PROJECT REPORT

ADDIS ABABA SIDEWALK SAFETY AND IMPROVEMENT STUDY

March 2022

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Addis Ababa City Government Plan and Development Commission

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Addis Ababa Sidewalk Safety and Improvement Study

March 2022

The World Bank

1818 H Street NW, Washington DC 20433

Telephone: 202-473-1000; Internet: www.worldbank.org

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This report was prepared by a team led by Wenyu Jia (Sr. Urban Transport Specialist) and Bezawit Tesfaye Fantta (Transport Specialist) at the World Bank. Abinet Ergando, Director of the Addis Ababa Plan and Development Commission, is the task leader on behalf of the Addis Ababa City stakeholders. IDOM led the preparation of the report with sub-consultant, DA-YA consulting, as local partner. Key team members are Yessiel Mercado Alcalá (IDOM), Francisco Burgos Martí (IDOM), Alejandro Cuñat (IDOM), Estefania Mejía (IDOM), and Stephen Kome Fondzenyuy (World Bank Program Intern).

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ABREVIATIONS AND ACRONYMS

AA	Addis Ababa
AADT	Annual Average Daily Traffic
GIS	Geographical Information System
GoE	Government of Ethiopia
GPS	Global Positioning System
GRSF	Global Road Safety Facility
ITDP	Institute of Transportation and Development Policy
ITS	Intelligent Transportation System
KML	Keyhole Markup Language
LRT	Light Rail Transit
MUDI	Ministry of Urban Development and Infrastructure
NGO	Non-governmental organization
NMT	Non-motorized transport
PRM	Person with reduced mobility
SHP	ESRI Shapefile
SSA	Sub-Saharan Africa
ToD	Transit Oriented Development
TRANSIP	Transport Systems Improvement Project
WB	World Bank
WHO	World Health Organization

EXECUTIVE SUMMARY

Background

1. **Essential services, infrastructure, and urban transport mobility have yet to catch up to rapid urban growth in Addis Ababa.** Much of ongoing urban development lacks coordination with planning strategies. In recent years, vehicle growth has maintained a rate of 8% per year[1], reaching 630,000 vehicles in 2020. In a hurry to accommodate vehicle growth, efforts usually prioritize roads and car related needs over other types of users, despite 54% of the city's residents moving on foot and 31% using public transport[2].

2. **Walking is the mode of travel predominantly used in Addis Ababa (AA) as it represents more than half the daily trips; however, pedestrians are at greater risk of traffic accidents.** The warm weather in Addis Ababa makes the use of this healthy and green mode of transport possible. However, sidewalks are often narrow, uneven, obstructed, or non-existent, making them a nuisance and a safety risk for the most vulnerable road users: pedestrians. Studies conducted by WHO and the GoE have shown that AA has disproportionately high pedestrian fatalities compared to the rest of the country[3]. In AA, nearly 500 people lose their lives due to road accidents each year, 76% of whom are pedestrians[4].

3. **Sidewalk deficiencies and pedestrian mobility limitations stem from issues ranging from planning and design to construction and maintenance**. It is common to find inappropriate intersections, deficient crossings, missing sidewalk segments, poor accessibility for vulnerable users, and even intentional barriers on main avenues across the city. Sidewalks also lack proper maintenance, leading them to be invaded by vegetation, rocks, or debris. Moreover, sidewalks are often obstructed by street vendors, parked vehicles, or loading and unloading maneuvers. These deficiencies enable risky behaviors by road users, especially drivers and pedestrians: pedestrians step into dangerous traffic, such as crossing streets in ways and places that are prohibited.

4. **Prior studies have not properly addressed the current situation regarding sidewalks.** Road safety initiatives have focused on roads and intersections, rather than sidewalk conditions or systematic diagnoses of sidewalks and walkability. In addition to these studies not addressing sidewalk conditions, walkability, and pedestrian experience specifically, sidewalk maintenance lack attention.

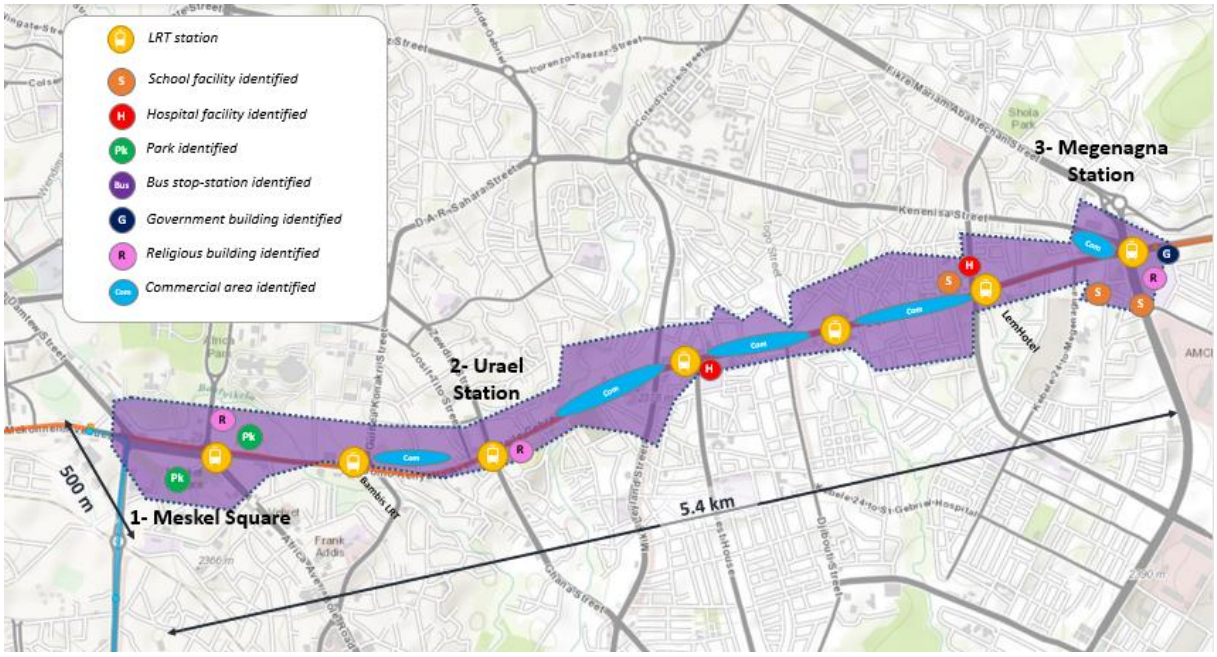
5. **This study integrates sidewalks, urban design, as well as road safety to create a comprehensive multimodal approach to address sidewalk safety and improvements**. It applies innovative digital technology in sidewalk field surveys, conducts evidence-based analytics on walkability for pedestrians in the selected study area. Based on analytics, it helps identify strategies, formulate short-term actions, establish a framework for sidewalk

improvements, and ultimately promote public health and human capital development through safer and greener transport. This study creates an analytical approach for Addis Ababa to understand sidewalk conditions and walkability and can be easily replicated and scaled up in other cities.

Study Approach

6. **The study area is a section measuring 5.4 km along the Light Rail Transit (LRT) Line A corridor (Figure ES-1)**. The selected area is based on the criteria agreed on with the Planning Commission. The analysis has focused on three main station areas: Meskel Square, St Urael Station, and Megenagna Station, given that they significantly generate and attract pedestrian activities, and have mixed land use and facilities in the station area.

Figure ES- 1 The selected study area (shaded in purple) along the Line A corridor



Source: Authors

7. **The study innovatively used mobile data collection to form a georeferenced Urban Inventory, complemented by User Surveys.** Through photographic evidence, and the use of a mobile application, the Urban Inventory canvassed current sidewalk conditions within the study area. It entailed identifying and classifying elements into five categories: Urban Life, Sidewalk Condition, Urban Elements, Pedestrian Crossings, and Safety. The User Survey was conducted by means of questionnaires distributed to users around the study area and focused on sociodemographic characteristics, general walking activities, specific trips made by foot, and user perception regarding the condition of the studied area. Although this study only analyzes a small portion of the street network, it allows us to observe that deficiencies are exacerbated in the rest of the city, given that they represent corridors that are less used in terms of travel

and with less investment in pedestrian infrastructure, and therefore fosters the application of the proposed measures to the rest of the city.

Sidewalk Conditions: Findings of Urban inventory and User Surveys

8. **Some sidewalks in the study area have adequate width, particularly in the new segments, and have street furniture and streetscape** (trees for shading, tactile paving, and lighting). These best practices should be replicated in other segments of the sidewalk network across the city.

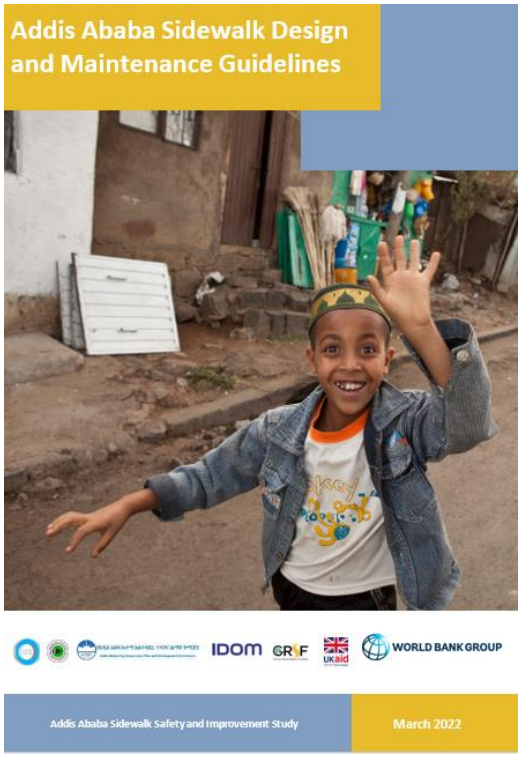
9. **The Urban Inventory indicates that 67% of the network falls under Levels C and D of Global Walkability Index, which confirms deficient, unsafe sidewalk conditions.** A significant number of issues have been identified in the study area, including that (i) the walking environment lacks interaction with buildings and fronts, with 85% of buildings in the study area being unattractive to pedestrians or lacking connection with sidewalks; (ii) sidewalks have low numbers of adequate bus stops, which discourages last-mile connection for bus riders; (iii) 26% of the network lacks paving and 50% of sidewalk pavement is ranked in the poor to very poor category in this LRT corridor; (iv) 50% of the sidewalk network has no tactile paving for visually impaired users and lacks proper lighting; (v) walking is constantly blocked by obstacles; and (vi) 79% of the network has inadequate crossings, which incentivizes jaywalking, i.e., pedestrians crossing roads while disregarding traffic rules.

10. **Users' perception based on surveys corroborated Urban Inventory findings.** Pedestrians perceive sidewalks to be inaccessible (75%), unsafe in terms of infrastructure quality (66%), unsafe in terms of exposure to traffic (63%), lacking crossing points (63%), obstructed (70%), and particularly unfit for children and people with mobility constraints.

Sidewalk Design and Maintenance Guidelines

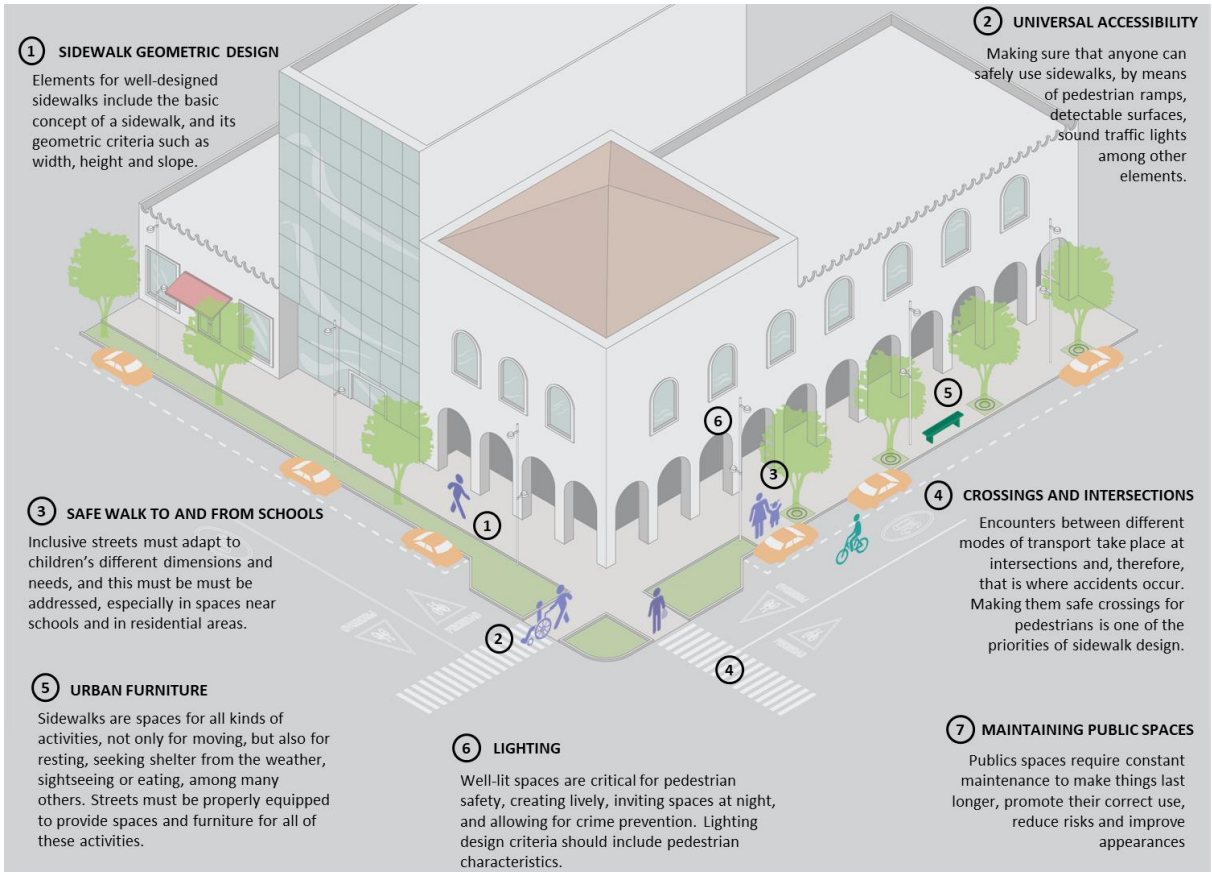
11. **The Sidewalk Design and Maintenance Guidelines aim to promote the development of quality pedestrian infrastructure and walking environments, based on the assessment of conditions and global best practices**. The information and visual rendering shared in the guidelines seek to provide recommendations and specifications for the city's planning and transport authorities to consider when developing the city's own design and maintenance standards for urban roads, sidewalks, public spaces, and transit-oriented development, some of which will be carried out as part of the technical assistance program of the ongoing TRANSIP operations. The guidelines also provide tools and share knowledge on building and maintaining streets, all the while prioritizing pedestrians.

Figure ES- 2. Cover from Guideline



Source: Authors

Figure ES- 3. Excerpt from Guideline



Source: Authors

Citywide Strategies and Corridor Actions

12. **Improvement strategies are proposed based on the local applicability of global best practices.** The study proposes a variety of strategies to improve urban life, sidewalk conditions, urban furniture, and safety for pedestrians. These strategies are adapted to AA's context and are aligned with the transport and mobility vision for the city as defined in the Addis Ababa Transport Development Plan. The improvement strategies proposed in the study are further divided into priority short-term actions with a clear and fast impact on pedestrian mobility.

13. **Short-term actions are proposed for three LRT station areas to achieve impact in a reduced timeframe.** The proposed actions focus on the hotspots identified in three station areas (Meskel Square, St Urael Station, and Megenagna Station). The design of station actions reflects the unique land use and transport conditions, and integrates best practices into the local context. Figure ES-4 portrays the actions for Meskel Square, which include (1) a redesign of Ras Biru St. crossing; (2) a redesign of Menelik II Ave. crossing; (3) a transformation of Meskel Square into a new commercial hub; (4) an enhancement of the Square public space; (5) enhancements in terms of maintenance and reconstruction; and (6) an introduction of community activities in the area under the tram infrastructure.

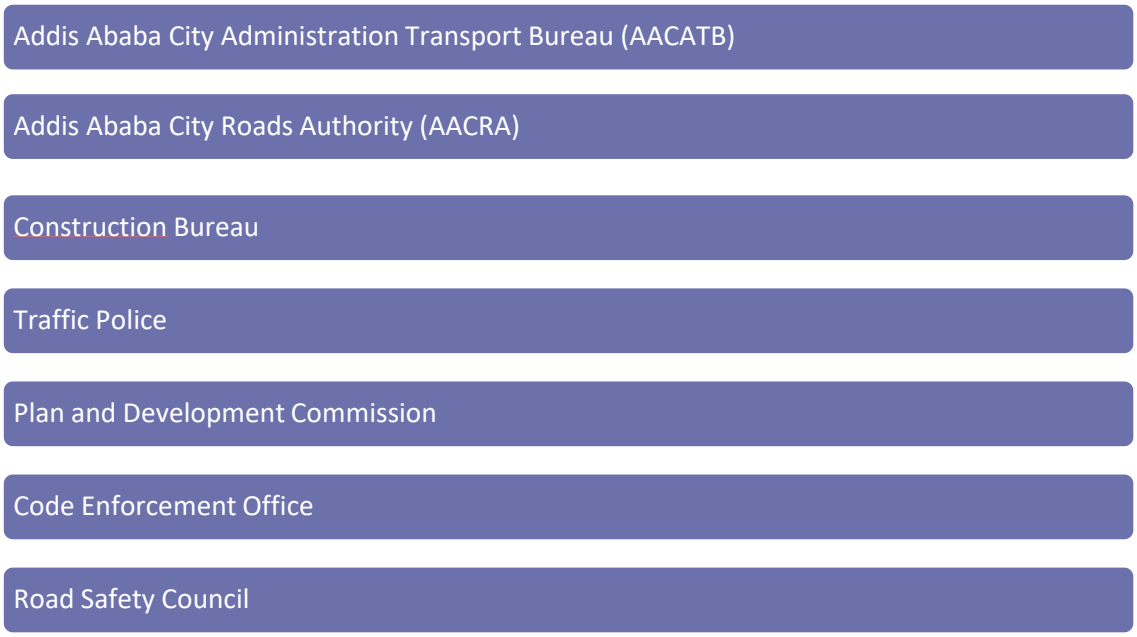
Figure ES- 4. Short-term Actions for Meskel Square Station

Source: Authors

Other Considerations

14. **Enhanced coordination between institutions is key to the implementation of recommendations and improvement of infrastructure**. A number of city agencies are involved in sidewalk planning, design, construction, cleaning, and maintenance, requiring coordination among stakeholders. Furthermore, better law enforcement is essential for preventing sidewalk obstruction, reducing road accidents, and upholding the impact of sidewalk improvements.

Figure ES- 5. Institutions involved in the life cycle of sidewalk development



Source: Addis Ababa non-motorized transport strategy 2019-2028

15. **The study suffered some setbacks due to Covid-19**. The study was initiated right before the beginning of the Covid-19 pandemic. Due to Government imposed safety measures and travel restrictions, there were no in-person meetings with stakeholders, which limited the in-depth assessment of the local situation. All stakeholder consultations were held through virtual workshops.

INTRODUCTION

Walking is the mode of travel predominantly used in Addis Ababa (AA) as it represents more than half the daily trips. The warm weather in Addis Ababa makes the use of this healthy and green mode of transport possible. However, sidewalks are often narrow, uneven, obstructed, or non-existent, making them a nuisance and a safety risk for the most vulnerable road users: pedestrians. Currently, the city possesses inadequate research and data regarding sidewalk conditions for pedestrians. As a result, the studies and initiatives that have been undertaken have focused on roads and intersections, and not on a systematic diagnosis of sidewalk conditions and walkability.

This "ADDIS ABABA SIDEWALK SAFETY AND IMPROVEMENT STUDY" represents the first systematic approach towards addressing sidewalk safety and walking experience for the largest group of transport users in AA, and seeks to provide the Addis Ababa City Government with the tools to conduct sidewalk analyses across the city. This study uses digital technology in sidewalk field surveys, conducts evidence-based analytics regarding walkability for pedestrians in the selected study area, and integrates sidewalks, urban design, and road safety to create an integrated multimodal approach. Based on analytics, it identifies strategies, formulates short-term actions, establishes a framework for sidewalk improvements, and ultimately promotes public health and human capital development through safer and greener transport.

While the study focuses on a selected sidewalk network, the tools and analytical methodology can be used and replicated in other parts of the city, as well as in other cities in SSA. The design guideline can be considered for the city's incorporation in its own standard development, and transit station area improvement actions can be implemented short-term at a low cost and with immediate impact.

The report contains 5 chapters

- **Chapter 1: Study approach and methodology** describes the challenges faced by pedestrians, the study objectives and the general methodology.
- **Chapter 2: Baseline analysis of sidewalk conditions** explains the data collection methodology and findings regarding walkability in the study area.
- **Chapter 3: Vision, general goals, and improvement strategies** presents the vision formulated for Addis Ababa's mobility and transport, general goals and improvement strategies based on global best practices, and short-term actions for station areas.
- **Chapter 4: Guideline and short-term actions** describes the guidelines stemming from the improvement strategies and short-term projects, measures, and actions to improve sidewalk conditions in the study area.
- **Chapter 5: Conclusions and recommendations** provides a summary of key findings and recommendations.

1 STUDY OVERVIEW

1.1 STUDY OBJECTIVE

The objective of this study is to develop analytics to diagnose sidewalk conditions and walkability in a selected study area of AA, to propose strategies and define “low-hanging fruit” actions to address sidewalk deficiencies, and bridge the connection between pedestrians, sidewalks, urban design, and road safety through an integrated multi-sector approach.

This study is strategically aligned with the ongoing, World Bank financed TRANSIP project in Ethiopia. The project is the first large-scale engagement with Addis Ababa to improve mobility in Addis Ababa and road safety compliance systems in Ethiopia. Approved by the Board in May 2016, this project has two main clients – the Addis Ababa City Administration Transport Bureau and the Ethiopian Ministry of Transport and Logistics. The activities for Addis Ababa consist of public transport modernization, traffic management and intelligent transport system (ITS), and integrated land use and transport planning. Findings and recommendations stemming from this study will inform several ongoing TRANSIP activities highlighted below, expected to have an impact in terms of walking environments and sidewalks.

- The Corridor Improvement Project applies the Complete Street Concept and ITS to improve mobility and road safety in five selected arterial corridors of the City. TRANSIP finances the design of all five corridors and the construction of one major corridor that the City Administration prioritizes. Upon completion, the corridors will be transformed into multimodal urban roads with continuous sidewalks, bicycle lanes, dedicated bicycle parking, and bus bays, among other things.
- A design of comprehensive transport and traffic improvement measures for the Merkato Area is also among the key activities financed through TRANSIP. Merkato is the largest open market in Africa, hosting many vendors and pedestrians.
- The Road Design and Maintenance Manual seeks to update the 2004 manuals to incorporate the Complete Street concept, prepare urban road design guidelines and standards, as well as promote the development of quality pedestrian infrastructure and walking environments.
- The Parking Strategies and Pilot Implementation Programs seek to determine parking management measures and conduct a traffic impact assessment for AA, and implement pilot projects in selected city center areas.
- The development of the Strategic Transport Master Plan aims to assess the performance of existing transport systems, propose adjustments in transport networks and land use plans, and promote sustainable transport development.
- The Transit Oriented Development (TOD) Study zooms in on the selected station areas in the LRT corridors by means of integrated land use and mass transport development to facilitate access to basic services, infrastructure, housing, job/employment density, and improvement of the residents’ overall economy.

