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TOWARDS A MORE WALKABLE AND TRANSIT-ORIENTED CITY:

A MULTIDIMENSIONAL ANALYSIS OF PALERMO

LA DOTTORESSA

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E volavo, volavo felice più in alto del sole
Ed ancora più su
Mentre il mondo pian piano spariva lontano laggiù
Una musica dolce suonava soltanto per me

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ACRONYMS

API	Application Programming Interface
CENSUS UNIT	Italian national statistics units
CNU	Congress for New Urbanism
EIT	European Institute of Innovation and Technology
ESPON	The European Observation Network for Territorial Development and Cohesion
IDA	Industrial Development Areas
IDRD	District Institute of Recreation and Sports
IMM	Istanbul Metropolitan Municipality
ISTAT	Italian National Institute of Statistics
ALAG	Local Action Group
LASIAD	Laleli Industrialists and Businesspersons Association
LSL	Local Labour Systems
MA	Metropolitan Area
MS	Microsoft
PGTU	General Plan of Urban Traffic
PMPT	Integrated Plan for Mass Public Transport
PUT	Urban Traffic Plan
QGIS	Quantum Geographic Information System
QoL	Quality of Life
RFI	Italian Railway Network
SNAI	The National Strategy for Internal Areas
SUMP	Sustainable Urban Mobility Plan
TOD	Transit Oriented Development
TPL	Local Public Transport
UAA	Utilised Agricultural Area
UNESCO	United Nations Educational, Scientific and Cultural Organisation
ZTL	Traffic Limited Zone

CHAPTER 1

Introduction and the Scope of the Research

1. Introduction and the Scope of the Research

This thesis investigates the relationship between walkability, pedestrian accessibility, and car dependency in contemporary urban environments. With increasing attention toward sustainable mobility and human-centred urban planning, there is a pressing need to develop strategies that promote walkable cities while reducing the reliance on private vehicles. This research explores these themes through a multi-dimensional approach, integrating spatial analysis, socio-cultural perspectives, and policy evaluation to understand how pedestrian mobility is shaped in car-dependent contexts.

The study is rooted in the recognition that walkability is not only a spatial or infrastructural matter but also a cultural and behavioural issue. Much of the existing literature on walkability and transit-oriented planning focuses on the built environment, emphasising infrastructure quality, street design, and public space allocation. However, there remains a critical gap in understanding the socio-cultural dimensions that influence whether people choose to walk, cycle, or rely on cars, even when pedestrian infrastructure is available. This research seeks to fill this gap by examining both spatial and behavioural barriers to walkability, combining the principles of Transit-Oriented Development (TOD) and the 15-Minute City into an integrated framework that accounts for both physical and socio-cultural accessibility constraints. The analyses have a greater focus on the walkability principle of the 15-minute city and the proximity of the train stations of the TOD that are compatible with each other to decrease car-dependency and promote more sustainable mobility behaviours.

While this research examines the principles of the 15-minute city model, particularly the emphasis on proximity and pedestrian accessibility, it is important to clarify that the study is not a direct or full implementation of the 15-minute city framework. Rather than conducting a comprehensive evaluation of the 15-minute city concept, the focus of this thesis is primarily on overcoming car dependency and enhancing walkability, which are among the core objectives of the 15-minute city model itself.

Given the complex urban and infrastructural characteristics of Palermo, a full assessment of whether all essential land uses and services are accessible within a 15-minute walk from the study areas would require a separate, in-depth investigation. Such a study would necessitate a systematic inventory and evaluation of every functional component, like housing, services, green spaces, employment, education, and healthcare, within the targeted areas.

Instead, this research takes a targeted approach by analysing pedestrian accessibility and proximity concerning TOD principles. TOD inherently focuses on accessibility to public transport nodes, operating under the assumption that well-connected transit hubs can help reduce car dependency even without a complete replication of the 15-minute city model.

Thus, this study addresses the fundamental ambitions of the 15-minute city, promoting sustainable, walkable urban environments through a more focused lens adapted to Palermo's realities. A deeper, full-scale application of the 15-minute city model in Palermo would be a valuable extension of this research and is discussed in greater detail in the concluding chapter, along with proposals for further study and potential policy measures.

At the core of this study is an investigation into how car dependency affects pedestrian mobility and whether socio-cultural perceptions play a role in discouraging walking, even when alternative mobility options are present. To this end, the research explores:

- The spatial and functional integration of walkability principles into urban planning, with a focus on railway station areas as potential hubs for pedestrian-friendly development.
- The socio-cultural and behavioural barriers to pedestrian mobility, particularly in historically car-dependent cities like Palermo.

Through this multi-layered approach, the study seeks to contribute to theoretical and practical knowledge in the fields of urban mobility, transport planning, and sustainable urbanism, offering insights that can inform policy decisions and urban development strategies in Palermo and similar Mediterranean cities that face the challenge of car-dependency.

1.1 Interest and scope of the research

Urban mobility is an integral part of daily life, shaping how people navigate their environments and connect with opportunities. As a universal activity that everyone engages in, mobility should be designed to be a positive and enjoyable experience for all. Recognising the diverse needs of individuals, it is essential to ensure that moving through the city is not just functional but also a pleasant and inclusive experience that enhances the quality of everyday life. Thus, the 21st century demands a paradigm shift in urban planning, with a growing focus on creating liveable and walkable cities.

Walkability, neglected by car-centric development, has re-emerged as a cornerstone for achieving these goals. However, implementing walkability strategies in contexts that are heavily car-dependent presents unique challenges. Car dependent cities prioritise car travel over alternative mobility modes such as walking, cycling and public transport (Newman and Kenworthy, 1999) and it leads to engrained problems like pollution, urban heat island effect (Louiza, Zéroual, & Djamel, 2015), traffic congestion (Newman and Kenworthy, 1999), social isolation and fragmentation (Jacobs, 1961) and urban sprawl (Brown, Morris, and Taylor, 2009).

For the last 30 years, a significant effort has been made to make urban mobility safer, more sustainable, and smarter to overcome those problems. Initially, the focus was on improving travel efficiency and minimising negative environmental effects. However, our comprehension of the concept of sustainable mobility has progressively matured and taken on a more comprehensive perspective regarding the overall quality of life as it extends to issues of liveability (Holden et al., 2019). In this context, the concept of proximity has risen to the forefront of urban planning discourses. The traditional definition of proximity as physical distance has turned into a diverse understanding that considers the attractiveness and accessibility of different destinations. However, achieving proximity within cities gets more complicated by a deeply ingrained car dependency. Alternative modes are the main mobility methods within the proximity concept, yet cities designed around widespread car use have created significant barriers to walkability like unsafe pedestrian infrastructure, unpleasant walking experiences caused by heavy traffic and the dominance of motorised traffic that discourages people from walking or cycling for daily activities.

Tackling these challenges, innovative urban planning models like the 15-minute city and Transit-oriented Development (TOD) have emerged. The 15-minute city, brought by Carlos Moreno (2021), proposes urban environments where essential services like shops, schools, and healthcare are all within a 15-minute walk, cycle, or public transport journey of any resident's home. This focus on proximity fosters a more environmentally sustainable and liveable urban environment. TOD shares these goals, emphasising the development of walkable neighbourhoods through integrating public transportation options (Bertolini, 2010; Cervero, 2012). These two concepts are seen as complementary based on their common ground principles about prioritising alternative modes and proximity.

These models primarily focus on creating well-connected, walkable urban spaces with an emphasis on proximity and the built environment. However, a critical gap exists in the scientific discourse: achieving the primary goal of walkability requires a deeper focus on understanding and influencing people's travel behaviour. Without addressing this behavioural dimension, the effectiveness of these models may be limited. Research by scholars like Ewing and Cervero (2010) has shown a strong correlation between the built environment and travel choices. Cities can encourage residents towards more sustainable travel modes by improving infrastructure for pedestrians and cyclists while restricting car use in certain areas.

However, this does not imply that only the built environment should be considered; rather, travel behaviour and people's mindset about transportation and mobility culture should not be overlooked in the transition to sustainable mobility in cities, as they have been. Today, a renewed focus on walkability and the creation of vibrant pedestrian areas is emerging as a cornerstone for sustainable and liveable cities. Walkable neighbourhoods foster social interaction and a sense of community by providing spontaneous encounters (Jacobs, 1961). Furthermore, walkability ensures access to essential services and amenities for all residents regardless of their socio-economic background or car-ownership, which are the crucial principles of the 15-minute city and TOD concepts.

Keeping these facts in mind, this research examines barriers towards walkability in car-dependent urban contexts and seeks to address how the principles of the 15-minute city and TOD concepts can help to create more sustainable and equitable urban environments concerning walkability. In doing so, it examines socio-cultural reasons and travel behaviours as well as mobility preferences to understand the underlying reasons behind perceived barriers to walkability. Additionally, by integrating the principles of the 15-minute city and TOD, it investigates the potential and limits of these models in developing walkable communities. The findings will be of interest to urban planners, policymakers, and researchers seeking to create healthy, sustainable, and liveable cities for the decades to come.

1.2 The rationale for a case study of Palermo

The selection of a case study area with a high-level of car dependency arise from research (Steg and Vlek, 1997; Tertoolen et al., 1998) indicating that in such contexts, individuals tend to justify their reliance on cars by attributing positive value to practical, symbolic, and emotional factors associated with car usage. This research hypothesises that a similar scenario may exist in the Palermo study area, potentially serving as a significant indicator for revealing barriers to walkability.

Palermo is the capital of the Sicilian region and ranks as the fifth-largest city in Italy. According to the national census conducted by ISTAT[1], its population was 630,167 in 2023. Despite experiencing a decline in population over recent decades in favour of smaller neighbouring towns, the city remains a hub for thousands of daily commuters due to its dense concentration of amenities and services. Moreover, Palermo has become a more popular destination in the last years due to factors such as growing tourism and ongoing regeneration initiatives since the 1990s. This revitalisation has been partly fuelled by access to national and European funding opportunities. Notably, areas like the Old Town and waterfront have seen significant transformation both in terms of physical infrastructure and economic development (Vinci, 2019; 2022).

[1] The Italian National Institute of Statistics, a public research organisation, is the main producer of official statistics in the service of citizens and policymakers. It operates in complete independence and continuous interaction with the academic and scientific communities.

In recent years, Palermo has shifted its focus towards promoting sustainable mobility and has moved away from its car-dependent model. Despite its reputation as one of Europe's most congested cities (Pishue, 2023), a significant effort has been made in the last three decades to improve public transit and reduce car dependency by implementing more alternative modes-oriented transport policies. Key initiatives include the approval of the Integrated Plan for Mass Public Transport in 2002, followed by the implementation of the first General Urban Traffic Plan in 2013 and the Sustainable Urban Mobility Plan in 2017. These plans aim to enhance public transit options, expand bike lanes, and establish limited traffic zones, particularly in the Old Town area. A great emphasis was put on the Railway Network with projects such as the Railway Bypass and Railway Ring aimed at improving connectivity and accessibility. Even though some delays have been encountered due to financial and logistical problems, these initiatives are expected to play a crucial role in shaping the future urban development in Palermo. Therefore, this research gives priority to the Railway network alongside walkability to have a better understanding of enhanced urban mobility prospects for Palermo.

1.3 Structure of the research

The thesis comprises 3 main parts that are divided into 9 chapters. Part 1 establishes the theoretical foundation by examining the role of walking within the broader context of urban planning paradigms, concepts, and applications. The 2nd chapter focuses on the concept of walkability, exploring its relationship with car dependency and its effects on pedestrian accessibility, travel behaviour, and urban design. Key frameworks such as the 15-minute city and Transit-Oriented Development (TOD) are critically analysed alongside planning experiments from cities around the world, offering insights for diverse approaches to enhancing walkability. By focusing on the relatively new and highly debated 15-minute city concept and combining its principles with TOD, this thesis addresses the growing need for a refined perspective on urban mobility. The research seeks to fill a significant gap in the field of mobility, where much of the focus remains on spatial and built-environment factors, often neglecting the sociocultural dimensions of pedestrian accessibility.

The 3rd chapter presents a comparative analysis of pedestrianisation projects in various cities, examining how different urban contexts approach walkability and public space management. It categorises these projects into comprehensive pedestrianisation strategies (such as Pontevedra, Ghent, Oslo, and Helsinki) and incremental/tactical pedestrianisation initiatives (such as Milan, Bogotá, Istanbul, and Copenhagen). The chapter evaluates the successes, challenges, and policy lessons derived from these international case studies.

Part 2 focuses on the case study of Palermo, providing a detailed analysis of its planning history and the evolution of its infrastructure over the decades. The 4th chapter contextualises Palermo, focusing on demographic trends, territorial structure, urban functions, and transportation networks. It examines the historical evolution of the city's mobility system, assessing how past planning decisions have reinforced car dependency and shaped contemporary walkability challenges. The analysis is a foundation for identifying spatial and socio-cultural barriers to pedestrian accessibility.

Chapter 5 critically evaluates Palermo's urban mobility policies and planning tools, including the General Urban Traffic Plan (2013), Soft Mobility Plan (2015) and Sustainable Urban Mobility Plan (2024), which introduced pedestrianisation efforts, alternative transport modes and other mobility policies like traffic limited zones. This chapter also examines public transport investments, such as the railway bypass and tram network, that have shaped the urban development of the city. By analysing the implementation and effectiveness of these policies, the chapter highlights gaps in current strategies and assesses their impact on urban walkability and transit accessibility.

Chapters 6 and 7 are devoted to the research analyses. The 6th chapter focuses on the catchment areas of two railway stations (Orleans and Lazio) as strategic nodes for walkability enhancement. It examines how the 15-Minute City and TOD models can be integrated to improve first- and last-mile accessibility in these areas. Using GIS-based spatial analysis, functional diversity mapping, and socio-demographic assessments, the chapter identifies barriers to pedestrian movement and transit integration, urban design deficiencies impacting walkability, and opportunities for enhancing multimodal connectivity and reducing car dependency. The chapter concludes with walkability enhancement strategies and policy recommendations based on empirical findings.

On the other hand, Chapter 7 presents the survey research conducted in Palermo's historic Old Town, which serves as the city's most pedestrianised area and a focal point for walkability policies. Unlike the station area analysis, which is spatially oriented, this study investigates socio-cultural perceptions of pedestrianisation. Key themes include public awareness and attitudes toward pedestrian-friendly policies, mobility preferences and reasons behind persistent car dependency, and perceived barriers to walking and active mobility behaviour.

Part 3, the concluding section of the thesis, brings together the insights gained from both the theoretical framework and the Palermo case study. Chapter 8 synthesises key insights from the case study and survey research, identifying how theoretical frameworks translated into actionable strategies on the streets of Palermo. The final chapter, Chapter 9, has a broader approach to synthesising lessons learned from the analysis and connects theory with practice. Particularly by bringing together the sociocultural and spatial factors that shaped the research, this chapter offers generalised policy recommendations designed to guide policymakers and planners in creating urban environments that prioritise pedestrian accessibility and support sustainable mobility.

The following research questions served as the foundation for conducting the aforementioned studies.

- How can urban planning strategies be employed to promote proximity within cities, considering not just physical distance but also accessibility and attractiveness?
- What are the key barriers to walkability, both cultural and spatial, in urban environments, and how can they be addressed?
- How can models like the 15-minute city and TOD be implemented in a way that effectively promotes sustainable travel behaviour and fosters vibrant and equitable communities?
- How can travel behaviour data be used to inform the development and evaluation of strategies for promoting walkability and proximity in cities?

The research will adopt a mixed-methods approach, incorporating both qualitative and quantitative data. A comprehensive literature review will analyse relevant studies conducted in recent years, focusing on travel behaviour and factors influencing pedestrian activity. This foundational knowledge will be complemented by a targeted survey conducted with residents of Palermo.

Specifically designed to evaluate perceptions and experiences within the historic city centre, this survey will provide valuable data on current mobility patterns and a deeper understanding of the social and cultural dimensions of walkability.

On the other hand, the case study on integrating 15-minute city and TOD concepts and principles centres on the catchment areas of railway stations. These two concepts share common guiding principles, as highlighted by numerous studies (Jacobson and Forsyth, 2008; Thomas et al., 2018; Khavarian-Garmsir et al., 2023; Büttner et al., 2022). This is significant for strategic design, urban policy, and spatial planning, as it enables a comprehensive approach that can help to actualise the shift towards sustainable mobility.

