboration among integrated infrastructure are: institution plans/designs in line with the master plan of the city, organization collaborates with other utility service providers to design and implement projects with complementary services, organization efficiently possesses project communication plan, information sharing, and dissemination strategies to inform, accelerated decision making, efficient collaboration across utilities institution, road authority and regulatory agencies system in planning, implementing and data exchange and information technology support system for integrated infrastructure for human resources, budgets and data storage among all the 12 practice points regarding collaboration among integrated infrastructure which are not well practiced in adequate manner. This signifies the need to improve these identified relatively important practices.
- The top most important factors that affect collaboration among integrated infrastructure are: lack of communication and coordination between the service providers; lack of central database system for data and information exchange, planning and decision making; loose communication during implementation due to poor utility database; lack of communication during design preparation and lack of integrity and working together between sectors. So adopting and focusing on these most significant factors play important role in improving collaboration among integrated infrastructure in Adama city.
- Social, economic and environmental impacts of poor collaboration among integrated infrastructure are still significant, and the top most significant impacts are: lost time,

repetition works/overlap, sewage backing up, possible loss of product and revenue reduction during service interruptions, wastage of scarce resource, business opportunities and additional fuel consumption, cost of carrying out repairs and relocations; and reduction of the asphalt service year. So mitigating or tackling the challenges that negatively impact the collaboration among integrated infrastructure should be given due attention to improve collaboration among integrated infrastructure in Adama city.

- Adopting and incorporating the conceptual framework of most significant factors that affect collaboration among integrated infrastructure for the institution/sector and community can improve collaboration among integrated infrastructure in Adama city. Among the institutional benefits of cross sectoral integration; firstly it will enhance the performance level of the sector by minimizing the huge cost that will be allocated for maintaining the utility line destroyed by other sectors. In short it will save the time, energy and resources invested by the sectors to repair infrastructures and re-design. On the other hand, the community is beneficial in that it gets improved urban infrastructure service distribution, accessibility and quality. Explicitly, when infrastructure service sectors plan, monitor and implement jointly it could be easier to address the very need of the community when, where, how and why to locate infrastructures. Thus, it can be possible to satisfy the community's need by providing sustainable services and reducing the frequency of utility line destruction.

5.2.Recommendation

Implementing effective integrated infrastructure across the sector requires a reasonable approach after having the above findings and conclusion it is possible to forward the following suggestions and recommendations have been made to improve the application of collaboration among integrated infrastructure to be adopted and exercised could provide an important study results for policy makers, municipalities & infrastructure providing authorities as well as professionals in Adama city. The study was having advantages for all practitioners by providing useful information about the improvement of collaboration among integrated infrastructure for Adama city municipal. Moreover; municipalities, urban infrastructure providing authorities, policy makers and professionals could use the document as an input for further discussion, application and investigation.

From the study findings the following recommendations in general are forwarded to:

The government

- Need to establish cross sector integration and coordination department for improvement of collaboration among integrated infrastructure service in Adama city.
- Better provide common standards, policy and guidelines to all service providers for improvement of collaboration among integrated infrastructure service in Adama city.
- Need to adopt new practices to improvement of collaboration among integrated infrastructure.
- Need to facilitate the involvement of all stakeholders during planning and design of city master plan for improvement of collaboration among integrated infrastructure service.
- Need to strongly encourage and enforce the sectors to be sensitive about the implication of working in collaboration among integrated infrastructure on service delivery performances.

The sectors

- Need to clearly share vision for improvement of collaboration among integrated infrastructure service.
- Are recommended to have clear communication for improvement of collaboration among integrated infrastructure service.
- Need to use computerized and ICT based decision support systems for improvement of collaboration among integrated infrastructure service.
- Should follow and adopt city master plan, good governance, transparency, accountability, and fairness for improvement of collaboration among integrated infrastructure.
- May refer to the proposed conceptual framework to minimize unnecessary costs, energy and time that should be invested to maintain the damaged infrastructure and service, and to improve collaboration among integrated infrastructure service, in Adama city.

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APPENDIX

Appendix A: Survey Questionnaire

Adama Science and Technology University

School of Civil Engineering and Architecture

Department of Civil Engineering (Specialized in Construction Engineering and Management)

Questionnaire Survey for Thesis paper on Assess the improvement of collaboration among integrated infrastructure in Adama city

Dear/Sir;

The purpose of this questionnaire is to collect data for the research study entitled "**Assess the improvement of collaboration among integrated infrastructure in Adama city"** as a fulfillment of the requirement for the Degree of Master of Science in department of Civil Engineering Specialized by Construction Engineering and Management. Thus, your genuine, professional opinion and timely responses are vital to determine the success of this study. Please note that the information you provide will only be used for academic purpose and all the information relieved will be kept confidential. To this end, you are kindly requested to contribute your own share by filling in the questionnaires honestly and responsibly for further recommendations to improve similar works in the future. Thank you in advance for your cooperation!!!

