Identifying prospects and challenges of adopting smart city concept in Addis Ababa, In case of Lebu area.

By: Adem Tibo

A Thesis Submitted to the Department of Architecture

School of Civil Engineering and Architecture

Presented in Partial Fulfillment of the Requirement for the Degree of Master's in Urban Planning and Design

Office of Post Graduate Studies

Adama Science and Technology University

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Advisor Name: Doctor Belay Zeleke (Phd)

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Declaration

I hereby declare that this Master Thesis entitled *"Identifying prospects and challenges of adopting smart city concept in Addis Ababa, In case of Lebu area"* 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

Adem Tibo Hamda	_____	_____
Name of the student	Signature	Date

RECOMMENDATION OF ADVISORS/ SUPERVISORS

I, the major advisor/supervisor of this research proposal, hereby certify that I have closely advised/supervised the student while developing this proposal and read the draft thesis/dissertation proposal entitled "**Identifying prospects and challenges of adopting smart city concept in Addis Ababa, In case of Lebu area"** prepared under my guidance by Adem Tibo Hamda. Therefore, I recommend the submission of the proposal to the department for further review and evaluation.

Dr Belay Zeleke		Jun/21/2023
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Approval Page Thesis Paper

I/we the advisors of the thesis entitled **"**Identifying prospects and challenges of adopting smart city concept in Addis Ababa, In case of Lebu area" and developed by Adem Tibo Hamda.

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We, the undersigned, members of the Board of Examiners of the thesis by Adem Tibo Hamda have read and evaluated the thesis entitled ***"Identifying prospects and challenges of adopting smart city concept in Addis Ababa, In case of Lebu area"*** 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 Urban Planning and Design.

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ABBREVATIONS

AACA …….. Addis Ababa City Administration

AACPC …….…… Addis Ababa city plan commission

AI …… Artificial Intelligence

AVE …….. Average Variance Extracted

CR ……... Composite Reliability

GPS …….…….. Global Positioning Systems

ICT …….……...…….. information and communication technology

IMD ……Institute for Management Development

IoT …….…….…….. Internet of Things

MCIT …….…… Ministry of Communication & Information

MOST ……..…… Ministry of Science and technology

PLS-SEM ……. Partial Least Square-Structural Equation Modelling

RFID …….……...……. Radiofrequency Identification

SM …….……..…….……. Smart City

STI …… National Science, Technology and Innovation

STS ……...…….. Smart Transportation Systems

SUTD ……Singapore University for Technology and Design

UC ……..……...……. ubiquitous computing

UNDP ……..…. United Nation for Development Program

USC ….....……..... Urban Systems Collaborative

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ABSTRACT

This paper aims to identify the prospects and challenges of adopting the smart city concept in Lebu area, Addis Ababa. Accordingly, assessing the causal relationships between survey data and the previous scholars' work and the survey's strategy concentrated on a socio-technical perspective and the concept's application domains conducted. Finding result, through the PLS-SEM statistical analyses and the researchers' interview analysis implies that lack of equity to opportunities, inefficient resources management, climate change, residents' living standard, citizens being high obstacles to social mobility, citizens' low educational level and digital skills, data privacy and security concerns, urban poverty, and low institutional capacity in governance are Significant challenges. To overcome these challenges and harness the prospects of smart city adoption, this paper recommends strategic planners to prioritize investments in digital infrastructure, upgrading citizens' life standard, establishing effective public-private partnerships, fostering innovation and entrepreneurship, formulate regulatory frameworks to ensure data protection, privacy, and inclusivity and enhancing citizen engagement through awareness campaigns and capacity-building programs.

Generally, the findings of this study contribute to the understanding of the potential benefits and challenges associated with adopting smart city initiatives in Addis Ababa mainly Lebu area. By considering the prospects and addressing the identified significant challenges, city authorities can develop a roadmap for transforming Addis Ababa into a livable, inclusive, and technologically advanced smart city.

Keywords: smart city adoption, Smart city concept, smart city domains, ICT

CHAPTER 1: Introduction

1.1. Background

Globally, high population growth and urbanization rate affects efficiency of urban services and development. To overcome these and such problems the world cities have been deploying key urban planning and design concepts and approaches in addressing various aspects of sustainable, livable, and equitable urban development. Some of these concepts are

Mixed-Use Development: The integration of various land uses and services,

Transit-Oriented Development: developments centered around public transportation nodes,

Sustainable Development: Development that meets the needs of the present generation without compromising the ability of future generations,

Historic Preservation: The protection and conservation of historic buildings, districts, and cultural heritage sites to maintain a sense of place, and promote cultural identity.

Urban Renewal: The process of interventions such as revitalizing, upgrading or regenerating deteriorated urban areas to improve quality of life and attract investment.

Smart City: the use of Internet of Things and technology-based innovation to the design, development, and administration of urban forms and environmental management techniques.

In order to increase the efficiency of urban services, so many Cities all around the world are searching for intelligent methods of managing urban planning such as smart city solution (Su et al., 2011). The concept of a "smart city" has been proposed as a way to leverage technology and creativity to increase the standard of living for its citizens in improving efficiency of services (Addis Ababa City Administration, 2017). This concept makes use of cutting-edge technology like the Internet of Things, artificial intelligence, and big data (Molla, A., 2020).

According to Zewdu and Kibret (2020), Addis Ababa, will have a population of more than 4.5 million by 2021, making it one of the African cities with the greatest population growth. In case, Addis Ababa has been striving to adopt the smart city concept to address its pressing urban challenges and enhance its citizens' quality of life. However, this transformation poses significant prospects and challenges (Tadele, D., & Yirgu, M., 2021).

(Moreno et al., 2017) define Smart City as a developing idea for a reaction to the difficulties encountered by cities, such as expanding population, severe budget cuts, climate change, environmental degradation, etc. There have been several studies conducted on smart cities. However, owing to the high subjectivity, ambiguity, and complexity of the design and development of smart cities, it is frequently difficult to extract and/or convey a generalized understanding of smart cities (Yigitcanlar, 2015).

Moreover, There are some prospects, such as improving transportation, enhancing public safety, efficient waste management, and digital inclusion. While lack of infrastructure, limitation of funds, less citizen participation, and data security concerns can be raised as major challenges for the adoption of the smart city concept in Addis Ababa (Abdu, M., & Mohammed, N. 2020).

1.2. Problem Statement

Addis Ababa's infrastructure and services are under pressure as a result of the city's rapid urbanization and population growth. The concept of "smart cities" has the potential to alleviate some of these issues and improve the standard of living for residents. However, there has not done on the possibilities and challenges of applying smart city principles in Addis Ababa. International studies that are accessible do not provide much information.

Number of scholars and research institutions such as IMD defines a "smart city" as it is a cutting-edge concept in urban planning that attempts to improve citizens' quality of life by utilizing technology and data-driven solutions. The concept is gaining popularity on a global scale, although it has taken longer to spread in some locations. Addis Ababa is one such location that is experiencing difficulty in implementing the concept of smart cities (Demissie, M. G. 2020).

Even though Addis Ababa has a big opportunity such as well-positioned to benefit from technology youthful and tech-savvy population that has the possibility of executing smart city ideas successfully; less understanding undermined the value and focus to the concept (smart city). At country level, varieties of smart city initiatives have been launched. Addis Ababa is also promoting the smart city projects. For instance, the city government on January 2018 (Addis Ababa City Government., 2019) presented “Addis Ababa One,” a digital platform that aims to provide residents with access to a range of public services online. This campaign aimed

to reach service to all Addis Ababa residents by 2025. Only 12% of the city population and 22% of institution in the city effectively utilizing and using the plat form until 2022 (World Resources Institute, 2022). Currently also, a number of programs are intended to improve the city's transportation network and promote the usage of renewable energy sources (Addis Ababa City Government., 2019). For such retarded implementation of Smart City initiative projects and aspirational goals, none of prospects and related challenges identified yet.

A. for transportation service, B. for notice information, C. for tax payment

Figure 1*: Queue for services in Addis Ababa, Image*

Source: https://addisstandard.com/news-city-transport-bureau-threatens

1.2.Research Objectives

1.3.1. General Objectives

The main objective of this research is to investigate the prospects and challenges of adopting the smart city concept in Addis Ababa.

1.3.2. Specific Objectives

I. To identify challenges to the adoption of smart city concept in Addis Ababa city.
II. To explore the socio-economic benefits of adopting smart city concept.
III. To recommend key stakeholders, such as policymakers, urban planners, and end users in Addis Ababa, on how to effectively adopt smart city concept.

1.4. Research Questions

Based on the objectives mentioned above, the following research questions are prepared:

1. What are the key challenges faced by Addis Ababa in adopting the smart city concept, and how can these challenges be addressed?
2. What are the socio-economic benefits that can be gained from the adoption of the smart city concept in Addis Ababa, and how can these be maximized?
3. What are the key lessons that can be learned from other cities that have successfully adopted smart city initiatives, and how can these lessons be applied in the context of Addis Ababa?

1.5. Significance of the study

Studying the possibilities and difficulties of adopting the smart city concept in Addis Ababa is important for a number of reasons.

Improving urban services: By looking into the advantages and challenges of implementing smart city technologies in Addis Ababa, policymakers can identify the most effective ways to improve the delivery of urban system services, such as transportation, electricity, water, waste management, and public safety (UNDP, 2016).

Increasing economic development: The smart city idea can encourage economic growth and the creation of jobs by enticing new businesses and investments (AACA, 2016). According to this study in Addis Ababa, policymakers can create plans to boost entrepreneurship, innovation, and company growth.

Addressing urban issues: Policymakers can find creative solutions to problems like traffic congestion, air pollution, and inadequate infrastructure by researching the advantages and disadvantages of implementing smart city principles. (Gurmu, S. A., 2020).

