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Article

Fostering inter-sectorial integration: Legal and policy framework for physical infrastructure in Addis Ababa, Ethiopia

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Abstract: The rapid urbanization of Addis Ababa presents significant challenges and opportunities in coordinating the development of physical infrastructure. This study investigates the legal and policy framework for inter-sectorial integration across critical domains such as electricity, roadways, telecommunications, and water management. Drawing on Institutional Theory and policy integration theory, the research employs a comprehensive methodological approach, including documentary analysis, key informant interviews, focus group discussions, and observational studies. Through meticulous examination of existing laws, regulations, and institutional structures, the study identifies critical gaps and limitations that impede effective coordination among infrastructure-providing entities. Findings reveal the pressing need for cohesive policies, institutional reforms, and enhanced collaboration to mitigate disruptions and advance sustainable development goals. By situating these findings within the broader discourse on urban infrastructure governance, the research offers valuable insights into the intricate dynamics of infrastructure coordination in rapidly expanding cities. The study underscores the necessity for strategic interventions that promote efficient, environmentally sustainable, and economically viable infrastructure provision. Moreover, the implications of this research extend beyond academia, providing actionable policy and practice recommendations that can inform decision-making processes in Addis Ababa and analogous urban contexts worldwide. This holistic approach facilitates a nuanced understanding of the complex interplay between legal frameworks, policy dynamics, and institutional arrangements, thereby laying a robust foundation for informed decision-making and strategic interventions in urban infrastructure development.

Keywords: Addis Ababa; electricity; infrastructure coordination; institutional theory; road, water infrastructure coordination

1. Introduction

The integration of physical infrastructure across various sectors is fundamental to sustainable urban development, ensuring the efficient delivery of essential services and improving the quality of life for residents (Alemu and Lauterbach, 2019; UNEP, 2019). Legal and policy frameworks are pivotal in shaping the dynamics of infrastructural integration, offering the regulatory scaffolding necessary to harmonize disparate sectoral interests and foster collaboration among stakeholders (Brooks, 2019). Effective coordination among sectors such as electricity, roadways, telecommunications, and water management are crucial for optimizing resource use, reducing redundancies, and enhancing service delivery (United Nations, 2020; World Bank, 2021). Legal and policy frameworks provide enforceable regulations

and strategic guidelines that ensure coordinated planning, implementation, and management across these sectors (Gelan and Girma, 2021; Keita and Kourouma, 2023; Molla et al., 2019; Perveen et al., 2017; World Bank, 2022).

The terms "legal framework" and "policy framework" are often used interchangeably but refer to different aspects of governance and regulation. A legal framework consists of laws and regulations that provide a formal structure for governing activities and relationships within a society (Keita and Kourouma, 2023). This framework is established through legislative processes and is enforceable by judicial bodies (World Bank, 2022). It sets out rights, responsibilities, and standards of conduct for individuals and organizations. Conversely, a policy framework refers to the guidelines, strategies, and plans developed by governments or organizations to achieve specific objectives (Angel, 2023; El-Bouayady and Radoine, 2023; Gelan and Girma, 2021; Keita and Kourouma, 2023; Molla et al., 2019; World Bank, 2022). Policies are often shaped by the legal framework but are more flexible and can be adjusted or updated more easily.

Infrastructure integration is increasingly important for sustainable urbanization (Koetter et al., 2021). The rise of "smart city" development concepts emphasizes the need for networked infrastructure systems that encompass digital communications, energy, transportation, water, and waste management (Thacker, 2015). Recognizing the significance of robust physical infrastructure is key to enhancing the sustainability and economic growth of urban areas (Dodgson and Gann, 2011; Guidotti et al., 2019; Timilsina et al., 2021).

In this research, urban infrastructure integration refers to aligning and connecting various physical infrastructure systems (such as transportation, energy, water, telecommunication) and their associated policies, regulations, and management practices. It involves ensuring that different sectors work together efficiently to enhance service delivery, resilience, and sustainability in urban areas (UNECE, 2020). Urban physical integration, in turn, necessitates policy integration (Bera, 2020; El-Bouayady and Radoine, 2023; Gelan and Girma, 2021; Mantzavinos, 2012; Mirzayev, 2024; Molla et al., 2019). Policy integration aims to align and integrate policies across different sectors (e.g., water, energy, road, environment) to achieve cohesive and sustainable urban development outcomes. It seeks to overcome sectoral silos, enhance synergies, and address interconnected challenges such as climate change, urbanization, and resource management (Huitema et al., 2009).

Urban physical infrastructure integration plays a crucial role in facilitating the effective delivery of goods and services, promoting prosperity and growth, and enhancing quality of life (Yilema, 2019). There is a growing consensus that various forms of infrastructure integration have the potential to make networks smarter, more cost-effective, and environmentally friendly (Esubalew, 2017; McLean, 2017). Scholars categorize infrastructure integration into five distinct forms: organizational integration, technological integration, sectoral integration, geographic integration, and social integration (Bobylev and Jefferson, 2014; Esubalew et al., 2017; McLean, 2017; Sánchez et al., 2013).

The integration process can be described in six distinct phases: planning, organization, execution, monitoring, evaluation, and feedback (Arts et al., 2016; Yilema and Gianoli, 2018). Each phase involves specific actions, timing, sequencing,

and resource allocation, with tasks developed, authority and responsibility chains established, and various components influenced by different factors throughout the process (Amin, 2014; Yilema, 2019; Yilema and Gianoli, 2018).