If you need further explanation, you can contact me through the address indicated below:

Adane Muniye Gelaw, Mobile Number: +2519-13-502448 or +2519-36-043950

Email: kirumamgold@gmail.com

General Instruction:

- No need of writing your name/address.
- To those questions with alternatives mark your response on the space provided by putting " ✓ "
- For any additional option or explanation you are kindly requested to write briefly on the space provided.

Part One: - General information about the respondents

1. Name of your institution

☐ ETCU ☐ EEU

☐ ACWSA ☐ ACIDA

☐ ACCOPCA ☐ Others _____

2. Educational background (qualification)

☐ PhD ☐ MSc/MA ☐ BSc/BA ☐ Diploma ☐ Below diploma

3. Work experience

☐ Less than 5 years ☐ 5 – 9 years

☐ 10 – 14 years ☐ above 14 years

4. Current position/responsibility in your institution _____

5. your primary area of work

☐ Design ☐ Construction ☐ Operations & Maintenance ☐ Other (Specify) ____

Part Two: - Integrated infrastructure practice

To what extent do you agree with the current practice of collaboration among integrated infrastructure in Adama city? Please indicate the current practice level by making on the appropriate box using the following scale: Strongly Agree (SA) = 5, Agree (A) = 4, moderately Agree (MA) = 3, Disagree (D) = 2 and Strongly Disagree (SD) = 1.

Integrated Infrastructure Practice	Current Practice Level				
	SA	A	MA	D	SD
There are strategic alliances and relationships among Road Authority, Regulatory Authority and other Utilities.					
Your institution plans/designs in line with the master plan of the city.					
You are aware of the other institutions/organization plans.					
Your organization communicates its plan with the other institutions/organizations.					
There are efforts made to introduce integrated approach for infrastructure collaboration between institutions/organization.					
Your organization has established relationships with stakeholder in solving the root causes of problems of the integrated infrastructure implementation.					
Your organization efficiently possesses project communication plan, information sharing, and dissemination strategies to inform, accelerated decision making.					

Your organization routinely shared the Information about current or planned utilities services and results with project beneficiary and other stakeholders.					
Your organization collaborates with other utility service providers (actors) to design and implement projects with complementary services.					
There is an efficient collaboration across Utilities institution, Road Authority and Regulatory agencies system in Planning, Implementing and data exchange.					
There is an information technology support system for integrated infrastructure for human resources, budgets and data storage/archiving.					
The current legal instruments and the established Adama City's regulatory authority are capable of creating collaboration in integrated infrastructure.					

Part Three: - Existing integrated infrastructure

1. To what extent do you influence of the following factors to affect collaboration among integrated infrastructure in Adama city? Please indicate the influence factors by making on the appropriate box using the following scale: Very high (VH) = 5, High (H) = 4, Medium (M) = 3, Low (L) = 2 and Very low (VL) = 1.

Factors that affect collaboration among integrated infrastructure in Adama city	To what extent it affects				
	VH	H	M	L	VL
Lack of cooperation & coordination across sectors					
Limitation in institutional capability in terms of system, technology & strategies					
Lack of decision support tools to enable strategic analysis & planning					
Shortage of professionals (lack of adequate professionals)					
Lack of integrity and working together between sectors					
Budget constraints (Shortage of budget)					
Absence of responsible body to do the job					
Current status of integration among infrastructure providing institutions					
Lack of communication during design preparation					
Loose communication during implementation due to poor utility database (due to lack of accurate information about the location)					
Lack of communication and coordination between the service providers					
Lack of central database system for data and information exchange,					

planning and decision making					
Lack of strong legal enforcement					
Lack of common standards and guidelines to all service providers					
Lack of clearly stated rules and regulations among integrated infrastructure					
Lack of clear policy and legal ground of infrastructure integration					
Lack of policy, manuals, procedures, standards and regulations integrated infrastructure					
Lack of interest and commitment of service providers					
Lack of commitment for coordination between sectors					
Level of presence of formal committee and regular meeting between sectors					
Emphasis of the city master plan for utility providers					
Lack of long and short term plan among integrated infrastructure					

2. To what extent do you rate the following impacts as a result of poor collaboration among integrated infrastructure on sustainability in Adama city? Please indicate the highest impacts by making on the appropriate box using the following scale: Very high impact (VHI) = 5, High impact (HI) = 4, Medium impact (MI) = 3, Low impact (LI) = 2 and Very low impact (VLI) = 1.