Increasing citizen involvement: By giving locals, the chance to exchange information, offer comments, and take part in decision-making processes, this research in Addis Ababa can increase citizen engagement and participation (AACA, 2016).

Taking on sustainability issues: This Addis Ababa research can help achieve sustainability objectives, including lowering carbon emissions, preserving resources, and fostering green

growth. Municipal administrations can better coordinate the execution of their many activities thanks to the development of smart cities (Vito Albino et al., 2015).

Economic Development: By implementing the smart city concept, Addis Ababa can attract international investment, boost its local economy, and create employment, all of which will contribute to the growth of both the city's and the country's economies.

1.6. Study limitations

Limited Data Availability: The lack of comprehensive and current data makes it difficult to evaluate the possibilities and difficulties of adopting the smart city concept in the study area. This make it challenging to carry out a careful analysis and reach reliable results.

Lack of adoption: Addis Ababa's smart city initiative only on beginning to take shape. This make it difficult to evaluate the whole range of opportunities and difficulties related to adopting the concept. It is difficult to obtain real-world data and experiences without significant real-world application from which to derive meaningful conclusions.

Technological Readiness: Advanced technological infrastructure and connection are necessary for the successful deployment of a smart city. However, Addis Ababa experience technological readiness issues, including as network coverage, internet access, and digital literacy. These restrictions affect the opportunities for and challenges in adopting the smart city idea in the city.

Financial Constraints: Like many other cities in developing nations, Addis Ababa experience resource shortages and financial constraints. These limitations reduce the scope and rate of adoption of the smart city concept and may have an impact on its opportunities and difficulties.

Stakeholder Engagement: Studying the prospects and challenges of adopting the smart city concept necessitates engaging various stakeholders, including government agencies, private sector entities, academic institutions, and citizens. However, limited participation and engagement from these stakeholders is a limitation, making it challenging to gather diverse perspectives and fully understand the dynamics and complexities of the smart city concept in Addis Ababa.

1.7. Scope of the study

The boundaries for the investigation of the objectives and research questions raised above presented as follows:

A. Geographical/Spatial Scope:

The study will focus on the city of Addis Ababa, Nifas Silk Lafto sub-city, and Woreda 01, known as the Lebu area. This study area incorporates elements of smart city adoption. Hence, the site development is Compact, mixed-use and suitable for intelligent transport. Also access for installing real time information is so convenient in this study area.

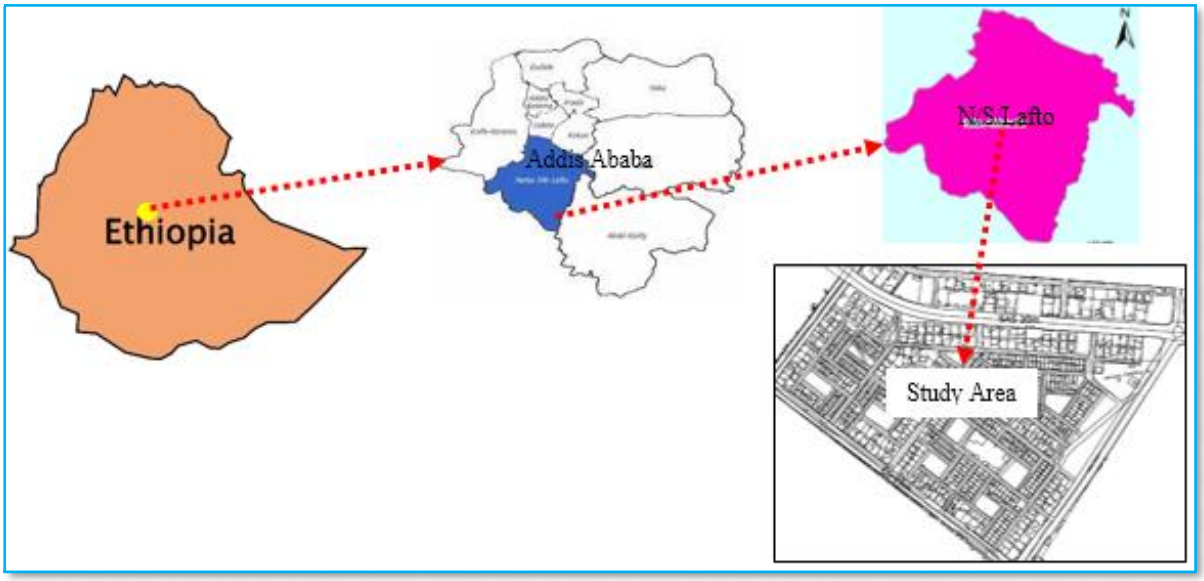


Figure 2*: Spatial study map*

B. Temporal/Time Scope:

The study examined the current state of urban system mainly technology infrastructure and the potential for adopting the smart city concept in Addis Ababa city, lebu area.

C. Social scope: The study targeted on four focal groups in the city of Addis Ababa with an aim of getting information from: the first are communities or residents in study area. The second are governmental sectors. The third are non-governmental agencies and community based organizations. The fourth one is private institutions.

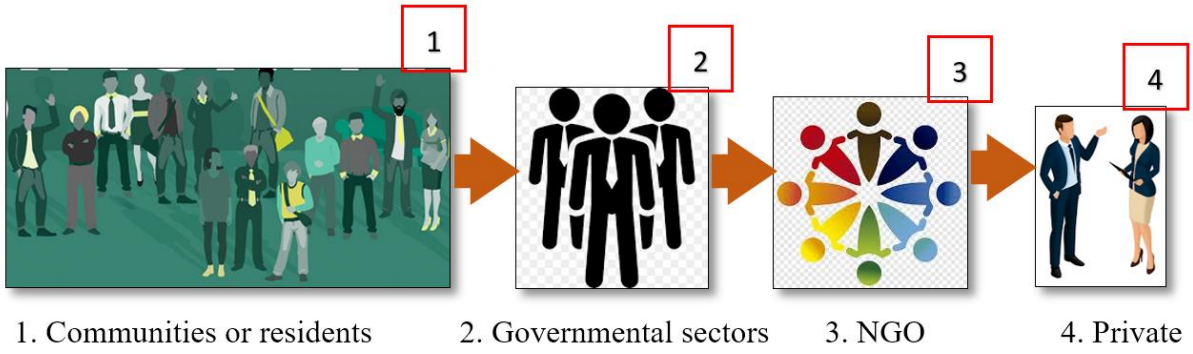


Figure 3*: focus groups representation*

D. Thematic scope: The study will focus on the prospects and challenges of adopting the smart city concept in Addis Ababa city, with a particular emphasis on the following themes:

- Technology Infrastructure: The research will evaluate the Addis Ababa city's present urban system and its potential for improvement via the use of the smart city concept.
- Challenges: The research will outline the main obstacles to achieving the idea of a smart city in Addis Ababa and provide solutions.
- Advantages: The research will evaluate the possible advantages of implementing the smart city idea in Addis Ababa City, including economic development, sustainable development, and enhanced quality of life.
- Stakeholders: The study will identify the important participants in the Addis Ababa city smart city concept implementation and their responsibilities.

1.8. Operational definitions

Smart city concept. According to Vito Albino et al. (2015), a "smart city" is one that is "instrumented, interconnected, and intelligent."" According to Pedro C. et al. (2013), the term "smart city" refers to the use of Internet of Things (IoT) and technology-based innovation to the design, development, and administration of cities for urban forms and environmental management techniques.

Urban system. The urban system component of urban residents, urban form, and urban fabric, as well as all of these elements' interactions (Whebell, C. F. J. 1969). summarizing the literatures (Abarca-Guerrero et al., 2015; Gil-Garcia et al., 2015; Airaksinen et al., 2016; Gou et al., 2017; Kusiak; Memos; Xu and Lu; Ardito; and Laufs; 2019; and 2020). Urban systems' level of intelligence divided into two categories: physical infrastructure systems and social/human infrastructure systems. Important physical infrastructure systems include those for smart transportation, smart energy, smart water, smart waste management, smart construction, smart land use, smart manufacturing, and smart infrastructure. Additional examples of social/human infrastructure systems include smart governance, smart surveillance, smart safety, smart education, and smart financing.

Smart city. It refers to "instrumented, networked, and intelligent city." (Vito Albino and colleagues, 2015)." The term "instrumented" describes the capacity of sensors, meters, appliances, personal digital assistants, and other similar sensors to record and incorporate real-time, live data. The term "interconnected" describes how these data have been added to a computing platform. "Intelligent" refers to the inclusion of challenging analytics, modeling, optimization, and visualization services to enhance operational choices. (Vito Albino and colleagues, 2015).

The term "smart city" in the context of this study refers to cities that coordinate the functioning of their infrastructure and services using advanced information systems. The application of the Internet of Things and technological innovation in the design, development, and administration of urban forms and environmental management strategies referred to as "smart city" technology.

CHAPTER 2: REVIEW OF LITERATURE

2.1. Theoretical Review

2.1.1. Introduction:

In recent years, the idea of a "smart city" has drawn more and more attention as a means of addressing urban difficulties via the use of cutting-edge technology and data analytics.

Smart City Concept: A "smart city" is a concept for an urban development approach that blends innovation, technology, and sustainability to improve the quality of life for residents. The concept is based on reducing waste, improving urban operations, and maximizing resource use by using data and technology (Caragliu, Del Bo, & Nijkamp, 2011).

Technology Readiness: Technology availability is crucial for the effective implementation of the smart city idea. There is discussion about the city's technical infrastructure and the readiness of its stakeholders to adopt new technology. (2007) (Hollands). Technology readiness is crucial for the adoption of smart city technologies including IoT sensors, data analytics, and mobile apps.