Policy Integration Theory examines the coherence among infrastructure sectors, uncovering the complexities of planning and implementation and shedding light on potential synergies or conflicts (Arts et al., 2016; Derrible, 2017). Bureaucracy Theory interprets findings related to the bureaucratic structures and processes governing infrastructure development (Pandit et al., 2017). Institutional theory emphasizes the importance of understanding the institutional context and its influence on actors' behavior and decision-making (Desalegn and Solomon, 2020; Kassahun and Tiwari, 2012; Yilema and Gianoli, 2018). Networks theory analyzes the structure and dynamics of networks connecting different infrastructure systems (Bogale, 2005; Espada et al., 2015; Rode et al., 2020; Singletary et al., 2003). Stakeholder theory studies the practices and challenges of infrastructure integration, highlighting the need for collaboration among various stakeholders, including government agencies, private companies, and communities (Eskerod and Huemann, 2013; Esubalew et al., 2017; Singletary et al., 2003). System theory identifies the components of infrastructure systems, their interrelationships, and how they function together (Desalegn and Solomon, 2020; Rajabalinejad et al., 2020; Rode et al., 2020).

Developed nations exhibit stronger organizational, sectoral, institutional, geographical, and technical integration compared to developing countries (Mukwaya and Mold, 2018). Best practices in infrastructure integration can be observed in cities such as those in China, India, and Japan in Asia (Abiad and Teipelke, 2017; Ide et al., 2014; Kumar and Meshram, 2022; Porter and Roach, 1996), as well as in Scandinavian countries and Western European nations like Germany and the UK (Desta and Sertse, 2015; McLean, 2017). In South America, Brazil stands out (Amin, 2014), while Kenya serves as an exemplary country in Africa with soundly integrated urban infrastructure systems (Mwaniki, 2017).

Despite ongoing government initiatives aimed at enhancing infrastructure networks in Sub-Saharan Africa, the region continues to face significant deficiencies, with overall progress lagging (Azolibe and Okonkwo, 2020; Deen-Swarray et al., 2014). In delivering urban infrastructure services, Ethiopia, as part of this region, faces limitations in infrastructure availability concerning both quantity and quality (Calderon et al., 2018). The four key sectors—electricity, road, telecom, and water—operate independently with their own planning, implementation, and evaluation frameworks (Calderon et al., 2018). Discussions and sharing of techniques and designs occur only after the preparation phase and are initiated exclusively upon request, following a reactive rather than proactive approach (Yilema and Gianoli, 2018).

In Addis Ababa, electricity interruptions are commonly associated with road construction sites. Pedestrian roads are often dismantled to accommodate the installation of electricity, water, sewerage, or telecom infrastructures. However, modern city visions prominently feature uninterrupted infrastructure networks that operate beyond conventional sector borders (Kumar and Meshram, 2022; Salamagy et al., 2023).

This research aims to investigate the legal and policy framework governing the inter-sectorial integration of physical infrastructure in Addis Ababa. By critically examining the regulatory landscape and policy initiatives, this study seeks to unravel the complexities and nuances inherent in aligning diverse sectoral interests. The primary objective is to identify key drivers and barriers to infrastructural integration, focusing on understanding the role of legal mechanisms and policy instruments in shaping collaborative efforts among sectors. Specifically, the research examines how the electricity, roadways, telecommunications, and water management sectors coordinate during the planning, implementation, and assessment stages of infrastructure projects.

To address the research problem, this study addresses the following research questions: What are the existing legal and policy frameworks governing infrastructure integration in Addis Ababa? What are the main challenges and barriers to effective inter-sectorial integration? How do legal mechanisms and policy instruments influence collaboration among infrastructure sectors? What strategies can be recommended to enhance inter-sectorial coordination and promote sustainable urban development?

The theoretical framework for this study draws on Institutional Theory and Policy Integration Theory, providing a lens to analyze the interactions between legal frameworks, policy dynamics, and institutional arrangements (Howlett and Rayner, 2007; North, 1990). Empirically, the research utilizes documentary analysis, key informant interviews, focus group discussions, and observational studies to gather comprehensive data. This approach facilitates a nuanced understanding of the interplay between regulatory structures and practical coordination efforts.

Following this introduction, Section 2 reviews the theoretical and empirical literature on inter-sectorial integration and legal and policy frameworks for infrastructure. Section 3 outlines the research methodology, including data collection and analysis techniques. Section 4 presents the findings and discusses key drivers and barriers to infrastructural integration in Addis Ababa. Section 5 provides actionable recommendations and strategies for improving inter-sectorial coordination. Finally, Section 6 concludes the paper by summarizing main insights and suggesting areas for future research.

2. Literature review

2.1. Theoretical literature review

Urban infrastructure governance is fundamentally shaped by theoretical frameworks that explain how institutions, policies, and actors interact to manage and develop urban infrastructure systems (Gelan and Girma, 2021). This section explores key theoretical perspectives relevant to understanding urban infrastructure governance.

2.1.1. Institutional theory

Institutional Theory provides a lens through which to examine how formal and informal rules, norms, and organizational behaviors shape the governance of urban infrastructure (North, 1990). Institutions are viewed as stable structures that

influence the choices and actions of individuals and organizations within a given context (DiMaggio and Powell, 1983). In the context of urban infrastructure, institutions include government agencies, regulatory bodies, private sector actors, and civil society organizations involved in planning, financing, and delivering infrastructure services.

The theory emphasizes the importance of institutional arrangements and their impact on policy implementation and infrastructure development outcomes (Mantzavinos, 2012). For instance, variations in institutional capacity, regulatory frameworks, and administrative practices can significantly affect the efficiency and effectiveness of infrastructure provision (North, 1990; Thelen, 1999).