Impacts of poor collaboration among integrated infrastructure on sustainability	level Impact				
	VHI	HI	MI	LI	VLI
a. Social impacts					
Lost time					
Business opportunities and additional fuel consumption					
Spoiling of food because of refrigeration failure					
Injuries and traffic accidents					
Traffic congestion					
Safety hazards					
Lack of transportation access					
Service interruption					
Handicap people faces many challenges					
b. Economic impacts					
Property damages					

High cost of compensation					
Cost for any temporary service arrangements necessary					
Cost of carrying out repairs and relocations					
The possible loss of product and revenue reduction during service interruptions					
Wastage of scarce resource					
Repetition works/overlap					
Reduction of the asphalt service year					
c. Environmental impacts					
Hygiene problems may arise because of water supplies being contaminated					
Sewage backing up					
Flooring and storm water inundation					
Noise pollution					
Air pollution					
Dust induced lung diseases					

Appendix B: Focus Group Discussion Questionnaire

1. What do you think about the current factor affecting of collaboration among integrated infrastructure service in Adama city?
2. What is your attitude towards the poor collaboration among integrated infrastructure effects on sustainability in Adama city?
3. What do you think about the aims of having cities master plan practice in infrastructure service integration in Adama city?
4. Why do you think that the sectors should collaborate in order to manage integrated infrastructure in Adama city?
5. Do you have communication on infrastructure service integration with stakeholders? How?
6. What would you say are the most important issues of collaboration among integrated infrastructure service in Adama city?
7. What changes do you think might improve the current process of collaboration among integrated infrastructure service in Adama city?
8. Do you have comments/suggestions regarding any area that needs to be improving collaboration among integrated infrastructure service in Adama city?

Appendix C: Correlation Matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	1.00	0.93	0.95	0.95	0.35	0.88	0.63	0.63	-0.45	0.37	0.34	0.36	0.32	0.32	0.34	0.34	0.32	0.88	0.92	0.95	0.93	0.97
2	0.93	1.00	0.95	0.96	0.33	0.88	0.63	0.63	-0.52	-0.33	-0.33	-0.31	0.32	0.32	0.33	0.33	0.31	0.87	0.92	0.96	0.93	0.95
3	0.95	0.95	1.00	0.99	0.32	0.91	0.65	0.65	-0.45	0.38	0.34	0.39	0.30	0.30	0.37	0.37	0.31	0.90	0.97	0.98	0.97	0.97
4	0.95	0.96	0.99	1.00	0.34	0.92	0.66	0.66	-0.49	0.33	0.38	0.35	0.32	0.32	0.38	0.38	0.32	0.96	0.94	1.00	0.96	0.99
5	0.35	0.33	0.32	0.34	1.00	0.32	0.32	0.32	0.56	0.59	0.59	0.59	0.68	0.68	0.68	0.79	0.68	0.34	-0.31	0.36	0.34	0.49
6	0.88	0.88	0.91	0.92	0.32	1.00	0.89	0.89	-0.33	0.33	0.36	0.34	0.33	0.33	0.31	0.31	0.33	0.99	0.88	0.91	0.94	0.90
7	0.63	0.63	0.65	0.66	0.32	0.89	1.00	1.00	-0.39	0.35	0.32	0.39	0.34	0.44	0.41	0.41	0.44	0.89	0.67	0.66	0.74	0.66
8	0.63	0.63	0.65	0.66	0.32	0.89	1.00	1.00	-0.39	0.35	0.32	0.39	0.34	0.44	0.41	0.41	0.44	0.89	0.67	0.66	0.74	0.66
9	-0.45	-0.52	-0.45	-0.44	0.56	-0.33	-0.32	-0.39	1.00	0.52	0.49	0.51	0.38	0.86	0.78	0.78	0.86	-0.32	-0.49	-0.49	-0.49	-0.49
10	0.34	-0.33	0.32	0.33	0.59	0.33	0.35	0.35	0.52	1.00	0.98	0.99	0.36	0.46	0.47	0.47	0.46	0.43	-0.35	0.31	0.51	0.48
11	0.34	-0.33	0.31	0.32	0.59	0.32	0.31	0.31	0.49	0.98	1.00	0.99	0.35	0.45	0.57	0.57	0.45	0.95	-0.33	0.28	0.39	0.35
12	0.36	-0.31	0.34	0.35	0.59	0.34	0.34	0.34	0.51	0.99	0.99	1.00	0.35	0.55	0.67	0.67	0.55	0.31	0.39	0.51	0.74	0.68
13	0.32	0.31	0.30	0.32	0.69	0.30	0.34	0.34	0.39	0.36	0.35	0.55	1.00	1.00	0.99	0.99	1.00	0.90	0.44	0.21	0.83	0.32
14	0.32	0.31	0.30	0.32	0.69	0.30	0.34	0.34	0.39	0.36	0.35	0.55	1.00	1.00	0.99	0.99	1.00	0.90	0.44	0.31	0.83	0.32
15	0.34	0.33	0.32	0.34	0.68	0.31	0.34	0.34	0.38	0.37	0.37	0.67	0.99	0.99	1.00	1.00	0.99	0.96	0.63	0.38	0.32	0.48
16	0.34	0.33	0.32	0.34	0.68	0.31	0.34	0.34	0.38	0.37	0.37	0.67	0.99	0.99	1.00	1.00	0.99	0.96	0.63	0.38	0.32	0.48
17	0.32	0.31	0.30	0.32	0.69	0.30	0.34	0.34	0.39	0.36	0.35	0.55	1.00	1.00	0.99	0.99	1.00	0.90	0.44	0.32	0.83	0.33
18	0.88	0.87	0.90	0.91	0.31	0.99	0.88	0.88	-0.32	0.33	0.39	0.33	0.39	0.39	0.96	0.96	0.90	1.00	0.89	0.90	0.93	0.90
19	0.92	0.92	0.97	0.94	-0.31	0.88	0.67	0.67	-0.49	-0.35	-0.33	0.39	0.34	0.44	0.63	0.63	0.44	0.89	1.00	0.94	0.97	0.93
20	0.95	0.96	0.99	1.00	0.34	0.92	0.66	0.66	-0.49	0.33	0.38	0.35	0.32	0.31	0.38	0.38	0.31	0.96	0.94	1.00	0.96	0.99
21	0.93	0.93	0.98	0.97	0.34	0.94	0.74	0.74	-0.49	0.35	0.39	0.37	0.38	0.83	0.52	0.32	0.83	0.93	0.97	0.96	1.00	0.95
22	0.97	0.95	0.98	0.99	0.35	0.91	0.66	0.66	-0.49	0.38	0.35	0.38	0.33	0.32	0.48	0.48	0.32	0.90	0.95	0.99	0.95	1.00