Stakeholder Engagement: Engagement of stakeholders is essential for the smart city idea to be implemented successfully. It entails the design, development, and implementation of smart city solutions with the active participation of local government, residents, the private sector, and civil society groups (Nam & Pardo, 2011). With successful stakeholder involvement, trust can be developed, ownership can be encouraged, and the sustainability of smart city initiatives can be guaranteed.

2.1.2. Smart city definition perspectives

Since the term "smart city" first appeared in the early 1990s, scholars have emphasized technology, innovation, and globalization in the process of urbanization. (Gibson D, et al, 1992). Due to the urbanization, expansion, and related problems of modern cities as well as the quick development of new ICT, they have been able to conceptualize the idea of "smart cities," which is considered as the future shape for cities.

Even if it is challenging to define, a smart city is one that employs ICT to enhance the intelligence and effectiveness of a municipal system. Academics often adhere to the following perspectives when defining the ideas behind "smart cities":

Technical infrastructure. This term emphasizes the interconnectedness of a city's physical, ICT, social, and commercial infrastructures. Using network components and communication protocols, the smart city symbolizes data transmission and reception. (2009) Al-Hader et al.

Domain application. They defined six smart characteristics—economy, people, governance, mobility, environment, and living—in order to define and assess smart cities (Giffinger et al.2020).

System integration. Data transmission and reception provide the backbone of the functional operational framework required for effective network asset management (Al-Hader et al., 2009). Advanced data processing techniques were used to collect and analyze data in order to create smart services for a smart city (Yamamoto et al., 2012).

Data processing. The foundation of the functional operational framework necessary for efficient network asset management is data transmission and reception (Al-Hader et al., 2009). In order to provide smart services for a smart city, advanced data processing techniques were applied to gather and evaluate data (Yamamoto et al., 2012).

Some of scholars' definition perspective regarding Smart city concept summarized as in the following table.

Literature	Technical infrastructure	Application domain	System integration	Data processing
Harrison et al.	x	x		x
Giffinger et al.		x		
Washburn et al.	x	x		
Bowerman et al.	x	x		
Al-Hader et al.	x	x		x
Lazaroiu and Roscia		x		
Dirks and Keeling		x	x	
Moss Kanter and Litow		x	x	
Javidroozi et al.		x	x	x
Yamamoto et al.		x		x

Table 1*: Taxonomy of smart city definitions.*

Source: Al-Hader et al., 2011

2.1.3. Smart city application domain

With President Barack Obama's strong support for the idea of a smarter planet, the United States was one of the first nations to start a smart city initiative (Bronstein Z. 2009). (Hosaka T A 2010) Japan unveiled its i-Japan Strategy for 2015. Singapore published a plan called Intelligent Nation 2015 (P O, et al. 2011). China has aggressively invested in smart cities, spending more than 2 trillion RMB in 2015 alone, with more than 200 pilot smart cities (Liu P, & Peng Z. 2014). Smart economy, smart mobility, smart environment, smart people, smart living, and smart governance are identified as main components if smart city concept by researchers (Giffinger et al. (2007); Giffinger and Gudrun (2010); and the following table illustrates these application fields with the primary AI engagement areas.

Domain	AI involvement	Description
Smart Governance	E-governance, Decision-making policies, Disaster prevention and management, Urban planning	Improving the internal & external efficiency of the government; ensuring public services work efficiently
Smart Living	Smart building, Smart home, Smart education, smart healthcare, Smart tourism, Smart policing	Smart city's infrastructure for enhancing people's quality of life
Smart Economy	Smart business, E-commerce, Smart shopping, Peer-to-peer marketplace, Smart supply chains, Smart sharing services	A smart economy is an economy centered on technical innovation, sustainability, a high level of social wellbeing & resource efficiency
Smart Environment	Air quality monitoring, Weather monitoring, Waste management, Water management, Smart irrigation, Photovoltaics	Is creating an environment with integrated sensors, displays, and devices to let people comprehend better and manage their environment
Smart People	Social capital tracking management, activity monitoring, work effectivity analysis	Social and human capital, educational levels and skill, their capability to communicate with other, participation in public life.
Smart Mobility	Traffic management, Autonomous and sustainable mobility, Supply chain resiliency, Smart routing and parking	A smart mobility network is a network of intelligent transportation and mobility

Table 2*: Classification of smart city application domain.*

Source: summarizing from, Hosaka T. A., 2010, P O, et al 2011, and Liu P, & Peng Z. 2015

2.1.4. Summary of Theoretical review

Any smart city can be described as a methodical integration of technological infrastructures that relies on cutting-edge data processing, with the goals of enhancing municipal governance effectiveness, citizen satisfaction, economic prosperity, and environmental sustainability. A "smart city" is envisioned as being data-centric and multipurpose. The four layers of this composition are data collection, data vitalization, common data and services, and domain application.

smart city		
Definition perspectives	**application domains**	**composition**
Technical infrastructure	Government	Data acquisition
Application domain	Citizens	Data vitalization
System integration	Business	Common data and services
Data processing	Environment	Domain application

Table 3*: Theoretical review summary. Source: Giffinger and Gudrun (2010)*

2.2. Empirical Review

Despite the growing interest in smart cities in poor nations, there is still a dearth of research on the subject (specifically, the prospects and difficulties of adopting the concept of smart cities). The capital of Ethiopia, Addis Ababa, has been identified as a city with a high potential for adopting smart city concepts, and in recent decades, governmental initiatives and programs have evolved in this regard. As a result, the following studies, projects, and efforts related to smart city development have been assessed.

2.2.1. Literatures

(Alemneh, D. G., & Wondimu, H. A. 2019) Describe how the concept of a "smart city" might enhance service provision, promote economic growth, and enhance the quality of life for residents. (Teshome, A., & Adane, A. 2019) Draw attention to the importance of stakeholder involvement and public-private partnerships for the successful implementation of the smart city concept and point out significant roadblocks like a lack of infrastructure and funding.

(Kefyalew, G., & Tsegaye, T. (2018), and Alemu et al. (2019) discuss the need for a comprehensive policy framework and stakeholder involvement in implementing the smart city concept in their study. In addition, a study by Asefa and Alemu (2018) suggests spending money on capacity building, technology infrastructure, and stakeholder engagement to make the city more prepared for the creation of smart cities.

2.2.2. Developed nation vs. Developing countries

The approaches, strategies, and outcomes of developed and developing countries smart city initiatives compared and analyzed as labeled in the table below. This analysis aims to highlight the similarities, differences, and unique challenges faced by each category.

<table>
<tr><th colspan="2">Smart City Adoption practices</th></tr>
<tr><th>Developed nations</th><th>Common Character</th></tr>
<tr><td>* Often have robust existing infrastructure
* focuses on open data, collaborative governance, and innovation ecosystems.
* have established expertise and resources
* prioritizes comprehensive urban planning, digital infrastructure, and citizen engagement.</td><td rowspan="3">*numerous smart projects are emerging
* both benefits from Collaboration and knowledge exchange
*contribution of local stakeholders is crucial</td></tr>
<tr><th>Developing Countries</th></tr>
<tr><td>* face challenges related to limited infrastructure
* emphasizing affordable and inclusive solutions.
* working on knowledge transfer, partnerships, and capacity-building programs
* encounter unique challenges based on the specific context of each city and region.
* often aim to address these challenges</td></tr>
</table>

Table 4*: Developed nation Vs. Developing countries*

SC adoption comparison. Source: Bibri, S. E. (2018) and Nam, T., & Pardo, T. A. (2019).

2.2.3. Smart city initiatives and projects in Addis Ababa

The city of Addis Ababa has been implementing a variety of smart city programs and projects within the national government's comprehensive approach, with the political establishment playing a part in these efforts. The Prime Minister (Abiy Ahmed Ali (PhD)) has started a program for smart cities that focuses on creating partnerships that are people-centered in order to bring transformative change to Addis Ababa and afterwards replicate the outcomes across the nation.

I. Sheger beautification

The “Beautifying Sheger” is an initiative, currently under construction, of the Prime Minister of the Federal Democratic Republic of Ethiopia, H.E. Abiy Ahmed Ali, aiming to improve smart environment by changing the face of Addis Ababa.


Figure 4*: Sheger Park*

Source: 1) *https://encrypted-tbn0.gstatic.com/images?* ***2)****https://encryptedtbn0.gstatic.com/images?*

II. The La-Gare housing village modern project

One of the smart building and housing initiatives is the La-Gare housing village modern project in Addis Abeba, which is owned by the Ethiopian government and the Abu Dhabi-based construction business Eagle Hills.


Figure 5*: La-Gare housing Village.*

Source: 1) https://santaethio.files.wordpress.com/2018/11/fb_img_1542645270148-2010831846.jpg?w=1000 2) https://www.lagare.com/wp-content/uploads/2018/11/press-release-ethiopia-launch-1300x800.jpg

III. Building smart economy

Ethiopia’s digitization initiatives by the Ethiopian telecommunication corporation attract global giant technology companies, i.e., Alibaba Group and Twitter.

Figure 6*: Ethiopian agreement signing with Alibaba groups*

Source: https://addisstandard.com/wp-content/uploads/2019/11/Alibaba-MoU-.png

2.3. Gap of literature review

There is huge growing interest in adopting smart cities worldwide but not much research has been conducted in Ethiopia. The implementation of smart city principles in Addis Ababa is thus not supported by actual facts.

Stakeholders' Perspective: Studies that look at the many viewpoints and opinions of various stakeholders, such as decision-makers, city planners, companies, and citizens, are necessary.