Thus, the institutional theory helps in analyzing the broader institutional contexts within which urban infrastructure governance operates. This includes examining the legal frameworks, regulatory structures, and administrative practices that govern infrastructure planning, financing, and implementation in urban settings. For instance, in Addis Ababa, understanding the institutional landscape involves studying the roles and interactions of government agencies, regulatory bodies, private sector entities, and community organizations involved in infrastructure projects.

2.1.2. Policy integration theory

Policy Integration Theory focuses on the processes through which policies from different sectors are coordinated and aligned to achieve common objectives (Howlett and Rayner, 2007). In urban infrastructure governance, this theory highlights the challenges and opportunities associated with integrating policies across sectors such as transportation, water management, energy, and telecommunications.

The theory emphasizes the need for coherent policy frameworks that facilitate collaboration among diverse stakeholders and promote sustainable development outcomes (Klijn and Koppenjan, 2016). Effective policy integration requires overcoming sectoral silos, fostering inter-agency coordination, and aligning goals and incentives across governmental and non-governmental actors involved in infrastructure planning and management.

2.1.3. Network governance

Network Governance theory posits that governance processes in complex policy domains, such as urban infrastructure, are characterized by interdependent networks of public and private actors (Kickert et al., 1997). These networks operate through collaborative arrangements rather than hierarchical control, facilitating adaptive responses to dynamic urban challenges.

In urban infrastructure networks, relationships among stakeholders are critical for mobilizing resources, sharing information, and fostering consensus on policy decisions (Provan and Kenis, 2008). Network governance frameworks emphasize the importance of trust, communication, and mutual dependence among network participants in achieving collective goals related to infrastructure development and management.

2.1.4. Bureaucracy theory

Bureaucracy theory, pioneered by Max Weber, provides a foundational

framework for understanding organizational structures and administrative processes within bureaucratic settings (Weber, 1946). According to Weber, bureaucracies are characterized by hierarchical authority structures, division of labor, formalized rules and procedures, and impersonal relationships. These elements are designed to achieve efficiency, predictability, and rational decision-making in organizations (Gouldner, 1954).

In the context of urban infrastructure governance, bureaucracy theory helps analyze how bureaucratic principles influence policy implementation and service delivery in cities like Addis Ababa. For example, municipal government agencies responsible for infrastructure planning and management often operate within bureaucratic frameworks that dictate decision-making processes and resource allocation (Niskanen, 1971). Studying these bureaucratic structures reveals their impact on project timelines, budgetary constraints, and the quality of infrastructure services provided to urban residents.

In conclusion, bureaucracy theory offers valuable insights into the organizational dynamics and administrative practices that shape urban infrastructure governance. By understanding these bureaucratic mechanisms, policymakers and urban planners can better navigate the complexities of infrastructure development, enhance operational efficiency, and improve service delivery outcomes in cities like Addis Ababa.

2.1.5. Stakeholder theory

Stakeholder theory focuses on the relationships and interactions between organizations and their stakeholders, emphasizing the importance of considering the interests, needs, and expectations of all affected parties (Freeman, 1984). In the context of urban infrastructure governance, Stakeholder Theory provides a framework for understanding how diverse stakeholders, including government entities, private sector firms, community groups, and citizens, influence and are influenced by infrastructure development and management decisions.

According to the stakeholder theory, stakeholders are individuals or groups who have a stake in or are affected by the outcomes of an organization's actions (Mitchell et al., 1997). In urban infrastructure projects, stakeholders can include government officials responsible for policy-making, investors providing funding for projects, contractors executing construction, local communities impacted by infrastructure changes, and environmental groups concerned with sustainability impacts (Clarkson, 1995).

In conclusion, the stakeholder theory offers valuable insights into the complexities of urban infrastructure governance by emphasizing the role of stakeholders in shaping policy outcomes, project implementation strategies, and community impacts. By adopting a stakeholder-oriented approach, urban planners and policymakers can enhance project sustainability, improve governance legitimacy, and foster resilience in urban infrastructure development.

2.2. Empirical literature review

Empirical studies across various theoretical frameworks provide insights into urban infrastructure governance, focusing on organizational dynamics, policy

integration, network governance, bureaucratic processes, and stakeholder engagement.

Institutional theory is applied to analyze the formal and informal rules, norms, and regulatory frameworks shaping urban infrastructure governance. Research by Scott (2014) discusses how institutional structures influence policy stability and change, highlighting the role of legal frameworks and institutional arrangements in governing infrastructure development.

Policy integration theory examines how different policy domains interact and intersect within urban governance frameworks. For example, studies by Huitema et al. (2011) explore policy integration in environmental governance contexts, emphasizing the challenges and opportunities of integrating infrastructure policies across sectors such as transportation, energy, and water management.

Network governance focuses on collaborative arrangements and partnerships among diverse stakeholders in infrastructure decision-making. Research by Ansell and Gash (2008) discusses network governance models in urban settings, illustrating how collaborative networks facilitate information sharing, resource mobilization, and consensus-building among governmental agencies, private sector actors, and community organizations.

Empirical research applying bureaucracy theory in urban settings underscores both the strengths and challenges of bureaucratic governance. Research highlights bureaucratic efficiency in managing large-scale infrastructure projects and ensuring compliance with regulatory standards (Eisenstadt, 1956). However, it also identifies bureaucratic inefficiencies such as administrative red tape, slow responsiveness to citizen needs, and barriers to innovation and flexibility in adapting to changing urban demands (Thompson, 2003).