This sidewalk study is expected to contribute to the multiple TRANSIP studies, designs and implementations with its evidence-based findings, feasible short-term actions, and design guidelines. Beyond the synergy with TRANSIP activities, this study is the first systematic approach focusing on sidewalk conditions and improvements for pedestrians, and will fill the gaps of road safety initiatives undertaken by the government and development partners.

1.2 BACKGROUND

Essential services, infrastructure, and urban transport mobility are not proportional to the population (4,567,857 inhabitants in 2007)[1] and have yet to catch up to rapid urban growth in AA (3.8% per annum)[2]. Much of ongoing urban development lacks coordination with planning strategies. In recent years, vehicle growth has maintained a rate of 8% per year[3], reaching 630,000 vehicles in 2020, and representing enormous challenges for AA in many ways. In a hurry to accommodate vehicle growth, municipal efforts usually prioritize roads and car related needs over other types of users, despite 54% of the city's residents moving on foot and 31% using public transport[4]. A World Bank study on transport accessibility indicated that only 17% of jobs can be reached within one hour via public transport, and only 15% on foot.

Walking can also be dangerous: studies by the World Health Organization (WHO) and the Government show that AA has disproportionately high pedestrian fatality rates[5]. In AA, nearly 500 people lose their life to road accidents every year, and 76 % of those deceased are pedestrians[6]. 60% of pedestrian fatalities are attributable to trucks and taxis, and weekend nights have higher rates as well[7].

1.2.1 Initial Scan of Sidewalks

At the beginning of the study, the team conducted a field scan in selected areas of the city to get a sense of sidewalk conditions.

It showed the problems associated with sidewalk deficiencies and pedestrian mobility range from design, construction to maintenance (see Figure 1), which enables risky behaviors, especially on behalf of drivers and pedestrians. Across the city, it is common to find locations with inadequate intersections, deficient crossings, missing sidewalk segments, poor accessibility for vulnerable users, and even

[1] The 2007 Population and Housing Census, 2010

[2] Addis Ababa, Ethiopia_Enhancing Urban Resilience, World Bank, 2015

[3] Steering Towards Cleaner Air: Measures to Mitigate Transport Air Pollution in Addis Ababa. World Bank, 2021

[4] Urban Transport Study for Addis Ababa (2005), cited in International Consultants and Technocrats Ethiopia. (2012). Consultancy Services for Technical Advisory Services for Addis Ababa City Traffic Management.

[5] Global status report on road safety: time for action, World Health Organization 2009.

[6] Addis Ababa Road Safety Annual Report 2017-2018.

[7] Addis Ababa Annual Road Safety Report 2018-2019

intentional barriers, including guard railings on main avenues. Sidewalks also lack maintenance, being overcome with vegetation, rocks, or debris. Moreover, a lack of law enforcement causes the sidewalks to often be obstructed by street vendors, parked vehicles, or loading and unloading maneuvers.

Figure 1. Example of sidewalk and intersection problems.

(a) Lack of sidewalk or deficient construction and design

(b) Presence of guard rail and illegal crossings

(c) Construction and maintenance deficiency, and pedestrian invasion of the road

Source: Authors

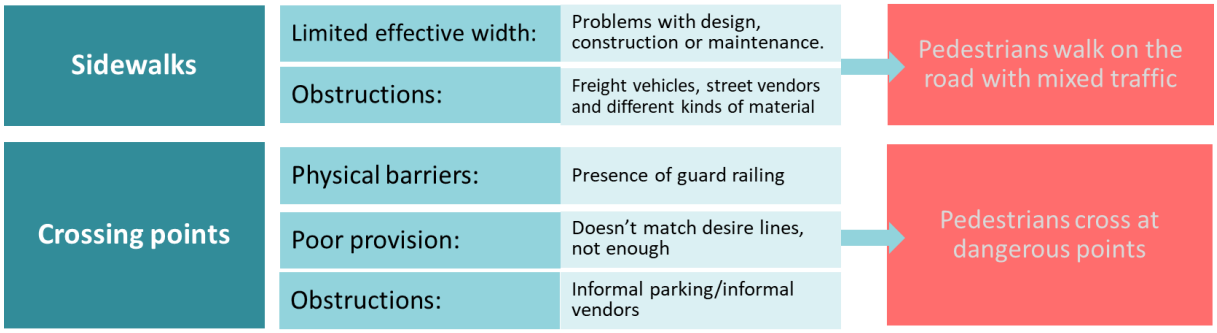
Figure 2. Sidewalks around the LRT Corridor.

Source: Authors

For instance, these problems can be observed along the LRT corridor presented in Figure 2, where wide and newer sidewalks present higher pedestrian flows. The effective width of the sidewalk is reduced by the invasion of informal vendors and parked vehicles, which in turn forces pedestrians to walk on the road with mixed traffic. Crossings for pedestrians are limited, which leads to jaywalking. Lighting is also scarce.

These conditions force pedestrians to mix with dangerous traffic and even encourage risky walking behaviors, including illegal pedestrian crossings. Pedestrians walk on the road with vehicles, and drivers often fail to yield to pedestrians, resulting in a vicious cycle (Figure 3).

Figure 3. Summary of walkability field scan in Addis Ababa.



Source: Authors

Consequently, adequate sidewalks, better infrastructure standards and maintenance, adequate traffic signaling, intersection redesign, proper lighting, and traffic enforcement are prerequisites to enhancing walkability and sidewalk safety, while improving the quality of the urban sphere. Moreover, sidewalk infrastructure improvements should be complemented with education and awareness for all relevant stakeholders.

1.2.2 Review of sidewalk studies

The study also reviewed relevant Government studies and documents on sidewalks in the urban environment. Please see the summary of the review in Annex 1.

1 ADDIS ABABA NON-MOTORISED TRANSPORT STRATEGY 2019-2028, Addis Ababa City Administration Road and Transport Bureau

2 IMPROVING ROAD SAFETY IN ADDIS ABABA. A report on Road Safety Inspections of Bole Road and Selected Intersections – World Resources Institute, 2015

3 SAFE NEIGHBORHOOD PROJECT Improving pedestrian safety in project area – World Resources Institute

4 Road Safety Inspection Report, IMPROVING PEDESTRIAN SAFETY ALONG THE LIGHT RAIL ALIGNMENT IN ADDIS ABABA - – World Resources Institute

5 STREET DESIGN STANDARDS FOR URBAN AREAS IN ETHIOPIA. Ministry of Urban Development and Housing

Previous studies and standards developed by the Government and NGOs have focused on planning pedestrian mobility as part of the city's non-motorized and general urban mobility. Still, none of the reports focuses specifically on pedestrians and the infrastructure required to improve the quality of walking trips. Likewise, the information available regarding the design of sidewalks can be found in the national design standards. Nonetheless, this national design information remains highly technical and mixed with information regarding other modes, making it hard to understand and apply at a ground level.

Therefore, the current study is a first attempt to integrate sidewalks, urban design, and road safety to create an integrated approach towards addressing sidewalk safety and infrastructure improvements, and promoting good maintenance practices. The study focuses on developing a quantitative and qualitative urban inventory assessment that is easy to replicate, as well as a design and maintenance guideline to inform government decision-makers, the public, including pedestrians, and development partners, filling a practice and knowledge gap that is needed to promote sidewalk improvements.

1.3 STUDY APPROACH

The project consists of four phases, as described in Figure 4, of which Phase 1 is executed throughout the entire project as stakeholder engagement is required in every step. Each Phase is described in the following subsections.

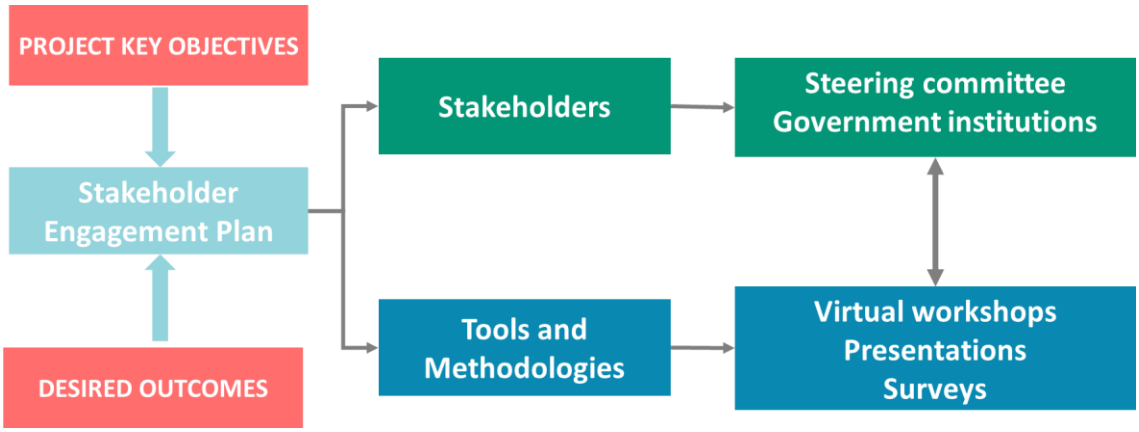
Figure 4. Phases of the project.

Source: Authors

1.3.1 Phase 1: Coordination and Engagement

Phase 1 of the study entailed an appropriate participation and consultation approach with stakeholders. Before onset, a Stakeholder Engagement Plan (SEP) was developed and agreed upon to ensure interactions and feedback of stakeholders during the study, as described in Figure 5. The involvement of different stakeholders was meant to be inclusive: it considered vulnerable groups and took their opinions and concerns into account.

Figure 5. Considerations for the Stakeholder Engagement Plan.



Source: Authors

A mapping of key stakeholders was initially developed under the guidance of the AA Planning and Development Commission, which resulted in the inclusion of the following stakeholders in the study.

- Government institutions: City Road Authority, City Traffic Management Authority, Transport Bureau, City Police Department, Ministry of Transport and Logistics, National Transport Fund Office, Addis Ababa City Rail Transport Service, Addis Ababa City Environmental Protection and Green Development Commission, Addis Ababa City Infrastructure Development Coordination, Construction Permit and Control Authority.
- Non-Governmental Organizations: World Resources Institute (WRI – Ethiopia), Institute of Transportation and Development Policy (ITDP Africa).
- Schools and communities: Students, faculty members, shop owners, and general pedestrians through user surveys.

Due to the constraints of the Covid-19 pandemic and the Government imposed safety measures, stakeholder consultations were held by means of six virtual workshops. These workshops encouraged participation with surveys and targeted questions, and sought input and feedback on technical deliverables.

- First workshop (June 2020): Initial engagement: The study objective was presented, and the team introduced to the stakeholders. The methodology proposed by the authors was shared and discussed.
- Second workshop (August 2020): Worldwide best practices: A review of identified worldwide best practices and the best way to adapt them to address current challenges in Addis Ababa.
- Third workshop (December 2020): The data collection and analysis results and the overall vision were presented to the stakeholders. A particular emphasis was made on the methodology to collect information and the findings.
- Fourth workshop (May 2021): The Gap analysis and the short-term strategies were presented. It also included the best maintenance practices worldwide, since it was a subject that was considered highly important in previous workshops and was required by the stakeholders to present a deeper analysis.
- Fifth workshop (September 2021): A summary of the complete study and the Sidewalks Design and Maintenance Guidelines was presented.
- Sixth workshop (November 2021): A dissemination event to share findings with the management of the city's transport and road agencies, and discuss how the study recommendations and guidelines can be put in practice.

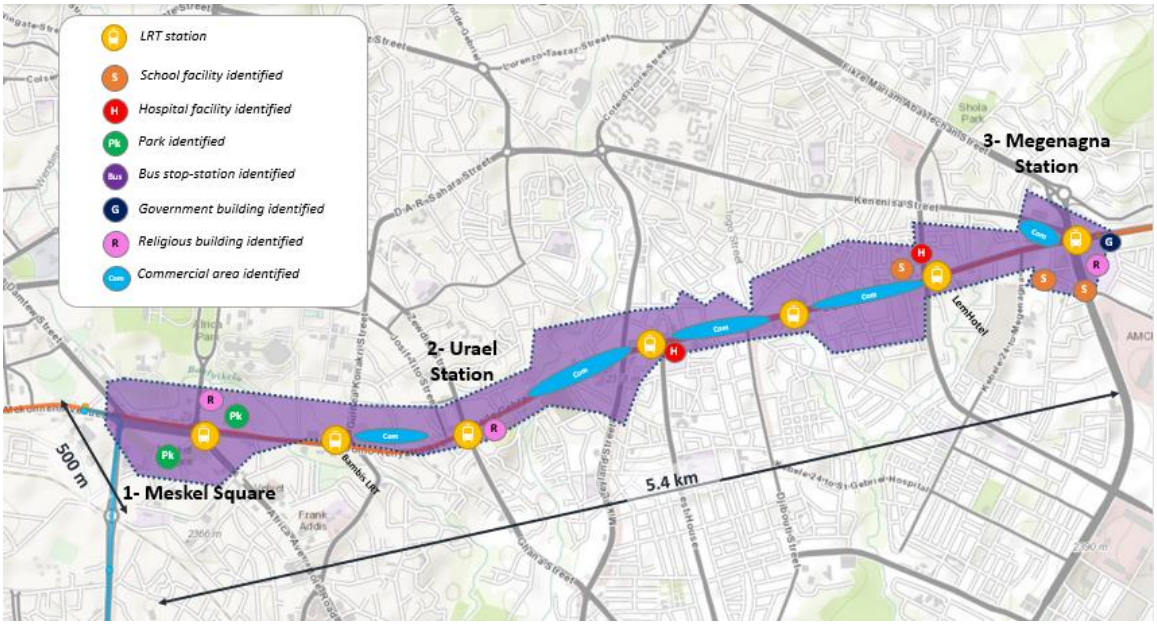
1.3.2 Phase 2: Baseline Analytics on Sidewalk Conditions

This Phase focused on defining a study area, analyzing the sidewalk conditions and pedestrian safety in the study area, and diagnosing sidewalk conditions, safety and deficiencies, with special attention to people with disabilities, students, and women. This Phase consists of the definition of the study area, data collection, analytics, and findings.

1.3.2.1 Area of study

The study area was selected through criteria agreed on with the Planning Commission, which encompasses the following: along the LRT corridors, 1-2 school sites, at least one LRT station area where ToD is planned. The final selected study area is a 5.4 km long section along the Line A LRT corridor (see Figure 6), with station area analysis on Meskel Square, St Urael Station, and Megenagna Station.

Figure 6. The selected study area (shaded in purple) along the Line A corridor.



Source: Authors

1.3.2.2 Data collection

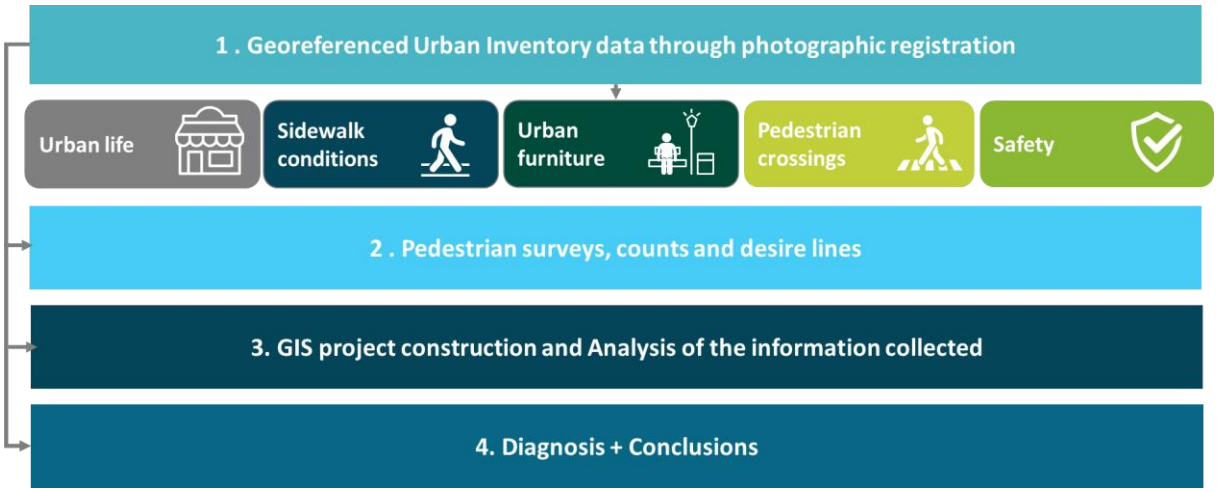
Data collection was carried out to gather information on the current situation of sidewalk conditions and pedestrian infrastructure. It included the following:

1. A digital-based field survey of the sidewalk inventory in the selected sites using georeferenced technology so that the team could pinpoint locations of concern and allow the stakeholders to view digital images. **This creates an urban inventory, a georeferenced database that captures features of sidewalk infrastructure and associated urban fabric along the sidewalk.**
2. A street survey within the key areas to obtain information regarding sociodemographic conditions, information on walking trips, and users' perceptions of walking conditions. **This informs the user experience and also validates the urban inventory.**

1.3.2.3 Analysis of walkability

The analysis brings sidewalk inventory data and user surveys into a GIS database for a spatially referenced analysis to represent a comprehensive understanding of sidewalk conditions and quality walkability from an infrastructure, user experience, and urban design perspective (see Figure 7).

Figure 7. The process of walkability analysis.



Source: Authors

Global Walkability Index. Developed by the ITDP, this index quantifies sidewalk walkability based on the information gathered from urban inventory. Through a set of metrics and criteria, the walkability index depicts the conditions that can be easily understood and benchmarked against different areas of the city or other similar cities. This methodology can also be used to track progress towards building a walkable environment.

The input indicators for the Index are related to the elements of the Urban Inventory. Each subcategory is divided into different scoring criteria to assign a quantitative attribute to each GIS point on the GIS database. First, elements of urban life and sidewalk conditions such as permeable fronts, access to public transport systems, sidewalk dimensions, and pavement conditions are considered. Secondly, elements associated with urban furniture like trees, benches, lighting and obstacles are applied. Finally, indicators relating to pedestrian crossings, universal accessibility, and safety perception are evaluated.

The global walkability index is then calculated using the following equation:

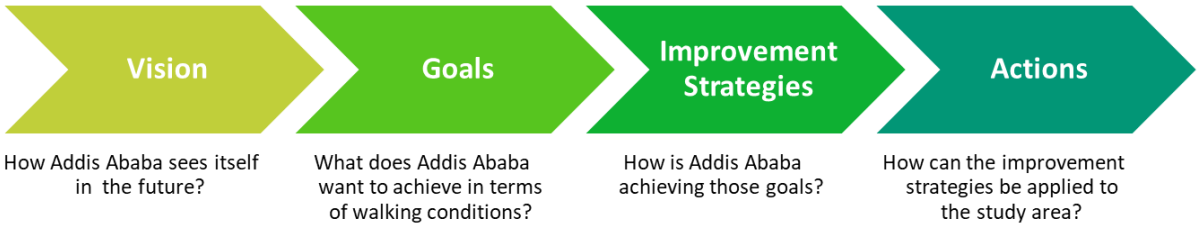
$$GLOBAL\ WALKABILITY\ INDEX = Variable_1 * Weight_1 + Variable_2 * Weight_2\ (\dots) + Variable_n * Weight_n$$

$Variable$ = Variable or indicator definition
n = Indicator quantification according to primary data
$Weight$ = Definition of the weight of variables
$GLOBAL\ WALKABILITY\ INDEX$ = Quantification of the global index

Source: ITDP Global Walkability with authors' modifications for the Adds Ababa context

1.3.3 Phase 3: Vision, Goals and Improvement strategies

Figure 8. Vision to actions approach.



Source: Authors

Based on the Vision design for Addis Ababa in the Sustainable Integrated Transport Development Plan of 2019, general goals to improve pedestrian infrastructure and sidewalk conditions in Addis Ababa are identified. Through a gap analysis (the difference between what AA has today and what the city wants to have in the near future), the study can then propose improvement strategies to bring the city closer to achieving the proposed goals.

Other cities around the world have faced problems similar to those identified in Addis Ababa. Taking advantage of the experience and success of other cities and countries around the globe with similar urban characteristics would complement the study and feed the formulation of those improvement strategies in AA.

1.3.4 Phase 4: Guidelines and short-term actions

The study creates short-term strategies, develops sidewalk design and maintenance guidelines, and proposes low-cost improvements for the selected LRT station areas based on detailed analysis as actionable projects for the city to finalize the design and implement it.

2 BASELINE ANALYTICS ON SIDEWALK CONDITIONS

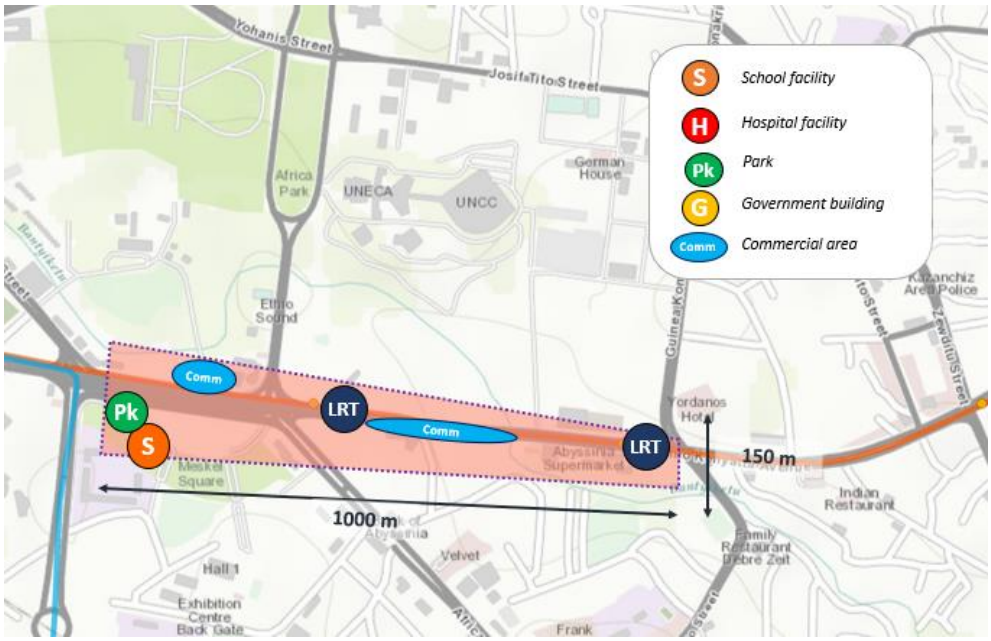
This chapter presents the innovative methodology used for data collection and the analytics that summarize the findings pertaining to sidewalk conditions, walkability, and user experience.

2.1 STUDY CORRIDOR AND STATION AREAS

As discussed in Chapter 1, Section 1.3, the study area was defined based on stakeholders comments and the requirements previously set by the study. Along the selected corridor, three station areas were identified for focused analysis as they considerably generate and attract pedestrian mobility, and have mixed facilities in the station area. These three locations are listed below:

Meskel Square has a length of approximately one kilometer and is an important transport hub where the two LRT lines converge. This connection generates large numbers of passengers boarding and alighting the LRT system, many of whom travel to offices, retail stores and an educational institution (St. Joseph School) in the area.