To recapitulate, this research synthesises the specific social practices and cultural norms alongside the spatial features and barriers for a thorough understanding and to treat the mobility challenges in cities like Palermo. While individual perceptions and attitudes are important, it is equally vital to understand the broader social structures and historical context that have shaped Palermo's urban mobility culture regarding travel behaviour and transport geography. Tackling the barriers to walkability requires going beyond mere infrastructure improvements and investigating the underlying social norms and cultural values that shape travel behaviour.

PART I

The Role of Walking in the Planning Culture: Paradigms, Concepts and Applications

CHAPTER 2

Theoretical Framework

2. Theoretical Framework

This chapter establishes the basis for understanding the core concepts and ideas that shape this research, with a particular focus on the relationship between urban planning, mobility, and walkability. It explores how car-centric urbanism has influenced the way cities are designed and how this, in turn, impacts the walkability and liveability of urban environments. Moving beyond the physical layout of cities, the chapter also explores the complexities of travel behaviour, examining not only rational decision-making but also the cultural and psychological factors that shape how and why people choose to walk or not.

The discussion then shifts to the concept of proximity-led mobility, highlighting its critical role in fostering walkable cities, besides the evolving position of active mobility within urban planning culture. By tracing the origins and principles of proximity-focused planning approaches, the chapter investigates how theoretical concepts such as chrono-urbanism and the 15-minute city have emerged as responses to car dependency and the need for more sustainable urban transformations. The 15-minute city is examined in depth, including its guiding principles, strategies for implementation, and the challenges of adapting it to real-world contexts.

Finally, the chapter introduces Transit-Oriented Development (TOD), a framework that complements proximity-led planning by focusing on the integration of mixed-use neighbourhoods around transit hubs. Together, these theories and concepts form the foundation of the research, offering critical insights into how urban mobility systems can shift from car dependency to walkability, creating more inclusive, sustainable, and liveable cities.

Before going into the detailed literature review of the various dimensions influencing walkability and pedestrian accessibility, the diagram below (Fig. 1) offers a conceptual overview of the interrelations among key factors. It illustrates how mobility policies and planning interventions serve as overarching frameworks that shape every other aspect related to walkability, including the urban environment, individual behaviours, social norms, and personal capabilities such as physical ability.

Pedestrian-oriented policies and actions play a central role in promoting a transition towards more walkable urban contexts. Incentives for walkable environments help foster a culture of sustainable mobility, while disincentives for car use, such as traffic-calmed zones and restricted traffic areas, contribute to shifting social perceptions that often associate private car ownership with status and convenience. Thus, walkability is influenced not only by physical infrastructure but also by evolving social norms and individual attitudes toward urban mobility.

Furthermore, the diagram emphasises the complex and often reciprocal relationships among urban form, socio-demographic attributes, cultural contexts, and behavioural patterns. For instance, while street design may appear to relate primarily to physical accessibility, it also has an indirect influence on perceived behavioural control, shaping whether individuals feel confident and empowered to choose walking over driving. In this way, the factors outlined are not isolated but instead form an interconnected system in which changes to one dimension can reflect across others.

Due to the dual perspective of this research, which aims to analyse both spatial and socio-cultural barriers and drivers towards walkability, those key factors and their interrelations form the foundation of the theoretical framework. Their mutual influence on each other helps to create the policy recommendations and guidelines that are given in the last chapter, since one factor cannot be imagined isolated from the others.

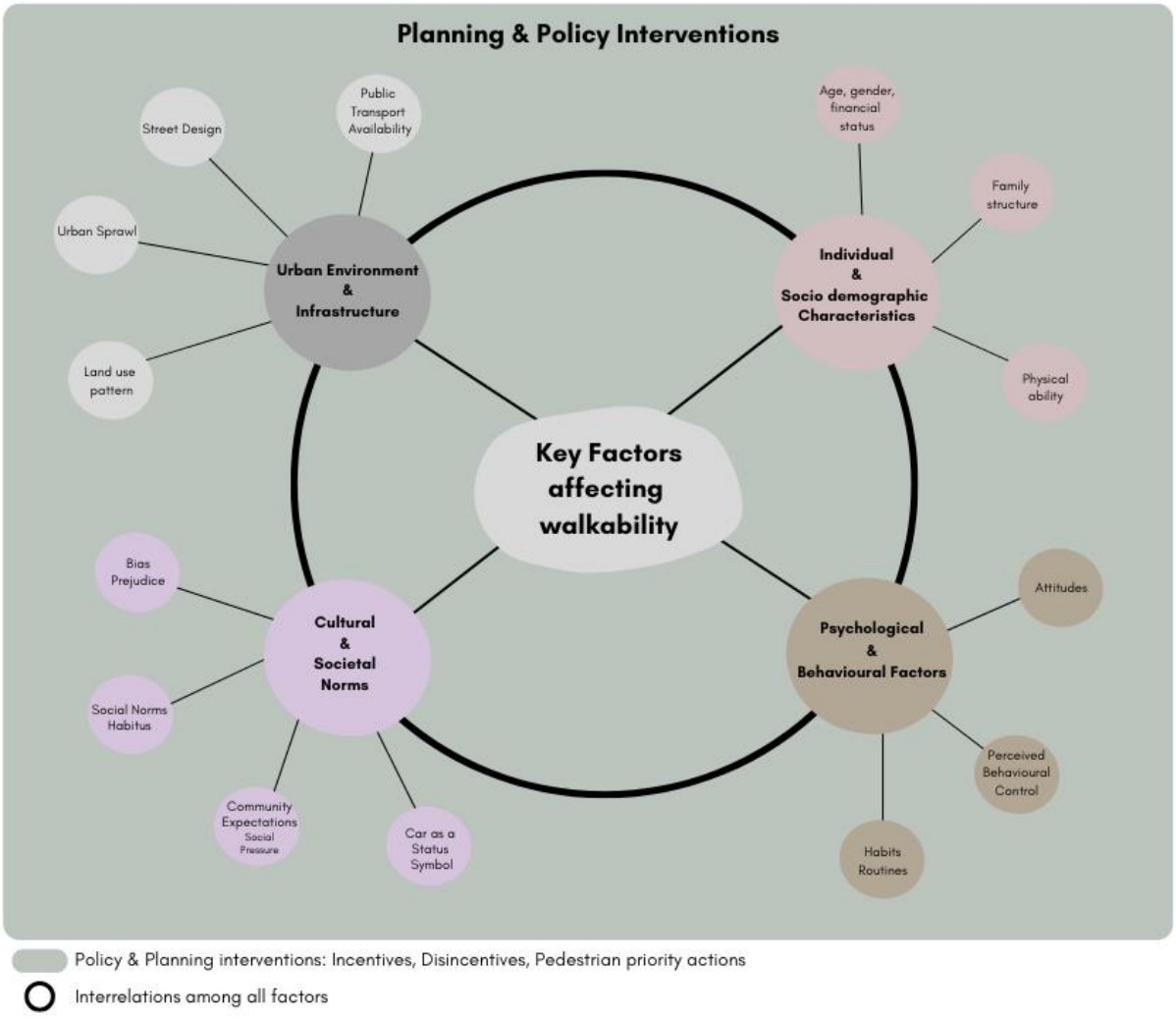


Figure 1. Key factors affecting walkability and pedestrian accessibility.

2.1 The impact of car-centric urbanism on walkability

Today, the continuing decentralisation of cities is a widely documented phenomenon (Bertolini, 1999). The car-centred conception has changed the dynamics of urban planning, and it paved the way for urban sprawl and its destructive results (Brown, Morris, and Taylor, 2009). Many studies are referring the car use and its relation to built environment (Newman & Kenworthy 1999, 2006; Bento et al. 2005), travel behaviour (Van Wee & Handy, 2014), travel mode choice (Stradling, 2011; Klöckner, & Friedrichsmeier, T. 2011; Jeong et al., 2022) and the car-dependency (Zhao, 2011; Mattioli et al. 2016; Wiersma et al., 2017; 2021; Saeidizand et al., 2022; Van Eenoo et al., 2022).

Regarding the definition of the term "car dependency," Goodwin (1995) rejected the notion that car dependence is simply synonymous with the amount of use and highlighted the distinction between car-dependent individuals and car-dependent trips. Based on this differentiation, he suggests that seeking to persuade large numbers of people to change their attitudes to car use is likely to be less successful than seeking to achieve a change in choices about how - and whether - to make specific targeted journeys. A sizeable portion of car owners express that they would struggle or find it hard to envision giving up car usage. However, there is a small percentage, around 5% to 10% of car owners, for whom the attachment to their cars appears minimal. Additionally, a more considerable segment of the population, a quarter to a third, expresses a desire to reduce their reliance on cars if circumstances permitted. This includes some individuals who value car usage for its flexibility and independence. The study also emphasises the importance of providing better alternatives to car use to change behaviour and adds that delaying policy implementation can make it harder to change established behaviour patterns.

Besides, many other academics have characterised a lack of choice as 'car dependency' (Jeekel,2013; Jones, 2011; Stradling, 2007; Wiersma et al., 2015; Wiersma, 2020). According to Newman & Kenworthy (1999), car dependency occurs when a city prioritises automobile usage as the primary consideration in its choices regarding transportation, infrastructure, and land use. However, according to Urry (2004), the use of automobiles is not merely a rational response to independently emerging societal needs. He contends that automobility fundamentally reshapes the dynamics of urban life. The urban infrastructure designed to accommodate cars has disentangled the historically intertwined territories of residence, employment, commerce, and leisure. Consequently, car dependency is not just a consequence but also a driving force behind societal transformations. Similarly, Handy (1993) explores how the automobile has indirectly triggered substantial shifts in access patterns to retail and service facilities within metropolitan regions, resulting in a 'cycle of dependence.' Contemporary developments in the Western world illustrate this phenomenon, as traditional, tightly knit spatial arrangements of amenities are eroding.

Over time, as society's needs have become more complex, we have relied heavily on cars to meet them. But this focus on cars has made it harder for other transportation options to thrive in our cities. (Wiersma, 2021).

While the debates on the definition of car dependency and its relationship with urban development have continued, different methodologies, including qualitative and quantitative studies, have been used to answer those debates. One of those studies is Zhao's (2011) novel approach to car dependence research, differentiating the objective car-use behaviour and individuals perceived (subjective) reliance on cars. This study proposed that subjective measures of car-dependence should be an integral part of objective metrics to explore the 'intent' to reduce car-use. It also underlines the multifaceted nature of subjective measurements influenced by a complex relation of attitudes, behaviours, and intentions by highlighting the need for further exploration of the psychological, behavioural, and contextual factors that shape people's relationships with cars. The study involves 1330 individuals and focuses on three determinants, which are demographic characteristics, socio-economic status, and land use patterns, by using structural equation models. While income and land use patterns emerged as significant predictors, their overall explanatory power for subjective car dependence remained limited.

The quantitative methodologies applied thus far have typically focused on either extensive car usage and ownership or the absence of accessible public transportation as key indicators of car dependency. Kenworthy and Laube (1999) conducted a study involving thirty-two major cities across the globe, assessing the degree of car dependency among their residents by comparing car ownership and car usage with the utilisation of public transportation, all while considering land use characteristics. Their study highlighted that;

- City wealth is not a reliable predictor of automobile dependence.
- Higher population density correlates with lower car ownership, more transit use, and reduced transportation costs.
- Car costs significantly impact car use. Lowering car ownership and use often requires increasing car expenses.
- Cities with better and higher levels of rail network typically have higher transit use and lower car dependence.
- Active mobility is the best solution so far for environmental and economic enhancements.

Overall, this study suggests that effective land-use planning, focusing on transport policies towards non-auto modes and higher charges for car-use and car-ownership, are the three important dimensions for reducing car dependence.

However, an issue highlighted by Jeekel (2013), drawing on insights from Gorham (2002), is that studies carried out so far often lack a clear definition of 'dependency' when it comes to car ownership or use. He distinguishes between real (objective) car dependency and emotional (subjective) car dependency. Subjective car dependency can stem from habits or a lack of information about alternative transportation methods, whereas objective car dependency arises when there are no practical alternatives in terms of travel time and expenses.

Jeekel also emphasises that a variety of factors influence frequent car use, including social norms and personal identity. For some people, owning a car is seen as a symbol of status or independence. Besides, travel behaviour does not necessarily correlate with car dependency, as individuals may choose to use a car even when alternative transportation modes are available (meaning they are not 'dependent' on the car).

Recent research conducted by Langer et al. (2023) concentrates on a quantitative evaluation of car dependency within the city of Munich. The study integrates various metrics encompassing car utilisation, ownership rates, and limited public transportation availability to gauge car dependency and identify potential geographic factors associated with it. Another study conducted by Wang et al. (2018), the influence of urban infrastructure on car ownership and usage in smaller and mid-sized Chinese cities is examined. The research reveals that increased residential density, efficient land use, enhanced public transit services, and well-connected streets can notably diminish reliance on automobiles. These results emphasise the importance of urban planning strategies aimed at fostering alternative transportation modes while discouraging car dependency. On the other hand, Zhang et al. (2022) examine car purchase intention as an indicator of car dependency, particularly in the context of the COVID-19 pandemic. The study explores numerous factors that influence car purchase intention, such as social demographics, social norms, and past travel experience. In their recent research, Cao et al. (2023) explore the non-linear connection between the built environment and car dependency. Their study uncovers that greater land use diversity and enhanced accessibility to destinations can deter car utilisation and lessen the extent of car dependency. These results imply that customised land-use interventions hold the potential to effectively alleviate car dependency.

The complexity of modern life requires flexibility and freedom in mobility. Lately, studies show that car dependency is holistically a part of a mobile lifestyle, dominantly in Western society (Brindle 2003; Steer Davies Gleave 2005; Harms 2008; Jeekel 2013). Car use is associated with motility, personal ability to be mobile (Kaufmann et al., 2004), thanks to its flexibility. However, there is a continuous conflict between increasing car use and accessibility to amenities because the increase in car use leads to congestion, time loss in traffic, parking problems and financial costs.

Besides, functions and daily activities are spread out and being pulled away from each other by adapting the spatial context of car use and by creating car dependency that active mobility and public transport means to become less comfortable and flexible than private cars for users (Harms, 2008; Mattioli et al., 2020). Building more car infrastructure to solve these problems has not been successful in many cases, as Braess (1969) mentioned, ‘the more you build, the more they come.’

In recent decades, new urban planning theories and strategies have been developed to reduce car dominance and limit dependency on automobiles in both urban and suburban areas. Planning policies are often seen as key tools for addressing and reshaping car-oriented travel behaviour, helping to mitigate its long-term effects (Banister, 2008). In urban environments, proximity to commercial hubs and amenities, coupled with the accessibility of public transportation (and sometimes cycling infrastructure), creates a conducive environment for adopting sustainable modes of travel. Conversely, factors like traffic congestion, unsafe travel conditions, or constrained and costly parking facilities deter automobile usage. This dynamic is encapsulated by the concept known as the 'land-use transport feedback cycle (Wegener & Fürst, 2004). Improvements on travel time and increased accessibility to different modes through urban policies would have a strong influence and lead to a mode shift. Consequently, coordinated planning encompassing both land use and transportation could incentivise a shift in travel mode and a decrease in car travel distances (Ewing & Cervero, 2010, 2017). Furthermore, urban planning has the potential to enhance accessibility for individuals who face barriers in acquiring a driver's license, thereby reducing the risk of them missing opportunities for full societal engagement Fransen et al., 2018). Thus, it can be said that urban planning can contribute to decreasing the number of people who have no other mode of transportation than a car (Van Eenvoo et al., 2022).

2.2. The role of travel behaviour in fostering walkable urban environments

To facilitate a transition from car-dependent to sustainable urban mobility and walkability, a thorough understanding of travel behaviour patterns and motivations is crucial. A range of theoretical frameworks and empirical studies explore the factors influencing travel choices and strategies for behaviour change. A comprehensive examination of existing research is conducted in this section to establish a foundation for the development of sustainable mobility strategies.

There is substantial evidence supporting the idea that the built environment can impact travel behaviour and car ownership. However, there is still no clear agreement among experts about exactly how much this impact is and which specific features of the built environment have the biggest effects (Boarnet and Crane, 2001; Van Wee, 2002; Hickman and Banister, 2005 Clifton, 2017; Ewing & Cervero, 2017; Naess, 2019; Stevens, 2017). As mentioned by Klinger and others (2013), certain scholars state that urban form regarding to the 3D's density, diversity and design have impact on travel behaviour to a considerable extent (Frank and Pivo, 1994; Gordon, 1997; Newman and Kenworthy, 1999; Stead, 2001), while other researchers are mostly sceptical about such an impact (Gordon and Richardson, 1997; Snellen, 2001).