Stakeholder theory emphasizes the importance of considering stakeholder interests and engagement in infrastructure governance. Clarkson (1995) and Gray et al. (2015) discuss stakeholder management strategies and the impact of stakeholder inclusiveness on infrastructure project outcomes, highlighting the role of stakeholders in influencing decision-making and governance legitimacy. Empirical research applying stakeholder theory in urban contexts highlights its utility in identifying and managing stakeholder interests and expectations throughout the infrastructure lifecycle. For example, studies show that engaging stakeholders early and transparently in decision-making processes can enhance project acceptance, mitigate opposition, and foster collaborative governance approaches (Gray et al., 2015). Stakeholder Theory also emphasizes the importance of balancing conflicting stakeholder interests, ensuring equitable distribution of benefits, and promoting inclusive decision-making that considers diverse perspectives (Donaldson and Preston, 1995).

These empirical studies contribute to understanding the complexities of urban infrastructure governance, providing insights into how theoretical frameworks such as Institutional Theory, Policy Integration Theory, Network Governance, Bureaucracy Theory, and Stakeholder Theory inform policy development, organizational practices, and stakeholder engagement strategies in urban contexts.

2.3. Literature gaps

Despite the extensive application of Institutional Theory in understanding urban infrastructure governance, there remains a significant gap in the examination of how informal institutions and social norms specifically influence infrastructure development in rapidly urbanizing contexts such as Addis Ababa. While much of the literature, such as the works by North (1990) and DiMaggio and Powell (1983), focuses on formal institutional structures, the role of informal institutions and their interplay with formal rules is less explored. This gap is particularly pertinent in contexts where informal practices often fill the voids left by weak formal institutions, affecting the efficiency and outcomes of urban infrastructure projects. This study aims to bridge this gap by providing an in-depth analysis of both formal and informal institutional influences on infrastructure governance in Addis Ababa, thereby offering a more holistic understanding of institutional dynamics in such settings.

Policy Integration Theory has been widely discussed in the context of urban infrastructure governance, with scholars like Howlett and Rayner (2007) and Klijn and Koppenjan (2016) highlighting the importance of coherent policy frameworks. However, empirical studies on policy integration often overlook the specific mechanisms and processes through which policy coherence can be achieved in multi-level governance structures, especially in developing countries. There is a need for more nuanced research that explores how different levels of government—local, regional, and national—coordinate policies and how such coordination affects infrastructure development outcomes. This study addresses this limitation by examining the vertical and horizontal policy integration processes in Addis Ababa's infrastructure governance, identifying the barriers to effective integration, and proposing strategies to overcome these challenges.

Network Governance Theory has provided valuable insights into the collaborative nature of urban infrastructure governance, emphasizing the role of interdependent networks of public and private actors (Kickert et al., 1997; Provan and Kenis, 2008). However, there is a paucity of research that investigates the effectiveness of these networks in environments characterized by limited resources and high political instability, as is often the case in many African cities. Existing studies tend to focus on well-resourced, stable environments, leaving a gap in understanding how network governance operates under more challenging conditions. This study seeks to fill this gap by exploring the network governance dynamics in Addis Ababa, assessing how resource constraints and political factors influence network functionality and infrastructure outcomes. By doing so, the research will contribute to a more comprehensive understanding of network governance in diverse urban contexts.

2.4. The study sector context

As illustrated in **Figure 1** below, the study sectors are regulatory and controlling bodies (AAIICWPCA and Plan Commission and the hard sectors (electric, road, telecom, and water).

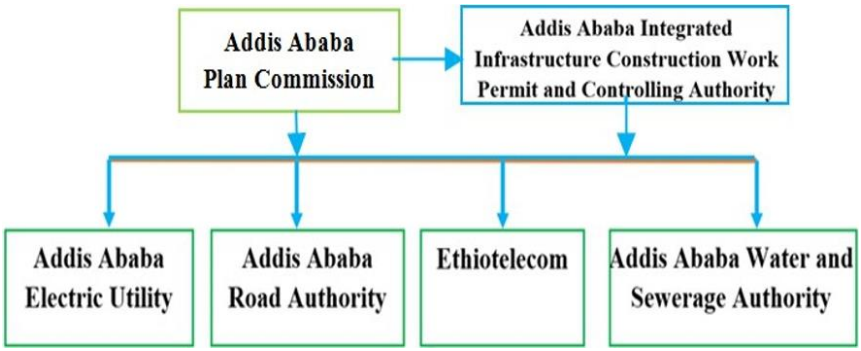

Figure 1. Organizational arrangement of the case of institutions of the coordinating office.
Source: AAIICWPCA, 2023.

2.4.1. Addis Ababa city plan commission

The Addis Ababa City Plan Commission was established with the emergence of Addis Ababa City (1886). It is an institution tasked with developing and revising the city plan, including the integrated infrastructure development plan. The Commission holds responsibility for preparing and monitoring the master plan of the city and the road network plan, acting as frameworks that guide the infrastructure-providing institutions involved in the case. These institutions are required to seek confirmation of their independent plans from the commission before proceeding with their work. However, it was noted that in some instances, these infrastructure-providing institutions proceed to execute and maintain their infrastructures without obtaining confirmation of their plans from the grand plan and the city's road network plan. In the event of such deviations, there is a lack of legal background empowering the institution to accuse these institutions and hold them accountable for their actions.

2.4.2. Addis Ababa Integrated Infrastructure Construction Work Permit and Controlling Authority (AAIICWPCA)

The Addis Ababa Integrated Infrastructure Construction Work Permit and Controlling Authority (AAIICWPCA) was established in 2020 under the Federal Integrated Infrastructure Development Coordinating Agency, AAIICWPCA serves as both a regulatory and coordinating agency, overseeing infrastructure-providing institutions to operate in an integrated approach. It underwent reorganization in 2022 through Proclamation No. 74/2022, with responsibilities that encompass enforcing transparency and accountability in design, contract content, and management, as well as in construction quality and control across the specified sectors, Addis Ababa Municipality Electric Utility, Road Authority, Ethio telecom, and Water and Sewerage Authority.