Figure 9. Meskel Square study area (shaded in light pink).



Source: Authors

St Urael Station is an essential commercial and financial center with religious venues and a main intersection, including St Urael Church and the AB Zone Business Center.

Figure 10. St Urael Station study area (shaded in light yellow).

Source: Authors

Megenagna Station is a hub for transit movements and is forecast to become a Transit Oriented Development (TOD) center. Currently, there is an elementary school and Government buildings within the study area.

Figure 11. Megenagna Station study area (shaded in light yellow).

Source: Authors

2.2 DATA COLLECTION METHODOLOGY

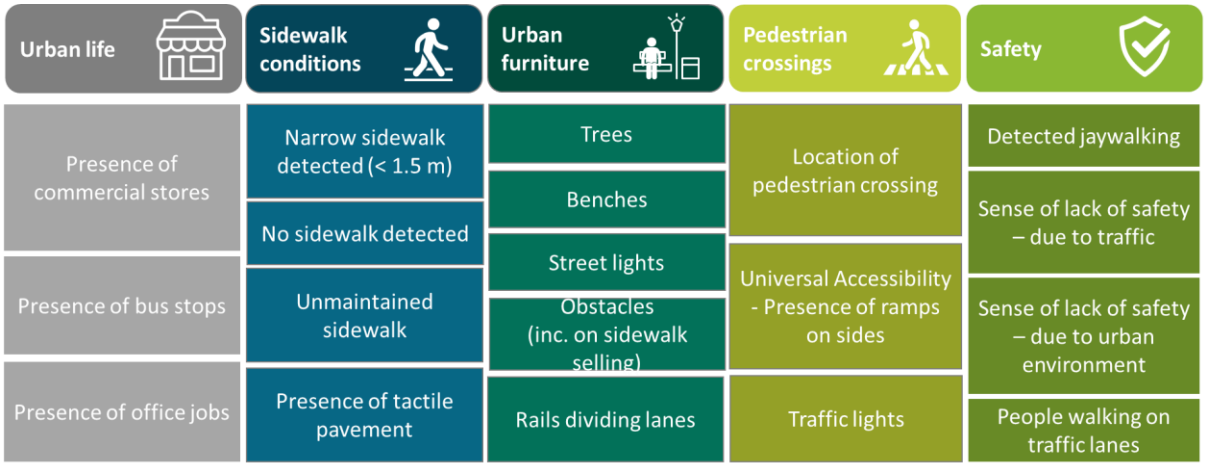
The purpose of collecting information is to identify and define current sidewalk conditions in the study area. Data collection captures all elements that make a sidewalk more walkable and information on sidewalk user preferences. The information was collected using two different methodologies: a georeferenced **Urban Inventory** based on photographic records and a mobile application to register urban elements and **User Surveys** in the studied corridor.

2.2.1 Urban Inventory

It is undeniable that sidewalk conditions and the urban elements that compose them are what define the attractiveness of a space for walking. In other words, a sidewalk that is comfortable to walk on with stores and activities, and where people feel safe will be inviting.

Therefore, a survey of the current sidewalk conditions in the study area was conducted. The first step was to identify and classify the elements that could hinder or discourage the presence of pedestrians. The elements identified were separated into five categories: Urban Life, Sidewalk Condition, Urban Elements, Pedestrian Crossings, and Safety. The detailed scheme in which each of the five categories includes subcategories is illustrated in Figure 12. Based on the authors' previous experience with similar projects, these indicators were adapted based on the indicator set by the Institute of Transportation and Development Policy (ITDP).

Figure 12. Indicator classification for the urban inventory



Source: Authors built up ITDP Guidelines: Pedestrians first Tools for a Walkable City (ITDP, 2018)

Subsequently, the local team was provided with mobile phones and trained to use the ArcGIS survey app (see Figure 13). The team then walked on the streets of the study area and took photos whenever they encountered any of the elements. The crew took as many pictures as possible using mobile phones to create a complete visual reality for later analysis. The application used had the elements pre-loaded, so the local team could know what to look for, select the category and subcategory, and assess the

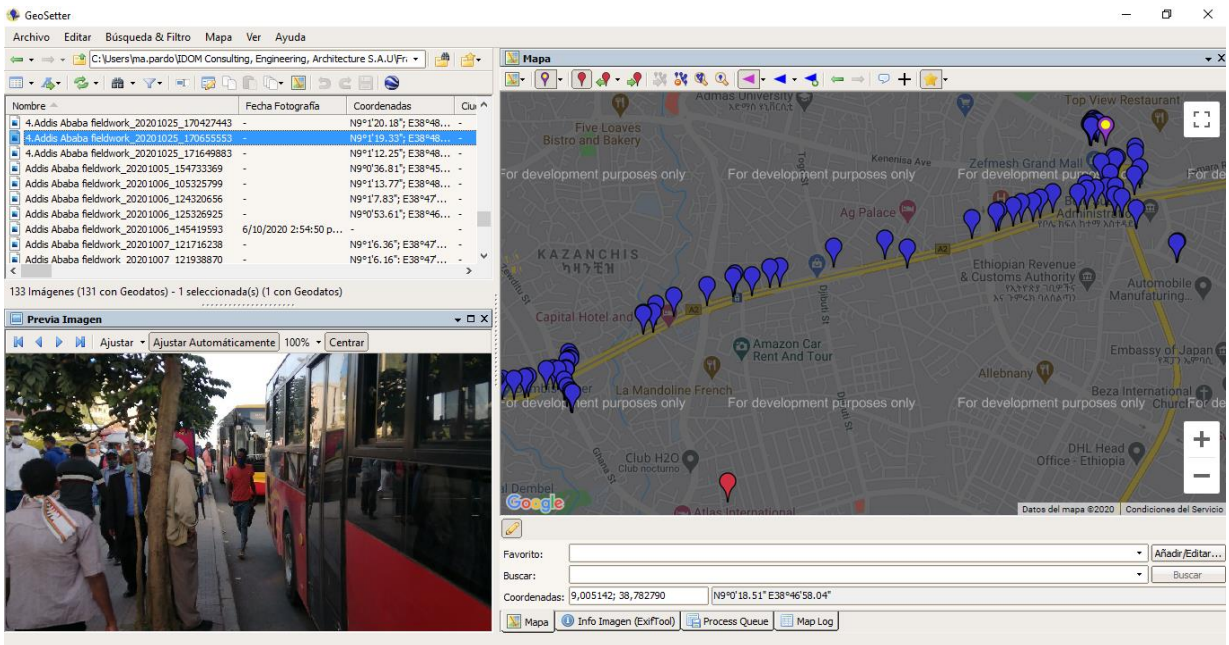
element while taking the picture, and then, facilitate the subsequent desk analysis. The advantage of this methodology is that no social contact on the field is required, given the Covid-19 pandemic.

Figure 13. Field work training

Source: Authors

Afterwards, GPS software was used to geolocate the 500 pictures taken and create a Keyhole Markup Language (KML) file for each subcategory. The KML files were later exported to a shapefile (SHP) for further analysis using GIS software. Figure 14 illustrates the geolocation processing of the pictures classified under *Urban Life-Presence of Bus Stops category* using the *GeoSetter* software.

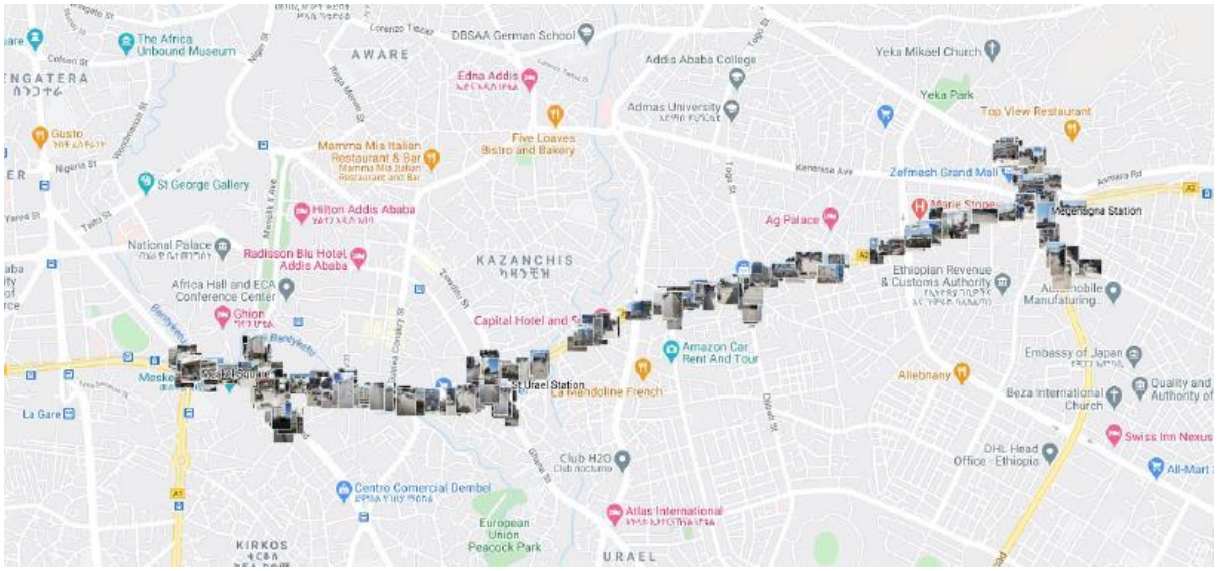
Figure 14. Example of picture geolocation to create KMZ file for the indicator of bus stop presence



Source: Authors

This process resulted in a set of GIS files, one for each subcategory or indicator, containing the location of the element or characteristic defined. Next, the GIS files were imported to a web mapping service, in this case, Google Maps, as illustrated in Figure 15.

Figure 15. Example of one of the GIS files created viewed in Google Maps



Source: Authors

There are other potential tools available for conducting an urban inventory, such as Mapillary, a free platform, or a Computer Vision analysis. While the team decided to use the tool that was adaptable to the needs of this project, the following paragraphs seek to provide an overview for the cities to consider the applicability of alternative tools.

The Mapillary platform allows a camera to easily capture street level imagery and to automatically analyze it with computer vision technology by detecting features such as road markings and traffic signs. Mapillary has the advantage of being free of charge, with photos georeferenced, anonymized (face and license plate), good interfaces with GIS and OSM, free storage, free object recognition, and map feature extraction functions. However, Mapillary doesn't provide information for all categories in ITDP's Walkability methodology and doesn't allow for an on-site conditions assessment of these elements.

The Computer Vision analysis uses fixed camera video footage for road safety assessments and relies on the combination of two processes. The first is object detection and classification in categories of interest (e.g. person, car, bus, and bicycle). The second is object tracking, the process of following detected objects through different frames of the footage to trace each object's trajectory. The output is a dataset that contains objects' positions and trajectories providing information on how road users and pedestrians are using the space. Based on sidewalk area definitions, different indicators can be used to estimate sidewalk usage by the application of an automated machine learning model. This is an affordable approach considering that it can be done with footage that has already been collected for other purposes. However, it can only be implemented for a limited number of locations since it does not perform an automatic analysis. Another limitation is that it only uses what is within the frame of collected footage, without taking into consideration the infrastructure of the area or network.

2.2.2 User Surveys

Survey questionnaires were distributed at specific locations throughout the study area: office buildings, stores, educational institutions, among others, and then collected after several days. In total, more than 300 surveys were answered. The surveys focused on declared preferences and had 26 questions divided into the following four sections:

- Sociodemographic: age, occupation, income, education level.
- General walking activity: description of walking activity, walking ability, walking frequency.
- A specific walking trip in the study area: point of origin, destination, travel time, frequency, purpose, reason for walking.
- Conditions of the area: user perception.

2.3 WALKABILITY FINDINGS

This section provides description of the indicators that represent key angles of Urban Inventory elements in the study area. It then presents the Global Walkability Index and displays the index.

2.3.1 Urban inventory assessment on sidewalks

Urban life

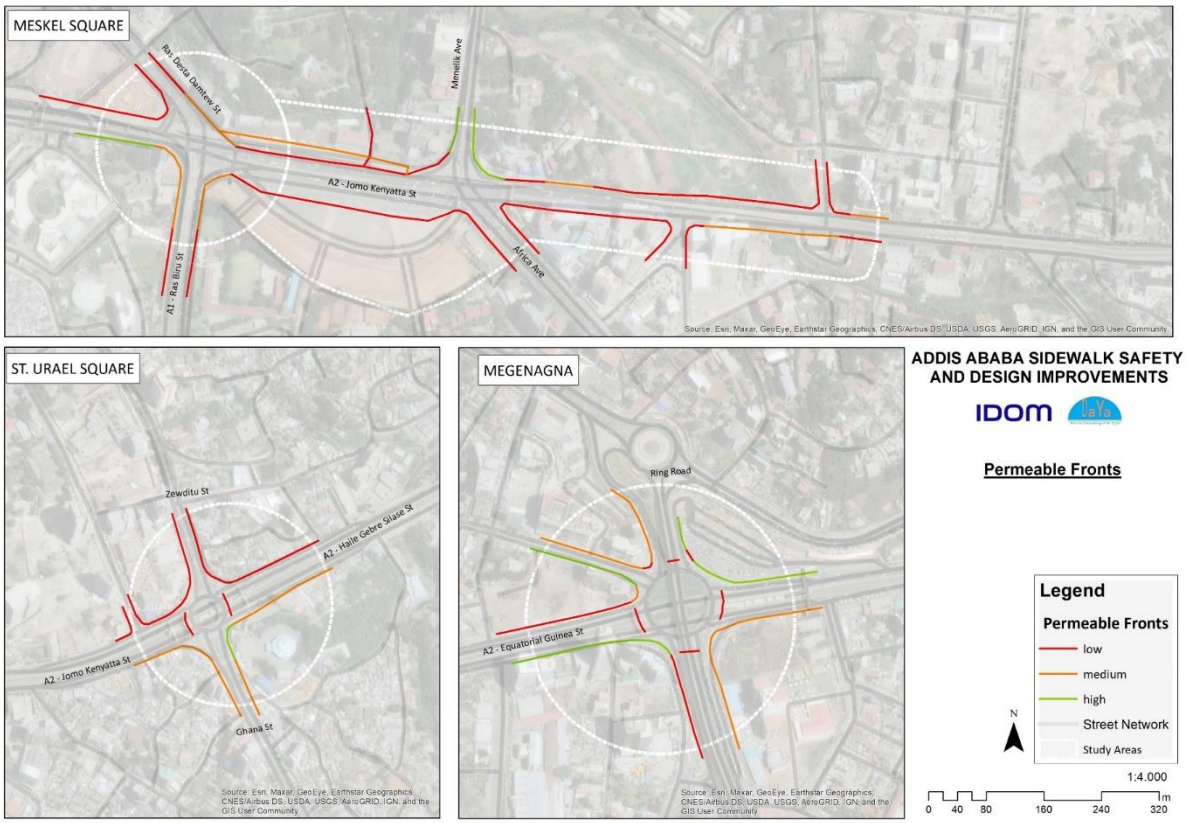
Permeable access to building fronts. Street permeability depicts the level of activities by front properties adjacent to the sidewalk and measures how sidewalks are connected and accessible with regard to indoor activities. A permeable front often incentivizes walking and promotes attractive activities for pedestrians in the public space, such as neighborhood shops, restaurants, or cafes, making the environment more dynamic. High permeability is defined by those fronts that promote pedestrian activity and allow pedestrians access. On the other hand, fronts that are not very permeable discourage activities in public spaces, generating a perception of insecurity or lack of leisure opportunities for pedestrians, especially at night. Fronts are classified according to their degree of permeability, into different categories as shown below.

POOR/LOW	FAIR/MEDIUM	GOOD/HIGH
		

In the study area, only 15% of the network has fronts with high permeability. In contrast, more than half the network (55%) having fronts with low permeability (see Figure 17 below). This finding calls for the need to incorporate land-use policies and enhance mixed-use as part of sidewalk

development strategies. It must be highlighted that the area near Megenagna Station has a large section with good permeability, mainly due to commercial facilities.

Figure 16. Permeable or accessible front indicator quantification for the studied area.



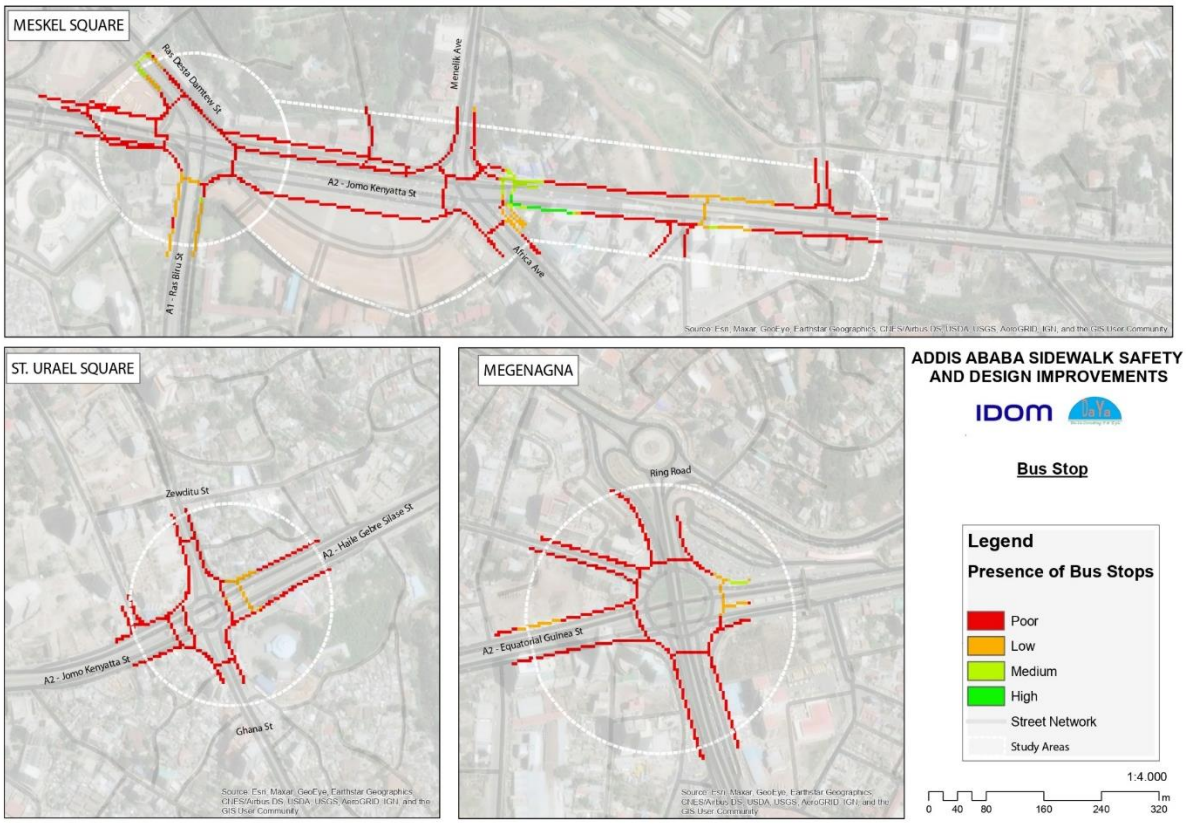
Source: Authors

Bus stops. Places with well-defined bus stops tend to incentivize the use of public transport as bus riders can easily walk from bus stops to local destinations. It also gives a sense of security and attracts more pedestrians under public visibility. The bus stop indicator is divided into three categories.

POOR/LOW	FAIR/MEDIUM	GOOD/HIGH
		

A bus stop analysis was conducted using a raster analysis with GIS software that reveals areas with high, medium, and poor presence of bus stops. **Most of the transport network has a low presence of adequate bus stops, which discourages last-mile connection for bus riders, leads to the emergence of informal ones, and generates road safety risks.**

Figure 17. Bus stop indicator analysis in the study area.



Source: Authors

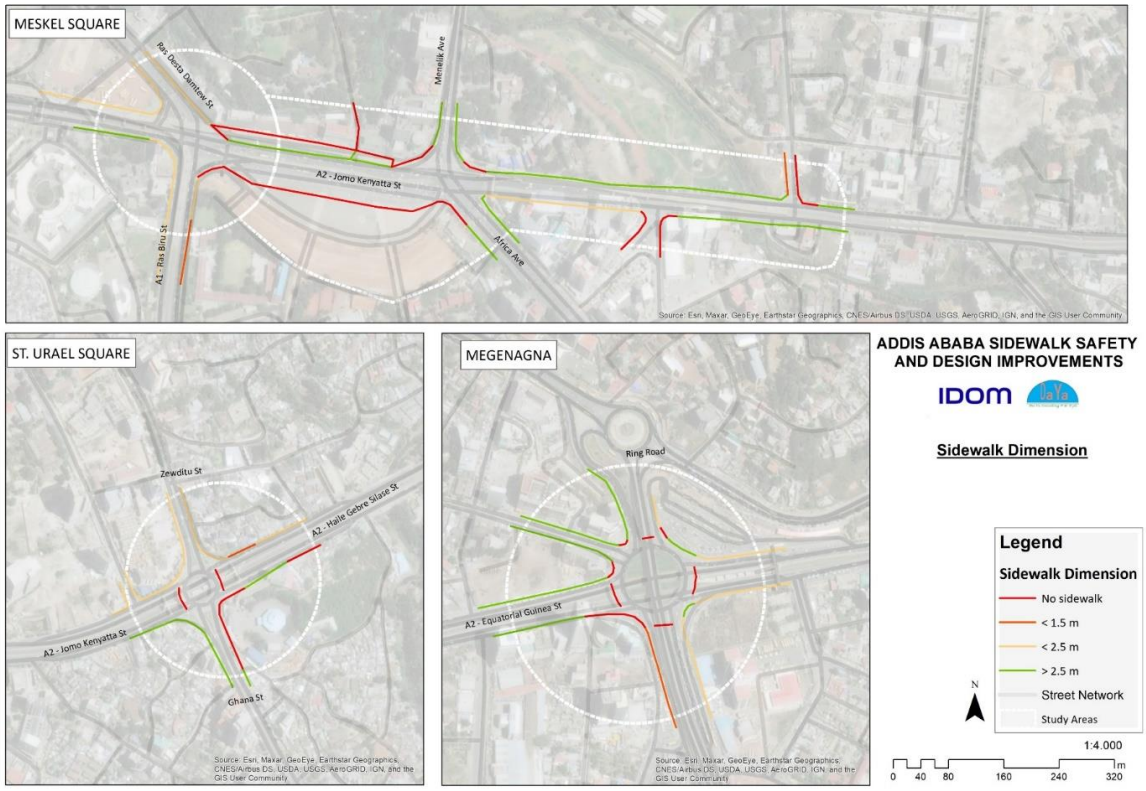
Sidewalk conditions

Sidewalk dimensions. Dimensions refer to the space available for pedestrians to circulate. The appropriate sidewalk width provides a comfortable and enjoyable experience. Four categories are established based on international guidelines and observations on the field, as illustrated below. The category "very poor" corresponds to the absence of pavement or sidewalk. Subsequently, narrow sidewalks (poor/low) are considered those with a width of less than 1.5 meters (m). Next, an average sidewalk (fair/medium) is one with a width over 1.5 m. and lower than 2.5 m., and finally, optimal sidewalks (good/high) have a width of more than 2.5 m.

