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Infrastructure and modal integration as drivers of logistics system efficiency in developing countries: Evidence from Ethiopia

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Authors:
Dagmawit M. Bekele[1]
Intaher M. Ambe[2,3]

Affiliations:
[1]Department of Applied Management, College of Business and Management Sciences, University of South Africa – Ethiopia Regional Learning Centre, Addis Ababa, Ethiopia

[2]Department of Applied Management, College of Economic and Management Sciences, University of South Africa, Pretoria, South Africa

[3]Department of Business Administration, College of Business, Jackson State University, Jackson, Mississippi, United States of America

Corresponding author:
Dagmawit Bekele,
dagmawitb@africanunion.org

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Background: The relationship between infrastructure investment and logistics performance in emerging economies remains poorly understood, particularly as existing studies examine infrastructure and modal integration as separate concerns rather than an interconnected system.

Objectives: This study aimed to examine how infrastructure and modal integration jointly shaped logistics system performance in Ethiopia, and analyse the conditions under which infrastructure investments translated into efficiency gains.

Method: A qualitative research design was adopted, drawing on 10 key informant interviews and two focus group discussions with six participants each, conducted between 09 and 25 February, 2026. Participants were purposefully selected from public and private transport and logistics service providers. Data were analysed using thematic analysis following the six-phase framework.

Results: Three overarching themes were identified: (1) infrastructure adequacy and spatial distribution, characterised by spatially uneven development concentrated along specific corridors; (2) modal integration failure, marked by the absence of functional coordination across road, rail, and dry port systems; and (3) the infrastructure–integration–performance relationship, revealing that infrastructure investments yielded diminishing returns in the absence of system-wide coordination.

Conclusion: Infrastructure and modal integration functioned as interdependent components of logistics performance in Ethiopia. Extensive investment without coordinated, integrated systems produced limited and spatially uneven efficiency gains. The findings challenge infrastructure-led development strategies and support a system-oriented approach to logistics development in Ethiopia.

Contribution: This study contributed to the literature by providing empirical evidence on the conditionality of infrastructure returns in emerging economies and advancing a system-integration perspective on logistics hub development.

Keywords: logistics system; infrastructure; modal integration; system-oriented logistics; multimodal integration; emerging economies; Ethiopia.

Introduction

Global trade has grown increasingly dependent on the efficient functioning of logistics systems that seamlessly connect production centres, transport networks and markets (Rodrigue & Notteboom 2009:1). With this growth, logistics hubs have emerged as strategic nodes that consolidate cargo flows, integrate transport modes and provide value-added services, effectively forming the backbone of modern trade corridors. Well-developed hubs enhance supply chain coordination, lower transaction costs and strengthen regional and global connectivity, thereby improving trade performance (Notteboom, Pallis & Rodrigue 2022:9).

The growing complexity of global supply chains has intensified interest in logistics hub development, particularly among emerging economies seeking to improve trade competitiveness. For those economies, the efficient and seamless flow of goods and global connectivity are not only crucial for trade performance but also significantly contribute to their growing economies

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(Arvis et al. 2023:15). Logistics hubs now extend well beyond traditional port environments to include inland dry ports, multimodal logistics centres and corridor-based distribution platforms. This shift reflects a broader transformation in which infrastructure, technological innovation, institutional coordination and regional integration together shape logistics performance (Weerapong, Makprang & Singhdong 2026:9).

Logistics hub performance depends not only on the availability of infrastructure but also on how effectively transport modes and logistics functions are integrated within a coordinated system (Kurniawan 2024:219). Much of the existing literature, however, continues to treat infrastructure, operations and coordination as separate concerns rather than as parts of one interconnected system (Rodrigue 2020:191). This fragmented framing limits explanatory power, especially in emerging economies where coordination challenges tend to be most consequential (Notteboom et al. 2022:299).

Ethiopia offers a compelling case for examining this relationship. The country has invested substantially in transport and logistics infrastructure, including large-scale road expansion, the Addis Ababa–Djibouti standard-gauge railway, inland dry ports and expanded air cargo capacity through Ethiopian Airlines (Ministry of Transport and Logistics 2022). Yet Ethiopia ranked 129th out of 139 countries on the World Bank's 2023 Logistics Performance Index, with a score of 2.38 out of 5 (Arvis et al. 2023:45). Infrastructure investment alone, in other words, has not translated into improved logistics competitiveness. The same report shows that the underperformance reflects less a shortage of investment than a gap between physical expansion and the operational and institutional coordination needed to utilise it.