Culture's influence: Culture has a big impact on how smart city concepts implemented. To further understanding, the cultural factors that can influence Addis Ababa's acceptance of smart city concepts, more study is needed.

Social equity: There are considerable differences in access to technology and other resources in places like Addis Ababa.

2.4. Case Study

Abstract

This case study presents an overview of the city-states of Singapore, Zurich, and Oslo's strategies and major projects for the development of smart cities. In this study, the effects of smart city efforts on livability, economic growth, and citizen well-being are examined.

These cities were selected for this case study based on their top ranking as smart cities around the world. Depending on their survey conducted on hundreds of citizens from 118 cities across five key study areas: health and safety, mobility, activities, opportunities, and governance, the Institute for Management Development (IMD) in collaboration with the Singapore University for Technology and Design (SUTD) has released the 2020 and 2021 Smart Cities. From 118 cities, the top 15 are displayed in table 5.

Smart City Rank 2021	City	Smart City Rating 2021	Structure 2021	Technology 2021	Smart City Rank 2020	Change
1	Singapore	AAA	AAA	AAA	1	—
2	Zurich	AA	AAA	A	3	▲ +1
3	Oslo	AA	AAA	A	5	▲ +2
4	Taipei City	A	A	A	8	▲ +4
5	Lausanne	A	AAA	A	NEW	—
6	Helsinki	A	AA	A	2	▼ -4
7	Copenhagen	A	AA	A	6	▼ -1
8	Geneva	A	AA	A	7	▼ -1
9	Auckland	A	A	A	4	▼ -5
10	Bilbao	BBB	A	BBB	24	▲ +14
11	Vienna	BBB	A	BB	25	▲ +14
12	New York	BBB	BB	BBB	10	▼ -2
13	Seoul	BBB	B	A	47	▲ +34
14	Munich	BBB	AA	BBB	11	▼ -3
15	Zaragoza	BBB	A	BB	48	▲ +33

Table 5*: smart cities rank.*

Source: https://www.imd.org/smart-city-observatory/home/2021/

2.4.1. Singapore


Figure 7*: Singapore city*

Image Source: 1) https://i.pinimg.com/564x/61/2d/7e/612d7e2af4e36589ddadd5017d4d4f7c.jpg
2)https://i.pinimg.com/564x/14/0d/2b/140d2be3807c4082e30601ff89f94778.jpg

The smart city concept has been successfully applied in Singapore, which is an excellent example. To enhance urban living, sustainability, and economic development, the city-state has made significant investments in technology and innovation. Here are a few prominent instances of Singapore's smart city initiatives:

A variety of smart city initiatives have been put into place by the city-state. sectors like mobility, energy, waste management, and governance.

Traffic congestion has decreased because of Singapore's smart mobility solutions, which also include an integrated public transportation network and electronic road pricing.

Building sustainability and energy efficiency are priorities for the city-state, which has prompted the adoption of smart building technology, including automatic lighting and energy management systems.

To reduce carbon emissions, Singapore is funding energy efficiency and renewable energy projects.

2.4.2. Zurich

Switzerland's Zurich has become a leader in the creation of smart cities. Through the use of technology and innovation, the city is implementing the smart city idea with the goal of enhancing the quality of life for its residents.

Figure 8*: Zurich city*

Image source: 1)https://image-service.web.oebb.at/www. -und-staedte-1422x800/zuerich-fluss-limmat.jpg 2)https://switzerland-tour.com/storage/media/Zurich/Zurich%20City.jpg

Here are some essential components of Zurich's adoption of the smart city concept:

Sustainability is at the core of Zurich's vision for a smart city, with a particular emphasis on lowering carbon emissions, enhancing air and water quality, and fostering a circular economy.

To lessen traffic congestion and enhance air quality, the city has introduced a number of smart mobility options, including electric buses, a bike-sharing program, and a car-sharing program.

Zurich plans to become carbon neutral by 2050, so it is investing in renewable energy sources like solar, wind, and hydropower.

A biogas facility that turns organic garbage into electricity and a recycling incentive program are just two of the innovative waste management strategies the city has put into place.

Zurich places a great emphasis on citizen involvement and engagement, with programs like participatory

2.4.3. OSLO

Oslo, the capital city of Norway, is a leading smart and sustainable city.


Figure 9*: Oslo city*

Image source: 1) Oslo_Norway_skyline.png/1200px 2) norwegian-design-87094-2.jpg

The following are important aspects of Oslo's adoption of the smart city concept:

Sustainability is at the core of Oslo's vision for a smart city, with a particular emphasis on lowering carbon emissions, enhancing air and water quality, and fostering a circular economy.

In order to lessen traffic congestion and enhance air quality, the city has developed a number of smart mobility solutions, including electric buses, bike-sharing programs, and a congestion charge zone.

To reach its aim of becoming carbon neutral by 2030, Oslo is investing in renewable energy sources like wind and solar.

The city has introduced a number of intelligent trash management strategies, including a recycling incentive program and an app that informs residents about garbage management services.

Oslo places a great emphasis on public engagement and participation, with programs like citizen

2.5. Conclusion of the Literature Review:

Generally, there are hope full initiatives and plenty of resources indicating the potential to adopt SC concept in Addis Ababa. These opportunities found all through various areas, including transportation, enhancing public safety, waste management, energy management, and water management.

In addition, I have summarized the case study as; Strong government leadership, investments in technology and innovation, and cooperation between the public and private sectors all contributed to the development of those smart cities. Their strategy for creating smart cities has a strong emphasis on economic growth, sustainability, and public engagement. The above-mentioned successful smart cities all have a long-term emphasis on sustainability and resident well-being.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1. Description of the study area

Hence, the site development is Compact, mixed-use and suitable for intelligent transport, access for installing real time information is so convenient in nifas silk lafto, lebu area is selected for the study. Moreover, geographically, the study was limited to the silhouette of the chosen location, which is located in the woreda 01 (also known as the Lebu area) in the Nifas Silk Lafto subcity of Addis Ababa City and spans around 30 hectares. The effectiveness of service delivery and the improvement of residents' living situations will be the main research foci.

Nifas Silk Lafto sub-city is one of the eleven sub-cities in Addis Ababa, having a population of approximately 445,683 people (Addis Ababa City Administration, 2022). The sub-city's woreda 01 is home to many important institutions and known for its well-developed infrastructure.

Figure 10*: study area*

Despite these advancements, Nifas Silk Lafto continues to suffer a number of difficulties, including a lack of affordable housing, poor waste management practices, limited access to basic clean water, and frequent power and internet outages that have a significant impact on its citizens and companies.

3.2. Study design

The study design employed is as shown in the following diagram for the study on identifying opportunities and obstacles for implementing the smart city idea in Addis Ababa's Lebu neighborhood.

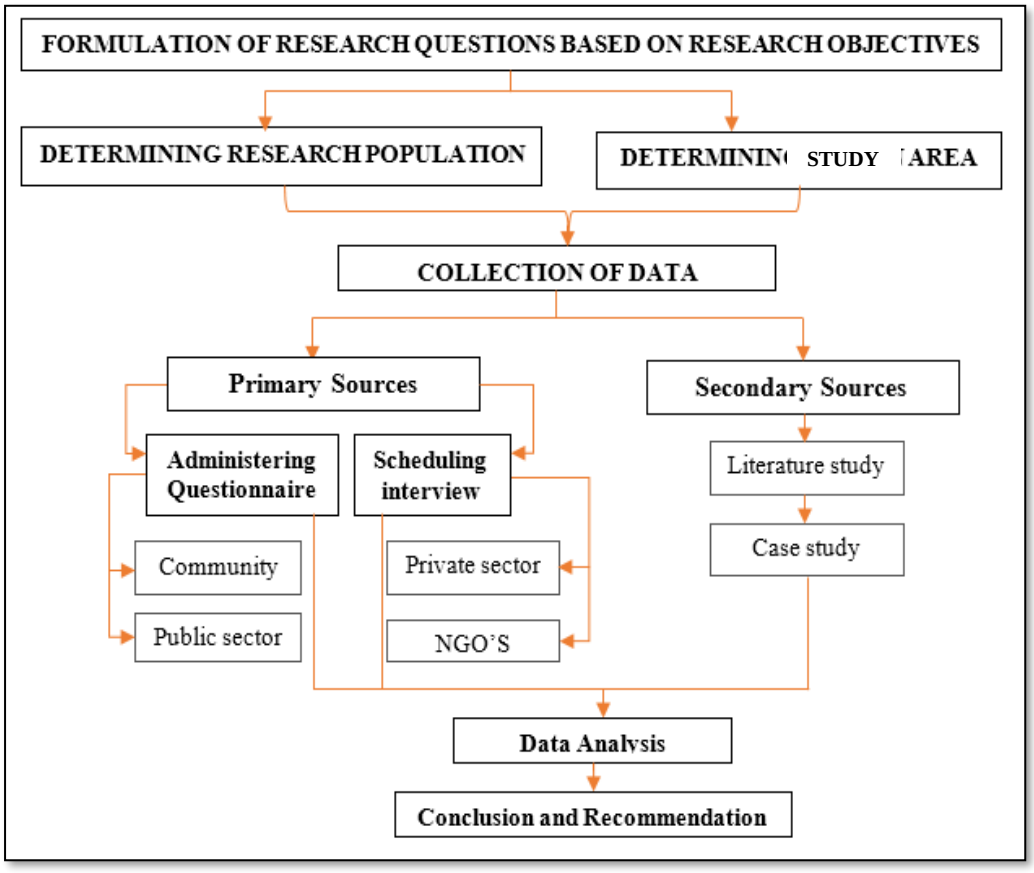


Figure 11*: Research design*

3.3. Study approaches

Gathering relevant data and documents use to address my research objectives will be conducted based on research design. Accordingly, Primary data Conducted by interviewing focus groups to collect their perspectives, experiences, and opinions. In addition, site observation and questionnaire surveys deployed to collect Primary data. Secondary data gathered from research sites, documents, case study and literature related to smart city. Then collected datas and documents will be analyzed to extract meaningful findings and draw conclusions.