VERY POOR	POOR/LOW	FAIR/MEDIUM	GOOD/HIGH
			

In the study area, 39% of the network has sidewalk widths greater than 2.5 meters, while 29% measure between 1.5 and 2.5 meters, indicating that 68% of sidewalks have acceptable dimensions in this LRT segment. However, 26% of the network (shaded in red) doesn't have any sidewalks at all, and those areas must be prioritized.

Figure 18 Sidewalk width indicator quantification for the study area.



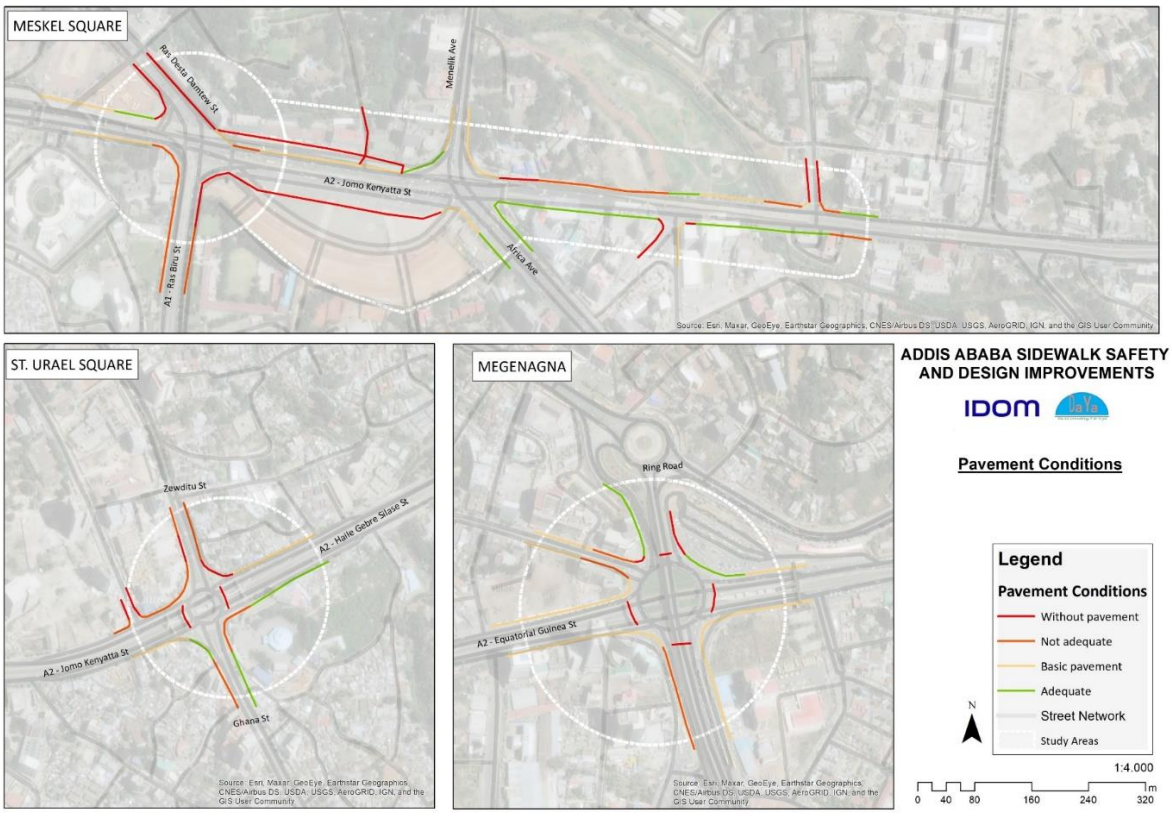
Source: Authors

Pavement conditions. This refers to the adequate use of pavement materials and incorporation of textures to delineate spaces, as well as drainage quality. Acceptable materials for sidewalks provide a more comfortable experience for pedestrians. Better drainage and better pavement translate to fewer flooding issues.

VERY POOR	POOR/LOW	FAIR/MEDIUM	GOOD/HIGH
			

The results indicated that nearly 50% of the sidewalks are in the poor to very poor category, including 26% of the network which doesn't have any pavement and 23% that has very poor pavement conditions, which must be prioritized. Only 19% of the network has pavement in good conditions, and 32% ranks in the range of fair/medium.

Figure 19. Pavement conditions indicator quantification for the studied area.



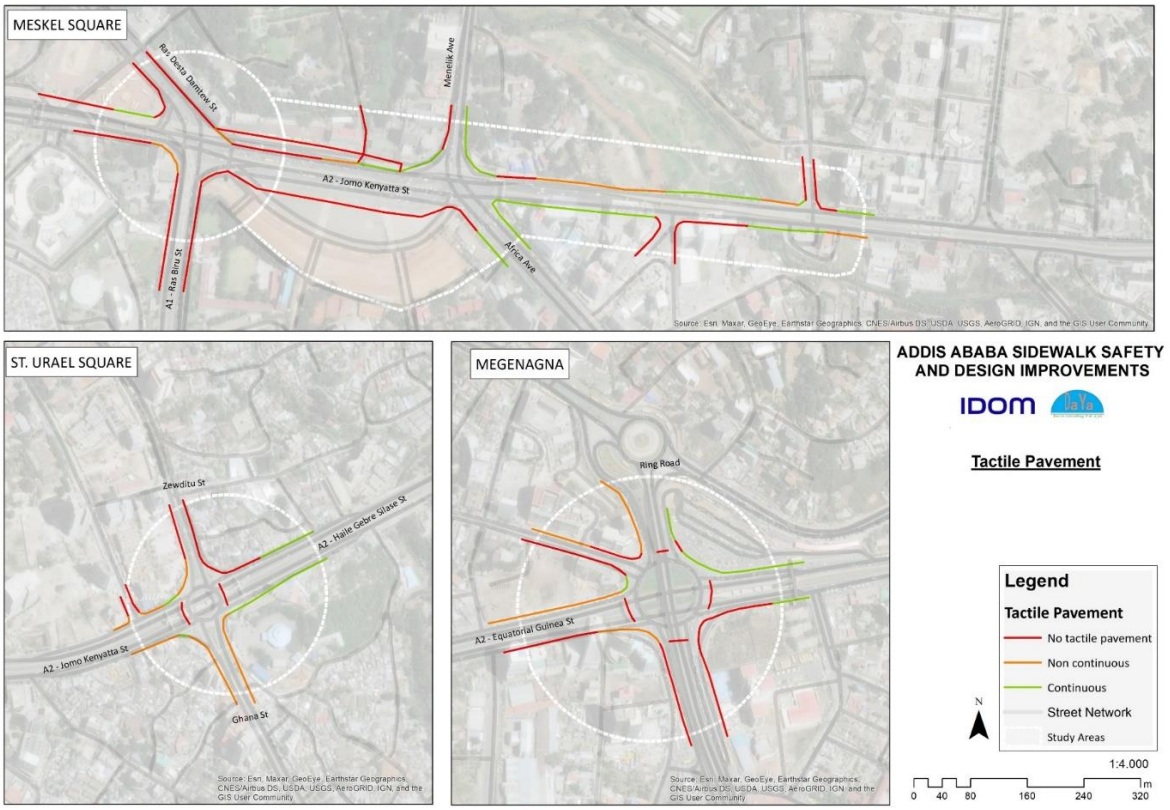
Source: Authors

Tactile pavement. Pod tactile floor for visually disabled persons is a surface with a texture that visually impaired pedestrians can recognize when stepping on it. The presence of this type of flooring translates to safety for users with reduced sight. However, it is not desirable to have non-continuous tactical flooring along the sidewalk. Thus, three categories have been established: the presence of continuous tactile pavement, the presence of non-continuous pavement, and its absence.

POOR/LOW	FAIR/MEDIUM	GOOD/HIGH
		

54% of the network has no tactile pavement for visually impaired users. Only 24% of the network has continuous tactile pavement on the newly built segment.

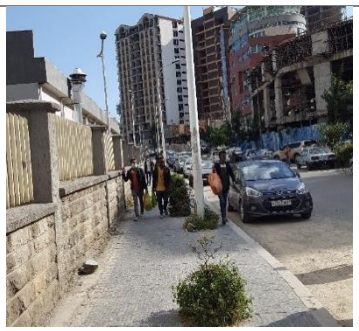
Figure 20. Tactile pavement indicator quantification for the study area.



Source: Authors

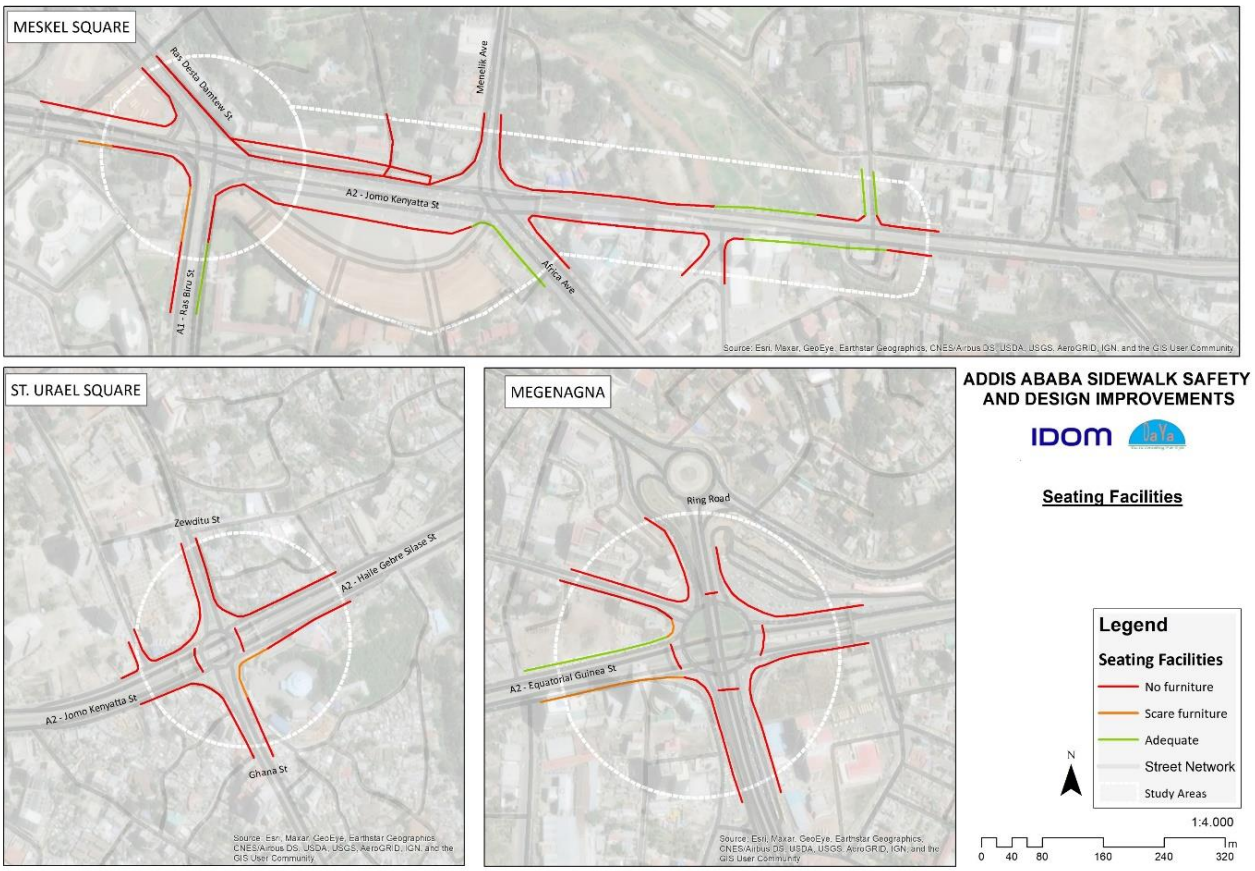
Urban furniture

Seating infrastructure. The presence of urban furniture including seating is indispensable for users' comfort. Three different categories were defined for these elements (absence, inadequate and adequate).

POOR/LOW	FAIR/MEDIUM	GOOD/HIGH
		

81% of the network lacks seating furniture, and only 13% has adequate seating infrastructure. The 6% left has furniture, but its conditions are inadequate, making it unusable.

Figure 21. Seating infrastructure indicator quantification for the study area.



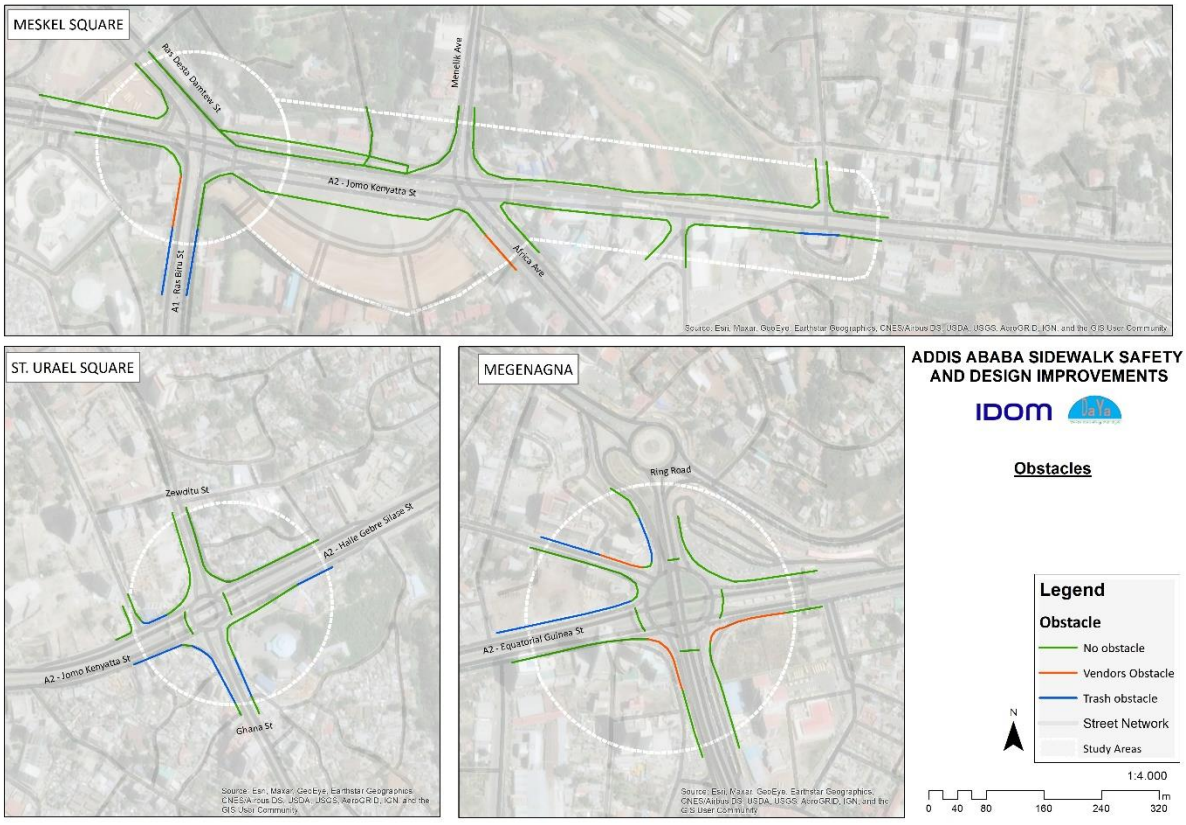
Source: Authors

Obstacles. A variety of obstacles on sidewalks have negative effects on their users and represent a road safety risk because they reduce the space available, and even cause users to step off the sidewalk and into vehicle traffic.

POOR	GOOD
	

In the studied area, 20% of the sidewalks are obstructed. Most obstructions are caused by trash, holes, or construction waste (63%). However, it can be observed that street vendors (37%) occupy more of the street width than trash. Therefore, relocation or formalization of vendors should be prioritized.

Figure 22. Obstacle type quantification for the study area.



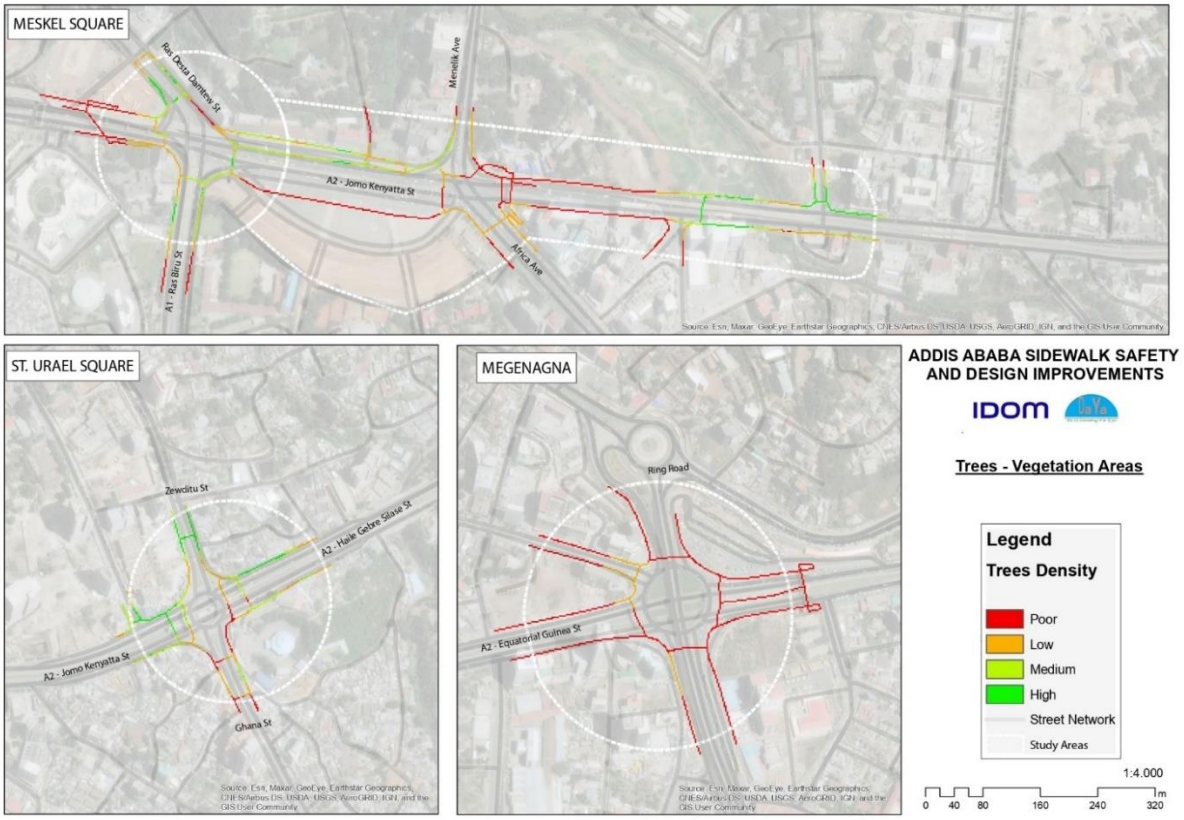
Source: Authors

Trees. Vegetation is an essential element on the sidewalks because it provides shading. Sometimes trees can also act as a barrier for pollution and protection from rain. The tree density analysis was conducted differently from other indicators: the evaluation was carried out using a raster analysis in the GIS software.

POOR/LOW	FAIR/MEDIUM	GOOD/HIGH
		

The presence of trees is significant in a large part of the segments analyzed, especially in St Urael Square and Meskel Square. Evidence suggests that new sidewalk designs contain an adequate density of trees. **The study reveals that 13% of the studied area has high density, 16% has medium density, 23% has poor density, and finally, 49% has no trees**. For instance, the area near Megenagna station has a very low tree density.

Figure 23. Tree density indicator analysis in the study area.



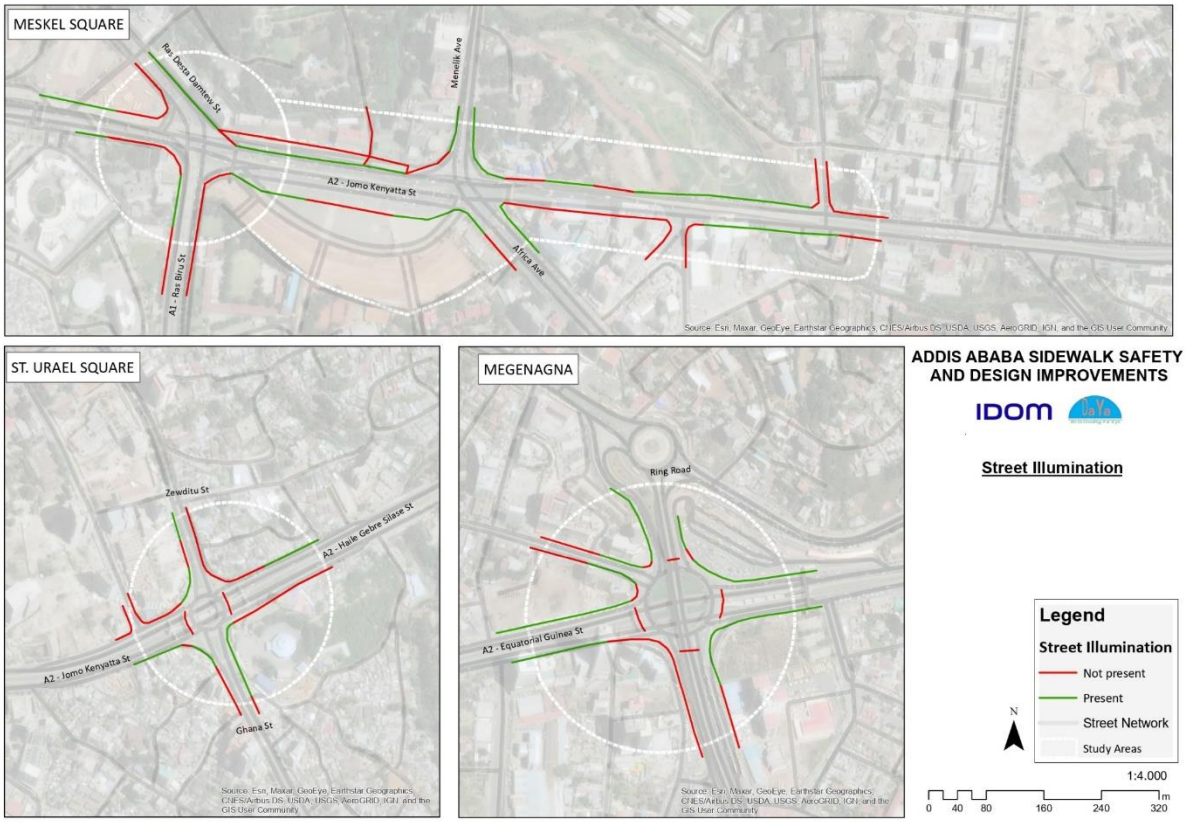
Source: Authors

Lighting. Adequate lighting in public spaces, especially sidewalks, improves security perception, especially at night and for women.

POOR	GOOD
	

Street lighting requires improvements, given that **only 48% of the street network has adequate street lighting**. This is crucial to improve the perception of personal safety for pedestrians, especially in the evening.

Figure 24. Street lighting indicator quantification for the study area.