Previous research has indicated that the built environment's explanatory power is typically limited, meaning that spatial features can account for only a portion of travel behaviour (Boussauw & Witlox, 2011; Naess, 2014). More recently, the research conducted by Van Eenoo et al. (2022) reveals that travel patterns tend to shift towards car usage once a household acquires a car, irrespective of the neighbourhood characteristics and built environment. Consequently, policies aimed at discouraging car ownership might prove more effective than trying to limit car usage, as they can prevent the establishment of a cycle of car-centric behaviour from the outset.

This is not surprising, as travel motivations and modes vary considerably and are heavily influenced by factors such as age, gender, income, and employment status (Naess, 2014). Furthermore, an individual's specific spatial and temporal constraints play a crucial role in shaping their travel behaviour (Fransen et al., 2019). Therefore, travel behaviour is highly individualised and contingent on the context.

A study on 'Mobility-as-a-Service' (MaaS) held in Belgium (Ghent) by Storme et al. (2020) demonstrates that, even though the survey participants displayed strong motivation and received financial incentives to adopt alternative modes of transportation, only a minority were successful in reducing their reliance on cars in their daily routines. This case serves as an illustration of the growing extent to which our lives and habits have become intertwined with car dependence. Van Eenoo et al. (2022) explain that, as sociologists describe this phenomenon as the entrenchment of the car-centric system, emphasising the significance of enduring patterns, structures, and feedback loops (Dennis & Urry, 2009; Urry, 2004).

Additionally, Mattioli et al. (2020) offer a comprehensive examination of the political economy surrounding car-dependent transportation systems, uncovering their constituents, processes, and characteristics.

Steg and Gifford (2005) proposed that reductions in the volume of car traffic, based on behaviour changes of individual car users, are the effective solution for the problems caused by intense car use. This necessitates a comprehensive understanding of the reasons behind car usage, as policies aimed at regulating travel demand can have the greatest impact when they target key factors that influence car use levels. Cars often serve as status symbols, allowing people to convey their identity and driving experience as something adventurous, exhilarating, and enjoyable. This suggests that the value of car travel hinges not only on its practical utility but also on symbolic and emotional aspects. However, there is limited empirical data available to gauge the importance of these non-practical factors (Steg, 2005). Some scholars have contended that travel is not solely a response to practical needs but can also be inherently desired, potentially leading to aimless (automobile) travel (Mokhtarian and Salomon, 2001). Although several researchers have highlighted the relevance of motivations related to emotions and the symbolic roles of cars (e.g., Sachs, 1983; Marsh and Collett, 1986; Mokhtarian and Salomon, 2001), the perceived significance of such motivations has primarily been based on theoretical rationale. Steg (2005) composes these theories on non-practical factors and asserts that it is worth noting that other factors can also be influential, such as the opportunities individuals have. Travel behaviour is influenced by situational factors, which impact the availability and attractiveness of various modes of transportation and the necessity of travel. Situational factors and motivations may interact; for example, people might choose to live far from their workplace (relying on their car) because they enjoy driving. Similarly, when car dependency is high, people may rationalise their car usage by evaluating it more positively based on practical, symbolic, and emotional aspects (Steg and Vlek, 1997; Tertoolen et al., 1998).

Another in-depth research (Handy et al., 2005) investigates the boundary between choice and necessity based on a categorisation of potential reasons for and sources of ‘excess driving’; it is seen that Americans seem to be complaining more than ever about how much they drive or how much everyone else drives. Nonetheless, the existing data indicates that a significant portion of the driving in question arises from choice rather than necessity. In cases of essential journeys, urban planners can investigate methods to diminish the necessity or distance of travel and boost non-driving alternatives. However, when it comes to travel by choice, the policy implications become more intricate and intersect with fundamental notions of personal freedom of choice. This underscores the significance of comprehending the causality behind travel behaviour. Looking at another example, a survey assessing attitudes in the UK, drivers indicated that slightly less than half of their yearly driving could be categorised as 'essential.' Approximately 10% of their driving was deemed 'not important at all,' while another 18% was considered 'not very important’ (Jones & Sloman, 2003).

The interesting results derived from the qualitative research of Handy et al. (2005) were that the number of people who do not drive more than they need to but drive more than they want should not be overlooked, and policies must work to further reduce the need for driving. These results reveal that land use policies which promote proximity could increase the viability of walking and biking and reduce necessary driving distances.

In a broader sense, researchers have adopted two main approaches to explain differences in travel patterns among cities. One approach focuses on objective criteria such as urban form and socio-economic factors, while the other emphasises the subjective dimension represented by individual preferences regarding mobility.

Van Acker et al. (2010) brought the discussion to the next level and suggested that those studies, analysing the influence of built environment on travel behaviour, often fail to explain the fundamental reasons behind the relationship between travel behaviour and spatial, socioeconomic, and personality traits. Thus, addressing this question necessitates integrating theories from transport geography (e.g., time geography, activity-based approach) and social psychology (e.g., Theory of Planned Behaviour, Theory of Repeated Behaviour). They highlighted that concepts like New Urbanism and Compact City Policy are designed to curtail car usage and travel distances by promoting high-density, mixed-use neighbourhoods. These theories integrate elements from transport geography, social psychology, and lifestyle theory to elucidate travel behaviour. Central to daily travel behaviour is the decision-making hierarchy, encompassing both rational and instinctual influences. Additionally, the spatial, socioeconomic, and sociopsychological attributes of individuals exert an impact on their travel patterns.

2.3 Beyond rational choices: The complexities of travel behaviour and decision-making process

Understanding why people choose to travel a certain way is more than just a simple rationality. It involves looking more closely into the interaction among conscious decisions, ingrained habits, and social environment.

While theories like the "Theory of Reasoned Action" suggest logical decision-making based on preferences and costs, research by van Wee (2002) and Mokhtarian & Cao (2008) shows that there could be incompatibilities even within similar socioeconomic groups regarding their travel behaviour. Individual variations in perception, attitudes, and preferences regarding location, activities, and travel itself can lead to diverse choices. Despite arguments against considering these subjective factors (Borgers et al., 1997; Golledge & Stimson, 1997), studies by Collantes & Mokhtarian (2007), Parkany et al. (2004), and Lanzendorf (2002) highlight their importance. However, most travel studies still lack these subjective indicators (Van Acker et al., 2010).

On the other hand, the social environment and environmental psychology play crucial roles in understanding travel choices and decision-making. Axhausen (2005) highlights the overlooked social aspect, emphasising the significance of social networks and environmental perceptions. For example, families with young children often rely on cars due to safety concerns (Mackett, 2002). This relationship can be assessed through objective factors like the number of young children or subjective indicators like parental attitudes (Van Acker et al., 2010).

Environmental psychology, as explored by Stokols (1977), examines how individuals perceive and interpret their surroundings, creating personalised "mental maps" that influence daily travel behaviour (Chorus & Timmermans, 2009). Numerous studies employing socio-ecological frameworks have identified social characteristics such as gender, age, ethnicity, and income as relevant to active mobility, although the associations are not universally accepted (Giles-Corti et al., 2009; Sirard and Slater, 2008; Steinbach et al., 2011; 2012).

The "Theory of Reasoned Action" proposes that people make informed choices based on beliefs and attitudes. For instance, someone believing biking is healthy might have a positive attitude towards it, but that does not guarantee that they would bike more. Intentions, influenced by attitudes and social norms (subjective norms), bridge the gap between beliefs and actions. However, this theory only applies to controllable behaviours (Ajzen, 1991, 2002).

Ajzen's "Theory of Planned Behaviour" addresses this limitation by introducing "perceived behavioural control," recognising individuals' perceptions of ease or difficulty associated with a specific behaviour, including available resources and opportunities. Studies by Scheurenbrand et al. (2018) suggest that people often prefer driving due to convenience and social norms. Feeling capable of a change based on skills, opportunities, and resources (Rex et al., 2015) creates a higher perceived control. However, issues like global warming or sustainability, which might seem abstract and distant, make behaviour change more challenging without clear incentives or restrictions (Catlin et al., 2017). For instance, Storme et al. (2020) suggest restrictions might be even more effective than incentives in triggering change.

The study by Nogueira, Dias, and Santos (2023) underscores the importance of subjective norms in pro-environmental behaviours. Social pressure from significant others (family, friends) plays a crucial role in encouraging sustainable choices, influencing individuals to adopt behaviours like using public transport or car sharing (Chen & Chao, 2011; Peterson & Simkins, 2019).

Their research, along with others, reveals that perceived behavioural control, positive attitudes towards mobility, and strong subjective norms are key factors influencing the likelihood of adopting sustainable travel options. In contrast, self-centred values and emphasis on social power negatively impact the intention to walk or cycle (Arroyo et al., 2020; García et al., 2019).

In other respects, Triandis (1980) introduces the concept of unreasoned behaviour and decision-making, presenting unconscious choices. He explains that habits, occurring without self-instruction, become automatic, weakening the link between attitude and behaviour, especially when habits are strong (Triandis, 1977). The "Theory of Repeated Behaviour" by Ronis et al. (1989) suggests that while initial behaviour is guided by attitudes and beliefs, repeated actions become ingrained habits, shifting decision-making away from conscious choices. This highlights the potential challenges in transitioning from habitual car use to active mobility modes like walking or cycling, as it might require learning new routines and skills, demanding personal investment.

Finally, by acknowledging the complex interaction of conscious decisions, habits, and social influences, one can develop more effective strategies to promote sustainable and equitable travel options for all. Moving beyond the simplistic "rational choice" model provides a deeper understanding of the factors shaping travel behaviour.

2.4 Cultural barriers to walkability and how to cope with

So far, the impacts of personal traits, built environment and external factors on travel behaviour have been examined. In the following part, cultural and social factors are briefly explained to define presumptive cultural barriers towards walkability.

As mentioned above, there are many factors influencing people’s choice of travel mode. Besides external factors and individual traits, cultural factors play a crucial role in shaping urban mobility, often creating cultural barriers to walkability. Typically, socio-cultural factors involve various values, norms, roles, language, symbols, customs, moral and religious beliefs, taboos, perceptions, and preferences that individuals acquire within a society (Giddens, 2006). These aspects, including language, customs, morals, and preferences, play a dual role. They help people connect and build communities, but they can also restrict choices, both for individuals and groups.

Given its prominence in this research, socio-cultural-related barriers are explored through social practice theory to help understand how individual actions and society interact for mobility change. It comprises both the material and symbolic elements of a transport system within a specific socio-cultural context, including discourses related to mobility, political strategies, institutionalised travel patterns, and the built environment (Götz & Deffner, 2009). Socio-cultural barriers stem from societal norms and cultural beliefs (Savolainen, 2016).

Nettleton and Green (2014) suggested that understanding tacit, practical knowledge through Bourdieu's theory of practice could be more effective in explaining why people perceive change as possible or impossible than relying solely on reasoned explanations of their practices. This approach has influenced the shift from viewing physical activity as a health-related behaviour to perceiving it as a social practice. It rejects the notion that actions are either entirely constructed by social structures or that they collectively create social realities. Instead, they are seen as mutually constitutive within a dialectical framework (Nettleton & Green, 2014).

There are other studies supporting this perspective; (e.g. Shove et al., 2012) arguing that understanding the dynamics of social practice, like how practices emerge, evolve, and disappear, is key to understanding travel behaviour and they question the idea that change is solely determined by individual decisions, highlighting how individual actions and social systems are linked. The theory advocates that even though individuals have their own intentions and perceptions, their daily routines often depend on unconscious knowledge shaped by these social systems.

Bourdieu's conceptual tools of habitus, field, cultural capital, and doxa can be applied to the mobility context. Habitus defines the subjective but not individual system of perceptions and actions that could be common to all members of the same group or class (Bourdieu, 1977, pp:86). This scheme of perception is created 'unconsciously' and can change depending on the social space so-called 'field,' so they are not fixed or permanent. Habitus shapes our everyday choices, including travel patterns. If car-centric lifestyles are the norm (e.g. Palermo case study), individuals may develop a strong car-dependent 'habitus,' making walking or cycling feel unfamiliar and even uncomfortable. On the other hand, the field represents a network and set of relations in which people express and continue their preferences. According to Bourdieu, people often act differently depending on which field they are in at a given moment. Thus, he advocates that context and environment are key influences on habitus. Finally, doxa portrays the beliefs that are taken for granted and unquestioned. Regarding mobility in urban areas, these rooted assumptions could be exemplified as follows: cars are essential for freedom, and walking is inconvenient, uncomfortable, and time-consuming. Even if most of the time these assumptions are inaccurate, they can act as powerful barriers to embracing alternative modes.

In addressing the challenge of mobility and car dependency, it is crucial to explore those mentioned unquestioned beliefs together with the influence of habitus, which adapts to social contexts. This understanding can enhance walkability initiatives in car-dependent cities other than focusing on spatial aspects. Given this context, where individuals feel most comfortable within their social environment and where their habits align with their common norms, their understanding of that environment is more practical than theoretical and more implicit. This practical understanding (Bourdieu, 1977, pp:80) suggests that actions are often instinctive and shaped by societal norms. Thus, the true influences and constraints on behaviour may remain tacit, and sociologists should move beyond individuals' reasoning on their actions and aim to grasp practical knowledge, as it forms the basis for actions. He also adds that, in traditional societies, actions seemed more obvious and predictable, but in modern societies, especially in cosmopolitan and diverse environments, there is more room for debate and questioning of practices. People navigate through different social environments, each with its own set of norms and expectations (Nettleton and Green, 2014).

As argued by different scholars (Watson, 2012; Cairns et al., 2014), this shift in focus from individual travel behaviours has the potential to reveal policy interventions that could reduce car dependency but are currently overlooked.

2.5 Proximity-led urban mobility for walkability

As discussed in the section of car dependency, the introduction of automobiles has reshaped urban planning dynamics, spreading a car-centric approach that has, in turn, enforced urban sprawl and its detrimental consequences (Brown, Morris, and Taylor, 2009). The definitions of urban sprawl and city decentralisation vary across different academic disciplines, including economics, geography, environmental science, and urban and transport planning. Economists' interpretation of urban sprawl has faced criticism from other fields for its oversimplified portrayal of this multifaceted phenomenon. Geographers and urban planners offer alternative definitions, framing urban sprawl as a specific pattern of urban development that can be demonstrated as fragmented, dispersed, and decentralised development, where disconnected patches are separated by non-urban areas (OECD, 2018; 2020).

Concerning the aim of this research study, the most suitable definition of urban sprawl is made by Galster and others (2001) by underlying that it is a land use condition characterized by reduced metrics in various urban form dimensions, including density, continuity, concentration, clustering, centrality, mixed uses, and proximity.

With the decentralisation trends in cities since around the mid-twentieth century, the distances and trips elongated between residential areas and activity sites within the city (Dieleman and Wegener, 2004; Hanson, 2004) that designating mobility as the key factor of accessibility, instead of proximity (Hanson, 2004). Urban development policies centred around cars have resulted in economic and social inequalities, traffic congestion, extended commutes for basic needs, increased greenhouse gas emissions, and more. Currently, cities produce 70% of global greenhouse gas emissions, with this proportion expected to rise as urbanisation continues (OECD, 2020). Moreover, the COVID-19 pandemic and lockdowns highlighted flaws in our cities by showing how much we rely on cars (EIT, 2022).

Urban sprawl and its consequences are tied to the discussions surrounding proximity and accessibility, both critical topics in contemporary urban planning. Accessibility, recognised as fundamental for the quality of life, has steadily gained importance in research and urban planning fields (Handy, 1992, 2020; Geurs & Ritsema van Eck, 2001; Bertolini et al., 2005; Ferreira & Batey, 2007; Levine, 2020). While accessibility improvements can be achieved through proximity and/or mobility approaches (Levine et al., 2012), mobility has historically received greater emphasis. This often translates into evaluating accessibility based on the fastest mode of transport (typically cars or, occasionally, public transport) (Silva et al., 2013). This focus on maximum travel distances with higher speeds has led to the prioritisation of mobility catchment areas (Silva, 2020), which heavily depend on transportation conditions instead of proximity.

Consequently, many cities have focused on providing more efficient transportation networks with higher speeds (Van Hoose et al., 2022), with reduced travel times causing even more people to move to low-density urban areas with longer average travel distances in the end (Silva, 2020). As said by Jeff Speck (2013), “The faster a society moves, the more it spreads out and the more time it must spend moving.” This phenomenon is highlighted by different studies (e.g. Ewing et al., 2002; Kockelman et al., 2002) for several contexts such as the United States, Canada, Australia and even Europe. Consequently, this emphasis on speed has led to an overdependence on cars, diminishing accessibility for individuals without cars. It is possible to argue that this trend adversely affects sustainability, quality of life, and other vital urban aspects.