The research findings would be discussed in relation my research objectives and the existing literature and finally Conclusion and Recommendations Summarized from the main findings of the study.

3.4. Data Type and Sources

Primary and secondary data from both quantitative and qualitative categories are used in this study. Questionnaire Surveys, observations, interviews, and the researcher's own photos were used to acquire primary data. Books, official websites such as Google Scholar, Sci-hub, Researchgate and ScienceDirect, and official papers are a few examples of secondary data.

Area of SURVEY	Survey technique	Data types	Data collection techniques	Specific Sources Include:
The general Study area	Integrated data Development	Primary and secondary Qualitative and quantitative	Interview , literature, case study, and Archival	Addis Ababa plan commission Office, STI, MCIT, MOST, Google Maps.
N/S/Lafto sub-city	Systematic Random sampling (Probability sampling)	Primary and secondary, Qualitative and quantitative	Interview ,literature, photographs, sketches, observation & Archival	Researcher's observation, Google Maps, N/S/Lafto construction bureu, health bureau, finance bureau, Development Bureau.
Lebu Area	Systematic sampling (Probability sampling)	Primary and secondary Qualitative and quantitative	Interview, questionnaire, literature, photographs,	Researcher's observation, Maps, N/S/Lafto Woreda 01 vital event Bureau. Community,& NGOs

Table 6*: summary of methodology*

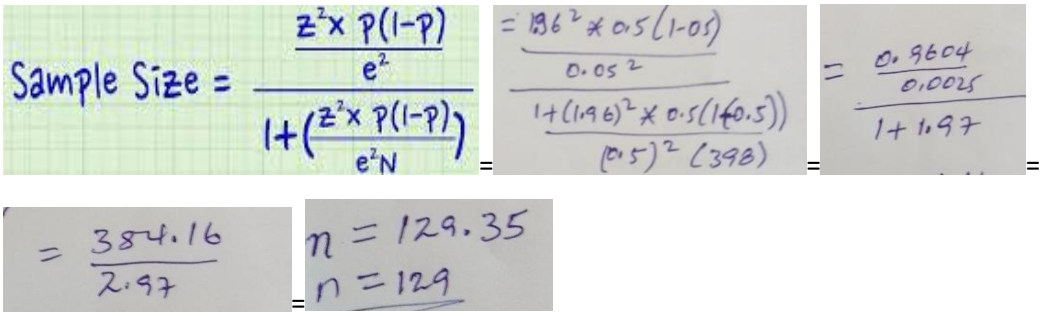
3.5. Study Population

The Woreda 01 study on the prospects and challenges of adopting the smart city concept in Addis Abeba's Nifas Silk Lafto sub-city focuses on those who are involved in the area's planning, development, implementation, and use of smart city technologies and services. This presumably includes citizens, government officials, urban planners, architects, engineers, technology corporations, telecommunications providers, business owners, and organizations.

As labeled in figure 10 the study area numbered by block in order to identify focus groups. Accordingly, from 21 blocks assigned, 19 of block built up with 313 buildings that possed by 398 households those have equal chance to be selected as respondent (see table 7). Then the population size selected for question are calculated using probability sampling formula for known population.

Where N= population size=398 e=margin of error -5% Z=z-score=1.96 for 95% and p=standard of deviation=0.5 for 95%

Hence, I have allowed error of 5% from sample size of total=129, I conducted survey to 105 respondents (see table 8).



Block #	Land mark	# of bldg	Governmental sector	Residence	Private Company /Institution	Non-Governmental organization
BLC_1	Lebu-star	8	1	3	4	0
BLC_2	Amenities, Royal	5	0	2	3	0
BLC_3	Lalo, HMD	21	0	11	10	0
BLC_4	Andinet, banks	23	1	12	9	1
BLC_5	1st instant court	12	1	10	1	0
BLC_6	w-01 clinic	7	1	48	0	1
BLC_7	Kasma realstate	14	0	126	6	
BLC_8	Cloth trade	16	0	15	0	1
BLC_9	Kibe	17	0	17	0	0
BLC_10	Dalu	14	0	14	0	0
BLC_11	Greenery	0	0	0	0	0
BLC_12	Naima	23	0	23	0	0
BLC_13	Wube shiro	27	0	22	5	0
BLC_14	Zelalem	19	0	19	0	0
BLC_15	Dr. Yilma	22	0	21	1	0
BLC_16	Aadaa food crt	15	0	13	2	0
BLC_17	Greenery	0	0	0	0	0
BLC_18	Maski	21	0	18	3	0
BLC_19	Forst Ashu CBO	20	0	11	9	0
BLC_20	Haiqoch, bridge	16	0	8	8	0
BLC_21	Dessalech, fiqre	13	0	5	8	0
SUM UP		313	4	**398**	69	3

Table 7*: Demography character*

3.6. Sample size

To ensure accuracy, avoids bias and provides statistical means, random sampling deployed. Accordingly, questionnaires conducted on lebu area; partial of woreda 01, ketene (sub-woreda) 4, 5, 11, 12 and administered to randomly selected 105 respondents out of 398 households of the lebu area community. In the spatial restriction I have determined action area of A=30 hectare and then each block and built up parcel counted.

Besides, 25 more interviews were administered to focus groups: to the politicians/urban authority and technical person (Urban designer/Architect/engineer), Smart system developers and users such as telecommunication sectors, banking sector, etc. Finally random sampling used making a total of 105 respondents as shown below;-

Subjects.	**Category of respondents.**	**No of informants**
city Community	Household/Resident	105
Politicians	Councilors/ Urban Authorities.	4
Land, Housing and Urban Development	Urban designer/Architect/engineer.	5
Environmental specialist	Environmentalist	2
IT specialist	Computer science engineer	2
Police Officer	Security councilor/authority	2
Transport officer	Urban Authorities/ engineer.	3
Economists	Economic consultant/accountant.	2
Private Organizations	Smart system developers	5
TOTAL		**130**

Table 8*: sampling Subjects in the Study*

3.7. Sampling techniques

Both random and deliberate sampling methods were employed. A random sample approach is needed since each participant's participation in the study region is crucial for this research. As a result, links between communities and stakeholders that were created through a participatory method were successful in promoting information flow. The intentional sampling approach focuses on decision-makers from the government, business, and other groups. They are therefore end consumers and players in the execution of the smart city idea.

As a matter of technological technique, the domains for the smart city will first be determined. The following phase involved developing survey questions and interview guides based on the specified domains and associated efforts. The survey questions are broken up into two portions; the first component covers the respondents' demographics. A Likert scale

with five response categories (1–5) was employed in the second section's questions (see appendix), where "1" denotes strongly disagree and "5" denotes strongly agree.

Based on to methodologies I mentioned in above chapter3, section Information was obtained from 105 respondents in order to validate the features of smart cities that were derived from the literature. Partial Least Square-Structural Equation Modeling (PLS-SEM) was then used in Microsoft Excel to conduct descriptive, exploratory, and inferential statistics analysis. As a comprehensive statistical technique that enables continuous adjustment and assessment of the research model that examines the association between many variables, PLS-SEM is utilized in this investigation. PLS-SEM is also suitable for models that contain multiple hypotheses. The evaluation of the measurement model, which is done by looking at its characteristics, validity, and reliability, is the first of PLSSEM's two key investigations. Second, it involves inferential analysis, which involves examining the relationships between the ideas (hypotheses).

Taking into account the criteria for smart cities that earlier study (Marciniak and Owoc, 2013, Madkour et al., 2013, Moreno et al., 2017, Jnr et al., 2018, Giffinger et al., 2007, Giffinger and Gudrun, 2010, Azkuna, 2012) discovered. Smart economy, smart mobility, smart environment, clever people, smart lifestyle, and smart governance are independent factors, whereas acceptance of the smart city is the dependent variable. Based on these domains from the literature, this study's adoption model for smart cities is displayed in table 9 below.

The domains for the smart city will be choosen initially as a matter of technical procedure. The next step was to create survey questions and interviewing guidelines based on the designated areas and related initiatives. The survey questions are divided into two sections; the first section covers the demographics of the respondents. The questions in the second portion (see appendix) used a Likert scale with five answer categories (1–5), where "1" stands for strongly disagree and "5" for strongly agree.

3.8. Descriptive Analysis

Based on variables hypothesized as shown in table 9, PLS-SEM findings are utilized in this study's analysis to calculate the mean, standard deviation, minimum, maximum, and normalcy (Skewness and Kurtosis) scores for each item used to rank the domains of a smart city.