This study examines how infrastructure and modal integration jointly shape the performance of Ethiopia's logistics system. Its central argument is that performance is an emergent outcome of system integration rather than of isolated infrastructure investment, a framing intended to contribute to a more integrated understanding of logistics system development in emerging economies.

Contextual background of the logistics sector in Ethiopia

Ethiopia is a useful case of an emerging economy attempting to strengthen its logistics position through sustained public investment and policy reform. Between 2009/10 and 2019/20, the economy grew at an average annual rate of roughly 9.5%, among the fastest in the world over that period (World Bank 2024). More recently, growth has moderated but remains strong, reaching 7.3% in 2023/24, driven primarily by industry (9.2%) and agriculture (7.0%) (African Development Bank 2026). This expansion has increased demand for transport, storage and distribution systems capable of supporting both domestic distribution and international trade.

Successive Growth and Transformation Plans (GTP I and II) and a 10-year perspective plan have all emphasised infrastructural expansion, industrialisation and trade facilitation (Ministry of Transport and Logistics 2022). The resulting investments are substantial: the road network expanded from roughly 100 000 km in 2015 to an estimated 180 000 km by 2022/23, with the federal network alone comprising approximately 41 000 km, including 4400 bridges (DT Global 2023). In addition to the road network, the Addis Ababa–Djibouti standard-gauge railway became operational in 2017; eight dry ports now offer a combined annual throughput capacity of 597 112 Twenty-Foot Equivalent Units (TEUs); and air cargo capacity has expanded considerably through Ethiopian Airlines, Africa's largest cargo carrier (DT Global 2023).

Yet the logistics system remains constrained by structural inefficiencies. Road transport carries roughly 88% of domestic freight, against just 11% by rail (Ministry of Transport and Logistics 2021). This imbalance puts pressure on road networks, contributes to congestion and higher maintenance costs, and reduces the efficiency of long-distance freight movement, a pattern seen across much of sub-Saharan Africa (United Nations Trade and Development [UNCTAD] 2023:101). Institutional fragmentation compounds the problem: responsibility for logistics planning and regulation is split across multiple government agencies, and weak coordination among them creates procedural bottlenecks that slow cargo movement, raise costs and make the system less predictable (Notteboom et al. 2022:442).

These conditions position Ethiopia as a compelling empirical case. It illustrates a tension common in logistics development in emerging economies: infrastructure expansion that has outpaced the institutional and operational foundations required to make that infrastructure perform. The gap between investment and integration remains a central, unresolved challenge.

Literature review: Infrastructure and modal integration for logistics development

The evolution of logistics systems thinking

For much of the 20th century, logistics performance was understood primarily as a function of physical assets, the roads, ports and terminals that move goods from one place to another. Recent scholarship has reframed this, arguing that performance emerges from the coordination of infrastructure, institutions and transport modes as an integrated system rather than from any single component in isolation (Rodrigue 2020:191). Modern logistics systems operate as networks rather than collections of physical infrastructure, connecting production zones, distribution centres, ports, inland terminals and markets through coordinated multimodal transport (Rodrigue & Notteboom 2009:3). This reframing matters for how logistics development is planned and evaluated, particularly where these interactions remain weak or poorly

coordinated, which is precisely the condition this study examines in Ethiopia.

Within this landscape, logistics hubs have become central to trade facilitation. They consolidate cargo flows, enable movement across integrated transport modes, and provide services including warehousing, customs clearance and freight distribution (Weerapong et al. 2026:3). Through this advancement, hubs become multifunctional platforms that generate employment, attract investment and stimulate innovation through the integration of multimodal infrastructure, advanced technologies and public–private partnerships (Notteboom et al. 2022:140). For developing economies in particular, well-positioned hubs can overcome geographic disadvantages and connect domestic producers to global value chains (Arvis et al. 2023:14).

Theoretical perspectives on logistics hub competitiveness

Why do some logistics hubs succeed while others, despite comparable infrastructure investment, underperform? Answering this requires more than a single theoretical lens. This study draws on four complementary perspectives: Resource-Based Theory, Institutional Theory, Network Theory and Social Exchange Theory, each of which illuminates a different dimension of the infrastructure–performance relationship.