Source: Authors

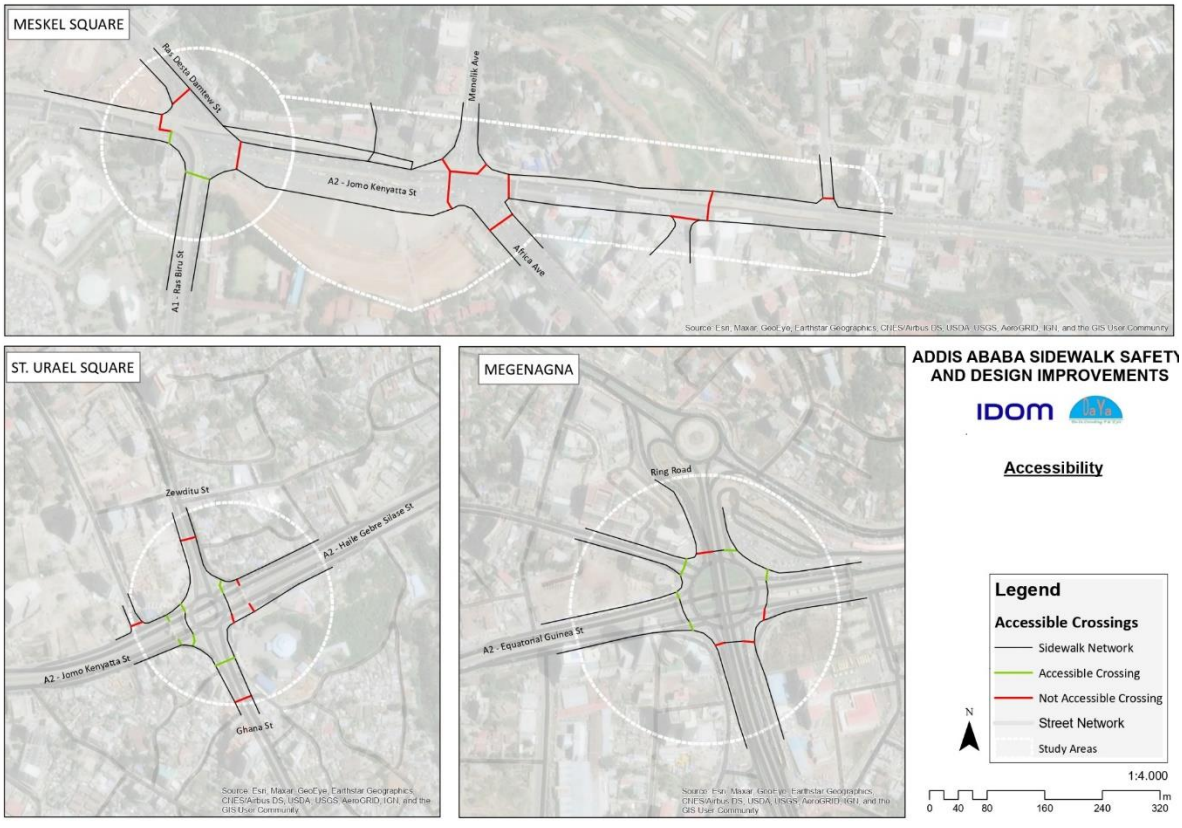
Pedestrian crossings

***Accessible crossings*.** The degree of crossing accessibility is associated with the characteristics of a pedestrian crossing. The degree of accessibility is provided by elements that allow persons with reduced mobility (PRM) to make use of a sidewalk without difficulty and is reflected by pedestrian signaling, traffic lights, and adequate accessible ramps especially for people with mobility constraints.

POOR	GOOD
	

65% of crossings are not accessible for PRM. Most dangerous pedestrian behaviors were identified at these crossings.

Figure 25. Accessible crossings indicator quantification for the study area



Source: Authors

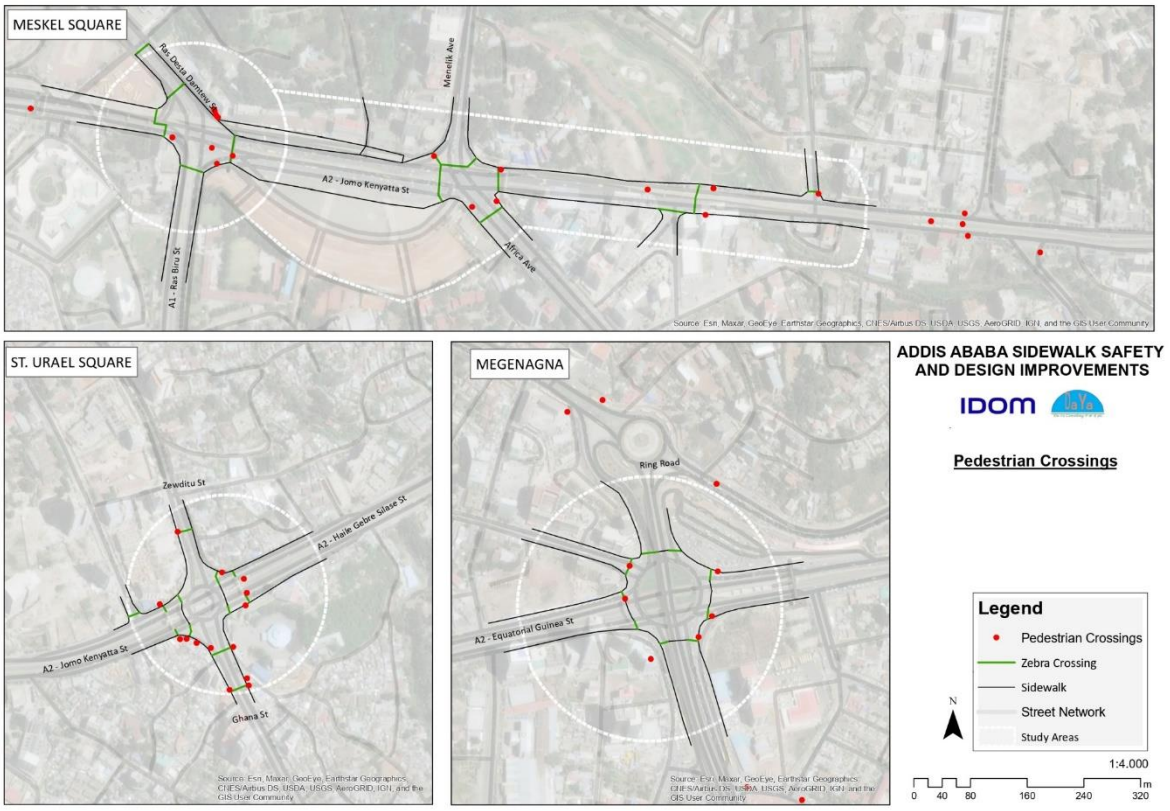
Safety

***Improper crossings*.** Identifying locations where improper crossings occur (jaywalking) indicates that there are inadequate numbers and density of pedestrian crossings along the corridor. This indicator identifies the locations where improper crossings happened during the urban inventory.

POOR	GOOD
	

The following figure illustrates the classification of crossings and indicates the locations of improper pedestrian crossings. **79% of the network in the studied area is associated with improper crossings.** Most identified inappropriate pedestrian behaviors occur near existing crossings, which may indicate their lack of quality.

Figure 26. Pedestrians crossing improperly in the study area



Source: Authors

2.3.2 Global Walkability Index Findings

To develop the Global Walkability Index (see Chapter 1), the weight value for each sidewalk feature was defined. According to ITDP's Methodology and the experience of the authors in similar projects, the importance of each variable is defined as follows. A general weight factor and a school area weight factor are differentiated because children have specific needs that warrant more weight in certain variables. In this case, it is important to have adequate crossing accessibility for children's walkability.

Table 1. Weight factors for each variable to calculate walkability index

Key Features	General Weight Factor	School Area Weight Factor
Permeable Fronts	**8%**	**6%**
Sidewalk Dimensions	**18%**	**20%**
Pavement Conditions	**18%**	**18%**
Seating Infrastructure	**9%**	**8%**
Street Lighting	**9%**	**6%**
Obstacle	**5%**	**5%**
Crossing Accessibility	**14%**	**20%**
Improper Crossing	**5%**	**5%**
Trees	**14%**	**12%**

Source: Authors

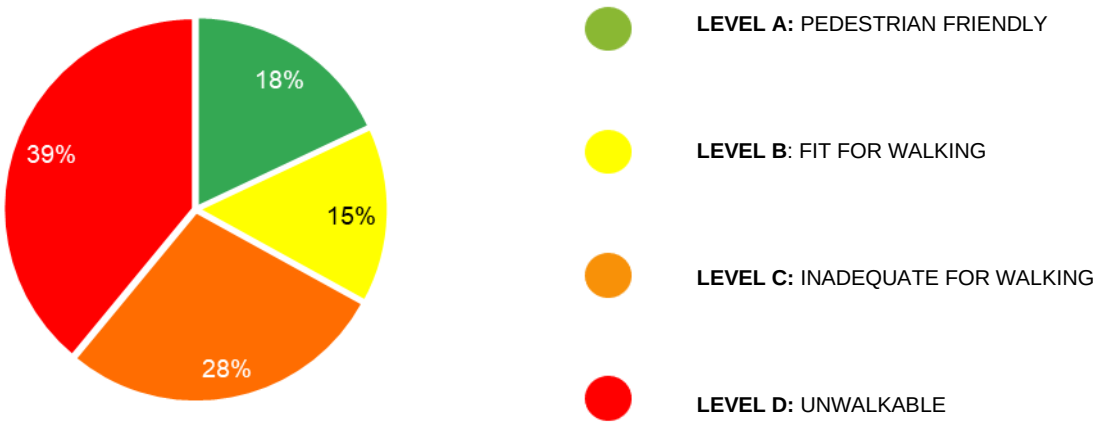
After the numerical quantification of each variable for the specific segment of the network, the Global Walkability Index was calculated using both general weight factor and a school area weight factor. Thus, even though the Walkability Index's total value changes depending on the weight input, the overall classification level was the same for both analyses. This analysis can also be used as a tool for prioritizing improvements.

LEVEL A: PEDESTRIAN FRIENDLY	LEVEL B: FIT FOR WALKING	LEVEL C: INADEQUATE FOR WALKING	LEVEL D: UNWALKABLE
			

According to the network classification, the higher the Walkability Index score, the higher the classification level. This means that more criteria are met in terms of a sidewalk being pedestrian-friendly, and therefore, that the segment is more walkable. Level A indicates that most of the criteria identified are complied with. Level B refers that although the most relevant criteria are met, the sidewalk still requires some form of minimal investment to be of optimum quality. Level C conveys that the sidewalk requires major improvements in order to become walkable (this includes sidewalk

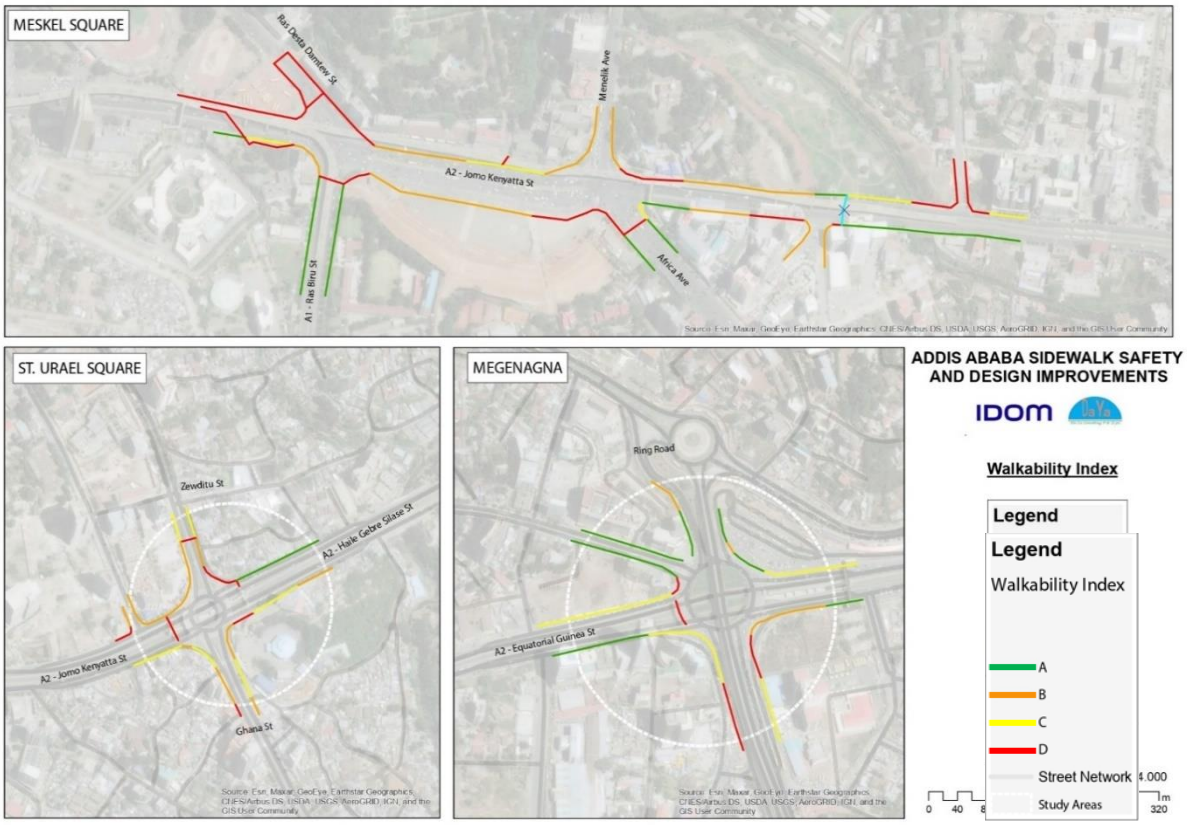
reconstruction), while level D means that the sidewalk is either non-existent or unusable, and requires redesign.

Figure 27. Classification Levels of the Global Walkability Index and percentage of distribution on the pedestrian network.



Source: Authors

Figure 28. Global Walkability Index Estimation



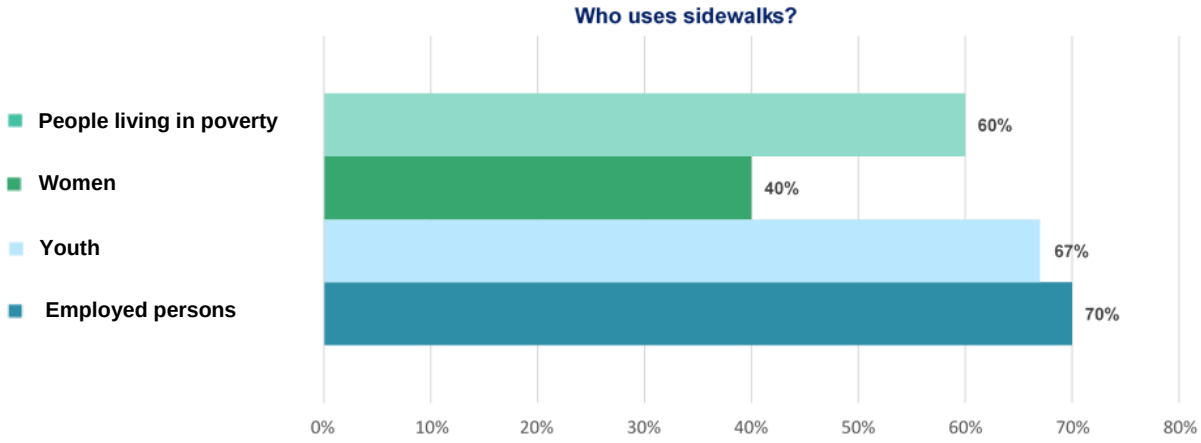
Source: Authors

As illustrated in Figure 29, **67% of the network is classified under Levels C and D. It must be highlighted that 39% of the network is classified under Level D.** Only 18% has a good walkability index, namely Level A (shaded in green), and another 15% of the network is classified under Level B shaded in Orange.

2.3.3 User experience findings

This section describes the main findings from the user survey. It can be noted that almost 40% of the users are women, and that most users are young and middle-aged adults (18 to 35 years, representing 67% of the total) for both genders (see Figure 29). However, participation of kids in school-age (under 18) was also considerable: 10% of the sample's total. This is consistent with a downtown commercial area with offices and other types of buildings, such as schools and religious facilities.

Figure 29. Sidewalk Users



Source: Authors

Analysis based on gender suggests that slightly more men (60%) participated in the survey than women (40%).

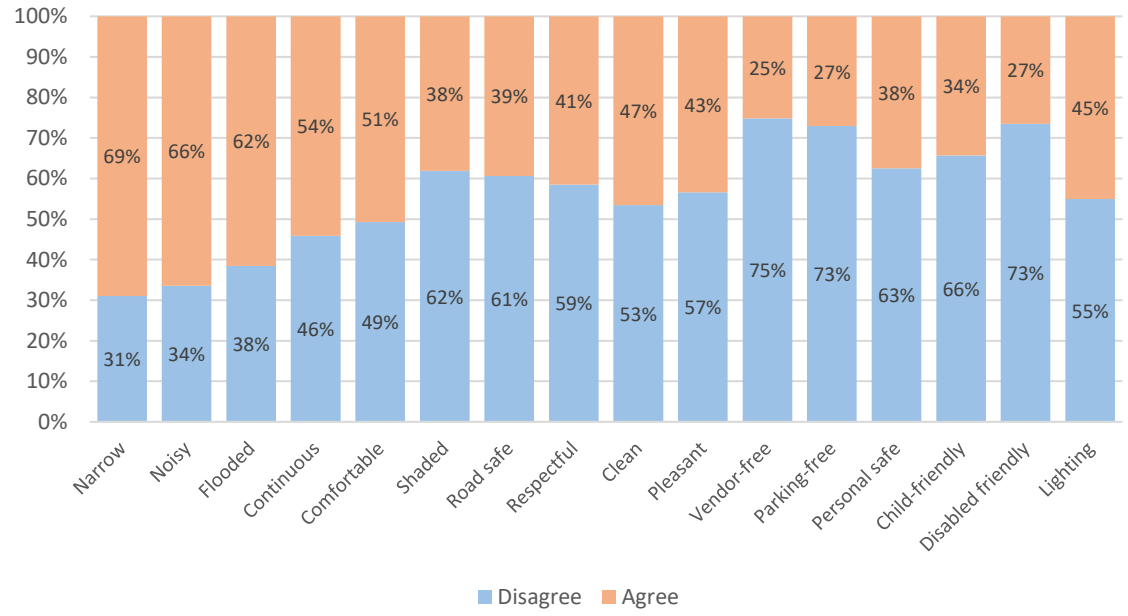
- **Women have an average income 21% lower than the average income for men.** More than 55% of women find themselves below the mark of 5,000 Ethiopian Birr.
- **There are more employed men (60%) than women (40%)**.
- Educational level suggests that most of the surveyed individuals have a university degree (45%), 80% of them, men.
- **There are no considerable gaps based on gender in walking patterns or user perception,** apart from slight differences in travel time and purpose, comfortability, and accessibility.

Overall, user experiences are summarized below and captured in Figure 30.

- **More than 60% of survey participants reported walking almost every weekday for work or school trips.** This refers that the corridor has a vast potential in terms of adding walkable segments to commuting trips.

- **Users perceive that sidewalks are inaccessible (75%), unsafe in terms of infrastructure quality (66%) and unsafe in terms of exposure to traffic (63%).** Similarly, users feel that sidewalks are inadequate for children (66%) and disabled persons (73%).
- **Most sidewalk users (70%) consider that streets are obstructed by street vendors, parking, or other obstacles:** encroachment due to parking (73%) and blockade by vendors (74%).
- **Crossing points are scarce.** 63% of users reported a lack of crossing points.
- **Users hold strong views on other negative aspects of sidewalk conditions**, including narrowness (69%), noise (66%), flash flooding (62%), and lack of continuity (54%) (See Figure 30).

Figure 30 Survey results of user experience



Source: Authors

2.3.4 Summary

The application of digital data collection regarding sidewalk conditions and user surveys, combined with the use of several analytical tools, including a georeferenced inventory database and global walkability index, helped the team test the innovative method in the studied corridor and allowed for the revealing of a comprehensive picture of sidewalk conditions and walkability from an urban design, road safety, and user experience perspective.

It is reassuring that the sidewalk network within the study area is adequately wide, with 39% over 2.5 meters, and secondly, 29% between 1.5 meters and 2.5 meters. Street lighting can be found in 48% of the sidewalk network. The urban inventory also showed that sidewalk features are clearly better in the recently built segments.

Nevertheless, even in this bustling urban corridor with LRT service, walkability is far from ideal for pedestrians and public transport users. Considering key sidewalk features, nearly two-thirds of crossings are inaccessible, and it is important to remember that most dangerous pedestrian behaviors occur at crossings. More than half of the network in this urban center corridor has no tactile pavement for visually impaired users and no adequate street lighting. **As a result, 67% of the network falls under the C and D category levels of the Global Walkability Index, confirming the deficient, unsafe sidewalk conditions**.

Users further corroborated analytical findings with their own experience, citing that sidewalks are inaccessible (75%), unsafe in terms of infrastructure quality (66%) and unsafe in terms of exposure to traffic (63%), and the majority of sidewalk users (70%) considers that streets are obstructed by street vendors, parking, or other obstacles.

These analytical findings will feed into the study's formulation of short-term strategies and guidelines for sidewalk design and maintenance.

3 VISION, GOALS, AND IMPROVEMENT STRATEGIES

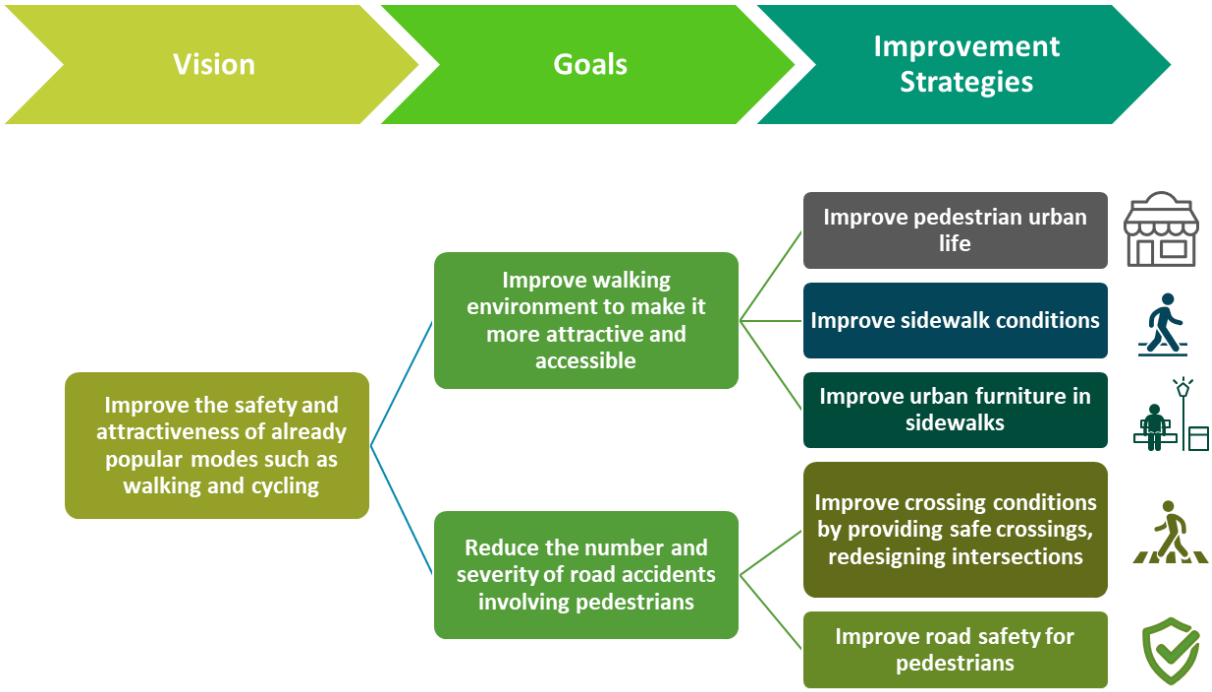
The improvement strategies proposed by means of this study are aligned with the transport and mobility vision for the city, defined in the Addis Ababa Transport Development Plan of the Addis Ababa City Transport Bureau. The city published its Vision for Sustainable Transport in Addis Ababa: 2020 to 2030.