However, fundamental problems related to the unequal distribution of services in cities, unjust accessibility opportunities and vulnerability of different demographic groups have been revealed during the COVID-19 pandemic (McPhearson et al., 2020; Kakderi et al., 2021) and therefore significant attention has been drawn to the proximity-based solution and human-scaled urban design due to their alignment with the principles of sustainability, social equity, and improved life quality. Proximity-centred accessibility has evolved within research over the years by introducing updated terms and approaches. Initially, 'local accessibility' has been used to refer to proximity by Handy (1992). Subsequently, terms like pedestrian accessibility and neighbourhood accessibility emerged. Especially after 2010, there has been a remarkable increase in scientific publications on this topic with updated terms such as bike accessibility and active mobility. In the grand scheme, there have been terms that directly emphasise proximity while others imply it through active mobility modes depending on distance and speed limitations (Silva et al., 2023).

Table 1. Summary of terms concerning accessibility related to proximity and active modes found in academic works.

Accessibility Terms in the Academy	
Proximity-related	**Active modes-related**
Local accessibility	Active accessibility
Neighbourhood accessibility	Non-motorised accessibility
Proximity-based accessibility	Pedestrian accessibility
Accessibility by proximity	Walking accessibility
Micro accessibility	Bicycle accessibility

Source: Silva et al., 2023.

Through the efforts of the studies mentioned above, the benefits of proximity in different fields are highlighted. Proximity encourages human interaction, economic efficiency, and social cohesion (Bourdeau-Lepage et al., 2009) by ensuring that amenities are equally accessible to people from different social backgrounds, and so it has the potential to promote more equitable and socially sustainable travel habits. Recent research reveals that cities experience several benefits in areas like public health and environmental impact when residents have proximity to their jobs and essential services in compact, diverse urban environments where active mobility modes are also encouraged. Furthermore, proximity holds important implications for transportation policy, particularly in creating environments that support easy access for social groups with limited time and mobility options, such as working women and low-income individuals (Marquet et al., 2014), which makes proximity an important urban development policy regarding decreasing urban inequalities. Nevertheless, obtaining proximity in different urban contexts is a complex endeavour.

The concept of proximity in urban planning goes far beyond a simple measurement of physical distance. As Roger Brunet emphasises in his book "Sustainable Geography" (2011), relying solely on Euclidean distance overlooks the complexities of urban space. Pure Euclidean distances are insufficient to measure proximity or accessibility in urban areas, as different amenities and places have various levels of attractiveness, influencing how people travel each day. Achieving proximity in urban planning requires a comprehensive understanding encompassing both physical and relational aspects (Méndez, García, & Hurtubia, 2017). It necessitates a layered analysis that considers the city's functions, available resources, and the daily trips citizens make to access various facilities (Geurs & van Wee, 2004). It also implies a deeper meaning linked to improving social connections, as some urban environments naturally facilitate these connections better than others. (D'Onofrio & Trusiani, 2022). Today, the conversation around proximity has evolved beyond just functional needs. Jane Jacobs, in her seminal work "The Death and Life of Great American Cities" (1961), highlights the importance of creating spaces that foster social interaction – the very essence of a vibrant city. This aligns with the ideas of Steuteville and Duany (2021), who advocate for the reuse of urban spaces to create opportunities for community engagement. In his book named 'Walkable City,' Jeff Speck (2013) underlined that building walkable neighbourhoods fosters a sense of community, as people can easily interact with their neighbours.

In the contemporary context, many movements have occurred, such as the 15-minute city (Moreno et al., 2021) or the 20-Minute neighbourhood, favouring higher proximity and promoting less dependence on car-centric mobility, which have been further emphasised in post-COVID cities. Especially regarding the social and economic consequences of the pandemic on highly urbanised areas (Mouratidis & Yiannakou, 2022), neighbourhoods have emerged as resilient hubs, providing vital support during crises (Vatavali et al., 2020), which required a great attention to proximity. Initiatives like the 'C40 network' prioritise the 15-minute city concept, promoting proximity to essential services within walking or cycling distance to reduce reliance on cars and public transport, easing traffic congestion and pollution while enhancing community interaction (D'Onofrio & Trusiani, 2022).

The following section of the literature explores active mobility as the main mobility mode of proximity-based development models before going to the second part of the literature review, which focuses on the complementary relationship between the 15-minute city and Transit-Oriented Development (TOD) concepts, highlighting their combined efforts to promote active mobility.

2.6 Active mobility in the planning culture

The traditional approach to traffic congestion, which includes expanding road capacity, is increasingly being questioned. Studies have shown that building more roads often leads to increased traffic, rather than reduced congestion. This phenomenon, known as traffic induction, occurs as drivers adjust their travel behaviour in response to new road infrastructure. As urban areas face limited space for expansion, alternative strategies that prioritise sustainable transportation modes, such as public transport, cycling, and walking, are becoming more crucial (European Commission, 2004).

Walking is an integral part of urban life and is the most basic, environmentally friendly, and economical form of transportation. Globally, people walked an average of 200 kilometres in 2018, equivalent to less than seven minutes of daily walking. Despite the clear benefits, walking is primarily associated with leisure rather than daily transportation in many urban areas. However, there is a growing recognition of walking as a sustainable mode of urban mobility (Project Drawdown, 2020).

Considering the abovementioned studies about proximity and its benefit to creating inclusivity, Speck (2013) advocates that walkable cities are inclusive cities, ensuring that everyone has equal access to essential services and amenities. And that is why active mobility, primarily walking, is the main mobility mode for proximity-based urban development models. “Pedestrian movement is the most natural, ancient and necessary form of human disposition in the environment” (Pakzad, 2005).

Simply, walking is the foundation of all city travel, regardless of the transportation mode. It is the most effective way for people to engage with their environment since they can fully experience and interact with other people and the city itself (Majid Mofidi & Kashani Jou, 2010). There are numerous advantages of active mobility studied (Ewing and Cervero, 2017; Cao, Handy & Mokhtarian, 2006; Cervero, 2001; Bourdeaudhuij, Sallis, & Saelens, 2003; A. L. Brown, Khattak, & Rodriguez, 2008), especially regarding lower household transportation costs (Hamidi & Ewing, 2015), enhanced community cohesion (Kim & Kaplan, 2004; Speck, 2013), increased social and economic mobility upward (Ewing, Hamidi, Grace, & Wei, 2016), greater social interaction and sense of neighbourhood (Podobnik, 2011; Speck, 2013), and heightened social capital (Leyden, 2003; Rogers, Halstead, Gardner, & Carlson, 2011), improved quality of life (Anokye et al., 2012; Krzepota et al., 2018), and finally enhanced mental well-being (Hamer et al., 2009; Whitelaw et al., 2010; Roe et al., 2011; White et al., 2017; Schuch et al., 2018). These favourable impacts have encouraged governments to shift from car-dependent transportation to active mobility.

Achieving the transition from car-dependent to a more sustainable mobility necessitates effective policies and a thorough understanding of the determinants influencing the choice of active modes (Ton et al., 2019). These determinants can be individual characteristics, household characteristics, trip characteristics, built environment, season and weather characteristics, work conditions (Hunt and Abraham, 2007; Heinen et al., 2010) or practical/tacit knowledge and societal practices as previously mentioned in the part of travel behaviour.

In terms of infrastructure essentials for a pedestrian-oriented urban development, physical improvements such as well-maintained pavements concerning the safety of pedestrians (McDonald, 2016), incorporating greenery and necessary visual appeal (Donovan et al., 2011) are necessary. Safe crosswalks and adequate pedestrian signals (Hu and Meyerhoff, 2017), well-connected pedestrian networks with attractive walking routes (Ewing and Cervero, 2010) regarding mixed-use functions within walking distance, and finally integrated public transportation with walkable areas, allowing residents to easily access transit stops (Litman, 2015) are crucial determinants for a pedestrian-friendly environment for a sustainable mobility transition.

From the cultural dimension of transitioning to sustainable mobility, spatial interventions such as traffic calming measures (Litman, 2015) which force drivers to be aware of pedestrian movements, restriction of vehicles in specific areas (Newman & Kenworthy, 2018), developing attractive and walkable destinations as parks, plazas, public markets that encouraging walking for leisure and social interaction (Jacobs, 1961) are frequently addressed components. Lastly, promoting the benefits of walking and encouraging healthy walking habits through public awareness campaigns and events (Browne et al., 2009) is highly deliberated. The most effective approach involves a combination of strategies tailored to the specific context of a city.

2.7 The concepts paved the way for proximity and chrono-urbanism

The quest for creating better, more liveable cities and their smaller units, like neighbourhoods, is not a recent endeavour. Here is a diagram extracted from a study conducted by EIT (2022 that illustrates historical urban development models that have influenced the idea of a "15-minute city" and highlights their shared principles with this concept.

As mentioned above, the fundamental design components of the popular concepts of today could be traced back to the first attempts of urban utopias such as “Garden Cities of Tomorrow” from Ebenezer Howard (Howard, 1902). The design was focusing on strong cultural, recreational, and shopping facilities in walkable neighbourhoods, healthy and self-sufficient human settlements with diverse housing typologies. He even organised the Garden City Association in 1899 in England to promote the ideas of social justice, economic efficiency, beautification, health, and well-being in the context of city planning that we still discuss today (Moreira, 2021).

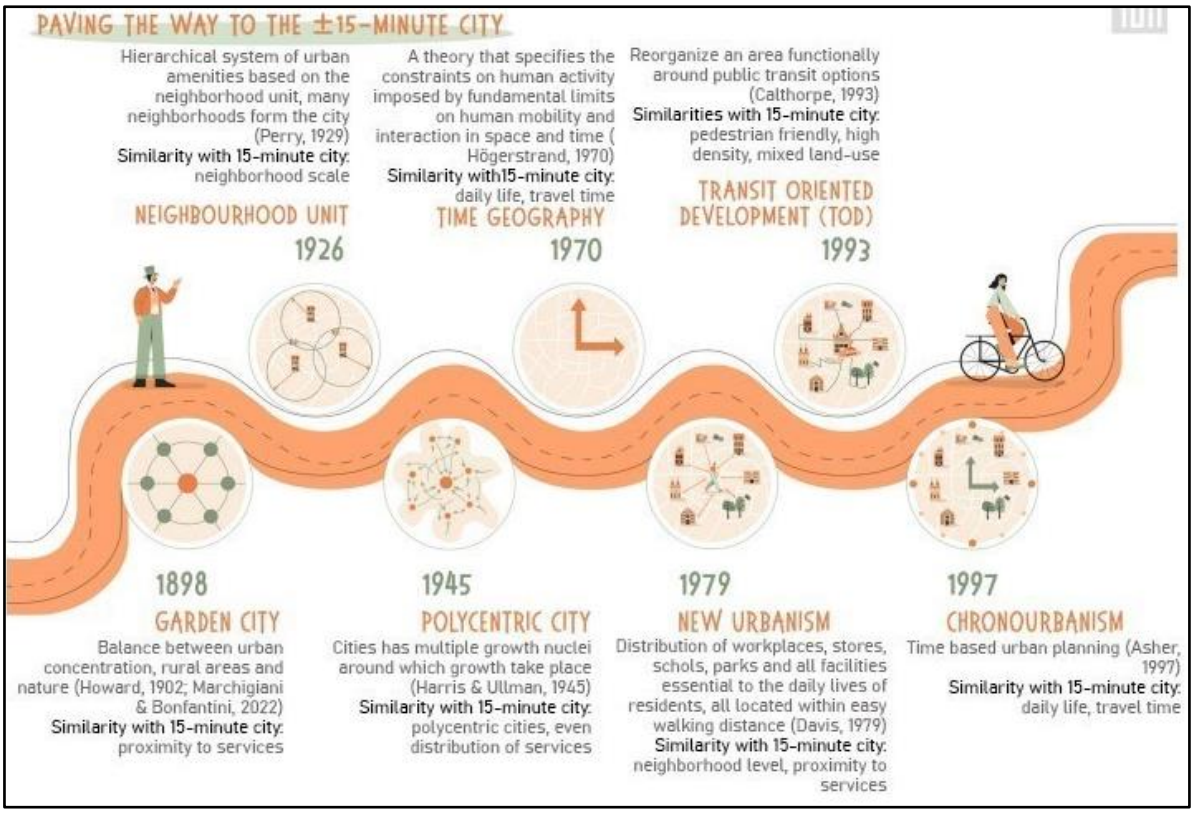


Figure 2. Timeline of related planning concepts that preceded the 15-minute city.
Source: Büttner et al., 2022.

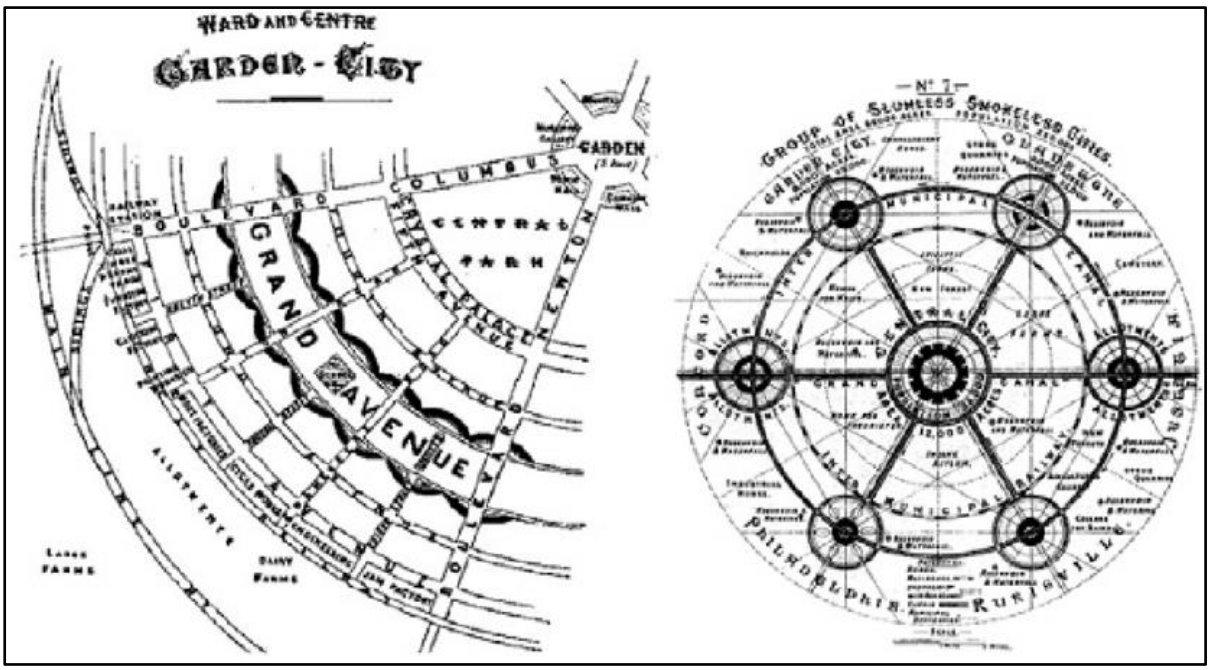


Figure 3. Garden Cities illustration by Ebenezer Howard.
Source: Howard, 1902.

Over time, the ideology of the garden city has turned into in different forms, especially with the post-war planning needs. Planners and architects started to debate over topics such as desirable density, housing types and green areas, but the ideological position on ecological dimension, which 1930s was strongly present, has become flexible and pragmatic after 1945 (Buder, 1990).

The design principles of Garden Cities are repeated by other urban planners in different urban design concepts over time. For instance, the idea of neighbourhood unit and its spatial scheme introduced by Clarence Perry (Perry, 1929) was influenced by the garden city movement (Dahir, 1947), which aspired compact residential units where the proximity among functions and residents to establish the sense of community. Especially until 1968, the concept integrated planning, design, development, and policymaking communities to improve standards in residential environments, and it shaped land use planning norms (Brody, 2013).

Briefly, the neighbourhood unit is a model to create residential environments that respond to the needs of local people, including facilities, parks, local shops, and housing. Perry, as he mentioned (1929, p. 35), united the social theory of Charles Cooley (1909) and Roderick McKenzie (1923) with his own works in the community centre movement (Perry, 1921).