Resource-based theory

Resource-Based Theory holds that competitive advantage derives from possessing resources that are valuable, rare, difficult to imitate and non-substitutable (Barney 1991:106). Applied to a logistics hub rather than a single firm, the unit of analysis shifts to a regional ecosystem: tangible resources such as the quality of physical and digital infrastructure remain important, but increasingly it is intangible capabilities, organisational coordination capacity, institutional knowledge and the ability to operate information systems effectively that differentiate high-performing hubs from low-performing ones. Conceptualised this way, Resource Based Theory (RBT) suggests that infrastructure investment is necessary but not sufficient on its own; it must be paired with the organisational capabilities to use it. This framing is directly relevant to Ethiopia, where substantial tangible investment has yet to produce commensurate system-wide gains.

Institutional theory

Institutional Theory asserts that organisational performance is shaped by the broader social, political and economic environment, encompassing formal rules such as customs regulations and transport policies, as well as informal constraints such as business norms and levels of coordination (North 1990). A supportive institutional framework that lowers transaction costs, ensures predictability and promotes efficiency is a primary determinant of a logistics hub's success. In Ethiopia, responsibility for logistics governance is distributed across several agencies with different mandates, and this fragmentation is itself an institutional condition in the sense North describes, one that limits how much infrastructure investment can achieve on its own.

Network theory

A third perspective, Network Theory, locates an actor's performance in its position and connectivity within a wider network rather than in its standalone characteristics (Liu et al. 2012:392). For a logistics hub, this means competitiveness is partly a function of how well the infrastructure connects to the rest of the system, and of the degree of coordination and synchronisation across modes, including compatibility, operational alignment and information exchange. In this framing, infrastructure is the physical backbone of the network; modal integration determines whether that backbone actually functions as a single, cohesive network. This perspective speaks most directly to the central argument of this study: that Ethiopia's transport infrastructure has not yet operated as a coherent network because the connections between its parts remain weak.

Social exchange theory

A fourth and complementary perspective examines logistics performance as embedded in the relationships among the actors who operate the system. Social Exchange Theory holds that cooperation depends on trust, commitment and reciprocity between parties (Cropanzano & Mitchell 2005:874). Within a logistics hub, fundamentally a network of interacting firms and institutions, this suggests that coordination failures are not purely technical or structural but also relational: where customs authorities, transport operators and service providers lack established working relationships, even well-designed systems struggle to function as intended. This reinforces a point that runs through the other three perspectives as well, that modal integration challenges are rarely just about infrastructure.

Infrastructure and modal integration: The critical relationship

The interaction between infrastructure and modal integration has become a central concern in logistics scholarship. Intermodal and multimodal systems allow goods to move efficiently across transport modes, reducing bottlenecks and optimising cost and time across the supply chain (Kurniawan 2024:219). Achieving this in practice, however, requires more than physical compatibility between infrastructure assets, it depends on operational alignment between service providers and real-time information exchange across the network, conditions that are frequently absent in emerging economies.

In many such economies, freight transport is concentrated heavily in a single mode, typically road, while rail and multimodal systems remain underdeveloped or underused (Wei et al. 2025:2). This is often the legacy of decades of uncoordinated investment, where individual modes were developed in isolation from one another. The consequences run beyond road congestion and higher maintenance costs:

when transport modes are not functionally connected, the system loses its ability to route freight efficiently, absorb demand shocks or offer competitive service on long-distance corridors (Rodrigue 2020:205). The lack of seamless intermodal connections limits how far logistics flows can be optimised across the network, a pattern that recurs across corridor efficiency studies in sub-Saharan Africa (UNCTAD 2023:100).

Weerapong et al. (2026:9) show that infrastructure-led strategies need institutional and operational reform alongside them to produce real efficiency gains. Port and hub performance, in other words, is shaped less by the capacity of individual nodes than by the quality of the connections between them (Notteboom et al. 2022:54). This view sits awkwardly with development strategies built primarily around infrastructure spending.

The system integration perspective and conceptual framework

Towards an integrated conceptualisation

Taken together, these four perspectives point in the same direction from different starting points. Resource-Based Theory suggests that infrastructure alone is an incomplete resource bundle without the organisational capacity to use it. Institutional Theory locates the missing element in the rules and coordination norms that govern how agencies and firms interact. Network Theory reframes the question entirely, away from the quality of individual assets and towards the quality of connections between them. Social Exchange Theory suggests that these connections are formed or not based on ongoing cooperation among actors. None of the four, on its own, fully explains why infrastructure investment so often fails to translate into logistics performance. Read together, however, they converge on a single proposition: that infrastructure functions as a system only to the extent that it is integrated organisationally, institutionally, relationally and operationally with the modes, agencies and actors around it (Rodrigue 2020:191). This proposition is the theoretical foundation for the empirical question this study asks of Ethiopia: not whether infrastructure exists, but whether it has been integrated into a functioning system.