As part of this Vision, three main 2030 Goals were presented:

- To promote rapid and affordable mass transit, including light rail, rapid and local bus transit;
- To improve the safety and attractiveness of popular modes, such as walking and cycling;
- To contain the growth of privately owned vehicles so as to minimize traffic congestion and pollution.

Within the framework of the overarching 2030 vision for pedestrian mobility, this study focuses on the short-term strategies to help the city move in that direction; therefore, short-term goals are defined (see Figure 35).

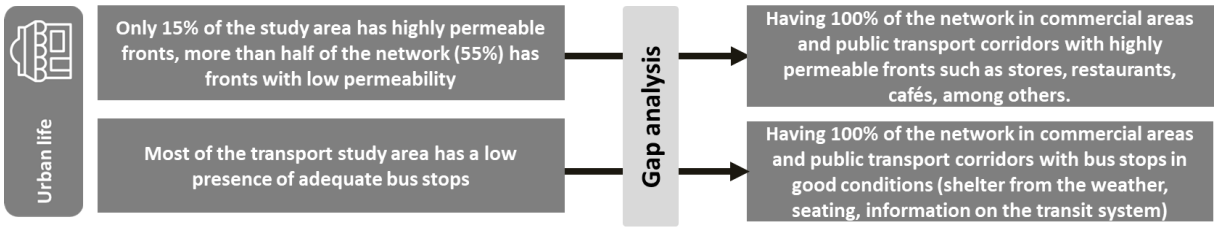
Figure 31. Vision, goals, improvement strategies and actions proposed



Source: Authors

Once the short-term achievements for the city are made clear, a gap analysis will determine the difference between the city's current situation, i.e., the diagnosis made during the previous phase, and the changes it hopes to achieve in the future. The gap analysis provides the improvement strategies and short-term actions that can be implemented with a clear and fast impact in pedestrian mobility.

3.1 IMPROVING URBAN LIFE



Sidewalks play a vital role in city life as they improve connectivity and promote walking. Safe, well-designed, and maintained sidewalks bring together people and communities, and represent the essential fabric of urban environment.

A sidewalk that is attractive and useful for citizens should connect the points of origin and multimodal points (transit stops, parking lots, taxi bases, etc.) with their destinations. As stated before, more dynamic sidewalks, with permeable fronts and engaging activities, such as shops, restaurants or cafés, are more comfortable and pleasant, which in turn, attracts more pedestrians.

Land use regulations regarding sidewalks, such as zoning and density, influence walkability. If land use connecting sidewalks is varied, trips will be shorter and easier to make on foot. The same is true for denser cities that allow more activities within more reduced spaces, decreasing the distance between trips. Urban policies such as Transport Oriented Developments (TOD) also promote walkability and must be paired with well-designed pedestrian infrastructure.

Connecting pedestrians with other modes will improve connectivity. Transit networks should have visible bus stops, bicycle parking, regulated car parking spaces, as well as taxi bases. The main transit corridors, including the studied area, should be provided with bus stops equipped with shelter from weather, conformable waiting areas with seating, and information displays for using transport services, such as maps of bus routes and surrounding neighborhoods, and bus schedules.

A coherent parking policy will improve space management through parking regulation, pricing (using the user pay concept) and enforcement, which will also prevent vehicles from encroaching sidewalks. A World Bank discussion paper on Improving Public Transport and Managing Land Use and Traffic highlighted that in developing cities, only a small percentage of the population, part of the highest income bracket, has access to a motorized personal-use vehicle, and thus it is an equity issue. Additionally, parking is underpriced, and the publicly run on-street parking is often significantly cheaper than private parking garages, only furthering the lack of appreciation of the value of the curbside asset, incentivizing driving, and discouraging walking.

The application of the Complete Street concept to urban roads enables safe use and supports mobility for all users. In Addis Ababa, this concept includes an equitable distribution of the available space for different use purposes, including wider sidewalks for pedestrians, space for cyclists and public transport, and more limited space for privately-owned vehicles. The ongoing comprehensive corridor improvement

project under TRANSIP applies the Complete Street concept and Traffic Management ITS in selected corridors, which will serve as a template to improve mobility and road safety.

Better quality spaces encourage more pedestrian presence, as they make people feel safe and own the space. This strategy includes widening sidewalks, plazas, and open spaces through tactical urbanism and giving new use to available areas.

The following actions are therefore proposed to address the current situation and make progress towards the end-goal:

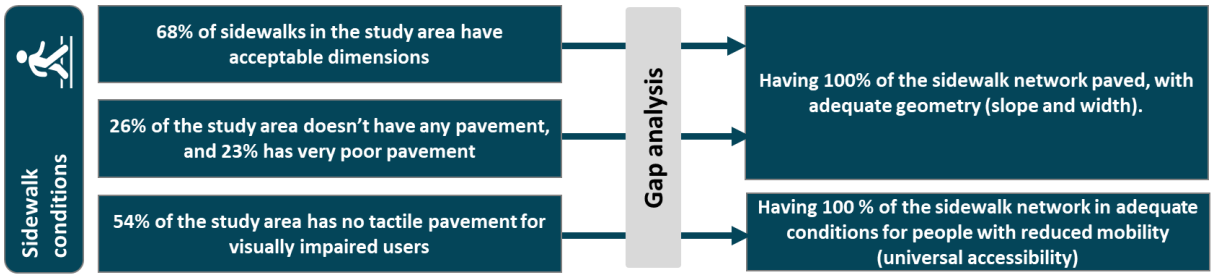
Action 1 Promote land-use policies that lead to denser areas around the main roads and transport corridors, and enhance mixed-use in the framework of sidewalk development strategies.

Action 2 Improve multimodal infrastructure (bus stops, car and bicycle parking, taxi bases, etc.) to promote walking as part of the transport network.

Action 3 Promote better spatial distribution of the different modes with policies like complete streets and parking regulation policies.

Action 4 Reclaim urban spaces to encourage more pedestrian presence, which in turn, will make people feel safer and own the space.

3.2 IMPROVING SIDEWALK CONDITIONS



Sidewalk conditions represent a key feature in terms of achieving attractive, accessible, and safe walking infrastructure. The following points will have to be considered while improving sidewalk conditions in the studied area:

- **Sidewalk geometrics.**
    - **Slope level:** during a platform design process, an proper slope for urban drainage and vegetation must be considered. The slope of the sidewalk depends on the context and geometric conditions of the road. According to the NACTO guide, a maximum 2% gentle side slope should be used to direct water flow.

- **Correct width:** the total width of the sidewalk should include a frontage zone where the sidewalk acts as an extension of the building, a walking zone where pedestrians have a safe and adequate space to walk, and a street furniture zone where amenities or green elements are provided.

- **Pavement:** the pavement must be continuous, firm and slip-resistant. The materials should be durable and non-slippery.

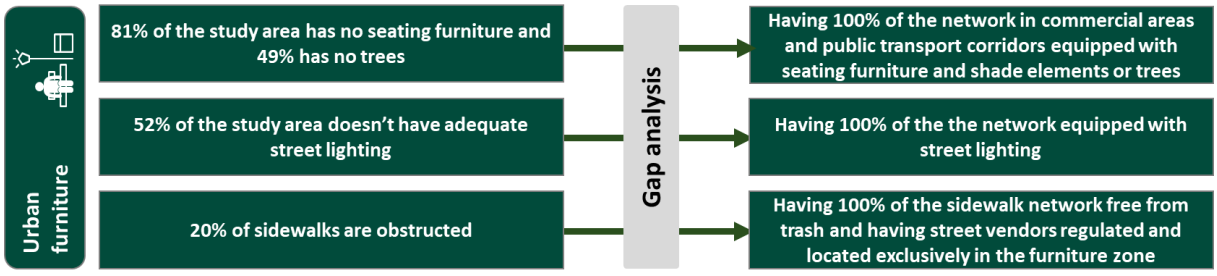
Additionally, access for people with reduced mobility (PRM) must be guaranteed, i.e., installing infrastructure for the blind (tactile pavement and audible traffic lights), access ramps, flat and continuous surfaces, and adequate width for wheelchair use.

The following actions are therefore proposed to address the current situation and make progress towards the end-goal:

Action 5 Develop a guideline that informs designers, decision-makers, and local authorities regarding the importance of correct sidewalk geometry design and how to achieve it.

Action 6 Build sidewalks wide enough with the correct slopes, adequate pavement, and the infrastructure needed to ensure universal accessibility.

3.3 IMPROVING URBAN FURNITURE



Urban furniture involves all elements of a street that help make the sidewalks more comfortable, including street lighting, trees, benches, garbage bins, weather protection, playgrounds, and even multimodal furniture, such as bicycle parking spaces and bus stops. The following is a list of essential furniture elements to make the sidewalks in the study area safer and more comfortable.

- **Street lighting:** Lighting for pedestrians is essential to facilitate the movement of people in low natural lighting situations and promote safety and personal security. Quality lighting can create a safe environment for pedestrians and transport users to easily navigate in low light conditions and enhance the pleasing quality of public spaces, encouraging movement and fostering enjoyment at night.

- **Shade and vegetation:** In sunny places like Addis Ababa, providing shade in public roads makes walking more comfortable and attractive. Placing natural elements like trees or

vegetation, or placing artificial elements, like canopies or pergolas, can increase the presence of shades, natural or otherwise. However, they must be placed following certain criteria so that they do not become obstacles, and on intersections or waiting areas.

- **Removing obstacles:** Another measure that can help reclaim space for pedestrians is removing obstacles that make it difficult to walk on sidewalks, including poorly placed furniture and regulating street vendors. It is recommended to designate suitable areas for vendors, such as furniture strips. Standardizing the spaces assigned to vendors can also improve the sidewalks' image without reducing the activities that attract pedestrians.

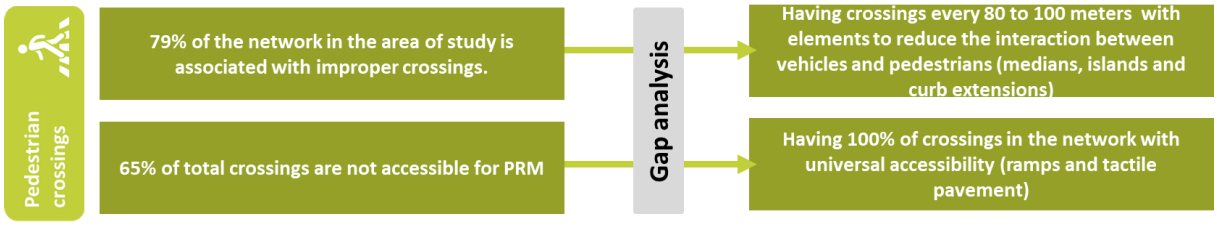
The following actions are therefore proposed to address the current situation and make progress towards the end-goal:

Action 7 Increase the urban furniture available on sidewalks, including benches, trees, weather protection, garbage bins, and other types of furniture, to make sidewalks more comfortable.

Action 8 Place street lighting in all the sidewalks and pedestrian crossings of the network.

Action 9 Regulate street vendors by designating suitable areas in furniture strips.

3.4 IMPROVING PEDESTRIAN CROSSINGS



Intersections are the points of convergence of all street users, and also where pedestrians are most vulnerable. Therefore, it is essential to provide them with a properly marked space to ensure that their interactions with vehicles occur as safely as possible.

Crosswalks should be located close enough to each other so as to reduce the distance pedestrians have to travel to conduct a crossing, and avoid situations in which pedestrians are tempted to cross at unmarked locations. Crossings should be as short as possible to reduce the likelihood of accidents by reducing the space for interaction with vehicles. The placement of curb extensions and refuge islands provides space for pedestrians to take shelter, facilitates visibility, and creates a space to put up signage.

Some of the elements that can make crossings easier and safer for pedestrians are:

- **Pedestrian crossings:** Crossing major avenues can be intimidating for many pedestrians, especially where insufficient gaps in traffic make crossing risky, and no striping or signage exists

to alert motorists. Intersections on main or wide streets can minimize crossing distances and reduce pedestrian exposure.

- **Midblock crossings:** Facilitate crossings to places where people want to go but are not well connected. These should be located wherever there is a significant pedestrian desire line. In order to ensure pedestrian safety, some considerations and recommendations should be taken into account, for example, using a paving pattern or special material so that drivers can easily tell them apart, and creating 2-stage crossings.

- **Medians:** Medians or safety islands create 2-stage crossings for pedestrians, making it easier and safer since they form barriers in the middle of the street that act as islands and separate traffic flow. They reduce the size of the intersections and crossings with the addition of curb extensions and medians.

- **Signs and signals:** These are necessary to promote a safer, easier and faster crossing for pedestrians. Crosswalks at signalized intersections should have a pedestrian light counter providing sufficient time for all pedestrians (including slower users) to cross safely.

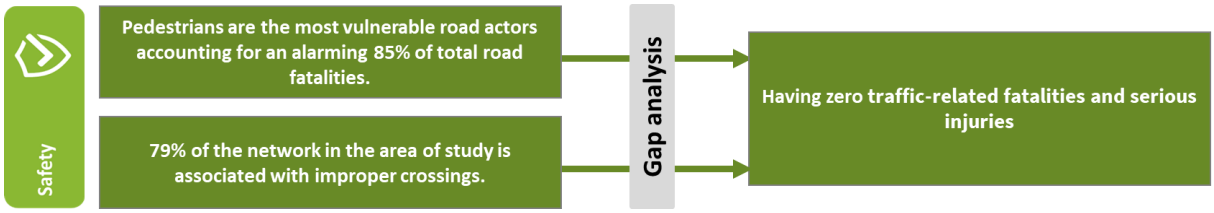
The following actions are therefore proposed to address the current situation and make progress towards the end-goal:

Action 10 Increase the number of pedestrian crossings, reducing pedestrians' travel distance to get to their destination.

Action 11 Build ramps and place detectable surfaces in the pedestrian crossings of the network.

Action 12 Reduce the interaction between vehicles and pedestrians by reducing the distance of pedestrian crossings, and improving signals at intersections.

3.5 IMPROVING SAFETY FOR PEDESTRIANS



The risks pedestrians face on the streets of Addis Ababa make it crucial to emphasize road safety. It is necessary to implement policies such as the Vision Zero policy implemented in Sweden in 1997, based on the premise that traffic fatalities are preventable and unacceptable. Therefore, a systematic approach to road safety must be taken to eradicate traffic fatalities and serious injuries. These approaches should include improving sidewalks to make them safer, traffic calming, and preventive measures in high-risk spots and areas with high levels of pedestrian traffic, such as schools and hospitals.

- **Traffic calming:** Among traffic calming measures, reducing the speed of motor vehicles will reduce the risk of accidents. In countries like Ethiopia, where the authorities do not have the necessary tools to enforce traffic regulations, the solution lies in ensuring that vehicles comply with the speed limits. Other common methods involve raised intersections, speed cushions, painting curb extensions, medians, and roundabouts.

- **Safe walking to and from school:** Based on global best practice, sidewalk conditions have been improved and safety in school zones increased by the city to protect children and promote safe walking to and from school. For example, child fatalities are preventable through safe crossings and limiting school zone speed to 30 km/h. The following are some of the measures that have been put in practice in school zones.

    - Set-up of bus boarding bays to provide dedicated spaces for school buses.
    - Building of new sidewalks and pedestrian crossings.
    - Inclusion of mid-block crossing and speed management measures.
    - Transformation of the paths to school bus stops into spaces paved with a colored surface, painted distance numbers, and speed marks to create a playful walking experience while waiting to board school buses.

- **Road safety assessment**: Several tools to assess road safety (such as iRAP), inspection of existing roads, and road safety design audits are available to identify the location and infrastructure needed to reduce the number of deaths and serious injuries in road accidents. The City of Addis Ababa recently carried out an iRAP assessment for more than 500 km of roads in other locations resulting in ratings of 1 to 2 stars.

- **Awareness campaigns:** Most accidents are the result of human carelessness, and although better infrastructure conditions can reduce the impact of accidents, the best way to prevent them is through social responsibility and respect of speed limits, not driving with distractions, and prioritizing pedestrians**.**

The following actions are therefore proposed to address the current situation and make progress towards the end-goal:

Action 13 Implement traffic calming measures to reduce the severity of traffic-related accidents and increase pedestrian safety.

Action 14 Develop road safety strategies and assessments in high-risk environments such as schools, hospitals, and areas with a high pedestrian presence.

Action 15 Create an awareness campaign to inform the community of road risks and promote road safety measures.

3.6 GLOBAL BEST PRACTICES

The following table summarizes the implementation of the actions proposed at a global level. Some interventions are characterized by their low cost and ease of implementation, making them more suitable to be applied in Addis Ababa. Therefore, an applicability indicator has been developed, based on the cost of intervention and maintenance required for the action to achieve the objective. Thus, three categories were defined: the lower the cost of implementation and maintenance, the higher the applicability; contrarily, the higher the cost of implementation and maintenance, the lower the level of applicability.

Table 2 Legend of applicability

Applicability		
Low	Medium	High
		

Source: Authors

Table 3. Summary of best practice interventions

Intervention	Description	Benefits	Cost	Maintenance	Applicability	Street type	Example
Speed cushions (Melbourne, Australia)	Small and intermittent pavement elevation	Easy to remove and install. Do not slow down buses and freight vehicles.	low	low		Two-way streets, moderate speed	
Pedestrian crossings (Shenyang, China)	Implement signaling at crosswalks	Provide safety for vulnerable users	low	low		All types of streets	
30 km/h zones (Netherlands)	Limit speed to 30 km/h within area	Reduce the permitted speed for vehicles, make it easier and safer to interact with pedestrians	medium	medium		Local neighborhoods and local streets	

Intervention	Description	Benefits	Cost	Maintenance	Applicability	Street type	Example
Intersections with bus corridors	Mass transit Intersections require specific signage to guarantee pedestrian accessibility.	Facilitate crossings to transit	low	low		All types of streets	
Bicycle parking infrastructure (Madrid, Spain)	Locate free or low-cost bicycle parking with weather protection and security	Multimodality allows people to combine walking with cycling when using public transport.	low	high		Main transit corridor, multimodal interchanges	
Complete streets (College Street, Toronto, Canada)	Multi-lane in main streets and transit corridors, where space for pedestrians, cyclists and mass transport should be prioritized.	Allocation of space for all modes, reduction of conflicts	medium	medium		Multi-lane streets, medium to high speed	
Sidewalks for kids' play (Detroit, USA)	Transform the walking path to school bus stops	Create a playful walking experience for children waiting to board school buses	low	low		Networks near schools	

Intervention	Description	Benefits	Cost	Maintenance	Applicability	Street type	Example
Signal Controls (Bogota, Colombia)	Provide traffic signal control to separate traffic flow with proper walking phases.	Reduce conflicts, address pedestrian crossing time, and reduce risks	medium	medium		All types of streets, all speeds	
Chicanes (Budapest, Hungary)	Artificial turns built to reduce the size of the roadway	Create a chicane effect to slow traffic speeds and expand public space	medium	medium		Two-way streets, moderate speed	
Pinch points or chokers (Delaware, USA)	Curb extensions to narrow a street in specific points	Increase sidewalk space, decrease crossing distance, and reduce traffic	medium	medium		Two-way streets, moderate speed	

Intervention	Description	Benefits	Cost	Maintenance	Applicability	Street type	Example
Curb Extensions (Watsonville, CA, USA)	Street modifications that visually and physically narrow the roadway	Create safer and shorter crossings for pedestrians while expanding available space	medium	medium		Two-way streets, moderate speed	
Medians (Bainbridge, WA, USA)	Barriers in the middle of the street that act as islands and separate traffic flow	Create 2-stage crossing for pedestrians	medium	medium		Two-way streets, moderate speed	
Midblock crossings (British Columbia, Canada)	Installation of midblock crosswalks in locations with significant pedestrian desire lines	Facilitate crossings to places that people want to go but are not easily accessible with the existing street network	medium	medium		Secondary and local streets	

Intervention	Description	Benefits	Cost	Maintenance	Applicability	Street type	Example
Mixed use and dense cities (Barcelona, Spain)	Policies and regulations on density and land use mix	Encourage walking for shorter trips	high	high		Main transit corridors	
Speedbumps (Mexico City, Mexico)	Artificial pavement elevation across the road	Enhance crossing safety	high	high		Two-way streets, moderate speed	
Raised intersections/crossings (Bogota, Colombia)	Elevations on the road at sidewalk level	Make zones pedestrian-oriented, enhance crossing safety, and are bicycle-friendly	high	high		Two-way streets, moderate speed	
Traffic Circles (Mexico City, Mexico)	Central islands on the middle of an intersection	Reduce the severity of collisions, improve traffic flow, and are appropriate for two-way streets	Very high	High		Multi-lane streets, medium to high speed	

Intervention	Description	Benefits	Cost	Maintenance	Applicability	Street type	Example
Roundabouts (Chandigarh, India)	Curb extensions that narrow a street	Improve management of complex intersections, reduce the severity of crashes and conflicts, and provide green spaces	Very high	Very high		Multi-lane streets, medium to high speed	

Source: Authors

4 GUIDELINE AND SHORT–TERM ACTIONS

This chapter presents the application of the actions described previously in the Addis Ababa context with a low-cost strategy that generates immediate impact in the short term. The first section describes tactical urbanism, the second section introduces the proposed guidelines, and the third and final section describes how the improvement strategies can be implemented in the studied areas with short-term actions.

4.1 TACTICAL URBANISM

Some interventions are characterized by their low cost and ease of implementation, making them more suitable for the short term. One of the clearest examples is **tactical urbanism, defined as an approach to neighborhood building using short-term, low-cost, and scalable interventions in policies to obtain long-term changes in cities** (Mike Lydon and Anthony Garcia).

Tactical urban planning refers to developing infrastructure modifications gradually, creating the possibility of adaptation and acceptance over time. The measures are first carried out temporarily with movable restriction tools, such as cones and fences. Subsequently, non-definitive measures are undertaken, such as painting the streets and placing furniture and planters to define the space. Finally, once the user accepts the changes, definitive modifications to the infrastructure can be made.

Figure 32. Island created with cones

Source: Tactical urbanism in Culiacán, Mexico, https://dimensionturistica.com/es/lanzan-nuevo-proyecto-de-urbanismo-tactico-en-culiacan/ (2021).

The advantages of tactical urban planning are many. It is an ideal tool when changes must be made quickly, or funding is unavailable. It also allows for the identification of alternative uses of spaces to guarantee that they adapt to users' needs. Most importantly, the later project is adaptable to the results of the previous phases, i.e., if the transformation carried out with tactical urbanism works, it is made permanent later through investment in construction. Otherwise, if changes are required, the final project can be adjusted. Thus, the final project will be optimal because the neighborhood has already made the space its own. Moreover, while the project is being designed, it's possible to check how the neighbors

have used it, define if any elements are missing (such as benches or tables), and if it is necessary to redistribute them.