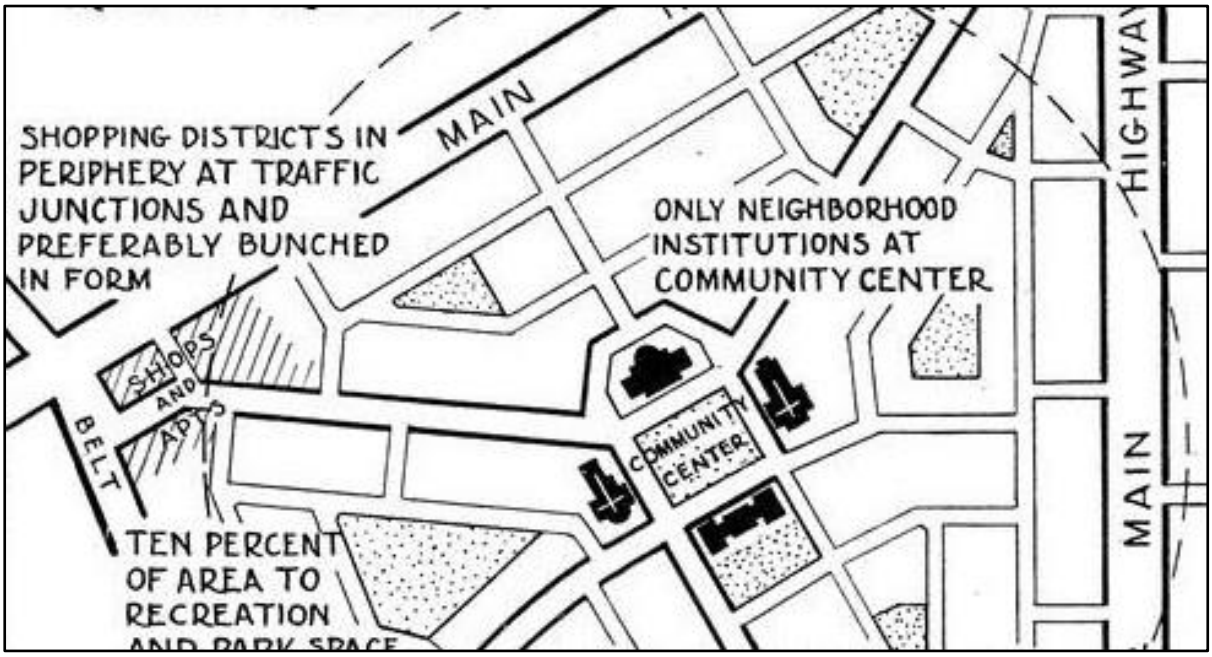


Figure 4. The neighbourhood unit concept.
Source: Perry, 1929.

Afterwards, the neighbourhood unit concept has been adopted and advanced by proponents of New Urbanism (Duany et al., 2001). They share common aspects such as promoting proximity, mixed land-use and minimising distances for daily functions for people. The New Urbanism concept, which emerged in the 1980s as a movement against urban sprawl, has evolved into a new paradigm in urban planning. Professionals were frustrated with formulaic urban development patterns, which are based on dispersed housing far from traditional downtowns and urban renewals destroying the historic neighbourhoods. In 1993, the New Urbanists united around the idea that the physical environment has a direct impact on our lives, and they believe that well-designed urban environments help to create a community which can be described as a happy place for people and businesses to evolve and prosper. By the time, the debate of New Urbanism has changed from the alternative urban development forms to discussing how best to preserve, design, develop, and restore our regions, cities, and neighbourhoods. Thus, the core principles of the movement are articulated in the Charter of the New Urbanism by The Congress for the New Urbanism (CNU, 1996, 2000).

Briefly stated, the Congress for the New Urbanism has a mission to advocate walkable urbanism. The three main goals of the congress could be listed as: to diversify neighbourhoods, to design for climate change, and to legalise walkable places. The charter mentioned above includes the principles to achieve these goals. Those principles are clearly stated as metropolitan regions that are composed of well-structured cities, towns, and neighbourhoods with identifiable centres, environmentally sensitive, compact development, interconnected streets, pedestrian and cyclist-friendly mobility, mixed-use urban layout, and high-quality public gathering places (Ellis, 2002). More precisely, the charter mentions that many activities and functions of daily life should be found within walking distance, allowing independence to pedestrians. Street networks which are connected should be designed to encourage walking to reduce the number of cars and the length of daily car trips.

As mentioned in the article of Garde (2020), there is substantial literature on New Urbanism. It can be said that a remarkable part of this literature consists of the ideas and the principles of New Urbanism (Duany & Plater-Zyberk, 1991; Ellis, 2002; Ewing et al., 2013; Forsyth, 2015; Fulton, 1996; Passell, 2013). Besides, there is literature on the socio-spatial dimensions and the expected benefits of New Urbanist projects and the critiques of the concept as a new paradigm in the urban design field (Day, 2003; Talen, 2005). Some of those critiques have questioned the New Urbanist approach to physical design to create social engagement. Southworth (1997) stressed that the walkable neighbourhoods in regions with urban sprawl may not help to reduce car dependency. Robbins (1998) mentioned that the sense of community cannot be designed; it can be encouraged by social programs and engagement with locals.

Several researchers underlined the positive sides of New Urbanist type of compact, mixed use and transit-oriented developments that includes a variety in typology of housing, especially affordable housing in neighbourhood-scale projects (Garde, 2020). Besides, there are benefits of increasing transportation modes and choices, increasing local economic development and viability of local economy, reducing air pollution and energy consumption related to transportation, reducing local infrastructure costs (Boarnet, 2011; Cervero & Kockelman, 1997; Ellis, 2002; Garde, 2006; Moore, 2013; Schlossberg & Brown, 2004; Trudeau, 2016).

There is an ongoing discussion about how New Urbanism gained importance, particularly through advocacy efforts in the 1990s (Talen, 2019). Traces of New Urbanism can be seen in many contemporary urban development projects worldwide, and in the United States, it remains a key approach integrated into various planning tools. The question now is what the future of New Urbanism is. To understand this, it is crucial to examine the challenges and evolving conditions that affect the concept, including technological advances, remote working, climate adaptation, the restructuring of the global economy, and the digital era, alongside the impact of the pandemic (Garde, 2019).

New Urbanism originally focused on the Baby Boomer generation, but now millennials, the largest adult generation, are controlling contemporary trends in urban growth (Fry, 2020; Myers, 2016). Consequently, the future of New Urbanism will be significantly influenced by where and how millennials choose to live. The social changes have emerged during the pandemic, which began in 2020s, have also affected urban design concepts. People are increasingly reclaiming public spaces in their streets and neighbourhoods, leading to a greater demand for active mobility and placemaking integrated into land-use and transportation planning. In this context, concepts like the 15-minute city, which draw on New Urbanist principles, have gained significant momentum in recent years.

2.8 The 15-minute city concept: A framework for sustainable urban transformation

The climate crisis and the pandemic have shed light on many rooted urban problems, including unequal access to amenities, a lack of neighbourhood-level public services, limited green spaces, long commutes, and the environmental impact of human activities (Sharifi & Khavarian-Garmsir, 2020). These challenges have forced us to rethink our urban development strategies and prioritise solutions that create more sustainable and equitable cities (Mattar et al., 2021; Ferrer-Ortiz, Marquet, Mojica, & Vich, 2022). The 15-minute city is a concept that emerged from these concerns to create more just and sustainable cities and was re-proposed during the recovery process of the pandemic that happened in the last years (C40, 2020).

While core principles of the 15-minute city, like pedestrian accessibility, have been implemented for years under the umbrella of sustainable development, the concept itself gained significant attention during the pandemic. Confined to their neighbourhoods, people became aware of how poorly many built environments are designed and are not able to serve their daily needs. Separated functions and car-centric design prioritised vehicle convenience over human interaction and walkability. This, coupled with growing concerns about environmental impact and spatial inequality, highlighted the limitations of traditional urban development models. As a result, the 15-minute city concept rapidly gained popularity among urban planners and policymakers.

2.8.1 Origins and principles of the 15-minute city

Professor Carlos Moreno, a French Colombian scholar and one of the leading pioneers of the 15-minute city concept, envisions a paradigm shift in how cities are perceived and experienced. As an advisor to the Mayor of Paris, Moreno challenges the acceptance of urban dysfunctions such as long commutes, noisy streets, and underutilised spaces. Inspired from the humanist views of Jane Jacobs, Moreno emphasises the centrality of people in urban design, underlining that "…the city is alive…if we want to solve problems in cities the most important point to consider is humans, people, at the centre of activities…" (Reimer, 2020).

Moreno advocates for a reimagined urban landscape where residents can enjoy a higher quality of life by accessing essential functions like living, working, commerce, healthcare, education, and entertainment, within a short distance, eliminating the need for time-consuming daily commutes. To achieve this vision, he identifies four key principles that are ecology, proximity, solidarity, and participation (Steuteville, 2021).

Ecology stands as a cornerstone for green and sustainable cities, a primary focus in urban planning over the past decades. The principle of proximity emphasises minimising the distance to daily functions and activities, as the core of the 15-minute city concept. Solidarity highlights the importance of creating connections between people, underlining the need for a strong sense of community and safer neighbourhoods achieved through well-designed public spaces and streets. Lastly, participation plays a vital role in encouraging active citizen engagement, ensuring that planning processes reflect the needs and aspirations of the communities.

While the principles underlying the 15-minute city concept are not entirely new, as they are based on earlier urban planning models, the concept stands out for its innovative and modern application. The theory of New Urbanism, which emerged in the 1980s in the United States, similarly advocated for walkable, community-centred urban environments.

What makes the 15-minute city different is its comprehensive integration of sustainability and digital advancements. Unlike earlier concepts and approaches, which primarily focused on residential planning and access to basic amenities, the 15-minute city expands its scope to comprise a wide range of urban functions. These include commerce, healthcare, education, entertainment, and more, all within a 15-minute walk or bike ride.

In addition to reducing car dependency, the 15-minute city directly addresses contemporary challenges such as climate change and social equity. It promotes mixed-use development, human-scale urban design, and the use of digital technologies to enhance urban functionality. Furthermore, the concept emphasises adaptability and flexibility, enabling cities to respond dynamically to evolving societal needs, features that were less emphasised in traditional urban planning approaches (Khavarian-Garmsir, Sharifi, Hajian Hossein Abadi, & Moradi, 2023).



Figure 5. Illustration of 15-minute city Concept.
Source: Crook, 2021.

2.8.2 Core planning strategies

To achieve the principles outlined above, the 15-minute city concept relies on several key components that guide urban restructuring that are proximity, diversity, density, and digitalisation (Moreno et al., 2021).

Proximity, the cornerstone of the 15-minute city, shapes the spatial planning process by ensuring that essential amenities are located within a short distance from residents. It is important to distinguish proximity-centred approaches from accessibility-focused models. While accessibility emphasises reachability across a larger area, also related to speed and different mobility modes, proximity prioritises local access to essential services that directly enhance quality of life. These amenities include healthcare facilities, education centres, shops, leisure spaces, green areas, and more (Gil Solá & Vilhelmson, 2018).

Achieving proximity depends heavily on density and mixed land use, two crucial factors for sustaining demand for local businesses and services within a 15-minute walking or cycling radius. A denser population and a diverse mix of uses are essential to ensure a variety of services can operate successfully. Moreno et al. (2021) also highlight the importance of diversity, not just in land use but also in the social fabric of communities. Effective mixed-use development must consider cultural diversity as well as variations in residents' ages, abilities, and socioeconomic backgrounds. As emphasised in EIT (2022), a truly successful 15-minute city must be inclusive, affordable, and accessible to everyone within the community.

In addition to these core components, other critical factors contribute to achieving a high quality of life within the 15-minute city. Moreno et al. (2021) underline the need for attractive and safe walking and cycling facilities, as well as vibrant public spaces close to residential areas. Walkability and cyclability, alongside placemaking and liveable public spaces, are therefore essential principles of the concept.

A study titled Urban Planning in the 15-minute city: Revisited under Sustainable and Smart City Developments until 2030 (Pozoukidou & Angelidou, 2022) identifies eight foundational urban planning principles of the 15-minute city. The most relevant to this research include:

- Planning in neighbourhood units of appropriate size and characteristics.
- Allocation and hierarchy of urban amenities on a city-wide scale.
- Accessibility through proximity.
- Urban planning that favours active mobility.

This study underlines that urban density is a critical factor in urban liveability because it influences the availability of infrastructure required for a healthier urban environment. However, identifying the optimal density thresholds for a 15-minute city is essential, as these depend on the specific urban context. The structure of the neighbourhood, whether part of a mono or polycentric system, affects density and related factors (Zhang et al., 2022). Also, defining catchment areas for different uses is important for accurately estimating population sizes and determining the necessary amenities to serve them effectively (Macharia et al., 2021). Each type of amenity requires a different catchment area and population size for its successful operation, making it essential to understand the hierarchical relationships among amenities and their service areas.

As a fundamental principle, the proximity of basic amenities and services supports accessibility, making mixed-use land planning essential for implementation. In the 15-minute city, service areas for basic amenities typically range between 500 and 800 meters (Kamruzzaman, 2022), combining with mixed-use urban planning guidelines. However, the 15-minute city goes further and underpins the proximity to workplaces, which is a challenging element to achieve. Promoting smart, flexible, and hybrid modes of working offers a solution to this challenge (Pozoukidou & Chatziyiannaki, 2021; Pozoukidou & Angelidou, 2022). Public policies can also encourage partnerships with the private sector to reduce the size of central offices, transforming the traditional employment model and decreasing the need for physical workspaces (Pozoukidou & Chatziyiannaki, 2021). However, this aspect of the concept is also one of its most debated and criticised.

Another defining feature of the 15-minute city is its promotion of walking and cycling as core modes of mobility (Abdelfattah et al., 2022). Research shows that specific physical characteristics of the built environment significantly influence active mobility. Positive factors include residential and commercial density, as well as mixed land use, while negative factors include highway density and other barriers (Ahmadipour et al., 2021). Additional factors, such as street enclosures, view changes, shelters suited to local climates, and the proximity between destinations, also increase the appeal of walking (Mouzon, 2012). Moreover, a well-connected, high-quality public transport network plays a crucial role in creating human-scale streets and reducing motorised traffic. Additionally, an easily accessible and high-quality public transport network has a key role in transforming the streets into more human-scaled spaces and decreasing motorised traffic. The difference between the 15-minute city and the well-known concept of Transit Oriented Development is that here the focus is not on maximising density around transit stations, but optimising services and land uses in their vicinity (Pozoukidou, 2020).

Digitalisation and smart city innovations make the 15-minute city idea more enhanced and practical. (Moreno et al., 2021). By integrating modern technologies, the model aims to achieve sustainability, resilience, and equitable access to services. Within the smart city framework, inclusivity, resident participation, and efficient public service delivery are supported by digital platforms (McKinsey & Company, 2018; Dembski et al., 2020). For example, biking experiences can be improved through bike-sharing systems, while proximity can be enhanced by smart solutions such as online shopping, remote working, cashless transactions, and virtual communication (Cohen et al., 2020).

Despite its alignment with smart city innovations, the 15-minute city maintains a stronger focus on equity and ecological sustainability. Pandey (2018) highlights that many smart city developments have become unaffordable for most residents, as their focus on technology often leads to privatisation and exclusion. In contrast, the 15-minute city prioritises social inclusion and ecological harmony, ensuring that urban transformation benefits all residents.

2.8.3 Challenges to implementation

While the 15-minute city (15-minute city) concept offers environmental and quality-of-life benefits, it also faces significant critiques and concerns about its implementation and potential social consequences.

One of the main criticisms is the risk of social segregation. By focusing on localised access to amenities, the 15-minute city model could unintentionally create self-sufficient neighbourhoods that primarily serve wealthy residents while leaving lower-income communities marginalised. Casarin, MacLeavy, and Manley (2023) highlight this issue, pointing out that the concept could lead to "de facto social mix actions at the neighbourhood level," which may not effectively address deeper social inequalities. They argue that without deliberate policies to promote inclusivity, the 15-minute city could end up deepening existing social segregation.

Another concern is the potential conflict between the sustainability goals of the 15-minute city and its social impacts. While the concept reduces car dependency and promotes environmental benefits, it may also isolate marginalised groups if implementation cannot consider the complexities of social dynamics (Abbiasov et al., 2024).

Gentrification is another significant critique. Transforming neighbourhoods into 15-minute zones often raises property values, making them unaffordable for lower-income residents. This process can displace long-term communities, change the neighbourhood’s character, and reinforce socio-economic inequalities. Environmental upgrades and improved amenities tend to attract wealthier residents, increasing housing costs in the process.