This study adopts the integrated systems perspective, treating logistics hub competitiveness as an outcome of coordinated interaction among interdependent components, transport and logistics infrastructure, institutional capacity, technological systems and market dynamics, rather than as the sum of their individual strengths. Infrastructure requires institutional support to function efficiently; coordination mechanisms enable multimodal connectivity; governance structures enable or constrain how the system performs as a whole.

Comparative evidence from logistics hub development in Singapore, Zaragoza and Austria supports this reading. Despite very different structural starting points, each achieved high logistics performance by coordinating infrastructure, institutions and operations into a coherent system (Sheffi 2013:34). This points to where the constraint typically lies in emerging economies, not in the absence of individual components, but in the fragmentation between them.

For Ethiopia, the implication is that the effectiveness of infrastructure investment depends on the degree to which it is matched by functional modal integration, institutional coordination and operational alignment. The contribution of this study is to examine infrastructure and modal integration as interdependent parts of a single system rather than as separate determinants of performance, thereby providing empirical grounding for the integrated systems perspective in an emerging-economy setting.

Research methods and design

Research design and philosophical orientation

This study adopted a qualitative research design grounded in an interpretive philosophical orientation. A qualitative approach was particularly appropriate given the study's aim to understand how infrastructure and modal integration interact within Ethiopia's logistics system, as such systemic and institutional dynamics require direct engagement with actors who operate and manage the system and cannot be adequately captured through quantitative methods alone (Creswell & Poth 2018:41). Qualitative inquiry enabled the capture of complex institutional dynamics, contextual dependencies and experiential knowledge that quantitative approaches would overlook.

Study setting and case justification

Ethiopia was selected as the study setting because it embodies a paradox common to many emerging economies: substantial, sustained infrastructure investment alongside persistent logistics underperformance. Despite major investment in railways, dry ports, and road networks, the country ranked 129th out of 139 on the 2023 Logistics Performance Index (Arvis et al. 2023:45). This combination makes Ethiopia a critical case for examining the relationship between infrastructure and system integration, one whose findings are likely to resonate beyond its borders (Creswell & Poth 2018:75).

Participants' selection and profile

Participants were purposively selected based on direct involvement in Ethiopia's logistics system across planning, operations and policy.

All had at least 10 years of professional experience in the sector, ensuring that the findings reflected substantive practical knowledge rather than mere familiarity. Participants were drawn from two public-sector categories: transport and logistics authorities, including the Ministry of Transport and Logistics and the Ethiopian Shipping and Logistics Enterprise, and two private-sector categories: freight forwarders and logistics service providers.

In total, 10 key informant interviews (KIIs) and two focus group discussions (FGDs), each with six participants, were conducted, giving 22 participants overall. Table 1 presents the participants' profile.

Data collection

Data were collected through semi-structured KIIs and FGDs, both built around the same thematic guide covering infrastructure conditions, coordination mechanisms and modal connectivity. The KIIs elicited in-depth individual perspectives, while the FGDs captured how participants discussed these issues collectively, which was useful for cross-checking individual accounts and observing where views converged or diverged within a group setting. Participants were free to elaborate on whatever aspects of their operational experience felt most relevant. All sessions were conducted in person and audio-recorded with consent and ran between 45 and 90 min.

TABLE 1: Participants' profile.

ID	Category	Sector	Method	Experience (years)
KII-1	Transport and logistics authority	Public	KII	≥ 15
KII-2	Ethiopian shipping and logistics	Public	KII	12
KII-3	Ministry of transport	Public	KII	18
KII-4	Transport policy unit	Public	KII	14
KII-5	Freight forwarding company	Private	KII	20
KII-6	Logistics service provider	Private	KII	
KII-7	Multimodal operator	Private	KII	16
KII-8	Customs clearing agent	Private	KII	13
KII-9	Dry port operations	Public	KII	10
KII-10	Rail transport authority	Public	KII	15
FGD1-P1 to P6	Mixed logistics practitioners	Public and Private	FGD 1	10–20
FGD2-P1 to P6	Mixed logistics practitioners	Public and Private	FGD 2	10–18

KII, key informant interview; FGD, focus group discussion.