a. This matrix is not positive definite.

Appendix D: Standardized values of original factors

Factors	Item value	Mean	Standard deviation	Standardized value
Lack of cooperation & coordination across sectors	224	4	1.128	195.00916
Limitation institutional capability in terms of system, technology & strategies	208	3.714286	1.217	167.8924
Lack of effective decision support tools to enable strategic analysis & planning	210	3.75	1.210	170.4815
Shortage of professionals (lack of adequate professionals)	203	3.625	1.342	148.5116
Lack of integrity and working together between sectors	228	4.071429	1.204	186.0042
Budget constraints (Shortage of budget)	213	3.803571	1.327	157.6558
Absence of responsible body to do the job	210	3.75	1.352	152.5781
Current status of integration among infrastructure providing institutions8	218	3.892857	1.216	176.0413
Lack of communication during design preparation9	192	3.428571	1.263	149.3214
Loose communication during implementation due to poor utility database (due to lack of accurate information about the location)	185	3.303571	1.159	156.8137
Lack of communication and coordination between the service providers	181	3.232143	1.221	145.6046
Lack of central database system for data and information exchange, planning and decision making	192	3.428571	1.333	141.4745
Lack of strong legal enforcement	222	3.964286	1.220	178.6452
Lack of common standards and guidelines to all service providers	232	4.142857	1.182	192.7533
Lack of clearly stated rules and regulations among integrated infrastructure	228	4.071429	1.305	171.5489
Lack of policy and legal ground of infrastructure integration	223	3.982143	1.395	157.0382
Lack of policy, manuals, procedures, standards and regulations integrated infrastructure	211	3.767857	1.388	149.287
Lack of interest and commitment of service providers	216	3.857143	1.197	177.1696
Level of commitment for coordination between sectors	209	3.732143	1.228	167.1129
Level of presence of formal committee and regular meeting between sectors	213	3.803571	1.197	174.7287
Emphasis of the city master plan for utility providers	210	3.75	1.164	177.2136
Lack of long and short term plan among integrated infrastructure	219	3.910714	1.210	177.7288