Herbert (2021) underscores the need for affordable housing provisions and local ownership models to ensure that all residents share the benefits of these transformations. Similarly, the Transformative Urban Mobility Initiative (2021) warns that if it is not carefully planned, the focus on proximity within the 15-minute city could unintentionally exclude vulnerable populations and deepen social isolation.

The practical challenges of implementing the 15-minute city are particularly evident in cities with entrenched urban layouts or urban sprawl, low-density areas. Enhancing those environments to meet the model's goals of proximity can be expensive and difficult. The concept also struggles in regions where lower-income workers commute long distances, often beyond a single neighbourhood. Additionally, restrictive zoning laws like single-family zoning and resistance from communities (NIMBYism) frequently prevent the development of the mixed-use, high-density neighbourhoods that the 15-minute city requires. Issues like the poor quality of urban schools can further complicate matters, as families often move to suburban areas, making it harder to restructure city centres around proximity.

The idea of a polycentric city has also been criticised for oversimplifying the realities of urban life. By prioritising proximity to basic services such as healthcare, housing, transport, and commerce, the 15-minute city risks reducing cities to a narrow and overly functional perspective. This approach may overlook important aspects of urban life, such as cultural diversity, social interaction, and access to specialised services that cannot always be accommodated within a short distance. Marchigiani and Bonfantini (2022) argue that the idea of self-sufficient neighbourhoods meeting all residents' needs is unrealistic and heavily dependent on local conditions, social habits, spatial policies, and administrative systems. They also warn that this approach could lead to further segregation of certain neighbourhoods.

Another critique of the 15-minute city is that its foundational principle of proximity is not groundbreaking and new in urban planning. The idea of chrono-urbanism, or designing cities around time and accessibility, has been a central theme in urban planning since the modernist era. While the 15-minute city undoubtedly builds upon these historical concepts, many of the same criticisms persist. Although proximity is often seen as a way to strengthen community ties and improve quality of life, there is a risk of turning this idea into an overly simple and idealised view of urban living. Critics contend that this oversimplification may obscure the complexities of urban life, masking the intricate systems and interconnections that extend beyond individual neighbourhoods. These broader connections, they argue, are essential for the overall functioning of a diverse, dynamic city, ensuring that it remains adaptable, interconnected, and capable of meeting the needs of all its residents.

2.8.4 Bridging the gap between ideal and reality: Implementation strategies for the 15-minute city

Transforming a city into a network of 15-minute neighbourhoods requires a multi-step approach based on key urban planning principles (Pozoukidou & Angelidou, 2022). The initial step involves crafting a shared vision for the city's future. This vision should consider existing plans and initiatives while identifying local challenges. It is crucial to tailor the 15-minute city concept to address these specific needs, ensuring a case-by-case implementation.

Next comes data collection and public engagement. Gathering data on existing amenities, businesses, and public spaces within neighbourhoods is essential. Equally important is seeking public input to understand resident needs and priorities. This participatory approach helps to include a sense of community ownership and is key to the concept's success.

Finally, with individual neighbourhood plans in place, a comprehensive citywide plan can be developed. Crucially, this implementation should prioritise improvements in underserved and low-income areas first, ensuring equitable access to the benefits of the 15-minute city (Moreno et al., 2021).

There are many examples today putting the 15-minute city in the centre of their urban development models with many terminologies and interpretations (Büttner et al., 2024). Even though the concept of Moreno is called the 15-minute city, he acknowledges that the time should be determined by the local context, which the radius could differ from one city to another (Moreno et al., 2021). Most of them focus on access to essential destinations within short travel times. A global network of cities, including the C40, focuses on reducing environmental and social risks caused by climate change and their political agenda is mostly occupied by recovery from the pandemic to regain a “new normal”. Eventually, the 15-minute city concept is promoted as a complementary policy to their climate actions. While the concept emphasises access to essential services through walking, cycling, and public transport, implementations often extend beyond these parameters.

The various implications of the concept come with different names, like complete neighbourhoods, 20-minute neighbourhoods, walkable cities, and superblocks. These variations offer insights into how the core principles can be applied in different contexts.

- Paris (France): Ville du quart d'heure

The first and one of the most important examples is Paris. Hence, it is the place where the branded name of 15-minute city was born with the collaboration of Mayor Anne Hidalgo and her consultant Professor Carlos Moreno. The mayor announced a permanent pedestrianisation of the Seine riverfront, which is seen as a revolutionary step for Paris. The aim is to extend the concept to other parts of the city to make more car-free spaces. ‘Hyper-proximity’ and the 15-minute city were key pillars of Mayor Anne Hidalgo’s successful 2020 re-election campaign (C40, 2021).

At the centre of the concept for Paris, the schools are the focus of the neighbourhoods. Moreno suggests that they should be opened in the afternoons and weekend to allow other activities The Mayor's plans include installing bike lanes on every street and bridge, which helped to transform 70% of on-street car parking space into other uses, encouraging people to use their local shops and creating more playgrounds that allow people to spend more time in their neighbourhood and fight against the city's lack of public green space, especially in low-income neighbourhoods (O'Sullivan, 2020). With the 'Plan Vélo 2021-20206', Paris aims to make all streets cycle-friendly by 2026 and supply enough parking for bikes (EIT, 2022). The main approach is to cut air pollution and decrease daily travel to increase the life quality of Parisians and to help the city achieve its plan to become carbon neutral by 2050.

- Bologna, Italy: Proximity Ecosystems and Citta 30

This approach transforms neighbourhoods into networks of walkable communities with essential services. Their "Citta 30" initiative complements this vision by reducing citywide speed limits to 30 km/h, prioritising pedestrian safety and comfort. This creates a network of healthy, connected urban spaces where daily needs are easily accessible on foot or by bike.

- Edinburgh, Scotland: 20-Minute Neighbourhoods with a Place-Based Approach

This strategy tackles a wider range of challenges, including poverty, health, climate change, and economic recovery. Their plan emphasises creating better places to live and work while achieving a net-zero city by 2030. Uniquely, they incorporate a "place-based approach," ensuring initiatives consider the specific needs and aspirations of each neighbourhood and its residents.

- Barcelona, Spain: Superblocks

Another example is Barcelona's 'superblock', which modifies the road networks within 400 mt^2 blocks to improve the public space for leisure activities for pedestrians and cyclists with heavily restricted car traffic inside (only for local residential access). The idea is to create a network of public spaces, squares, and green areas where pedestrians have priority. It is implemented by including residents, associations, and organisations (Cities Forum, 2021). In June 2020, Madrid also announced a pilot superblock approach as a part of its transition to a 15-minute city to support the recovery process from the pandemic (Montojo, 2020). Notably, superblocks are scalable, applicable to both new developments and revitalising existing neighbourhoods.

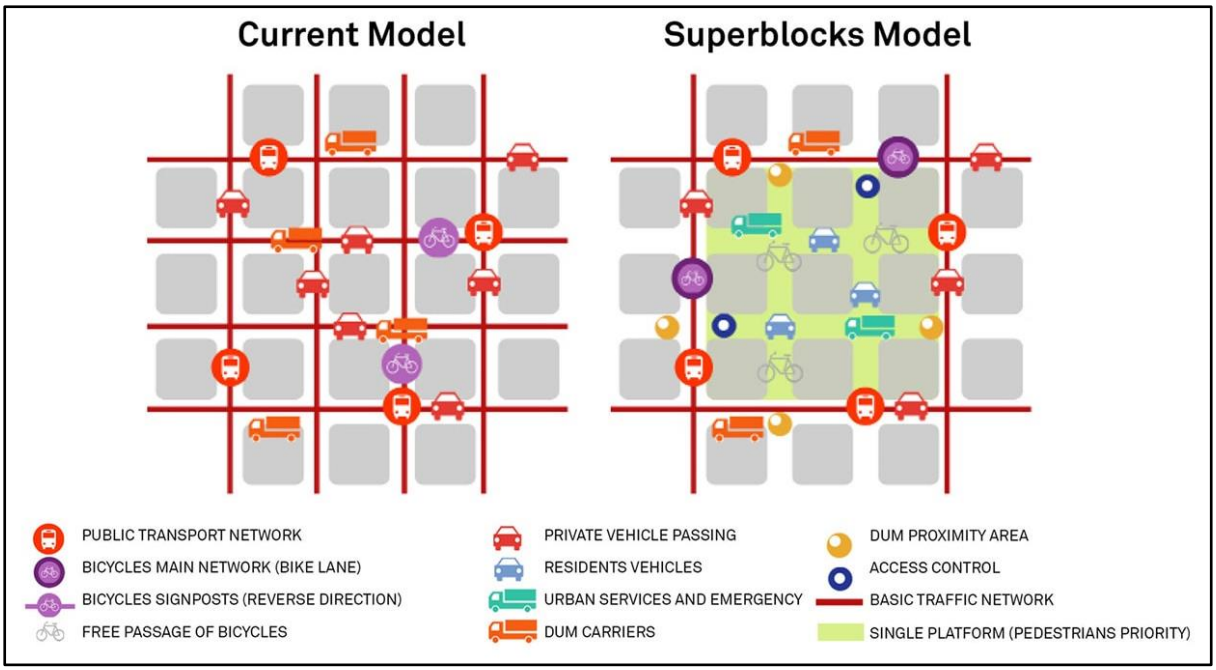


Figure 6. Superblock Development Model of Barcelona.
Source: City of Barcelona, Urban Mobility Plan of Barcelona 2013-2016.

As seen from the examples above, Paris' 15-minute city may be the most well-known example of chrono-urbanism, but it is not the only one. These examples highlight the adaptability of the 15-minute city concept and its potential to address various urban challenges in different contexts. Regarding the mobility, all these examples aim to increase active modes where people do not have to use private vehicles or depend on public transport, thereby reducing traffic and pollution, recovering daily travel time lost and increasing social life on the streets. In other words, the concept focuses on the idea of chrono-urbanism, which suggests that the quality of urban life is inversely proportional to the amount of time invested in transportation, especially using cars (Moreno et al., 2021).

Studies show that the idea of structuring urban planning around travel time to key destinations has been explored in various cities long before Paris embraced it. Cities in the United States, such as Portland, Eugene, and Tempe, as well as Singapore and Melbourne, have implemented similar time-based urban strategies. However, following the COVID-19 pandemic, the 15-minute city has gained significant momentum in Europe, with cities like Rome, Dublin, and Utrecht actively adopting or exploring the model (Büttner et al., 2022).

16 municipalities, either incorporated or in the process of incorporating a ±15-minute city strategy into their planning framework have been analysed by EIT Urban Mobility in Munich, (Büttner et al., 2022) According to this research, 16 cities engaging chrono-urbanism into their planning strategies, many have adopted Moreno's principles, including proximity to services, mixed land use, density, ubiquity, placemaking, and walkability/cyclability. One key finding is that several cities have integrated public transport systems alongside 15-minute city principles, highlighting a more comprehensive approach to urban mobility. Among these 16 cities, twelve have already integrated the 15-minute city into their official spatial or transport planning strategies. The remaining cities are at various stages of implementation.

The interdisciplinary nature of the 15-minute city is reflected in the diversity of planning approaches: some cities introduce it through land-use plans (e.g., Ottawa, Utrecht), others through transport strategies (e.g., Surrey, Singapore), and some via environmental policies (e.g., Eugene). Ideally, for successful implementation, the concept should be embedded in all planning tools related to land use, mobility, and environmental planning at the municipal level.

To understand at what level these cities follow the core principles originally outlined by the concept of 15-minute city, each city's planning strategy was analysed based on Moreno's eight principles: proximity to services, diversity of land use and people, density, ubiquity, placemaking, walkability, and cyclability. The table below shows the results of this analysis made by Büttner et al. (2022).

Public transportation plays a critical role in proximity strategies, serving as a vital link that allows citizens to access destinations beyond the designated radius and helps connect the individual neighbourhoods. This feature is fundamental to enabling mobility and promoting integration within the urban fabric. The researchers also observed that cities have adopted different terminologies to categorise their plans, with three cities using a 10-minute label, six cities using a 15-minute label, and seven opting for a 20-minute label. These distinctions reflect variations in how the cities define their proximity boundaries. The planning efforts consider commonly accepted thresholds for walkable distances, typically ranging from 800 to 1200 meters, which have been supported in the scientific literature (e.g., Marquet et al., 2017). This range of distances is used as a standard to ensure that urban spaces are designed to be accessible to pedestrians within reasonable walking distances, further reinforcing the principles of the 15-minute city concept.

Table 2. Key planning principles in 15-minute city plans and strategies.

CITY	Proximity to services	Proximity to public transport	Mixed land use	Density	Place-making	Affordability	Walk and cyclability	Inclusiveness
Dublin Ireland	X	X	X	X	X	X	X	X
Edinburgh Scotland	X	X	X	X	X		X	X
Eugene USA	X	X	X	X			X	
Hailsham UK	X	X	X		X	X	X	X
Kirkland USA	X	X	X	X			X	
Melbourne Australia	X	X	X	X	X		X	X
Ottawa Canada	X	X	X	X	X	X	X	X
Paris France	X	X	X	X	X	X	X	X
Portland USA	X	X	X	X		X	X	X
Singapore	X	X	X				X	X
Surrey County UK	X	X	X	X	X		X	X
Tempe USA	X	X	X	X	X		X	
Utrecht Netherlands	X	X	X	X	X		X	X

Source: Büttner et al., 2022.

Through analysis of 16 case study cities, researchers at the European Institute of Technology (EIT, 2022) explored the question of translating the 15-minute city concept into reality. Their analysis of local policies identified four key spatial implementation strategies applicable to diverse urban contexts:

Transit-Oriented Development (TOD): This approach focuses on creating high-density, mixed-use neighbourhoods centred around public transportation stations. These walkable neighbourhoods provide easy access to the station and the broader city via public transport, making it ideal for new developments (as described in the previous section).

(Re-)Development of and Around High Streets/Main Streets: In existing towns and villages, established high streets often serve as natural hubs for essential services. Enhancing and revitalising these areas strengthens the 15-minute city concept within existing structures.

Development Around Vertical Centres/Hubs: This strategy creates central locations, such as shopping malls or large buildings, which integrate a variety of services – healthcare facilities, libraries, shops – all within a single structure. This model is particularly useful for dense urban environments.

Reuse of Existing (Public) Spaces: Reorganising existing public spaces to optimise their use for different activities is another strategy. Examples include creating community gardens, pop-up markets, or designated areas for exercise.

These strategies, as identified by EIT (2022), offer a roadmap for cities to implement the 15-minute city concept and transform the ideal into a tangible reality. The choice of implementation method can be tailored to the specific urban fabric of a given city or neighbourhood.

As mentioned above, there are many examples of implementation for city contexts. The challenge of strategies to achieve the goals of this model is to transfer these policies to different spatial contexts, such as suburban areas or neighbourhoods with low densities. There are studies showing (i.e., Vitale Brovarone, 2022) that suburban areas have limited access to several services within 15 minutes by walking or cycling, whereas it is easier in city centres. These are the areas where the implementation of those models faces the most challenges.
Policies and strategies should be tailored to individual cases based on their spatial, socio-economic, or other specific needs and features (Moreno et al., 2021). Some functions are not possible to locate in a ±15-minute radius, like universities, hospitals, museums, etc. Each of these requirements is more feasible on a smaller scale, which makes it operationally doable for urban centres and towns by mixed-use zoning strategies. However, the model is new, and its implementation and feasibility in suburban areas have not been explored yet (EIT, 2022).

Regarding land use applications, mixed-use and highly dense areas are crucial for the successful implementation of 15-minute city models. In contrast, suburban and peripheral areas have long been designed with car-oriented planning principles and low density, which presents challenges in adapting these regions to the concept. To effectively implement 15-minute city policies, flexible territorial boundaries and adaptive administrative frameworks are necessary, allowing for collaboration between municipalities, different stakeholders, and various territorial units. This multi-level cooperation is essential for the successful transition to more sustainable urban environments.

Furthermore, investments in the 15-minute city concept could potentially lead to a reduction in funding for public transport infrastructure, particularly if these efforts are not well coordinated with existing transportation networks. Without sufficient investment in public transport, there is a high risk that commuters will continue to rely on their cars for longer distances, undermining the goals of reducing car dependency and improving urban mobility.

Finally, the urban morphology typical of suburban areas may not be well suited to the principles of the 15-minute city. While the concept emphasises achieving 'optimal density' to ensure accessibility to services and functions, suburban areas are often dominated by single-family housing and expansive, low-density plots. This land use pattern makes it difficult to provide the necessary services, such as efficient transportation, educational facilities, and green spaces, which require a certain level of population density to be viable. Therefore, addressing these spatial challenges is critical to ensuring the success of 15-minute city policies, which rely on a balance between density, accessibility, and sustainability.