2.4.3. Electric utility and power infrastructure in Addis Ababa

Electricity was first introduced to Ethiopia in approximately 1898 during Emperor Menilik's era when the German government presented a generator as a gift to supply electricity for lighting services to his palace. Presently, Addis Ababa city consumes 40%–50% of the country's electric energy from its national grid. Currently, to cater to utility services, four districts and 30 service provisions operate, serving a total of 929,050 customers. According to the Master Plan study in 2021 by the

Ministry of Water Irrigation and Electricity (MoWIE), the total circuit length for electricity covers 13,006 km (MoWIE, 2016).

2.4.4. Road infrastructure in Addis Ababa

The modernization of Addis Ababa's Road development began during the reign of Emperor Menelik and Empress Taitu in 1886 with the construction of a road from Addis Ababa to Addis Alem (Seife, 2019). As of the 2020 road inventory, Addis Ababa's Road network spans a total of 4871 km, encompassing both asphalt and cobblestone types. Specifically, 2616 km (44%) of the city's roads are surfaced with asphalt. The planning and implementation of much of the road expansion and maintenance initiatives are overseen by the Addis Ababa City Roads Authority (AAPDCo, 2019). Approximately 15.5% of the budget is allocated for road development and border enforcement issues. The Addis Ababa Road sector report (2021) outlines the transport sector's 10-year perspective plan, focusing on six main objectives: providing an integrated, equitable, and accessible transport infrastructure; ensuring safe transportation services; ensuring integrated, fair, and accessible transport service; establishing efficient and reliable logistics services; establishing a transport infrastructure and service resilient to climate change; and increasing the sector's implementation capacity and effectiveness (Gebre, 2021).

2.4.5. Telecom infrastructure in Addis Ababa

Telecommunication in Ethiopia has a rich history dating back to 1894, with a significant reorganization of the Telephone, Telegraph, and Postal services occurring in 1941. The Ethiopian Telecommunication Corporation (ETC) is the key sector responsible for providing telecom infrastructure in Addis Ababa. As the oldest public telecommunications operator in Africa, ETC played a crucial role in integrating Ethiopian society by implementing an extensive open-wire line system that connected the capital with critical administrative cities across the country. After the destruction of the telecommunication network during the war against Italy, Ethiopia reorganized its communication services in 1941. Ethiopian Telecommunication Corporation (ETC) offers a range of telecommunication services encompassing fixed-line telephony, mobile telephony, and Internet and multimedia services. The corporation employs various technologies such as satellites, digital radio multi-access systems (DRMAS), Very Small Aperture Terminal (VSAT), Ultra High Frequency (UHF), Very High Frequency (VHF), extensive line, and high-frequency (HF) radio networks, as detailed in the ETC annual report of 2020. ETC extends different Internet services, including dial-up, leased line, and shared DSL Internet services, catering to government organizations, private and commercial companies, international institutions, and individuals. Broadband Internet services utilize technologies like asymmetric digital subscriber lines (DSLs) and fixed wireless access (FWA), among others, as outlined in the ETC annual report of 2020 (Ethio Telecom, 2018; Gebre, 2021).

2.4.6. Water/Sewage infrastructure in Addis Ababa

The inception of piped water in Addis Ababa dates to Emperor Menilik around the end of the 19th century (1900). This historical progression led to the establishment of a modern water service in 1924, marked by the creation of a water

department within the municipality of Addis Ababa in the 1940s and the completion of the Gefersa dam and centralized distribution network in 1944. In response to the growing water demand of the city, the construction of an additional centralized water supply dam at Legedadi, equipped with a treatment facility, commenced in the 1970s. The Addis Ababa Water Supply and Sewerage Authority (AAWSA) was officially founded in 1971. Over time, the city's water supply system evolved from small-scale springs at the foot of Entoto Mountain and manually dug wells to a more sophisticated centralized "modern" water supply system. To meet increasing demand, deep subsurface boreholes and surface water sources are now utilized, achieving a coverage of 76.6%, as reported by the AA Green Development Office in 2021 (AAWSA, 2021; Mulugeta, 2011).

Presently, Addis Ababa sources its water supply from three surface water sources: Gefersa, Legedadi, and Dire dams in the Oromia regional state, along with groundwater sources from the Akaki well fields and small boreholes situated across the city. The total water supply capacity is 580,000 m^3 per day, while the city's demand is 1.1 million m^3 per day. Approximately 450,000 m^3 of water per day is produced from surface and groundwater, with an estimated 36.5% wastage due to leakage and other system inefficiencies. The anticipated per capita distribution stands at around 40 L/day, falling significantly below the city's target of 110 L/day from the Gefersa dam and 195,000 m^3 per day from the Legadadi and Dire dams. The remaining supply is sourced from groundwater, including 70,000 m^3 per day from the Akaki aquifer, as reported by the Addis Ababa Green Development Office on December August 2021 (AAWSA, 2021).

3. Materials and methods

3.1. Description of the study area

Addis Ababa, one of the most populous cities in Africa, has an estimated population of 6.5 million and covers an area of 540 km^2. Founded in 1886 by Menelik II and Empress Taitu Betul, it grew from a settlement of approximately 15,000 people in 1888 to its current size (Addis Ababa Municipality, 2021; Weldeghebrael, 2021). Despite this significant growth, the city's annual growth rate has declined from 6.9% in the early 1960s to 2% between 2007 and 2013.