V.CODE	VARIABLES	MEASUREMENT	SOURCE
	DEPENDENT VARIABLE		
S.C	**Adopting Smart city concept**	Evaluation of more than 65 literatures on Smart City	official websites: Google Scholar, Sci-hub, Researchgate, ScienceDirect
	INDEPENDENT VARIABLE		
EC	**ECONOMY**		
EC1	Lack of fund to smart projects	literatures, Population within a study area	Giffinger et al. (2007), Lombardi et al. (2012)
EC2	role of the informal economy		
EC3	Shortage in access to technology		
MO	MOBILITY		
MC4	low quality infrastructures	literatures, Population within a study area	Azkuna (2012)Giffinger et al. (2007), Lombardi et al. (2012)
MC5	Lack of accessible and affordable public transport		
MC6	Lack of quality on neighbourhoods and public space		
ENV	ENVIRONMENT		
ENC7	Pollution	literatures, Population within a study area	Giffinger et al. (2007), Lombardi et al. (2012)
ENC8	Lack of equity in access to opportunities and resources		
ENC9	Inefficient resources cycle management		
ENC10	Climate change effect		
GO	GOVERNANCE		
GC11	Instability & lack of institutional capacity in governance	literatures, Population within a study area	Marciniak and Owoc, (2013)Lombardi et al. (2012)
GC12	Gap between government and governed		
GC13	Shortage in access to information		
LI	LIVING		
LC14	Deficit of social services	literatures, Population within a study area	Kourtit and Nijkamp (2012), Azkuna (2012)
LC15	Lack of accessible leisure facilities		
LC16	Urban violence and insecurity		
LC17	Threats to cultural identity and particularities		
PE	PEOPLE		
PC18	High obstacles to social mobility	literatures, Population within a study area	Kourtit and Nijkamp (2012), Madkour et al., (2013)
PC19	Low educational level and digital skills		
PC20	Urban poverty and inequality		

Table 9*: Variables, measurements and data sources*

3.9. Exploratory Analysis

This study measures the items loadings, convergent validity (Average Variance Extracted (AVE)), and discriminating validity to evaluate validity. The Cronbach's alpha, which ranges from 0 to 9, classifies the internal consistency reliability coefficient as follows: > 0.9 = "excellent," > 0.8 = "good," > 0.7 = "acceptable," > 0.6 = "questionable," > 0.5 = "poor," and > 0.5 = "unacceptable." Reliability (CR) is measured using Cronbach's Alpha and Composite Reliability.

CHAPTER FOUR: DATA ANALYSIS AND INTERPRETATION

4.5. Demographic Statistics

The demographic details of the survey respondents are shown in table 10 below, which summarizes the findings from the interview and questionnaire's first phase.

Profile	Options	Frequency	Percentage
GENDER	Male	49	46.67%
	female	56	53.33%
AGE	18-24	14	13.33%
	25-34	26	24.76%
	35-44	32	30.48%
	45-55	31	29.52%
	55+	2	1.90%
HIGHEST Qualification	< Grade 12	7	6.67%
	Diploma	26	24.76%
	Bachelor's degree	39	37.14%
	Master's degree	21	20.00%
	>= Doctorate	12	11.43%
job status	Governmental	23	21.90%
	Non-governmental	7	6.67%
	Private	59	56.19%
	other	16	15.24%
Area of Smart City Specialization	Smart Economy	9	8.57%
	Smart People	3	2.86%
	Smart Governance	18	17.14%
	Smart Mobility	5	4.76%
	Smart Environment	1	0.95%
	Smart Living	7	6.67%
	Others	62	59.05%
willingness to support the idea	highly negative	7	6.67%
	negative	23	21.90%
	neither/nor	26	24.76%
	positive	35	33.33%
	very positive	14	13.33%

Table 10*: Demographic characteristic of survey respondents*

This table displays the demographic data derived from an ordinal scale for the 105 survey participants. The results are summarized by frequency and percentage. The respondents were specifically chosen to offer information on the reliability of the literary components of smart cities in order to ascertain their prior knowledge of smart city issues.

4.6. Descriptive Analysis

4.6.1. PLS-SEM result Analysis

PLS-SEM used to verify the descriptive statistics for each smart city domains. The mean, maximum, minimum, standard deviation, skewness, and kurtosis values for the smart city dimensions are included in the descriptive analysis, as shown in Table 11. The results of Table 8 show the minimum and maximum replies on a 5-point Likert scale from the respondents. The results of Table 11 also show that the mean values are higher than 2.5 on a 5-point scale. Additionally, the standard deviation numbers exhibit a narrow dispersion from the mean, demonstrating consistency and narrow spacing in the respondents' replies. In order to confirm the data's normalcy, the results for Skewness and Kurtosis were also examined. Skewness and Kurtosis readings for the items were below the recommended cutoffs of 3.0 for Skewness and 8.0 for Kurtosis. So this data is very effective hence mean value is 4.

Smart City Dimension	Mean	min	max	Std. deviation	Excess kurtosis	Skewness
Smart Economy	4.484	4	5	0.5	-2.039	0.064
Smart People	4.421	4	5	0.494	-1.936	0.325
Smart Governance	4.021	3	5	0.821	-1.531	-0.04
Smart Mobility	4.053	3	5	0.773	-1.327	-0.092
Smart Environment	4.032	3	5	0.864	-1.682	-0.062
Smart Living	4.484	4	5	0.5	-2.039	0.064
Smart City Adoption	4.274	4	5	0.446	-0.956	1.032
Note: For Mean 1 = least effective; 2 = fairly-effective; 3 = effective; 4 = very effective; and 5 = most effective The recommended cut-offs are 3.0 for Skewness and 8.0 Kurtosis as recommended by Teo (2019)						

Table 11*: Descriptive analysis of smart city domains*

4.7. Results from interview analysis

From aimed 25 Interview participants I have taken minutes with 22 of them. I have categorized them in three: a) officials, b) proffessionals and c) ICT OR technology experts. From my respondents six of them are officials those working in government office at position of leader, 10 of them are professionals such as urban planners, architects, engineers and environmentalist. The left six of them are technology experts.

Name	Edu. level	S_City	Magnitude of challenges of SC						category
			EC	MO	ENV	GO	LI	PE	
XX1	BSc degree	5	4	4	5	4	5	5	a
YY1	MSc degree	5	5	4	5	4	5	4	a
XX2	Diploma	4	5	4	3	5	3	4	a
XX3	BSc degree	5	4	5	5	5	5	5	a
XX4	BSc degree	4	5	4	4	4	3	5	a
YY2	MSc degree	4	5	4	4	3	5	4	a
XX5	BSc degree	4	5	4	3	4	3	4	b
YY3	BSc degree	4	4	5	3	3	3	4	b
YY4	BSc degree	5	5	4	5	5	5	4	b
YY5	BSc degree	4	4	5	5	4	4	4	b
YY6	Doctorate	4	4	4	3	4	5	4	b
YY7	BSc degree	4	4	5	3	4	5	4	b
XX6	Doctorate	5	4	5	4	4	5	5	b
XX7	MSc degree	4	4	4	4	5	5	4	b
YY8	BSc degree	4	5	4	4	5	3	5	b
XX8	Doctorate	4	5	4	4	3	3	5	b
YY9	BSc degree	5	5	5	5	4	4	4	c
YY10	BSc degree	4	4	5	3	3	4	5	c
YY11	MSc degree	4	4	4	4	4	3	5	c
YY12	MSc degree	4	5	5	3	5	3	5	c
YY13	MSc degree	4	5	4	4	3	3	4	c
YY14	MSc degree	4	4	4	5	3	3	5	c

Table 12: interview's summary

I summarizes the research interview respondents' perspectives and ideas based on the interview questions flow:

Most of them has knowledge about internet, artificial intelligence, and technology. But identifying them and describing in term of IoT is difficult for more than half of them. Almost half of my interview respondents do not have average understanding about Smart city and Smart city concept.

Their response on challenging factors of Smart city adoption is also as follows.

Smart city adoption: They voiced worry about the current technical infrastructure and suggested that it needed to be up graded and expanded. To effectively use smart city technologies, staff must be trained and upskilled, according to city officials.

Economy: Implementing smart city efforts will be difficult due to the limited funding options. Participants talked about finding outside financing sources and the prospects of public-private partnerships.

Mobility: The need for a strong connectivity infrastructure, including roads and services, was stressed by the participants. A critical component for data collecting and analysis was recognised as the deployment of sensors across the city.

Environment: As the potential advantages of smart city, projects in fostering environmental sustainability and energy efficiency were underlined by participants. The importance of adopting renewable energy sources and improving resource management was stressed by experts.

Governance: Officials from the city emphasised the value of creating smart city laws and regulations to direct implementation. Various government agencies must work together, according to experts, to promote efficient governance and decision-making procedures.

Living: as most of their comment we our self (citizens) have to improve our living standard introducing betterment of tcechnologies and innovation.

People: The importance of including citizens in the planning and execution of smart city projects was raised by participants. Digital platforms and mobile applications have the ability to facilitate citizen interaction and feedback, according to experts.

According to the results of the interviews, Mobility or infrastructure development and Governance or good administration are essential to the implementation of smart city concepts in Addis Ababa. Additionally, Economy and citizen involvement noted as crucial elements for creating inclusive and long-lasting smart city. Also praised were the state of technology and the city's dedication to environmental sustainability. However, a lack of financing and technological readiness became important obstacles.

4.8 Exploratory Analysis

Assessments of reliability and validity are made, with reliability referring to how consistently accurate and error-free the variables' findings are. Similar to reliability, validity describes how much a variable or dimension deviates from other variables in the same model in terms of measuring what it is intended to measure. As can be seen in Table 10, PLS-SEM was used to assess the validity and reliability of the smart city dimensions. The results in Table 12 show the reliability measure based on the Composite Reliability (CR) and Cronbach's alpha score which should be greater than 0.70 for CR and Cronbach's alpha.