Data analysis

Data were analysed following Braun and Clarke's (2006: 77–101) six-phase approach to thematic analysis. The analysis progressed from verbatim transcription and familiarisation through open coding, code refinement and grouping, analytical category development and theme construction. The final stage involved interpreting themes in relation to the study's research objectives. Three overarching themes were identified, each comprising sub-themes and code categories as presented in Table 2.

Trustworthiness and rigour

Trustworthiness was assessed against the four criteria set out by Lincoln and Guba (1985): credibility, transferability, dependability and confirmability. Credibility was strengthened through triangulation across KIIs and FGDs, member checking of emerging interpretations, and repeated cross-comparison of participant responses for consistency. Transferability rested on a thick description of the Ethiopian context combined with the purposive selection of a critical case, supporting analytical generalisation to comparable settings. An audit trail of methodological decisions and coding procedures enhanced dependability, while confirmability was supported by reflexive attention to the researcher's positionality and potential biases throughout data collection and analysis. Saturation was reached by the eighth KII, after which no new codes emerged; the remaining interviews and the two FGDs confirmed rather than extended the existing categories.

Ethical considerations

Ethical clearance to conduct this study was obtained from the University of South Africa College of Economic and Management Sciences_ERC Applied Management

TABLE 2: Thematic framework of infrastructure and modal integration findings.

Overarching theme	Sub-theme	Key codes and/or gaps identified	Evidence source
Infrastructure adequacy and spatial distribution	Core transport infrastructure	• Poor road quality • Limited rail coverage • Corridor concentration	• KIIs • FGDs
	Supporting logistics infrastructure	• Inadequate cargo-handling equipment • Capacity shortages at dry ports • Uneven warehousing	• KIIs • FGDs
	Spatial distribution	• Regional disparities • Investment concentrated on specific corridors	• FGDs
Modal integration failure	Road–rail interface	• Weak coordination • Inefficient cargo transfer systems	• KIIs
	Rail–port integration	• Limited connectivity • Poor flow continuity	• FGDs
	First/last mile connectivity	• Fragmented delivery systems • Access gaps at logistics nodes	• KIIs • FGDs
	Coordination mechanisms	• No shared platforms • Information asymmetry • Silo operations	• KIIs • FGDs
Infrastructure–integration–performance relationship	Diminishing returns	• Infrastructure without coordination yields isolated gains	• KIIs • FGDs
	Systemic fragmentation	• The system operates as disconnected subsystems	• KIIs • FGDs

KII, key informant interview; FGD, focus group discussion.

(No. 6810). All participants provided informed consent prior to participation. Confidentiality and anonymity were maintained by using participant identifiers (KII-1 through KII-10; FGD1-P1 through FGD2-P6) rather than personal identifiers. Data were stored securely, used solely for academic purposes and reported transparently. Participants were advised of their right to withdraw at any time without consequence.

Results

Infrastructure and modal integration

The thematic analysis yielded three overarching themes: (1) infrastructure adequacy and spatial distribution; (2) modal integration failure; and (3) the infrastructure–integration–performance relationship. Table 2 provides a structured overview of the themes, sub-themes and code categories derived from the analysis.

Theme 1: Infrastructure adequacy and spatial distribution

The findings revealed that infrastructure development in Ethiopia was not only insufficient in certain areas but also spatially uneven and functionally disconnected. Participants consistently indicated that infrastructure investments were concentrated along specific corridors, particularly the Addis Ababa–Djibouti route, leaving other regions underserved. This uneven distribution limited the effectiveness of the overall logistics system. As a result, improvements in one part of the network did not translate into system-wide efficiency gains.

Participants identified a consistent set of constraints: poor road quality and inadequate maintenance, limited rail operational capacity, underdeveloped dry ports outside major logistics hubs, and insufficient and unevenly distributed warehousing. These constraints collectively restricted the movement of goods and reduced the reliability of logistics operations. Key informant interview-5 put it plainly:

> 'Developing but not adequate and lacking in some of the infrastructures such as warehouse and ICT infrastructure as well as integration … does not fit with the current growing economy and future requirements of the nation, region, and globe.' (KII-5)

Beyond core transport infrastructure, participants emphasised deficiencies in supporting logistics infrastructure, particularly at dry ports and logistics nodes, including a lack of cargo-handling equipment, inadequate parking and staging facilities and weak service ecosystems. Rather than functioning as efficient consolidation and distribution points, logistics nodes frequently became points of delay and congestion, reducing throughput capacity and limiting the effectiveness of broader infrastructure investments.