Other than the challenges for suburban areas, there are different challenges regarding city centres for the 15-minute city policies. The most distinct one is the risk of gentrification. The urban transformations, which are on behalf of a 15-minute city, enable access to urban functions, services, and opportunities within a 15-minute walking and cycling radius. Nevertheless, there is always a possibility that the policies are not ubiquitous, which may end up favouring certain neighbourhoods which causing gentrification. There is already an increasing inequality in cities depending on accessibility to services, distribution of resources and others, which are caused by land-use planning policies and approaches, favouring segregation, have been used for decades. Hence, the recent urban design models, such as the 15-minute city, complete neighbourhoods should be implemented alongside socially inclusive development processes (TUMI, 2021).

Finally, building on their case study research, researchers from Munich have developed a practical roadmap, the "15-minute city for All," to guide practitioners in implementing this model. This roadmap outlines five key steps:

Table 3. Key steps of the 15-minute city roadmap.

Vision Development	Since the 15-minute city concept depends heavily on the local context, the first step is to define a vision that aligns with the city's unique needs and goals.
Measurement and Assessment	Measuring the existing conditions within neighbourhoods is crucial. This data helps assess the current situation and track progress after implementing the strategy. It can also help to define areas requiring prioritised interventions.
Inclusive Planning	An effective 15-minute city plan relies on collaboration with decision-makers and local residents, who have valuable knowledge of their neighbourhoods. This approach helps create a plan tailored to the specific area.
Action Plan Development	The inclusive planning process should result in a detailed action plan that outlines the feasibility of the project, including budgets, timelines, and a focused assessment of priority areas.
Community Engagement	Continuous engagement with the local community is essential at every stage of implementation. This helps to ensure that the measures create human-centred spaces that reflect residents' needs and promote a sense of ownership.

Source: Büttner et al., 2022.

As it is seen, the 15-minute city is not just about proximity, but about creating vibrant, accessible, and people-centred neighbourhoods. It requires a clear vision, thoughtful planning, and continuous community involvement to ensure it truly serves those who live there. Beyond reducing travel time, it is about strengthening connections, enhancing urban life, and making cities more inclusive and liveable.

Due to their complementary nature with the 15-minute city, the next chapter will investigate the TOD concept, which can be a powerful tool to facilitate the implementation of the 15-minute city vision.

2.9 Transit-oriented development concept

The integration of transportation and land-use development around railway stations has gained popularity among states and local governments worldwide (Bertolini, 2010). Transit-Oriented Development (TOD), a well-known urban development model that combines urban and transport planning, is seen as an alternative to low-density, car-dependent land use patterns (Calthorpe, 1990). The term "transit-oriented development" was coined by Peter Calthorpe and explained in his influential work, "The Next American Metropolis: Ecology, Community, and the American Dream" (1993). While the concepts of pedestrian-oriented neighbourhoods and small-scale street designs have been part of urban development discussions since the 1950s, Calthorpe identifies himself as a "reviver rather than an originator of ideas" (Newman, 1991). The Centre for Transit-Oriented Development (CTOD) defines TOD as a type of community development that includes a mix of housing, office, retail, and other commercial developments integrated into a walkable neighbourhood within a half mile of quality public transportation (CTOD, 2019).

TOD takes advantage of existing transportation networks and aims to strike a balance between transportation-driven supply and land-use-driven demand while improving pedestrian friendliness and walkability (Vale et al., 2018). The integration of public transport and urban development, which forms the basis of the TOD model, is recognised as an efficient and sustainable form of urban development (Adelfio & Hamiduddin, 2014). It promotes increased accessibility by providing alternatives to car-oriented land use (Renne et al., 2016). Another primary advantage of TOD is a rise in ridership and a consequent increase in revenue. Studies show that individuals living near transit stations are five to six times more inclined to use public transport for their daily commute compared to residents living elsewhere in the same region (Cervero et al., 2004). Other benefits TOD offers are the revitalisation of declining neighbourhoods, increasing the availability of affordable housing, and providing financial returns to property owners and businesses near transit hubs. Additionally, Bertolini (2000) highlights the potential for an improved quality of life through increased human interaction in public spaces, which is more challenging in socially segregated, car-dependent environments.

The concept has a complex process that can generate sustainable transportation models, enhance regional connectivity, and decrease emissions. It has gained popularity among urban planners, developers, and engineers due to its integration of mass transit technology, efficient transportation, and high-density development. Moreover, a significant percentage of residents express a desire to live in high-density housing near transit (Thomas and Bertolini, 2020). Demographic shifts and changing housing preferences, such as the growth of households without children, single parents, and people living alone, have contributed to the rapid adoption of this urban model (CTOD, 2007). Studies conducted in the United States indicate that by 2030, 40% of households will be seeking high-density housing near transit (Thomas & Bertolini, 2020).

A study (Thomas and Bertolini, 2020) made with a meta-analysis of eleven international case studies on the success factor of TOD advocated that the most crucial factors are political stability at the national level, relationships between regional actors, interdisciplinary teams for implementation, and public participation. The research also highlights the significance of comprehending the functions of both public and private actors engaged in transportation and land development near stations, along with the influence of governance models. Other studies suggest that the successful implementation of the TOD model depends on the five Ds: density, diversity, design, distance to transit, and destination accessibility (Ewing & Cervero, 2010). These principles exhibit similarities with the dimensions of the 15-minute city concept, making TOD a compatible model where high-quality walking and cycling networks can be combined with an efficient public transport system to increase proximity, even in suburban areas.

Density refers to various variables of interest per unit of area, such as population, employment, or dwelling units (Ewing & Cervero, 2010). Creating densified housing around a transit network is challenging, especially in car-oriented, low-density regions. For instance, Renne (2017) points out that although the United States invested billions of dollars to build rail stations serving over 4400 passengers in 39 metropolitan regions by 2010, only 36 % of these areas achieved the minimum density requirement of 8 units per acre necessary to support transit use. Renne suggests that if every station were to achieve a minimum density of 8 units per acre, an additional 9 million dwellings could be created (Renne, 2017).

Diversity refers to different land uses, which in the context of the 15-minute city, also encompasses socio-economic and cultural diversity. Achieving diversity can be challenging in metropolitan areas that have relied on zoning and car-oriented development models for decades (Thomas & Bertolini, 2020).

Design encompasses the built environment and street network features, such as block size, intersections, and walking/cycling infrastructure. Erwing & Cervero (2010) suggest that walking is strongly influenced by characteristics of the built environment, such as intersection density and the number of destinations within walking distance. These principles align with those of the 15-minute city concept.

Distance to transit is typically considered to be around 800 meters, which is the maximum distance people are willing to walk to access transit, such as a metro or train station. This radius and walking preferences can vary depending on factors such as destination, age, land use, safety, density of services, and trip purposes (Thomas & Bertolini, 2020). Moreover, the distance people are willing to walk or bike to access transit can vary across cultural contexts. For example, a study conducted in Korea found that transit users in Seoul and Daejeon were willing to bike up to 2 kilometres to reach stations, while Dutch researchers suggested that people could bike up to 3.6 kilometres to access stations (Lee et al., 2016; Le Paix Puello & Geurs, 2015).

Destination accessibility refers to how easily people can reach key destinations such as services, jobs, and central business districts. Studies indicate that residents living in areas with high job accessibility but low competition for those jobs tend to experience shorter commute times (Deboosere et al., 2018). Additionally, research on seventeen TODs across four U.S. metropolitan areas found that housing within these developments led to a reduction in car trips by up to 50% (Thomas & Bertolini, 2020).

A successful TOD starts with a shared vision combined with input from the public that guides planning and implementation for the following years. Then, strategic planning for areas around stations is done, with zoning rules, incentives, and regulations to support it. The latter step is to extend the transit network to support development near transit. Some cities, like Los Angeles and Seoul, have built extensive rail infrastructure, while others, such as Toronto and Ottawa, are integrating bus rapid transit or light rail transit into their systems (Thomas & Bertolini, 2020). For example, the City of Vancouver in Canada has linked new locations for affordable housing to the recent transit network in its housing strategy (City of Vancouver, 2018). In Europe, popular implemented policies include anti-sprawl measures, transit ridership promotion, regional growth management, and polycentric growth strategies, all of which are combined in a regional approach to shift travel demand towards transit (Conesa, 2018). Many cities have also aligned their urban design guidelines with the concept of walkable neighbourhoods, as municipalities and developers see these models as offering higher urban quality of life and fostering a stronger sense of community (Noland et al., 2017).

However, TOD is not a magic bullet solution (Thomas & Bertolini, 2020) for addressing metropolitan transportation issues. It has its own set of challenges, including complex development processes, financial and construction challenges and displacement of residents and businesses. That is the reason it is important to draw lessons from both successful and failed built examples of TOD, to understand how best to address issues such as attracting new businesses, residents, or job opportunities.

One of the most common barriers is the historical car-oriented planning of cities, which has influenced land use regulations such as zoning. TOD promotes mixed-use development with higher densities and reduced space for cars, requiring the integration of transportation and land-use planning. Since TOD is a regional-scale model aimed at reducing car use and urban sprawl, it needs to be applied beyond isolated station areas and in coordination with tools, policies, and plans regulating urban growth, development of employment areas, and housing location (Thomas & Bertolini, 2020). Expanding the implication of TOD beyond individual station areas requires strong collaboration between municipal departments, various levels of government, and private sector partners that each have their own priorities and perspectives, which may not always align (Duffhues & Bertolini, 2015). However, the lack of integration among planning tools at a regional scale and inefficient collaboration among different partners create a significant challenge to these models (Deboosere et al., 2018).

Another important challenge is the basic characteristics of transport and land use systems, which determine the competitive position of public transport with the car. (Renne et al., 2016). Bertolini and Le Clercq (2003), suggested that there are two basic correlations. The first one is between the speed of a public transport system and the scale at which an urban system works. The second correlation mentioned is the one between the capacity and flexibility of a transportation system and the degree of spatial concentration of activities, for instance, residential and employment densities. Transit and cars have advantages and disadvantages based on land use and density conditions. For example, cars have low capacity and high flexibility. In contrast to high speed, public transit means can match cars regarding speed, and they have higher capacity, but the flexibility is lower compared to cars. On the other hand, non-motorised modes have both high flexibility and capacity, but they have disadvantages in speed and spatial reach. To compete with cars and provide an alternative, the strengths of transit and slow modes need to be combined. However, this combination can be convenient only in the presence of short-distance and/or high-density spatial patterns.

Furthermore, parking requirements are challenging for TOD implementation. Despite the expectation of reduced car usage near public transit, municipal regulations often provide a certain number of parking spaces for each housing unit, which can lead to costly parking infrastructure, resulting in less profitable developments for developers (Ewing & Cervero, 2010). It is suggested that lowering residential parking ratios in TOD areas could significantly (20 -33 %) increase densities, making developments more affordable and sustainable (2008, 54).

Regarding the accessibility of stations, which is an important principle of the implementation of TOD, enhancing pedestrian access, circulation for active modes, and the overall walking environment are key aspects for success. Nonetheless, the challenge comes from balancing the function of transit stations as both mobility hubs and appealing destinations, which can complicate these efforts. Studies (Cervero et al., 2004) show that people live approximately 500 m to station area arrive by foot or bikes, however this share decreases markedly if there are significant physical, symbolic, and psychological barriers to bike and pedestrian mobility such as wide and busy road, heavy traffic, and incomplete pavement networks.

To sum up, TOD has gained significant popularity despite the challenges, especially in car-oriented regions and has become a wider perspective integrating walkability, cycling, and public spaces to support various transportation modes (Curtis, 2012). Only in the US, over one hundred projects exist around heavy, light, and commuter-rail stations. These examples are typically in nodal form, but ‘TOD corridors’ are also beginning to emerge (Cervero et al., 2004). However, many cities still face significant barriers, including car-centric regulations, lack of regional coordination, high infrastructure costs, public opposition, and the potential loss of affordable housing in TOD areas.

CHAPTER 3

Research Methodology

3. Research Methodology

Mobility itself is a complex subject, including built environment, socio-cultural factors, behaviours, land use and transport policies. Therefore, the methodology utilised to examine walkability requires diverse approaches and resources, such as data collection. This research aims to tackle social and physical barriers towards walkability in car-dependent urban contexts. To have a wider spectrum of barriers and possible solutions to overcome them, it is inevitable to deploy a comprehensive and multi-model research methodology that includes qualitative and quantitative techniques. This chapter presents the methodological framework of the research, detailing the approach used to analyse pedestrianisation strategies and their applicability in car-dependent urban contexts. The study employs a mixed-methods approach, combining comparative case study analysis, GIS-based spatial assessment, and survey research to evaluate pedestrian accessibility in Palermo.

The research is structured into three main components:

a. Comparative Case Study Analysis – Examining pedestrianisation strategies across different cities to extract best practices and challenges.

b. Palermo Case Study – Assessing walkability conditions around two railway station areas, Orleans and Lazio, through GIS-based spatial analysis and socio-demographic assessment.

c. Walkability Survey – Understanding socio-cultural barriers to pedestrianisation in Palermo's Old Town.

The following sections outline the research design, data collection methods, analytical tools, and justification for each methodological approach.

3.1 Research Design

A mixed-methods strategy is particularly well-suited for this study because walkability is influenced by a combination of urban morphology, policy frameworks, and individual mobility choices. A purely quantitative analysis would overlook critical socio-cultural barriers that discourage walking, while a purely qualitative approach would fail to measure the objective spatial constraints shaping pedestrian movement. By combining case study research, spatial analysis using GIS, and survey-based behavioural assessment, this study bridges the gap between urban form, governance structures, and user perceptions, offering a more nuanced and actionable perspective on sustainable mobility transitions.

Table 4. Research methods

Method	Purpose	Data sources	Use
Comparative case study analyses	Identify best practices in pedestrianisation from diverse cities and compare them to draw valuable lessons from different experiences.	Literature review, policy documents, project reports	To determine transferable best practices by cross-case comparison among different pedestrianisation experiments and projects from diverse cities around the world.
GIS-based spatial analysis	Evaluating pedestrian accessibility in catchment areas of train stations regarding the metrics created by the integration of 15-minute city and TOD principles.	GIS, OpenStreetMap, ISTAT	To quantify walkability challenges and opportunities in catchment areas of train stations and to test the integration of the two concepts regarding walkability and accessibility.
Survey Research	Understand perceptions and behavioural barriers to walkability	Survey responses from residents of Palermo	To explore socio-cultural barriers towards walkability and to develop policy interventions that align with local mobility behaviours.

Urban mobility research has increasingly emphasised the importance of integrating multiple analytical perspectives (Stinder, Schelte, & Severengiz, 2022) to address walkability holistically. Several studies highlight the need to move beyond a strictly engineering-based approach to pedestrian planning, which often focuses solely on infrastructural improvements, and instead incorporate behavioural sciences, cultural studies, and governance perspectives. This research aligns with this interdisciplinary shift by employing spatial, social, and policy-driven methodologies to investigate pedestrianisation strategies that work across diverse urban contexts.

By integrating these methods, the study moves beyond a purely technical assessment and instead positions walkability as a socio-spatial phenomenon, assuming that successful pedestrianisation requires both infrastructure investment and cultural transformation. Consequently, the mixed-methods approach enhances the study's capacity to propose effective, context-aware, and equitable urban mobility solutions.

3.2 Comparative case study analysis

The use of comparative case study analysis in this research is grounded in the need to understand how different urban contexts implement pedestrianisation strategies and what lessons can be drawn for cities seeking to transition toward more walkable environments, or in other words this analysis seeks for a "knowledge transfer" among cities that have diverse experiences. Pedestrianisation is not a one-size-fits-all solution; its success depends on urban morphology, governance structures, socio-economic conditions, and cultural attitudes toward mobility.

By analysing multiple case studies, this research aims to:

- Identify commonalities and differences in pedestrianisation approaches across diverse urban settings.
- Understand how policy frameworks, infrastructure investments, and public engagement shape pedestrian-friendly interventions.
- Assess the transferability of best practices to cities with high car dependency, such as Palermo.
- Provide a structured comparison of large-scale pedestrianisation strategies versus tactical interventions, offering insights into their effectiveness.

This approach follows a qualitative comparative analysis (QCA) methodology, which allows for the systematic evaluation of urban interventions while acknowledging the context-specific factors influencing pedestrianisation outcomes.