Addis Ababa is a key city for Ethiopia and Africa, hosting the African Union, the UN Economic Commission for Africa, and several diplomatic missions, making it the third most important diplomatic city in the world, after New York and Geneva. The city is divided into 11 sub-cities and 121 districts (**Figure 2** shows the location of Addis Ababa within Ethiopia). Its prominence is evident in Ethiopia's historical, political, economic, and diplomatic arenas. According to the city's resilience strategy document, it stands at 2300 m above sea level and is located at coordinates 9°1′48″ N and 38°44′24″ E, surrounded by the Oromia regional state.

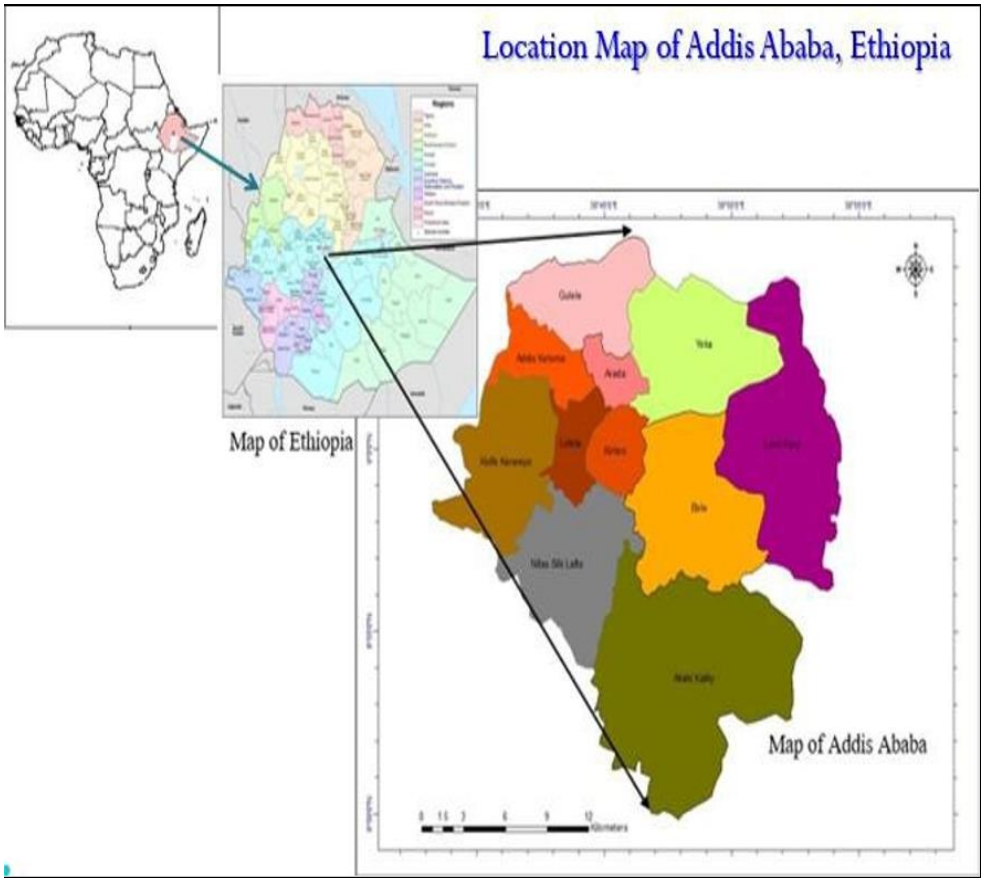

Figure 2. Location map of Addis Ababa, Ethiopia.
Source: Ababa City Administration and ERA (2024).

Economically, Addis Ababa is vital, contributing 30% of Ethiopia's urban GDP and 68% of urban jobs (Tsegay, 2018). Politically and symbolically, it holds great significance as the country's capital and largest metropolis. According to the Ethiopian constitution, Addis Ababa is a self-governing city reporting directly to the central government.

Addis Ababa was chosen as the study location due to its unique and critical role as Ethiopia's capital and largest city, serving as the country's political, economic, and diplomatic hub. With a population of 6.5 million and a rich history of rapid urban development, Addis Ababa exemplifies the challenges and opportunities of infrastructure integration in a rapidly growing metropolis. Its status as a self-governing city with direct reporting to the central government, coupled with its significance as the headquarters of the African Union and UN Economic Commission for Africa, provides a diverse and dynamic context for examining urban infrastructure governance. The city's historical development of infrastructure, from road construction in the late 19th century to modern utilities and telecommunications, offers a comprehensive case for exploring the complexities of inter-sectoral collaboration and the impact of legal and policy frameworks on sustainable urban development.

3.2. Population and sampling frame

The target population for this research consisted of Chief Executive Officers,

General Managers, Senior Experts, Division Leaders, and Directors from the infrastructure-providing institutions. These individuals were selected as key informants, as they possessed an elevated level of knowledge related to the study's focus. Their extensive experience in each study sector provided valuable insights into the issue under examination, including comprehensive information about the sectorial integration bylaws and frameworks.

We have conducted a total of 32 Key Informant Interviews (KIIs), although the original plan was to conduct sixty interviews. It was because the data was saturated at 32 KIIs, with the following distribution per institution. The researcher initially began the Key Informant Interviews (KIIs) by conducting interviews with participants from Addis Ababa Electric Utility and Electric Power. Subsequently, the interviews extended to Addis Ababa Road Authority, Ethio Telecom, and Addis Ababa Water Sewerage Authority in a sequential manner as listed. The second phase of interviews revisited these sectors, maintaining the same order. This systematic approach was consistently applied by the researcher, leading to a saturation point in the data collection process.

In addition, three Focus Group Discussion (FGD) sessions were conducted, involving a total of thirty-one participants from various groups (forum) community committee members, electric, water, and road workers, and traffic management volunteers. Notably, the telecom sector lacked a customer representative. These sessions were aimed at eliciting their experiences concerning infrastructure provision scenarios and instances of one institution demolishing the infrastructure of another.