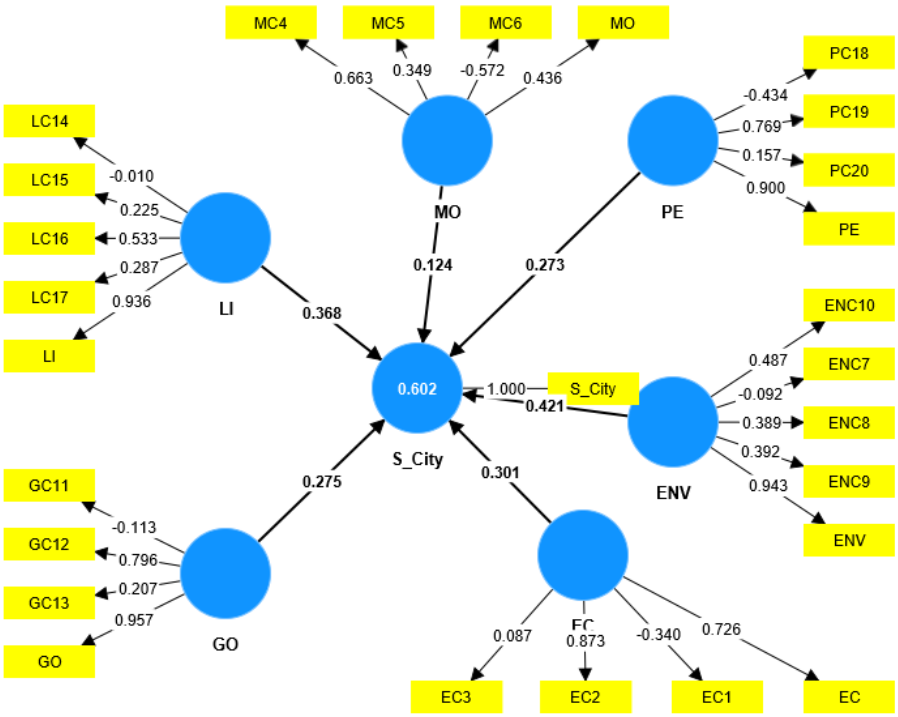


Figure 12 PLS-SEM analyses of the smart city adoption domains model

Cronbach's alpha is evaluating the internal consistency or reliability of a scale or questionnaire, it shows the degree to which groups of items (domains) are interrelated to one another and measuring the same underlying construct. When Cronbach's alpha score is less than 0.7, it implies the scale or questionnaire's components could not always assessing the same construct. If the Cronbach's alpha score is less than 0.7, the scale or questionnaire may have ambiguity, or a lack of uniformity. it suggest that when interpreting the data or making inferences based on the scale, we should take care or eliminating some items, performing further item analysis, or looking into other reliability metrics.

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
S. Economy	-0.055	0.509	0.396	0.388
S.Environment	0.058	0.593	0.529	0.304
S.Governance	0.189	0.701	0.32	0.425
S.Living	-0.137	0.527	0.069	0.332
S.Mobility	-0.028	0.491	0.324	0.392
S.People	-0.375	0.717	0.194	0.451

Table 13*: Reliability and validity analyses of smart city dimensions*

Composite reliability (CR). quantifies the extent to which the measurement items consistently measure the underlying construct. A higher CR value indicates greater internal consistency reliability, suggesting that the measurement items consistently and reliably measure the latent variable. Typically, a CR value of 0.7 or higher is considered acceptable, indicating satisfactory reliability.

Average Variance Extracted (AVE) is a metric used to gauge the amount of variance that a latent variable captures in relation to the measurement components that make up that variable. The commonly accepted rule of thumb is that an AVE of 0.4 or above is considered acceptable, indicating that the construct explains at least 40% of the variance in its indicators.

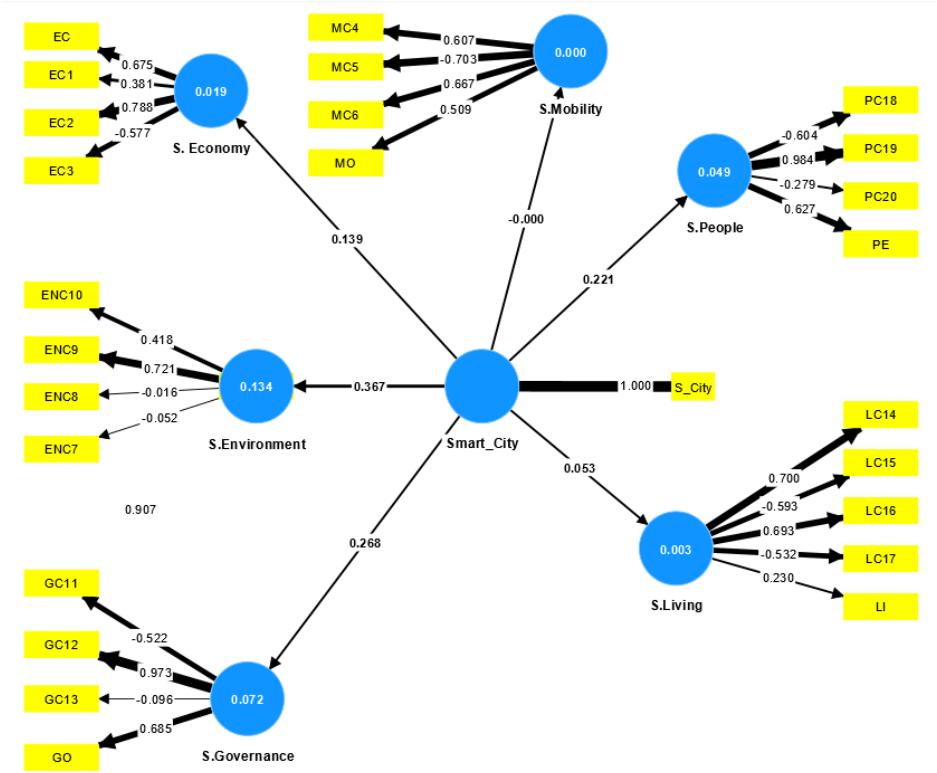


Figure 13*PLS-SEM* ***graphic output with relative value***

4.8 Inferential Analyses (checking domains/elements)

The hypothesized domain is investigated by applying the PLS technique in Smart PLS 4 and bootstrapping resampling to look at the path significance levels of each hypothesis. The two-tail test was performed to assess the statistical significance of each hypothesis, and the results are in Table 15 Another method of analyzing the structural model is to look at the path coefficients value (1), which evaluates the relationship between variables based on the degree of significance levels (p-value), which is significant when p=0.05. For t-value, which is based on the regression coefficients and associated significances listed Table 15, is then used to assess the consequences of each hypothesis. The t-value for a two-tail test should be more than 1.96

	Unstandardized coefficients	**Standardized coefficients**	**SE**	**T value**	**P value**	**Significant Challenge**
EC	-0.329	-0.369	0.444	0.741	0.461	Not
EC1	0.527	0.559	0.442	1.192	0.237	Not
EC2	0.713	0.886	0.437	1.631	0.108	Not
EC3	0.653	0.723	0.436	1.499	0.138	Not
MO	0.308	0.341	0.225	1.373	0.174	Not
MC4	-0.04	-0.043	0.232	0.173	0.863	Not
MC5	-0.084	-0.097	0.237	0.354	0.725	Not
MC6	-0.142	-0.156	0.237	0.598	0.552	Not
ENV	-0.166	-0.305	0.147	1.123	0.265	Not
ENC7	0.377	0.475	0.147	2.563	0.013	Yes
ENC8	0.459	0.584	0.151	3.04	0.003	Yes
ENC9	0.388	0.589	0.147	2.639	0.01	Yes
ENC10	0.419	0.66	0.142	2.942	0.004	Yes
GO	0.333	0.577	0.305	1.093	0.278	Not
GC11	-0.139	-0.156	0.304	0.457	0.649	Not
GC12	-0.127	-0.244	0.306	0.416	0.679	Not
GC13	-0.197	-0.23	0.318	0.619	0.538	Not
LI	0.286	0.553	0.132	2.171	0.033	Yes
LC14	-0.113	-0.186	0.136	0.833	0.408	Not
LC15	-0.075	-0.131	0.131	0.571	0.57	Not
LC16	-0.033	-0.056	0.139	0.235	0.815	Not
LC17	-0.011	-0.019	0.136	0.08	0.936	Not
PE	-0.458	-0.513	0.321	1.428	0.158	Not
PC18	0.687	0.763	0.321	2.136	0.036	Yes
PC19	0.712	1.2	0.324	2.196	0.031	Yes
PC20	0.702	0.785	0.319	2.198	0.031	Yes

Table 14*: Results of Hypothetic indicator*

If the p-value is less than a pre-determined significance level, typically denoted as $p < 0.05$ or $p < 0.01$, it is considered statistically significant. In this case, we reject the null hypothesis and conclude that there is evidence of a relationship or difference. If the p-value is greater than the significance level, typically denoted as $p > 0.05$, it is not statistically significant. In this case, we fail to reject the null hypothesis, suggesting that there is insufficient evidence to conclude a relationship or difference.

4.5. Discussion

From my finding from survey data analyzed deploying PLS-SEM software labeled in table 13, shows the significance of hypothetic variables encoded ENC7, ENC8, ENC9, ENC10 LI, PC18, PC19, and PC20. These are challenges indicators which represented the following terms consecutively Pollution, Lack of equity in access to opportunities and resources, Inefficient resources cycle management, Climate change, living standard, High obstacles to social mobility, Low educational level and digital skills, and Urban poverty and inequality. These variables, know after challenging factors to adopt Smart city are from analysis of 105 respondents. The result supports one of my respondent's, understanding. Mr. YY3 said me "አኗኗራችንን ሳናዘምን ሀገራችንንም ሆነ ከተማንን ልናዘምን አንችልም" literally; unless we modernize our living standard, we cannot make our country and our city smart.

There are several opportunities for the Addis Ababa Lebu area to adopt the smart city idea. Urban management must be effective and sustainable because of the city's constantly increasing population and urbanization rate. Smart city technologies can enhance a number of elements of urban life, including public services, waste management, transportation, and energy. Smart grids, for instance, can optimize energy use and cut waste, while intelligent transportation systems can assist reduce traffic congestion and improve mobility. These possibilities suggest that Addis Ababa's smart city concept adoption could improve both the quality of life for locals and the sustainability of the city as a whole.