Theme 2: Modal integration failure

A central finding was the absence of effective multimodal integration within the logistics system. Although different transport modes existed, they did not operate as a cohesive, coordinated system. Instead, they functioned largely in isolation, with limited interaction and synchronisation across scheduling, cargo transfer processes, data exchange systems and terminal operations. Participants emphasised that integration was often policy-driven but not operationalised, resulting in a gap between strategic intent and practical implementation. One FGD participant explained:

> 'There is no system integration between various ports and inland dry ports in Ethiopia. Most is being managed by personal connection.' (FGD1-P3)

This finding highlighted that modal integration challenges were not merely technical but reflected deeper institutional and coordination failures, consistent with Institutional Theory's emphasis on how governance structures shape operational outcomes (North 1990). The lack of modal integration manifested in persistent first-mile and last-mile connectivity gaps, weak rail-to-road and rail-to-port interfaces, inefficient cargo transfer systems and fragmented planning across logistics nodes. As another FGD participant observed:

> 'Delays are not only due to infrastructure gaps but also because systems are not well coordinated.' (FGD2-P2)

This observation pointed to a distinction running through the findings as a whole: logistics inefficiency in Ethiopia was not simply an infrastructure problem but a coordination problem that infrastructure investment alone could not resolve.

Theme 3: Infrastructure–integration–performance relationship

The findings suggested that logistics system performance was constrained not only by infrastructure deficits but also by systemic fragmentation and a lack of integration. Infrastructure expansion alone did not appear sufficient to improve performance unless supported by effective coordination and integration mechanisms. Key informant interview-5 emphasised:

> 'Having infrastructure alone is not enough if the system is not properly connected and coordinated.' (KII-5)

Key informant interview-7 (KII-7, maritime consultant, Male) reinforced this, noting that technology alone could not improve the system unless properly integrated and used by all stakeholders, highlighting the importance of system-wide alignment. These findings collectively supported the study's central proposition: that logistics performance was an emergent property of system integration, consistent with the network-based approaches discussed in the literature review (Liu et al. 2012:392).

Discussion

Infrastructure investment as a necessary but insufficient condition

The findings make clear that infrastructure investment alone was an insufficient basis for logistics system

performance in Ethiopia. This challenges development models that treat investment in roads, railways and terminals as the primary lever for logistics improvement (Notteboom et al. 2022:299). What mattered was not the presence of infrastructure but the degree to which different transport modes and logistics functions were coordinated around it. This finding aligns with scholarship positioning integration as the missing link in logistics development strategies (Weerapong et al. 2026:9).

This study confirms Rodrigue's (2020:205) observation that logistics performance emerges from the interaction of infrastructure, institutions and transport networks rather than from any single component. It extends this by providing empirical demonstration of what might be called the conditionality of infrastructure returns: the efficiency gains from investment did not materialise automatically in Ethiopia but depended on whether the surrounding system could move goods across modes, coordinate between actors and maintain operational continuity. Where those conditions were absent, infrastructure investments produced isolated improvements rather than system-wide gains (Kurniawan 2024:219).

System fragmentation as the primary constraint

The findings indicate that Ethiopia's logistics system operated as a set of partially connected subsystems rather than as a cohesive network. This structural fragmentation led to inefficiencies, including delays, increased costs and reduced reliability, consistent with network-based approaches to logistics systems that emphasise the importance of connectivity and coordinated interactions among nodes and links in determining system performance (Liu et al. 2012:392). This finding contrasts with successful logistics hub cases such as Singapore and Austria, where competitiveness was achieved not through any single structural advantage but through effective system integration that aligned infrastructure, institutional frameworks, and logistics operations within a coherent system (Sheffi 2013:34).

The modal integration challenges identified in Ethiopia were not primarily technical. Rather, they reflected deeper institutional conditions: fragmented planning responsibilities, weak coordination between government agencies, and limited operational alignment among private logistics actors. This governance dimension of logistics performance, which infrastructure investment cannot address on its own, aligns with Institutional Theory's argument that coordination failures of this kind are rooted in misaligned organisational roles and governance structures requiring deliberate reform rather than additional capital investment (Notteboom et al. 2022:299). Ethiopia's experience in this regard is not exceptional; it reflects a pattern documented across emerging economies where institutional constraints limit the returns to infrastructure spending (Arvis et al. 2023:25).