3.3. Data types and sources

3.3.1. Secondary data

The secondary data analysis phase involved the review and analysis of existing legal documents, policy documents, and scholarly literature pertaining to urban development, infrastructure governance, and inter-sectorial collaboration in Addis Ababa. Legal documents included national laws, regulations, and municipal bylaws relevant to infrastructure planning and governance. Policy documents encompass urban development strategies, sectoral policies, and institutional frameworks governing infrastructure management. The scholarly literature review encompassed peer-reviewed articles, books, and reports from reputable organizations focusing on urban studies, governance, and infrastructure development in Ethiopia.

3.3.2. Primary data

Semi-structured interviews were conducted with key stakeholders involved in infrastructure planning, implementation, and governance in Addis Ababa. Participants included government officials from relevant se sectoral offices and agencies, representatives from municipal authorities, urban planners, infrastructure developers, and civil society organizations. The interview questions were designed to explore participants' perspectives on the legal and policy framework for inter-sectorial integration of physical infrastructure, including challenges, opportunities, and strategies for improvement.

Case studies were conducted to complement the interview data and provide in-depth insights into specific infrastructure projects and initiatives in Addis Ababa. The selection of case studies was based on their relevance to the research objectives and their potential to illustrate key themes related to inter-sectorial integration and governance. Data for the case studies were collected through document analysis, site visits, and interviews with project stakeholders.

3.4. Data analysis

3.4.1. Secondary data analysis

The qualitative analysis of legal documents, policy frameworks, and literature involved thematic coding and content analysis. Key themes and patterns related to the legal and policy framework for infrastructure integration were identified and analyzed to gain a comprehensive understanding of the regulatory landscape and policy dynamics in Addis Ababa.

3.4.2. Primary data analysis

The data from semi-structured interviews and case studies were analyzed using thematic coding and qualitative content analysis techniques. Transcripts of interviews were coded and categorized based on recurring themes and patterns related to the research objectives. Similarly, data from case studies were analyzed to identify key issues, challenges, and strategies related to inter-sectorial integration of physical infrastructure in Addis Ababa.

Overall, the mixed-methods approach employed in this research allowed for a comprehensive examination of the legal and policy framework for inter-sectorial integration of physical infrastructure in Addis Ababa, Ethiopia. Through qualitative analysis of legal documents, policy frameworks, and literature, supplemented by empirical examination through semi-structured interviews and case studies, this study generated valuable insights into the regulatory landscape, challenges, and opportunities for improving infrastructure governance and promoting sustainable urban development.

4. Results and discussions

4.1. Challenges in infrastructure coordination

The challenges in coordinating infrastructure projects in Addis Ababa are a direct consequence of the city's rapid urbanization and escalating demand for various infrastructure services. As highlighted by Rode et al. (2020) and Mukwaya and Mold (2018), rapid urban growth often leads to competing infrastructure demands that outpace the capacity for effective coordination among agencies. This misalignment results in overlapping projects and inefficiencies, a phenomenon observed in many fast-growing cities around the world.

The fragmented nature of infrastructure planning exacerbates these challenges. Various government bodies and private entities, each with distinct mandates and operational silos, handle different facets of infrastructure development. This fragmentation often leads to a lack of cohesive strategy and execution. For example, overlapping construction projects in Addis Ababa have been known to cause

significant traffic congestion and environmental degradation. Such findings are consistent with global studies on urban infrastructure, which emphasize how isolated project execution can undermine overall urban efficiency and livability (Guma, 2020; Rode et al., 2020).

From a theoretical perspective, these findings resonate with the concepts of fragmented governance and institutional inertia. Theories on urban governance suggest that fragmented institutions with overlapping jurisdictions often struggle with coordination, leading to inefficiencies and service disruptions (Pierre and Peters, 2000). This fragmentation, as observed in Addis Ababa, supports the hypothesis that without integrated planning mechanisms, urban infrastructure projects may suffer from disorganization and poor implementation (Mukwaya and Mold, 2018).

Addressing these coordination challenges requires a shift towards integrated planning frameworks and improved institutional mechanisms. As Rode et al. (2020) argue, fostering stakeholder collaboration and enhancing transparency are essential for effective urban infrastructure management. This aligns with network governance theory, which emphasizes the importance of cooperative relationships and shared resources in overcoming coordination problems (Jessop, 2002).

4.2. Legal and policy framework for sectoral coordination

The assessment of Addis Ababa's legal and policy framework for sectoral coordination reveals several critical gaps that hinder effective infrastructure governance. Despite the presence of various laws and regulations, there is a notable absence of comprehensive legislation specifically addressing infrastructure integration. This gap leads to fragmented decision-making processes and competing interests among stakeholders, a situation commonly documented in urban governance studies (Rode et al., 2020).

The lack of enforceable mechanisms within existing policy initiatives, such as the Integrated Urban Infrastructure FDRE (2016), further complicates coordination efforts. These frameworks offer broad visions for sustainable development but fail to provide the necessary regulatory structures to ensure their implementation (Guma, 2020). The theoretical framework of policy integration theory underscores the importance of binding regulations and effective enforcement mechanisms to achieve integrated governance (Howlett and Ramesh, 2003). The findings in Addis Ababa demonstrate how the absence of such mechanisms can undermine the effectiveness of policy frameworks.

4.3. Institutional challenges and coordination gaps

Field observations and document reviews reveal substantial institutional challenges and coordination gaps contributing to infrastructure inefficiencies in Addis Ababa. The absence of structured accountability systems and compensation measures for infrastructure damage perpetuates these challenges. Such findings align with the concept of bureaucratic inefficiency**,** where institutional inertia and jurisdictional overlaps complicate coordination and project delivery (Guma, 2020; Miller, 2005).