The problem of data privacy and security, specifically in the context of smart life and smart people, is another difficulty found in the research. The collecting and processing of massive amounts of data from several sources is a prerequisite for smart city technology. This raises questions regarding the security of private data as well as individual privacy. To solve these issues and ensure public confidence in the smart city efforts, it is essential to develop stringent data protection legislation and put in place effective cybersecurity safeguards. The study also emphasized the value of citizen engagement and stakeholder collaboration. The active engagement and involvement of many stakeholders, including governmental organizations, businesses, academic institutions, and citizens, is necessary for the successful adoption of the smart city concept.

CHAPTER FIVE: CONCLUSION AND RECOMMENDATION

5.2. Conclusions

Addis Ababa has various chances to implement the concept of a smart city. In a nation where urbanization is happening swiftly and the population is growing, adopting smart city technologies and solutions can help to improve people's quality of life and boost the effectiveness of various municipal systems. Infrastructure for smart cities may promote sustainable growth, reduce resource consumption, and enhance urban services. Intelligent waste management, energy-efficient buildings, and intelligent transportation systems are a few examples. In addition, Real-time monitoring and data analytics can enhance public safety and security while encouraging citizen participation and enabling evidence-based decision-making.

Even though this study determined by several limitations; this paper inputs its scientific research role by identifying a set of smart city adoption challenges and mentioning potential benefits Addis Ababa, lebu area can gain from adopting smart city concept.

In case significant challenges that the city of addis ababa may face while adopting smart city concept are: Pollution, Lack of equity in access to opportunities and resources, Inefficient resources cycle management, Climate change, living standard, High obstacles to social mobility, Low educational level and digital skills, and Urban poverty and inequality. The city should break-through these all challenges to benefit smart city prospects such as

Improved urban services: urban services, such as transportation, electricity, water, waste management, and public safety delivered most effectively.

Increased economic development: citizens benefited from job creation, enticing new businesses and investments options of the smart city idea.

Addressed urban issues: using internet and technology based creative solutions, to problems like traffic congestion, air pollution, and inadequate infrastructure solved promptly.

Participatory decisions: digital platforms increase citizen engagement and participation in decision-making processes.

The study's findings outline the areas that policymakers, urban planners, and city developers should focus on in order to create a smart city. Descriptive, exploratory, and inferential analytical results also supported the validity and applicability of the specified smart city characteristics for offering recommendations to enhance smart city practice for cities in their transition to sustainable societies.

Additionally, it is clear that this research is not an exception to the rule that all studies have some sort of constraint. Consequently, only 105 respondents were included in this study's data collection, making the sample

This research paper on identifying the opportunities and difficulties of implementing the smart city idea in the Addis Ababa city, lebu area, has given insightful information on the subject. The use of smart city technologies offers promising opportunities for enhancing urban sustainability and quality of life. However, a number of issues must be resolved, including the need for stakeholder collaboration and citizen engagement, appropriate governance, concerns about data privacy and security, and a lack of adequate infrastructure.

A comprehensive strategy encompassing infrastructure expenditures, policy creation, capacity training, and public awareness campaigns will be needed to address these issues. The Addis Ababa administration should be aggressive in promoting smart city programs while also looking to form alliances with businesses and international organizations.

5.3. Recommendation

Depending on the study's findings, The Addis Ababa government needs to prioritize expenditure on digital infrastructure and connectivity to ensure citizens healthy life. Focus on challenging factors and limiting Pollution, making sure that everybody should benefits from resources and opportunities equitably, effectively managing Inefficient resources cycle, being essence to natural hazards like Climate change, improving living standard of citizen, upgrading communities ideology in common good such as brotherhood. Widening opportunity of training and education mainly on digital skills and reducing or omitting urban poverty and inequality. By improving internet accessibility and power availability, smart city technology can operate more efficiently.

Another challenge I found from case study were concerns of data privacy and security. To address concerns about data privacy and security, the government should enact tough cybersecurity regulations and robust data protection legislation. Also maximizing big data centers such as secured blockchains and launching or owing lot of sattelites is invaluable solution.

Collaborating with citizens in decision-making processes Effective collaboration between public sector organizations, corporations, academic institutions, and residents is necessary for the implementation of the smart city idea.

For individuals, technicians, and government workers to increase their skills and knowledge, capacity development initiatives must be implemented. In addition, Public awareness campaigns and citizen participation in smart city programs have to be adopted. Since it increase citizens' sense of ownership.

Government of Addis Ababa should have to effectively use a big opportunity of man power like well-positioned youth and tech-savvy population. By little empowerment they can execute smart city ideas successfully.

Smart city Initiatives and projects ongoing at country level are encouragable and recommends to identify empirical prospects and challenges. It helps to successful implementation of smart city concept.

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Appendix 1: Survey Questionnaires

Survey Questionnaires

My name is Adem Tibo, I am Masters of Science Degree candidate in urban Planning and design from Adama science and Technology University. As a part of the Curriculum, I am doing the research paper entitled "*Identifying prospects and challenges of adopting smart city concept in Addis Ababa, In case of Lebu area.*"
Appreciating your kind cooperation, I would like to affirm the informants that the following list of questions will only use for educational research purpose.

1. What is your age range?
   a) 18-24 b) 25-34 c) 35-44 d) 45-54 e) 55+
2. What is your gender?
   a) Male b) Female c) Prefer not to say
3. Your higher education level?
   a) Less than < Grade 12
   b) Diploma
   c) Bachelor's degree
   d) Master's degree
   e) Doctorate and above
4. Your employment status?
   a) Governmental
   b) Non-governmental
   c) Private
   d) other
5. Your area of your specialization?
   a) Smart Economy
   b) Smart People
   c) Smart Governance
   d) Smart Mobility
   e) Smart Environment
   f) Smart Living
   g) Others
6. Are you familiar with the concept of a smart city?
   a) Yes b) No
7. If your answer for question number 7 were not, definition would be as discussed in operational definition. Thus,
   - *Smart city concept is an application of Internet of Things (IoT) and technology-based innovation in the planning, development, and operation of cities for urban forms and environment management strategies.*
   - *The term smart city coined for the cities in application of complex information systems to integrate the operation of urban infrastructure and services such as buildings, transportation, electrical and water distribution, and public safety.*

8. To what extent do you agree with that the city of Addis Ababa especially lebu area will benefits of adopting a smart city concept?
   1: Strongly disagree
   2: Disagree
   3: Neither agree nor disagree
   4: Agree
   5: Strongly agree

9. On a scale of 1 to 5, please rate the following aspects considered as challenge to adopting smart city concept in Addis Ababa?

   Note 1: Not challenging factor at all
   2: Somewhat challenging
   3: challenging
   4: Highly challenging
   5: Extremely challenging

9.1. Lack of fund to smart projects ____
9.2. role of the informal economy _____
9.3. Shortage in access to technology_____
9.4. Low quality infrastructures such as roads, buildings…____
9.5. Lack of accessible and affordable public transport _____
9.6. Lack of quality on neighborhoods and public space _____
9.7. Environmental Pollution (water, air…) ____
9.8. Lack of equity in access to opportunities and resources ____
9.9. Inefficient resources cycle management _____
9.10. Climate change effect (global warm) ____
9.11. Instability & lack of institutional capacity in governance ____
9.12. Gap between government and governed ____
9.13. Shortage in access to information _____
9.14. Deficit of social services such as health center, school, …___
9.15. Lack of accessible leisure facilities such as recreation centers, sufficient internet access…___
9.16. Urban violence and insecurity _____
9.17. Threats to cultural identity and particularities _____
9.18. Residents/citizens being High obstacles to social mobility ____
9.19. Residents/citizens Low educational level and digital skills ___
9.20. Residents/citizens poverty and inequality ___

10. If you have any additional comments or suggestions related to the development of a smart city in Addis Ababa mainly lebu area?

Appendix 2: Interview questions

Interview questions

My name is Adem Tibo, I am Masters of Science Degree candidate in urban Planning and design from Adama science and Technology University. As a part of the Curriculum, I am doing the research paper entitled "*Identifying prospects and challenges of adopting smart city concept in Addis Ababa, In case of Lebu area."*
Appreciating your kind cooperation, I would like to affirm the informants that the following list of questions will only use for educational research purpose.

1. Organization/Office name:-	Gender
2. Education level:-	Age
3. Title and position:-	Phone#

1. Are you familiar with the term "smart city concept" before? If yes, please explain your understanding of the concept.

2. As discussed in operational definition.
   - *Smart city concept is an application of Internet of Things (IoT) and technology-based innovation in the planning, development, and operation of cities for urban forms and environment management strategies.*
   - *The term smart city coined for the cities in application of complex information systems to integrate the operation of urban infrastructure and services such as buildings, transportation, electrical and water distribution, and public safety.*

3. Do you believe a smart city concept could benefits Addis Ababa, mainly lebu area? How much you rate your confidentiality out of 5 ? 1 2 3 4 5

4. Do you think our economy status could be challenging factor to adopt smart city concept in Addis Ababa? How? How much you grade degree of economy challenge to adopt the concept out of 5?
   1 2 3 4 5

5. To make Addis Ababa smart city, on which domains (mobility, environmental sustainability, improving good governance, improving citizens life standard or on upgrading citizens knowledge and skill (people)? Why? How? based on their significance score out of 5; how you order them? (you can evaluate by the same score) mobility (__) environment (__) governance (__) living (__) people (__)

6. If you have any additional comments or suggestions related to the development of a smart city in Addis Ababa mainly lebu area?

Appendix 3: Site photos