Tactical urbanism inspires people to collectively re-imagine and re-invent public spaces, and strengthens the connection between people and the places they share, which fosters a collaborative process and pays attention to the physical, cultural, and social identities that define a place.

4.2 SIDEWALK DESIGN AND MAINTENANCE GUIDELINES

One of the measures needed to improve the quality of pedestrian infrastructure is to provide the tools and share the knowledge related to building and maintaining streets with pedestrians as a priority. To achieve this, a guide containing the basic criteria for sidewalk design and the requirements for maintaining them in optimal condition should be promoted and shared with decision-makers, and local authorities in charge of the design, construction and maintenance of public spaces. Global best practices conducted in the earlier tasks feed the guideline.

Figure 33. Draft of the Addis Ababa Sidewalk Design and Maintenance Guidelines

Source: Authors

Please refer to the guidelines, a separate deliverable of the study, for further information and design rendering.

4.3 ACTIONS FOR STATION AREAS

While the proposed strategies are applicable for the entire city of Addis Ababa, the scope of the project further highlights defining short-term, low-budget actions that would have an impact within the studied area. The short-term strategies focus on the hot spots identified in three station areas and integrate best practices into the local context. Stakeholders were consulted regarding the proposed strategies so that their input could be included. The Planning Commission and the transport agencies can further assess and add to the final design and implementation in a short timeframe.

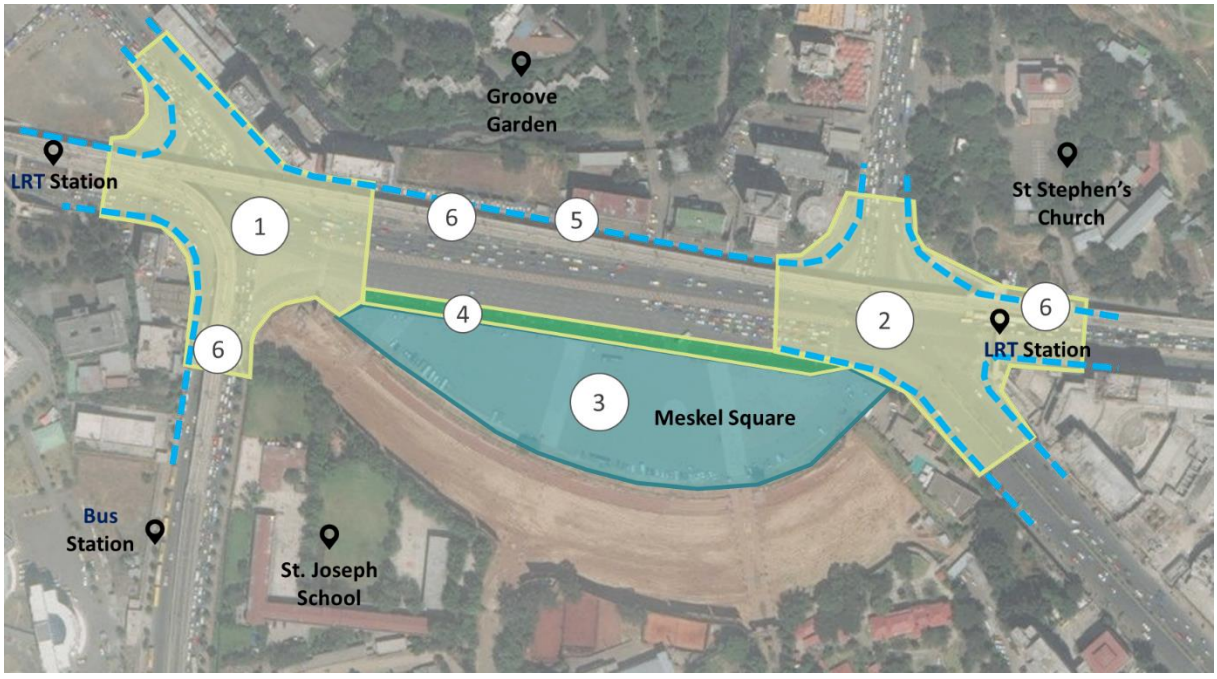
I. Meskel Square | II. St Urael Station | III. Megenagna Station

4.3.1 Meskel Square

Overall, a total of six short-term actions (see Figure 34) are proposed for Meskel Square:

1. *Improvement of the Ras Biru St. crossing.*
2. *Improvement of the Menelik II Ave. crossing.*
3. *Meskel Square as a city commercial center.*
4. *Enhancement of Meskel Square sidewalk geometry.*
5. *General enhancement of existing sidewalk – maintenance and reconstruction.*
6. *Introduction of new activities in the areas under the LRT infrastructure.*

Figure 34: Actions proposed for Meskel Square

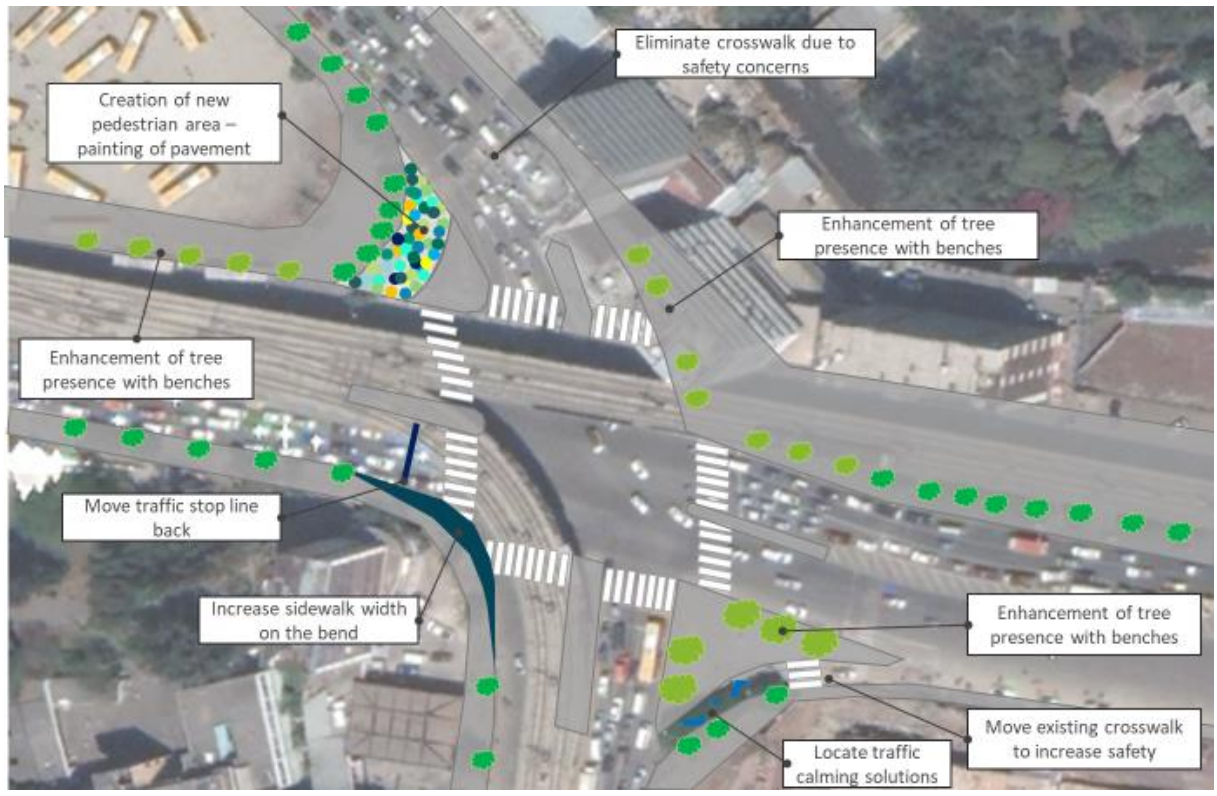


Source: Authors

4.3.1.1 Improvements for the Ras Biru St. crossing

The Ras Biru St. crossing has a high level of vehicular traffic, as well as pedestrian flow coming from the nearby bus station, schools, and LRT stations. Transit users are an important generator of pedestrian traffic into the intersection's crossings and at bus stops near the crosswalk points. The existing crosswalks need to be painted and adequate traffic signaling must be installed, as well as other proposals, described in Figure 35.

Figure 35. Proposed conceptual solutions for the Ras Biru St. crossing

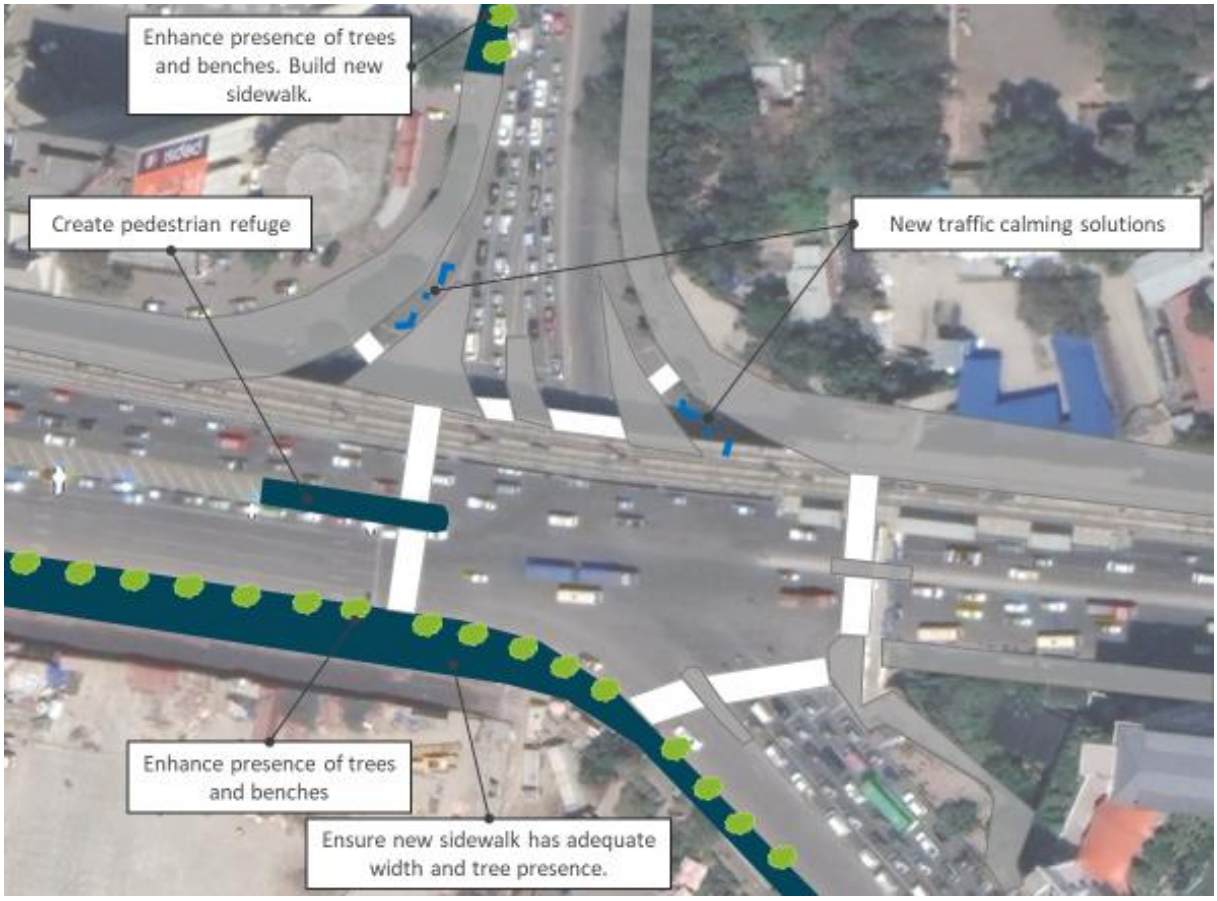


Source: Authors

4.3.1.2 Improvement for the Menelik II Ave. crossing

Compared to the previous intersection, the Menelik II Ave. crossing is better equipped with clear signage, a refuge island, ramps for accessibility, and a coherent design. Therefore, the following actions focus on enhancing urban comfortability and safety (see Figure 36).

Figure 36. Proposed conceptual solutions for the Menelik II Ave. crossing



Source: Authors

4.3.1.3 Meskel Square as a new commercial center and enhancement of existing sidewalk

The new Meskel Square project represents an opportunity to create a new commercial center in an iconic public space for Addis Ababa. The existing areas under the LRT infrastructure are currently places with no particular uses. A transformation of the spaces under the LRT is proposed for commercial use and enhancement of social activities; complementing furniture and shade/canopy solutions should be added within the square (see Figure 37).

In addition to the previous action, Meskel Square's new design should follow the design specifications described in the AA Sidewalk Design and Maintenance Guidelines for an adequate width of the sidewalk next to the street, and the inclusion of trees and benches, and its limits, as long as trees don't become a visual obstruction or safety hazard. Sidewalks in Meskel square also require repaving, since they have holes and present discontinuities.

Figure 37. Conceptual solutions in terms of new uses under the LRT infrastructure

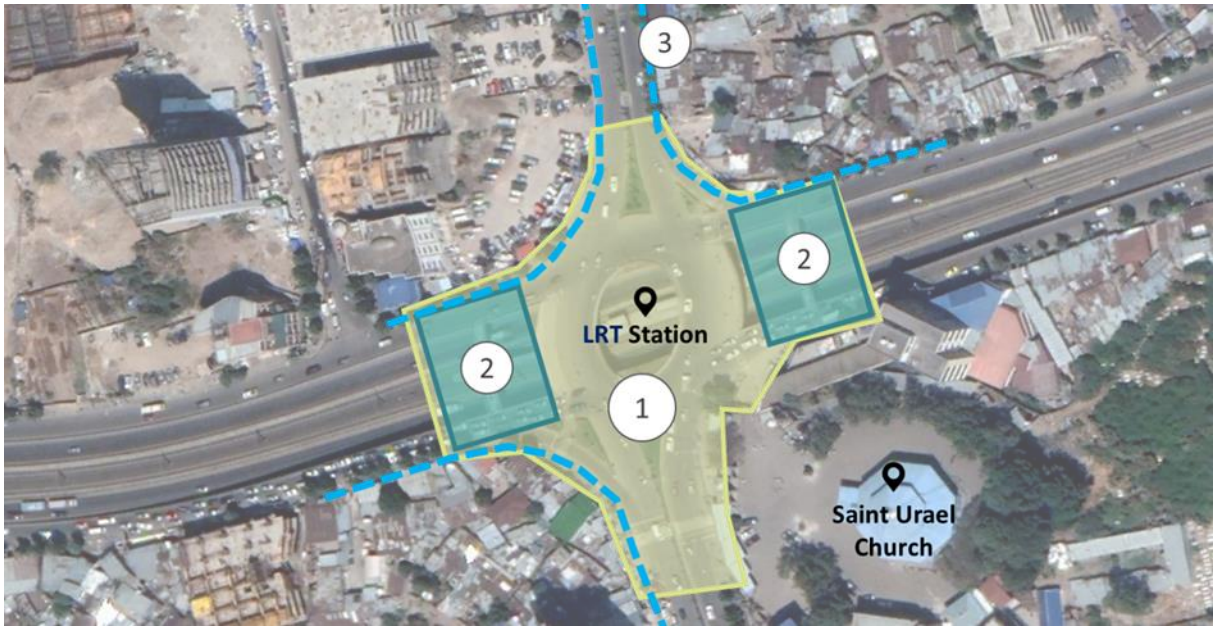
Source: Authors

4.3.2 St Urael Station

The second location is the area around St Urael Station. This area shows high pedestrian demand because it includes a commercial and financial center, a religious building, and a main intersection along the corridor. In this area, a series of solutions are proposed to achieve a higher level of urban accessibility, quality and comfort, especially when it comes to sidewalks and points that connect to the existing LRT station (see Figure 38).

1. *Redesign of the intersection.*
2. *Enhancement of LRT station accesses and crossings.*
3. *General enhancement of existing sidewalk, maintenance and reconstruction.*

Figure 38 Proposed actions for St Urael Station

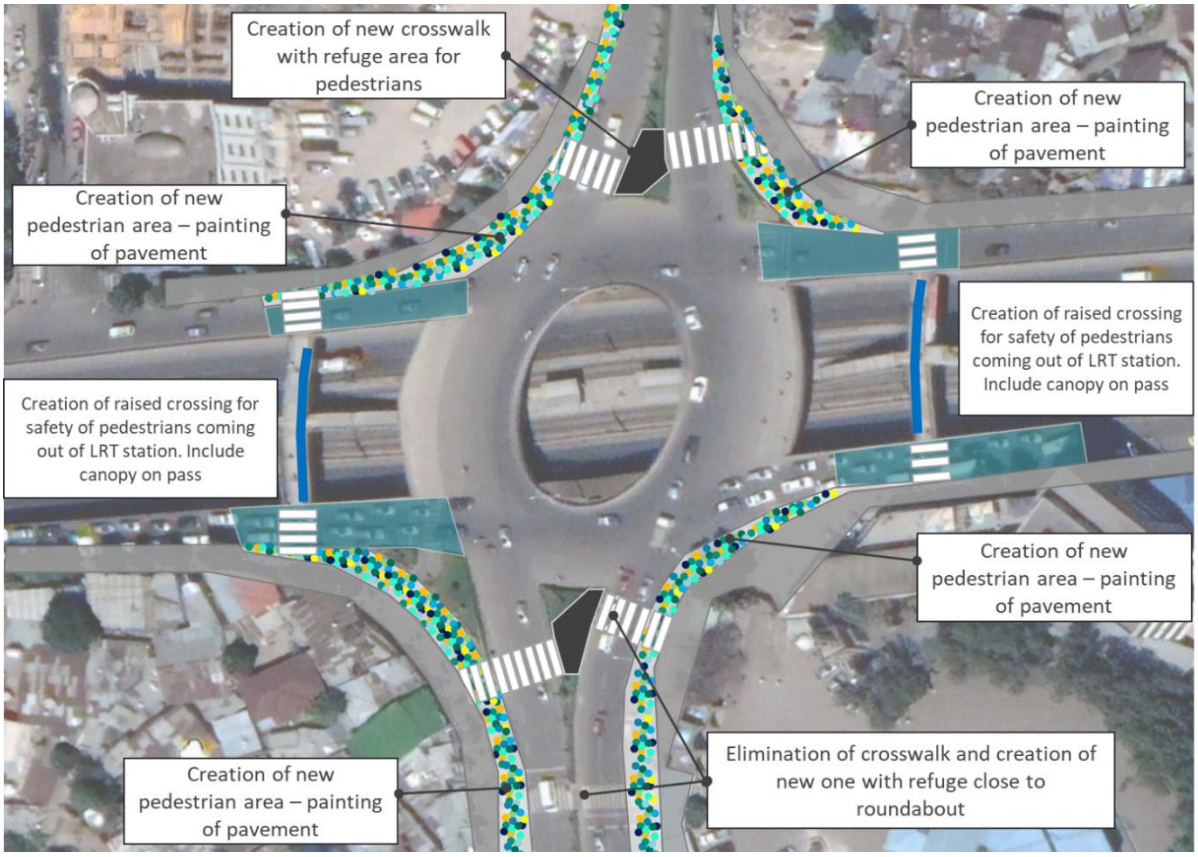


Source: Authors

The current design of the roundabout and the pedestrian crossings generates confusion for drivers and, consequently, potentially lead to an increase in the probability of an accident involving pedestrians. Furthermore, the crosswalks within the roundabout and the crossing points at the entrances of the LRT station are too far away from each other, and they don't provide sufficient space for interactions between drivers and pedestrians, especially at a roundabout with no traffic light management. A clearer and safer design, with painted pavement and a new refuge island, is proposed in Figure 39.

Sidewalk conditions in some sections of St Urael Station show lack of maintenance and repair. Potholes and discontinuity of pavement are observed. Therefore, a repair plan should be developed for the area, involving the filling of potholes and substitution of broken pavement. As previously suggested, for heavy pedestrian flow areas, concrete or asphalt pavement are recommended, potentially with the application of color paints to create an attractive perception. Solutions involving the use of tiles or stones are usually more expensive to maintain, especially if the material breaks due to heavy use or other actions that may deteriorate the tiles in terms of their structural limits.

Figure 39. Proposed conceptual solutions for intersection redesign and enhancement of the LRT station accesses and crossings



Source: Authors

4.3.3 Megenagna Station

Finally, the Megenagna Station area is an important multimodal transport and commercial hub. These aspects make this site an adequate study area to propose short-term actions to enhance pedestrian environment and safety. Currently, an elementary school and government buildings are in proximity to the area. Overall, five actions are proposed for the Megenagna Station (see Figure 40).

1. *Redesign of the Wal-Argi square area.*
2. *Enhancement of the connection between Megenagna Station and Wal-Argi square.*
3. *Improvement of LRT connectivity.*
4. *Improvement of the urban environment of the Megenagna Station Square.*
5. *New uses of the area under the road overpass.*

The actions to enhance Megenagna Station need to be complemented with actions on the nearby Wal-Argi square, given the importance of pedestrian mobility and the direct relation between both squares. Therefore, proposals 1 and 2 are for the Wal-Argi square.

Figure 40. Proposed actions for Megenagna Station

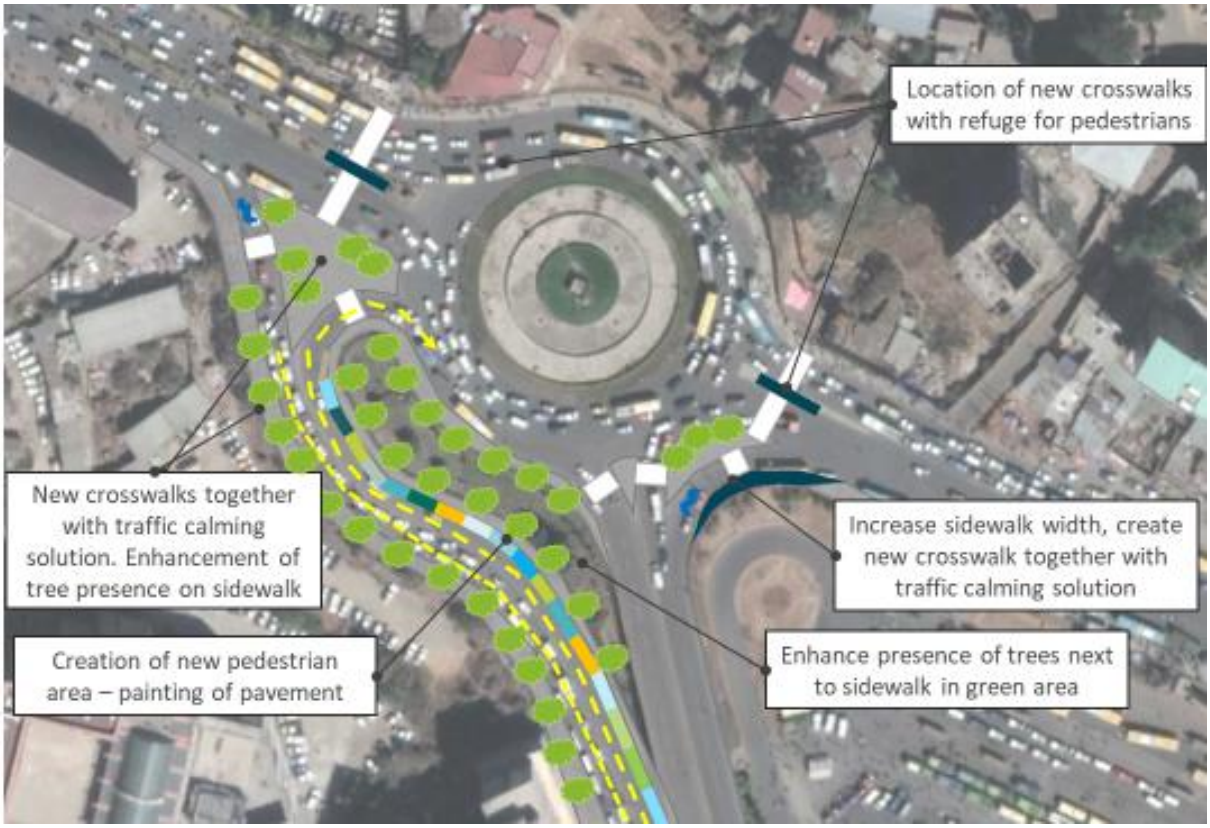
Source: Authors

4.3.3.1 Redesign of the Wal-Argi square area and enhancement of the connection between Megenagna Station and Wal-Argi square.