The lack of an integrated legal and policy framework allows institutions to operate independently, often without considering the broader implications of their actions. This results in duplicated efforts, resource wastage, and avoidable damage to existing infrastructure, echoing the concerns raised by Wei et al. (2019). The findings align with institutional theory, which posits that fragmented and overlapping institutional arrangements can lead to inefficiencies and coordination problems (North, 1990).

Efforts to address these challenges, such as the establishment of the Addis Ababa Integrated Infrastructure Coordinating Working Procedure Coordination Agency (AAIICWPCA), show promise but face limitations due to the absence of enforceable mechanisms (Guma, 2020). This situation highlights the importance of network governance theory, which advocates for multi-stakeholder initiatives and collaborative frameworks to overcome institutional barriers (Jessop, 2002). The need for coordinated efforts and policy reforms to enhance accountability and integration in infrastructure governance is crucial for addressing the identified gaps.

5. Summary, conclusions and future research directions

5.1. Summary

This study examined the challenges and gaps in infrastructure coordination in Addis Ababa, highlighting the impacts of rapid urbanization and fragmented governance on infrastructure development. The rapid population growth and economic expansion in Addis Ababa have intensified the demand for infrastructure services, including roads, electricity, telecommunications, and water systems. The simultaneous development of these sectors often occurs in isolation, resulting in inefficient resource allocation, overlapping projects, and conflicting priorities. This fragmentation exacerbates the difficulties of coordinating infrastructure efforts and undermines overall urban efficiency (Mukwaya and Mold, 2018; Rode et al., 2020).

The findings reveal that the lack of a centralized mechanism for coordinating infrastructure projects leads to significant inefficiencies. Multiple government agencies and private entities operate with distinct mandates and budgets, resulting in disjointed planning and implementation.

The study also assessed the legal and policy framework for sectoral coordination in Addis Ababa, uncovering critical gaps and limitations. Despite the existence of various laws and regulations, there is a notable absence of comprehensive legislation specifically addressing infrastructure integration. The lack of enforceable mechanisms within existing policies, such as the Integrated Urban Infrastructure FDRE (2016), undermines efforts to promote collaboration and effective implementation.

Institutional challenges and coordination gaps further complicate infrastructure governance in Addis Ababa. The absence of structured accountability systems and compensation measures for infrastructure damage perpetuates inefficiencies and incentivizes detrimental activities. Bureaucratic inefficiencies, jurisdictional overlaps, and institutional inertia hinder timely and cost-effective project delivery (Rode et al., 2020). Efforts to address these issues, such as the establishment of the Addis Ababa Integrated Infrastructure Coordinating Working Procedure Coordination Agency

(AAIICWPCA), show promise but face limitations due to the absence of binding regulations and enforceable mechanisms (Guma, 2020).

5.2. Conclusions

The study highlights the critical need for improved infrastructure coordination in Addis Ababa to support sustainable urban development. The challenges identified reflect broader issues observed in rapidly growing cities worldwide, where fragmented governance structures and institutional inefficiencies undermine effective infrastructure management. The findings underscore the importance of adopting a holistic and integrated approach to infrastructure planning and implementation.

To address the challenges of infrastructure coordination, several key recommendations emerge from the study:

1) Integrated planning frameworks: Establishing a centralized mechanism for coordinating infrastructure projects is crucial. Integrated planning frameworks that align various stakeholders' efforts and synchronize development activities can mitigate the risks of overlapping projects and inefficient resource use. This approach aligns with network governance theory, which emphasizes the benefits of collaborative relationships and shared resources.
2) Strengthening legal and policy frameworks: Comprehensive legislation specifically addressing infrastructure integration is needed. The existing policies should be supplemented with binding regulations and enforceable mechanisms to ensure effective implementation. This recommendation is supported by policy integration theory, which stresses the importance of coherent regulatory frameworks in achieving integrated governance.
3) Enhancing institutional accountability: Developing structured accountability systems and compensation measures for infrastructure damage can address institutional challenges and improve coordination. These measures will help reduce bureaucratic inefficiencies and jurisdictional overlaps, ensuring timely and cost-effective project delivery.
4) Promoting stakeholder collaboration: Increased stakeholder engagement and transparency are essential for building trust and fostering effective collaboration. Multi-stakeholder initiatives and strategic partnerships can enhance coordination efforts and address the gaps identified in the study. This approach aligns with institutional theory, which highlights the role of collaborative governance in overcoming coordination problems (North, 1990).

In conclusion, improving infrastructure coordination in Addis Ababa requires a multifaceted approach involving integrated planning, strengthened legal frameworks, enhanced institutional accountability, and active stakeholder engagement. By addressing these areas, Addis Ababa can overcome the challenges of fragmented governance and achieve more efficient, sustainable, and equitable urban development. These recommendations not only address the research questions posed in the study but also contribute to filling existing literature gaps by providing practical insights and solutions for urban infrastructure management.

5.3. Future research directions

Future research directions may include examining the effectiveness of specific policy interventions and institutional reforms in addressing coordination challenges and enhancing infrastructure governance. Comparative studies between Addis Ababa and other cities could provide insights into the factors influencing infrastructure coordination outcomes and the transferability of governance models. Furthermore, research on stakeholder perceptions and engagement strategies could inform the development of more inclusive and participatory approaches to infrastructure planning and decision-making. Finally, longitudinal studies tracking the implementation of policy reforms and infrastructure projects could assess their long-term impacts on urban development and sustainability.

By addressing these research gaps, future studies can contribute to advancing knowledge on infrastructure governance and coordination, informing policy and practice interventions to promote sustainable urban development

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