Implications: Rethinking logistics development strategies

The findings make a case for rethinking how logistics development is approached in emerging economies. The Ethiopian experience suggested that the dominant infrastructure-led model produced diminishing returns when not accompanied by deliberate investment in coordination, institutional alignment and multimodal integration. A more effective approach would treat infrastructure investment and system integration not as sequential phases but as mutually dependent conditions of performance, each reinforcing the others. This reframing has implications not only for Ethiopia but for the broader class of emerging economies where logistics underperformance persists despite sustained infrastructure investment (Arvis et al. 2023:24).

The findings reinforce the distinction between physical connectivity and functional integration. While infrastructure investments improved connectivity within the transport network, the absence of effective operational linkages between modes limited the system's ability to function as an integrated network, a pattern observed in other developing contexts (UNCTAD 2023:101). This suggests that policy evaluations of infrastructure investments must assess contribution to system connectivity, not just physical capacity.

Strengths and limitations

The study's primary strength lies in rich qualitative data from purposively selected key informants with substantial sector experience, enabling depth of insight into systemic dynamics that quantitative methods could not capture. Triangulation across KIIs and FGDs enhanced credibility, and the critical case selection of Ethiopia grounds the findings in a context with clear relevance to comparable emerging economies.

The study is limited by its single-country focus, which constrains direct cross-country comparison. The qualitative design does not permit statistical generalisation. Data were collected at a single point in time, and longitudinal analysis would strengthen understanding of how infrastructure–integration relationships evolve. Future research should examine how specific institutional reforms and integration initiatives translate into measurable performance gains across different settings.

Conclusion

This study examined how infrastructure and modal integration jointly shaped logistics system performance in Ethiopia, a context characterised by sustained infrastructure investment alongside persistent operational inefficiency. The findings revealed that the relationship between investment and performance was not direct but conditional: infrastructure produced meaningful efficiency gains only when embedded within a system that enabled coordination, multimodal connectivity and operational alignment across logistics actors.

Three conclusions followed from this. Firstly, logistics performance was an emergent property of system integration, not of infrastructure availability. Secondly, the primary constraint on Ethiopia's logistics performance was systemic fragmentation across infrastructure, institutions, and modal operations, not a shortage of physical assets. Thirdly, modal integration challenges in Ethiopia were rooted in governance and institutional conditions that infrastructure investment could not address on its own.

What made the Ethiopian case instructive was not simply that these challenges existed, but that they persisted despite significant and sustained infrastructure investment. This points to a broader pattern across emerging economies: the gap between physical expansion and system integration remains wide, and infrastructure-led development strategies have a structural limitation that more investment does not resolve.

Policy implications

From a policy perspective, three interconnected priorities stand out. Firstly, infrastructure investment decisions need to be evaluated not only on the basis of physical capacity but on their contribution to system connectivity, whether a new road, rail link or dry port actually improves integration of the broader network or simply adds isolated capacity. Secondly, institutional reform is as important as capital investment: the coordination failures identified in this study were governance problems that required clearer mandates, better inter-agency alignment, and stronger operational protocols among logistics actors. Thirdly, logistics nodes such as dry ports need to be developed as genuine multimodal hubs rather than single-mode facilities, with the equipment, staffing and information systems needed to facilitate seamless cargo transfer across modes.

Logistics development in emerging economies is not simply a question of how much infrastructure exists. It is equally a question of how well that infrastructure is connected, coordinated, and integrated into a system capable of moving goods efficiently across modes and actors. Ethiopia's experience offers a basis for rethinking development strategies in comparable contexts across sub-Saharan Africa and beyond.

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Competing interests

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CRediT authorship contribution

Dagmawit M. Bekele: Conceptualisation, Data curation, Formal analysis, Methodology, Writing – original draft, Writing – review & editing. Intaher M. Ambe: Conceptualisation, Supervision, Validation, Writing – review & editing. Both authors reviewed the article, contributed to the discussion of results, approved the final version for submission and publication, and take responsibility for the integrity of its findings.

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Data availability

The data that support the findings of this study are available from the corresponding author, Dagmawit M. Bekele, upon reasonable request.

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