The connection between Wal-Argi square and Megenagna Station square is currently inadequate, due to a high volume of pedestrian flow and reduced pedestrian sections. The lack of space causes pedestrians to invade traffic lanes, creating safety concerns. Therefore, the proposal aims to improve traffic safety and comfortability for pedestrians going from one square to the other (see Figure 41).

Firstly, a new pedestrian area is proposed along the connecting street. An action that would reduce the width of the traffic lane by 2 meters. The design of this new area is proposed in a colorful manner, providing new seating areas, tree pots and social areas (see Figure 42).

Figure 41. Conceptual proposal for redesigning the Wal-Argi square area and enhancing the connection between Megenagna Station and Wal-Argi square.



Source: Authors

Figure 42. Conceptual proposal for connecting streets between both squares.

Source: Authors

4.3.3.2 Improvement of LRT connectivity.

The current entrance design of the Megenagna LRT Station is not adequate, especially pertaining to its connection to the Bus Terminal. Therefore, a redesign of the entrances is proposed, mainly based on the creation of new sidewalk infrastructure to provide a wider and better approaching lobby for the station (see Figure 43). In addition, the strategy will organize pedestrian flows coming to the LRT station from upper Asmara Rd.

Figure 43. Conceptual proposal for improving connectivity between the LRT station and the nearby urban area and bus station.

Source: Authors

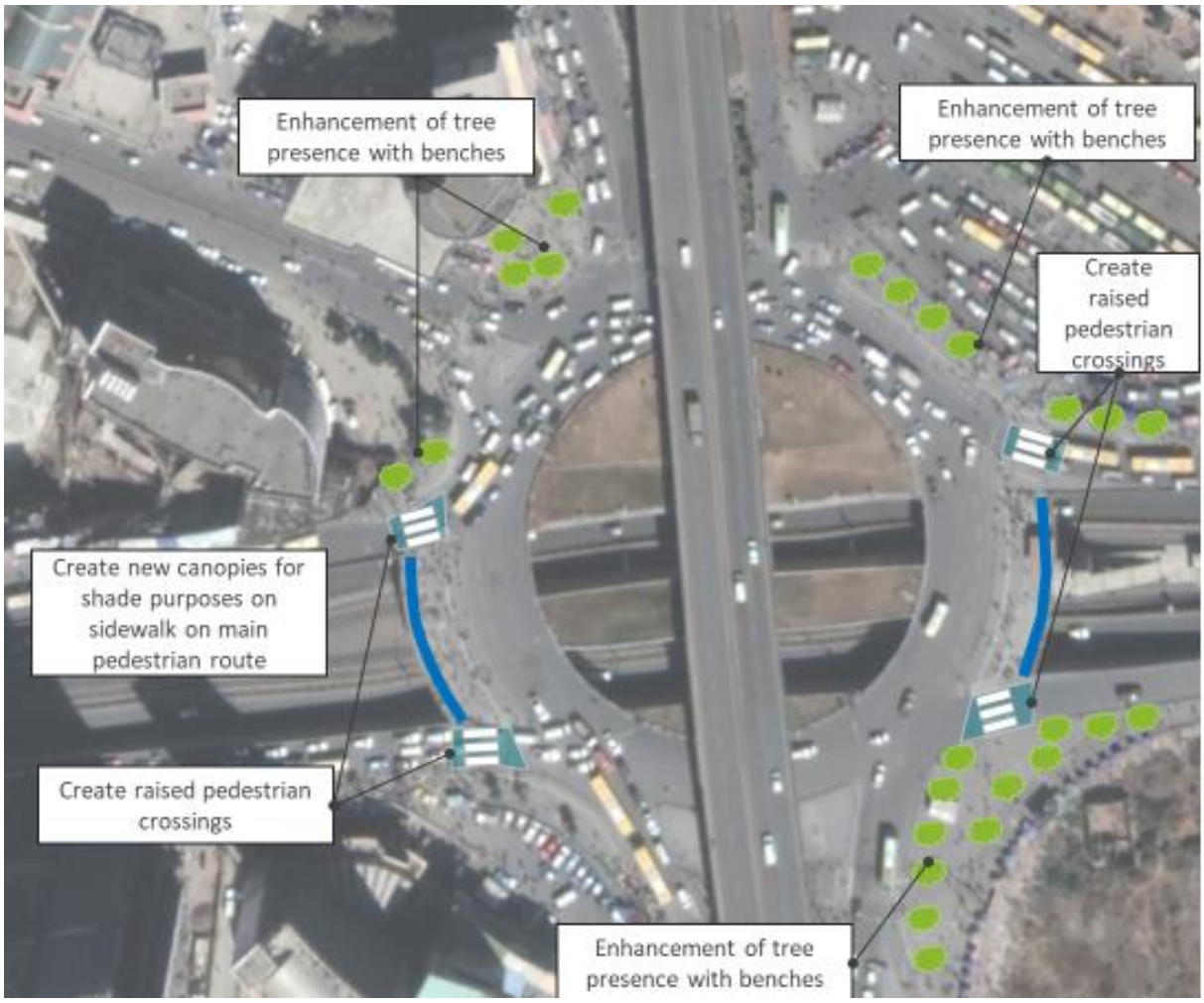
4.3.3.3 Improve the urban environment of the Megenagna Station Square.

The Megenagna Station Square presents an adequate design in terms of sidewalk sections, with adequate width on most of the roundabout spaces. However, the pedestrian crossing design in the two locations is in need for a design improvement, mainly to increase pedestrian safety (see Figure 44). Therefore, the proposed actions for the square are:

- Providing 4 new raised pedestrian crossings on main entrances and exits to the roundabout following the corridor's direction (east-west).
- Providing canopies along the sidewalk connecting both proposed raised pedestrian crossings.
- Providing trees and shades along the edge of the square and on main pedestrian routes.

It should be considered that, due to the heavy traffic observed in the area, the implementation of traffic light management in Megenagna Station Square and Wal-Argi square should also include measures to reduce the speed of the traffic flow accessing both roundabouts through raised pedestrian crossings.

Figure 44. Conceptual proposal for improving the urban environment of the Megenagna Station Square.



Source: Authors

Given the project's scope, the proposed actions are limited to the study area. The study hopes that both measures and methodology could be used as a basis for application in other areas of Addis City, in Ethiopia and even other Sub-Saharan African countries with similar conditions. The following chapter summarizes the issues identified in Phase 2, the strategies proposed in Phase 4, and the suggestions for project continuity and its replication elsewhere.

5 CONCLUSIONS

The conclusions of this study are presented in three sections. The first section sums up the current situation of sidewalk infrastructure and walking environment in Addis Ababa. The second section proposes strategies to be implemented in order to improve pedestrian conditions. Finally, the third section presents the challenges and suggestions that should be addressed in the medium term to ensure a comprehensive approach and sustained long-term impact.

Current pedestrian challenges in the study area:

- The challenges identified are associated with the development the city has experienced over the last few years, including population growth, urban footprint, and motorization.
- Pedestrians are the most vulnerable road users, accounting for an alarming 76% of total road fatalities. Pedestrian deaths are mainly due to accidents involving trucks and taxis.
- The existing sidewalk network in the studied area has an adequate width, particularly in the recently constructed segments. The studied area has some presence of furniture and streetscape (trees for shading, tactile pavement, and lighting). These best practices should be replicated in other segments of the network.
- 67% of the network is ranked at levels C and D in the Global Walkability Index indicating poor walkability, with 39% of the network classified in Level D. Segments with a deficient level of walkability tend to be located near crossing points. Therefore, the focus should be on enhancing and improving crossings and areas surrounding intersections.

Main strategies to be implemented

- The study suggests integrating urban planning measures such as tactical urbanism, reclaiming sidewalks and urban spaces, and improving pedestrian crossing conditions. These measures should be accompanied by speed management, traffic calming measures, as well as the improvement of signs, lighting, vegetation and all elements that should be part of a complete sidewalk.
- The creation of public spaces along the entire corridor under study should be promoted to encourage walkability. Increased public spaces provide safety and enable walking, thus reducing the number of trips made by motor vehicles.
- Improving arterial corridors, with changes in street design and infrastructure, decreases vehicle-pedestrian conflicts, reduces crossing distances, and enhances pedestrian safety. The Complete Street corridor design under TRANSIP is defining a street template for all users.

- In addition to awareness and education, the city needs to develop strategies that support a shift in mobility habits towards alternative mobility means, such as public transit and non-motorized transport.

- The international cases presented support the identification of practices and examples applicable to Addis Ababa. The city can analyze and incorporate as appropriate.

- The study includes *Addis Ababa Sidewalk Design and Maintenance Guidelines*. These guidelines are a compilation of proposals and measures to be adopted in the city based on the initial diagnosis made, short-term strategies and worldwide best practices.

The medium and long-term actions proposed for the city, and the short-term actions for the studied area are summarized below:

Actions	**Medium and long-term actions**	**Short- term actions in the study area**	**Institution responsible**
Action 1: Land-use policies	Promote land-use policies that lead to denser areas around main roads and transport corridors, and enhance mixed-use as part of sidewalk development strategies.		Addis Ababa Plan and Development Commission
Action 2: Improving multimodal facilities	Improve multimodal facilities (bus stops, car and bicycle parking spaces, taxi bases, etc.) as a means to promote walking as part of the transport network	Improve connection between LRT stations and bus stations	Addis Ababa City Administration Transport Bureau; Addis Ababa City Transport Authority
		Regulate parking for cars	Addis Ababa City Road Traffic Management Agency; Addis Ababa City Traffic Police
		Designate bicycle parking areas	Addis Ababa City Administration Transport Bureau; Ababa City Transport Authority
Action 3: Complete street and parking policies	Promote better spatial distribution among the different modes with complete street and	Increase sidewalk width	Addis Ababa City Roads Authority

	parking regulation policies, and other similar policies.	Placement of bollards to prevent vehicles from invading sidewalks	Addis Ababa City Road Traffic Management Agency; Addis Ababa City Traffic Police
Action 4: Reclaiming urban spaces	Reclaim urban spaces to encourage the presence of more pedestrians, which in turn makes people feel safer and own the space.	Creation of new pedestrian areas by painting the pavement	Addis Ababa City Roads Authority
		Introduction of new activities in the areas under the tram infrastructure	Addis Ababa City Roads Authority
Action 5: Guidelines for sidewalk design	Develop a guideline that informs designers, decision-makers and local authorities on the importance of correct sidewalk geometry design and how to achieve it.	Promote the guidelines developed by the World Bank to inform on basic design criteria for sidewalk design and the requirements for maintaining them.	Addis Ababa Plan and Development Commission
Action 6: Build adequate sidewalks	Build sidewalks wide enough, with correct slopes, adequate pavement, and the infrastructure needed to ensure universal accessibility.	Increase sidewalk width	Addis Ababa City Roads Authority
		Built ramps and place tactile pavement for accessibility	Addis Ababa City Roads Authority
		Rebuild and maintain pavement in sidewalks	Addis Ababa City Roads Authority
Action 7: Increase urban furniture	Increase the urban furniture available on sidewalks, including benches, trees, weather protection, garbage bins, and other elements to make sidewalks more comfortable.	Enhancement of tree presence	Addis Ababa City Roads Authority Addis Ababa Urban Beautification & Green Development Bureau
		Increase in number of benches	Addis Ababa City Roads Authority; Addis Ababa Urban Beautification and Green Development Bureau
		Placing canopy in raised crossing and open public areas	Addis Ababa City Roads Authority; Addis Ababa Urban Beautification & Green Development Bureau
Action 8: Install street lighting	Install street lighting in all sidewalks and pedestrian crossings of the network.	Install street lighting in sidewalks and pedestrian crossings of the studied area.	Addis Ababa City Roads Authority; Addis Ababa Urban Beautification and

			Green Development Bureau
Action 9: Regulate street vendors	Regulate street vendors by designating suitable areas in furniture strips	Remove street vendors from narrow sidewalks and relocate them to wider and reclaimed sidewalks, and public spaces	Addis Ababa City Administration Transport Bureau; Addis Ababa City Road Traffic Management Agency; Addis Ababa Law Enforcement Agency; Addis Ababa City Government Trade Bureau
Action 10: Increase the number of crossings	Increase the number of pedestrian crossings, reducing distances to their destinations.	Build new crosswalk to improve connectivity in the study area	Addis Ababa City Roads Authority; Addis Ababa City Road Traffic Management Agency
Action 11: Build ramps and detectable surfaces	Build ramps and place detectable surfaces in the pedestrian crossings of the network	Built ramps and place tactile pavement for accessibility purposes in crosswalks of the study area	Addis Ababa City Roads Authority; Addis Ababa City Road Traffic Management Agency
Action 12: Reduce crossing distance	Reduce interaction between the vehicles and pedestrians by reducing the length of the pedestrian crossing and improving signals in intersections.	Relocate traffic stop line to reduce pedestrian crossing and travel distance	Addis Ababa City Road Traffic Management Agency
		Relocate existing crosswalks to promote visibility	Addis Ababa Traffic Management Agency
		Create pedestrian refuge island	Addis Ababa City Roads Authority; Addis Ababa City Road Traffic Management Agency
		Improve signage at intersections (improve road markings and vertical signage to indicate crosswalks)	Addis Ababa City Roads Authority; Addis Ababa City Road Traffic Management Agency

Action 13: Traffic calming measures	Implement traffic calming measures to decrease the severity of traffic-related crashes and increase the feeling of safety for pedestrians.	Increase sidewalk area within curves and reduce turning radius	Addis Ababa City Roads Authority; Addis Ababa City Road Traffic Management Agency
		Place speed cushions	Addis Ababa City Roads Authority; Addis Ababa City Road Traffic Management Agency
Action 14: Road safety strategies for schools	Develop road safety strategies and road safety assessments in high-risk environments such as schools, hospitals, and areas with a high level of pedestrian presence.		Addis Ababa Plan and Development Commission; Addis Ababa City Administration Transport Bureau; Addis Ababa City Road Traffic Management Agency
Action 15: Awareness campaign	Create an awareness campaign to inform the community on road safety risks and promote road safety measures.		Addis Ababa City Administration Transport Bureau; Addis Ababa City Transport Authority

Other Recommendations

Enhancing institutional coordination. A lack of coordination between institutions hinders the implementation and improvement of infrastructure. A number of city agencies are involved in sidewalk planning, design, construction, streetscaping, cleaning, and maintenance, requiring monitoring of conditions as well as coordination among stakeholders. Some examples of measures that can potentially improve coordination are assigning lead institutions to be responsible for improvements, and organizing regular consultations and meetings of key municipal entities around investment plans.

Improving law enforcement is essential to alleviate or prevent sidewalk obstruction, reduce road accidents, and sustain the impact of sidewalk improvements.

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ANNEX 1 Review of sidewalk studies

The study also reviewed relevant Government studies and documents relating to sidewalks in the urban environment.

1 ADDIS ABABA NON-MOTORISED TRANSPORT STRATEGY 2019-2028, Addis Ababa City Administration Road and Transport Bureau

The purpose of the *Addis Ababa Non-Motorised Transport Strategy* is to explain strategies that help increase pedestrian safety in the city, creating better bases for a more accessible, inclusive, sustainable, efficient, healthy and attractive city. This document is consistent with other city documents that set out an action plan, such as the *Transport Policy of Addis Ababa*, which urges paying special attention to non-motorized transport by expanding pedestrian and bicycle networks; and the *Addis Ababa City Master Plan*, which calls for higher quality walking and cycling infrastructure. Bearing in mind that the aim of the document is to contribute to improving walkability in the city, an initial diagnosis is made, and walking is identified as a predominant mode in the city, along with the number of collisions and fatalities due to the city's vehicle-oriented design. Subsequently, a series of initiatives that contribute to the improvement of pedestrian conditions are defined for each guideline, considering the city context and a target for improvement. Finally, the institutions that play an important role in the implementation of the NMT Strategy are identified, allowing for the identification of the best way to create cooperative ties between stakeholders. In addition, this document contains a section on monitoring and evaluating the implemented designs; however, its scope is vague and does not propose a clear methodology for implementation. Nevertheless, the approach to create a generalized implementation guide or manual for the city is worthwhile.

2 IMPROVING ROAD SAFETY IN ADDIS ABABA. A report on Road Safety Inspections of Bole Road and Selected Intersections – World Resources Institute, 2015

The report is composed of a road safety inspection, consisting of a systematic review of an existing road to uncover potential dangers to road users. The road safety inspection developed focuses on the Bole Road corridor, from Meskel Square to the Bole roundabout. Its purpose is to improve traffic safety by identifying and addressing dangerous conditions, faults, and deficiencies along the road that can lead to injuries and fatalities.

The document reflects the field work that allowed for the identification of specific problems to which a solution is provided. Therefore, the final product is very specific to one area and does not allow its strategies or solutions to be easily applied in other corridors of the city. Likewise, no recommendations are made regarding the maintenance of the proposed solutions.

3 SAFE NEIGHBORHOOD PROJECT Improving pedestrian safety in project area – World Resources Institute

The report includes recommendations for intersections, arterial roads, and local streets found within a selected neighborhood area, as well as the use of shared streets and the complete streets principle, especially along local streets. Although, currently, local streets are functioning as shared streets, it is not designed for speed reduction, prioritizing pedestrians over motorist, and fostering overall safety for all road users. The final objective is to create places and neighborhoods that are sustainable, walkable, vibrant, social, and livable, increasing the quality of life for residents of all ages and incomes.

The document focuses on one study area and is based on general observations. However, the document falls short in terms of recommendations as the proposals are either too general or not suited for the specific context of the city. Additionally, no implementation and maintenance strategies are presented.

4 Road Safety Inspection Report, IMPROVING PEDESTRIAN SAFETY ALONG THE LIGHT RAIL ALIGNMENT IN ADDIS ABABA – World Resources Institute

The purpose of this report is to provide general recommendations for improved safety and access of LRT stations, drawings with specific recommendations for 4 critical stations are included. The document provides a full diagnosis of the LRT context and the conditions of the surrounding area. Based on this, problems are identified, and specific recommendations are made for each point of analysis. At the end of the document, general recommendations are made in five categories: pedestrian/cyclist priority, integration with shared taxis, public buses and infrastructure, safety improvement, parking management and improvement of public environment. For each of these items, specific objectives are defined in order to improve accessibility to stations and walkability conditions in the city. These recommendations are adequate, but their generality does not allow for further applicability in different city sectors.

In general terms, the existing documentation related to walkability identifies the city's potential to have a high percentage of trips made on foot and makes an adequate diagnosis of the current issues that deteriorate users' access quality. This detailed diagnosis leads to the identification of specific problems and applicable solutions. However, the documentation is not based on general objectives and strategies that can be applied in different city sectors. Therefore, a document that establishes general guidelines and specific details that will help implementers execute appropriate solutions are needed. Furthermore, the documentation should also establish an implementation plan and provide guidance regarding maintenance of the implemented strategies.

5 STREET DESIGN STANDARDS FOR URBAN AREAS IN ETHIOPIA. Ministry of Urban Development and Housing

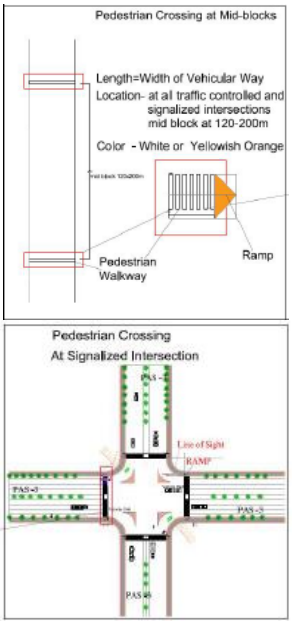
Developed by the Ministry of Urban Development and Housing (MUDH), these standards target urban centers in Ethiopia seeking to facilitate safe, walkable, livable and well-equipped streets. The document

includes a set of guiding principles, namely in terms of pedestrian and mass transport, walkable and attractive urban spaces, mixed activity and local economic development, safe and comfortable, smart, sustainable, and resilient streets. The standards classify urban streets into categories and use them to define road characteristics such as the Projected Annual Average Daily Traffic (AADT), required right-of-way, geometric specifications, and permitted speeds, among others.

Regarding urban sidewalks, the standards specify the geometry design standards, including width per category, slopes and materials, as illustrated in the Figure below. The standards also provide design features and locations of street elements, such as street furniture (public transport stations, street signs and signals, litter bins, street seating, bollards, etc.), vegetation, street vendors and traffic calming elements (curb extensions/bulb-out, raised walkway, speed bump and table).

Spacing, minimum width and type of pedestrian crossings and pedestrian crossing layouts of the Street Design Standards

S/N	Street types	Maximum spacing for pedestrian crossing			Minimum width of pedestrian crossings	Type of pedestrian crossings
		Commercial, mixed and city center	Residential	Industrial		
1	PAS (for urban level and service streets of other EW, MW and TR)	At all traffic controlled intersections and junctions	At all traffic controlled intersections and junctions	At all traffic controlled intersections and junctions	5	Signalized, fitted and synchronized with sound message in local language
		Mid-block at 120m	Mid-block at 150m	Mid-block at 200m		
2	SAS	At all traffic controlled intersections and junctions	At all traffic controlled intersections and junctions	At all traffic controlled intersections and junctions	4	Signalized, Signalized, fitted and synchronized with sound message in local language
		Mid-block at 120m	Mid-block at 150m	Mid-block at 200m		
3	CS	At all traffic controlled intersections and junctions	At all traffic controlled intersections and junctions	At all traffic controlled intersections and junctions	3	Signalized (Fitted and synchronized with sound message in local language) or un-signalized
		120m	150m	200m		
4	LS	100m	120m	250	2.5	un-signalized



Source: Street Design Standard for Urban Ethiopia, 2016.

While the document is useful for having a clear definition of the geometric features that should be used by an engineer or an architect to design a street, the standards are not easy to understand and do not represent a useful tool for a non-technical person. Also, the document includes information on all street components, making it difficult to identify those specific to sidewalks and pedestrian infrastructure. Although the standards and guiding principles included in the Standards will be considered for the development of the short-term strategies and guidelines of this study, a document that is intentionally easier to understand for non-technical people will be drafted, in order to provide a clearer and more illustrated way to understand the importance of sidewalk design recommendations, for both decision-makers and designers.

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Addis Ababa City Government Plan and Development Commission

IDOM