3.2.1 Case study selection criteria

The case studies analysed in this research were carefully selected based on the three key criteria that are diversity in pedestrian strategies, public participation and governance models, and urban context and historical significance. Even though the research aims to understand the socio-cultural drivers and barriers towards walkability in Palermo in the following chapters, the socio-cultural dynamics of the selected case study cities are not included in this comparison study because making place-based research on the socio-cultural conditions of eight cities is not feasible and practical at this moment.

Diversity in pedestrianisation strategies

A fundamental criterion for selection was the type and scale of intervention. The first group comprise comprehensive city-wide pedestrianisation strategies, which involve large-scale transformations prioritising walking across entire urban areas (e.g., Pontevedra, Ghent, Oslo, Helsinki). The second group consists of tactical or incremental pedestrianisation strategies, which focus on specific districts, streets, or experimental interventions that enhance pedestrian environments without fundamentally altering city-wide mobility patterns (e.g., Milan, Bogotá, Istanbul, Copenhagen). This classification helps to assess how different levels of intervention influence walkability and modal shifts away from car dependency.

Public participation and governance models

Another criterion is that chosen pedestrianisation processes should vary in the degree to which citizens, businesses, and local stakeholders are involved in the decision-making and implementation process. Some of the selected cases have top-down approaches, where government-led pedestrianisation policies drive implementation with minimal direct public engagement; some of them have bottom-up or participatory approaches, where residents and businesses actively shape pedestrianisation strategies through consultations, co-design workshops, or participatory budgeting mechanisms; and some of them have a collaborated approach where government-led policies adopted and enhanced by public support. Understanding these governance structures allows for an evaluation of how different decision-making models affect public acceptance and long-term success.

Urban context and historical significance

Another criterion is to choose pedestrianisation experiences among different urban settings, such as historic city centres where pedestrianisation efforts must balance walkability with heritage preservation and tourism management (e.g., Pontevedra, Istanbul), mixed-use commercial districts where pedestrian-friendly interventions should consider especially the economic vitality (e.g., Milan, Bogotá) and modern urban neighbourhoods where pedestrianisation strategies are implemented as part of broader urban renewal or transit-oriented development (e.g., Ghent, Helsinki). This diversity enables an analysis of how urban form and land-use patterns influence pedestrianisation outcomes.

3.2.2 Selected case studies

Based on the criteria outlined above, the research analyses the following eight case studies, categorised by intervention type.

Comprehensive city-wide pedestrianisation strategies

These cities have implemented systemic pedestrianisation measures with long-term regulatory and infrastructural transformations.

Pontevedra, Spain – Car-free city centre with extensive pedestrianisation and traffic calming measures.

Ghent, Belgium – Large-scale circulation plan prioritising pedestrians and cyclists while restricting car traffic.

Oslo, Norway – Implementation of car-free zones in the central district is supported by high-quality public transport.

Helsinki, Finland – Holistic walkability strategy integrated with public transit and urban planning.

Tactical or incremental pedestrianisation strategies

These cities have adopted targeted, flexible pedestrianisation initiatives. This selection ensures that both long-term structural reforms and short-term experimental initiatives are represented.

Milan, Italy – "Piazze Aperte" and "Strade Aperte" programs, using tactical urbanism to enhance pedestrian space.

Bogotá, Colombia – "Ciclovía" and other pedestrian-focused initiatives promoting active mobility.

Istanbul, Türkiye – Historic peninsula pedestrianisation balancing walkability with commercial and heritage considerations.

Copenhagen, Denmark – Gradual transformation of public spaces, expanding pedestrian-prioritised streets in a step-by-step manner.

3.2.3 Expected outcomes

The comparative case study analysis in this research serves as a methodological foundation for identifying replicable best practices in pedestrianisation, offering an understanding of strategies that can be adapted to Palermo's urban context. By examining a diverse set of cities that have implemented pedestrian-friendly interventions, this study systematically evaluates the governance structures, regulatory frameworks, and spatial planning mechanisms that have facilitated or hindered the success of such initiatives. A critical dimension of this analysis is the exploration of policy challenges associated with pedestrianisation, particularly in cities with entrenched car dependency, where institutional resistance, economic concerns, and socio-cultural factors shape public and political acceptance.

3.3 Station areas as targets for walkability

Well-connected pedestrian infrastructures with public transport services are one of the most important and maybe the most effective ways to tackle car dependency in urban areas. Within the scope of the Palermo case study, the railway is the most effective and influential (both in terms of land use and mobility) public transport mode. The railway system and other public transport services of Palermo are explained in detail in the following chapters. Given the fact that this research aims to understand pedestrian accessibility in car-dependent cities, the two catchment areas of train stations are examined in this context regarding their spatial and socio-demographic features with qualitative and quantitative methodologies.

3.3.1 Methodological framework of station target areas research

The research employs a multi-layered spatial and socio-demographic analysis integrating GIS-based walkability assessment that evaluates pedestrian connectivity and accessibility using network analysis, land use and functional analysis that examines the spatial distribution of key urban functions and land uses within the catchment areas, street quality analysis that assesses pedestrian infrastructure quality based on different built environment indicators, and finally, socio-demographic analysis that examines the demographic texture of the catchment areas.

Spatial analysis is a fundamental component of this research, providing a quantitative and qualitative assessment of pedestrian accessibility within the catchment areas of railway stations in Palermo. Given the city's historically car-dependent urban fabric, integrating TOD and the 15-minute city framework requires an evidence-based spatial evaluation to identify infrastructural gaps, barriers to walkability, and opportunities for multimodal integration.

The integration of 15-minute city and TOD principles in this research is operationalised through a set of quantitative and qualitative indicators assessing street quality, socio-demographic characteristics, and land use distribution within railway station catchment areas.

To analyse the socio-demographic profile of these areas, numerical indices such as population density, old-age dependency ratio, and education level are derived from statistical data at the Census Unit level. These indicators provide a detailed, small-scale analysis and facilitate direct comparisons between different station environments.

The functional analysis maps the distribution of urban amenities and services, evaluating their spatial relationship with the street network and train stations. This approach aligns with Bertolini's (1999) conceptualisation of accessibility as the ability to engage in activities within and around transit hubs, emphasising the diversity of available functions and their users.

Street quality is assessed through a hybrid method combining quantitative and qualitative evaluations, producing a numerical index that enables a spatial representation of conditions affecting pedestrian accessibility. This composite assessment ensures a comprehensive understanding of accessibility challenges and opportunities, guiding the development of targeted policy interventions to enhance walkability and multimodal integration in Palermo's station areas.

To promote a clear understanding of the research, the stages of the analysis are given below. A detailed explanation of the methodology of each research analysis is given again in the relevant chapter.

3.3.2 Creation of station catchment areas

The catchment area for each station was defined based on a 7–8-minute walking distance, corresponding to an average pedestrian speed of 5 km/h. This methodology ensures that the analysis remains both practical and representative of real-world pedestrian behaviour. The following steps were undertaken:

- Network-Based Accessibility Mapping:

Utilised QGIS Service Area Analysis to generate isochrones reflecting realistic pedestrian travel distances. Cross-validated with online API services (Iso4App) to ensure methodological robustness.

- Integration with Built Environment Data:

Overlaid the accessibility network with urban morphology data to refine catchment boundaries. Considered barriers to pedestrian movement, such as high-traffic roads and discontinuous sidewalks.

- Census Unit Overlay for Socio-Spatial Analysis:

Integrated statistical data on population density, age distribution, and socio-economic indicators to assess demographic trends influencing mobility choices.

This methodology ensures that the spatial definition of the station catchment areas aligns with both infrastructural realities and socio-demographic factors, providing a context-sensitive assessment of pedestrian accessibility.

3.3.3 Integration of 15-minute city and TOD principles

TOD and 15-minute city are two important concepts for urban development that have received significant attention from scholars and policymakers. TOD promotes high-density, mixed-use development around stations, while the 15-minute city ensures essential services are within a short walking distance, fostering a self-sufficient, pedestrian-friendly environment. Using a comparative analysis of two diverse train stations in Palermo, this study applies quantitative and qualitative indicators that are derived from the integration of the principles of these two concepts to assess walkability and multimodal connectivity. Key research questions explore what makes a transit node attractive, how transit and place interact, and how this informs policy. The findings provide evidence-based recommendations to enhance pedestrian accessibility and support sustainable urban mobility strategies.

Comparison of the Orleans and Lazio station catchment areas

The two selected station areas, Orleans and Lazio, represent contrasting urban environments, demographic structures and diverse land use, providing a comparative framework for assessing TOD and 15-minute city applications. Due to those differences, policies aiming for pedestrian accessibility in those catchment areas are also greatly different from each other. This dual case study approach enables the study to test how different urban conditions impact the effectiveness of TOD and 15-minute city strategies, ensuring that the findings can be applied to diverse urban contexts.

The benefits of choosing two diverse station areas have been explained in more detail in the respective chapter of the thesis.

Table 5. The comparison between the two targeted station areas.

Criterion	Orleans Station	Lazio Station
Urban Morphology	Historic, mixed-use	Modern, mono-functional
Street Connectivity	Dense, irregular network	Wide streets, lower permeability
Land Use Diversity	High (institutional, commercial, residential)	Low (primarily residential)
Pedestrian Barriers	Narrow sidewalks, high traffic	Large blocks, discontinuous pathways
Public Transport Integration	Strong multimodal connections	Limited bus-train integration

3.3.4 Contribution to urban mobility research

The integration of GIS-based spatial analysis, socio-demographic evaluation, and functional land-use assessment in this study contributes to urban mobility research by providing a comprehensive methodology for evaluating walkability in transit-oriented environments. By applying a replicable spatial framework, the study establishes a systematic approach to assessing pedestrian accessibility in railway station catchment areas, allowing for comparisons across different urban contexts.

A key contribution of this research is the integration of spatial network analysis with socioeconomic and functional land-use data, ensuring a multidimensional understanding of walkability. This methodological approach moves beyond traditional transport studies that focus primarily on infrastructure and travel demand, instead offering a place-based perspective that highlights the complex interactions between the built environment, mobility behaviours, and accessibility.

Furthermore, the findings generate policy-relevant insights by identifying the key interventions needed to enhance first/last-mile connectivity, ensuring that station areas function as effective multimodal hubs rather than isolated transit points. This evidence-based approach provides a foundation for strategic urban mobility planning, guiding the development of pedestrian-friendly, transit-oriented cities. By bridging the gap between urban planning theory and empirical spatial analysis, the research offers practical solutions for transitioning away from car dependency, particularly in cities like Palermo, where walkability remains a critical challenge.

3.4 Survey research: understanding walkability perceptions in Palermo

While the spatial analysis of railway station areas provides a quantitative assessment of walkability, it does not fully capture the socio-cultural dynamics influencing pedestrianisation in Palermo. To address this, a survey-based approach was implemented to explore public attitudes toward walkability, pedestrian infrastructure, and mobility behaviour. Unlike the station areas, which primarily serve as transit nodes, Palermo's Old Town represents the most pedestrianised and visited part of the city, making it the ideal case study for understanding the broader public perception of pedestrian-friendly policies.

Palermo's Old Town has been the focus of numerous pedestrianisation initiatives and urban regeneration projects, yet limited research has examined how these interventions have been perceived by residents and visitors. Given that the Old Town features the city's most developed pedestrian infrastructure, it provides a unique testing ground for assessing how locals perceive walkability, accessibility, and mobility choices. By surveying this area, the study moves beyond a localised, infrastructure-focused analysis (as seen in the station area studies) to capture a holistic socio-cultural perspective on pedestrianisation and mobility in Palermo.

3.4.1 Methodological framework for the survey

The survey research adopts a mixed-method approach, combining both quantitative and qualitative analyses to evaluate public perceptions of walkability and pedestrianisation in Palermo's Old Town. This methodology is designed to capture both individual mobility behaviours and broader societal attitudes toward pedestrian-friendly urban planning.

A key component of the survey focuses on demographic and travel behaviour assessment, examining respondents' socio-economic backgrounds, commuting patterns, and mobility choices. This allows for a refined understanding of how different population groups interact with pedestrian infrastructure and public transport. Additionally, the survey investigates perceptions of walkability and infrastructure, assessing the safety, comfort, and accessibility of pedestrian spaces within the Old Town. Respondents provide insights into their experiences as pedestrians, highlighting both positive aspects and existing barriers that impact walkability.

Beyond individual experiences, the survey also evaluates public awareness and approval of past and ongoing pedestrianisation projects. Given that the Old Town has been the focus of numerous pedestrian-friendly interventions, this aspect of the study measures how residents and visitors perceive the effectiveness of these initiatives, as well as their willingness to support future mobility policies. By structuring the survey around these key themes, the research ensures a comprehensive analysis of both behavioural and policy-related dimensions of pedestrianisation, offering valuable insights for future urban planning efforts.

The decision to conduct the survey in Palermo's Old Town was based on three key factors:

- Existing pedestrian infrastructure and urban context

The Old Town has the highest concentration of pedestrianised streets, making it the most relevant location for studying public attitudes toward walkability. It serves as a testbed for pedestrianisation policies, allowing the study to examine how infrastructure improvements impact mobility choices.

- Holistic perspective on walkability in Palermo

Unlike railway station areas, which primarily function as transport hubs, the Old Town provides insights into how locals experience walkability in everyday life. By surveying residents and visitors, the research captures a city-wide perspective rather than being limited to transit-oriented walkability.

- Policy and planning relevance

The Old Town has been the focus of numerous pedestrianisation projects, including traffic restrictions, urban design improvements, and mobility regulations. Evaluating public perception of these interventions provides direct feedback on policy effectiveness, informing future pedestrianisation strategies. Also, these projects and initiatives in the Old Town help to create a connection with the case studies compared in the following section.

This selection ensures that the study does not merely assess infrastructural accessibility but also the socio-cultural dimensions of pedestrianisation in a historically car-dependent city.

3.4.2 Data analysis and interpretation

The survey was conducted through a combination of digital and paper-based formats, ensuring broad participation from different parts of the city. Initially launched using Typeform, the survey was later transferred to Google Forms and MS Forms to reduce costs and facilitate data management. In one month, 677 responses were collected from a diverse range of socio-economic groups that capture varied perspectives on pedestrianisation.

The survey was structured into three sections:

1. Demographic and socio-economic profile for capturing respondents' age, occupation, and residential location, providing contextual insights into mobility choices.

2. First-hand pedestrian experiences for examining walking frequency, perceptions of safety, comfort, and accessibility, and identifying challenges to pedestrian movement.
3. Perceptions of pedestrianisation policies for measuring public awareness and support for existing pedestrian initiatives, as well as expectations for future improvements.

3.4.3 Contribution to urban mobility research

This study contributes to urban mobility research by expanding the analysis of walkability and pedestrianisation beyond spatial and infrastructural assessments. While much of the walkability research focuses on street design, connectivity, and accessibility metrics, this study integrates a socio-cultural perspective, examining how public attitudes, habits, and perceptions influence mobility choices. By capturing behavioural insights, the survey provides a deeper understanding of how residents of Palermo perceive pedestrian-friendly interventions, complementing the spatial analysis conducted in station areas.

A key focus of the study is evaluating whether public transport and active mobility options are perceived as viable alternatives to car use. Despite the availability of public transit and pedestrian infrastructure, many locals continue to rely on private vehicles. The survey investigates whether this reliance comes from genuine gaps in accessibility or a cultural predisposition toward car dependency, even in areas where efficient alternatives exist. By assessing how residents and visitors perceive walkability and pedestrian infrastructure in the Old Town, the study reveals whether the car is seen as an indispensable mode of transport or whether prejudices about walkability persist due to a lack of awareness of available mobility options.

Additionally, the research provides a critical assessment of past pedestrianisation policies, measuring public approval, resistance, and awareness of these initiatives. Palermo has undergone significant pedestrian-friendly transformations in recent years, yet it remains unclear how these changes have influenced mobility behaviour and public attitudes. The findings highlight whether pedestrianisation efforts are viewed as beneficial or restrictive, offering valuable insights for refining future policies.

Ultimately, this study bridges the gap between infrastructure provision and behavioural adaptation, ensuring that future walkability strategies not only enhance the built environment but also address cultural barriers to reducing car dependency. By identifying both support and resistance to pedestrianisation, the research contributes to evidence-based urban mobility strategies, helping policymakers develop more effective, context-sensitive interventions that align with public needs and expectations.

CHAPTER 4

Planning Experiments for Walkable Cities Around the World

4. Planning Experiments for Walkable Cities Around the World

This chapter provides a detailed analysis of innovative urban pedestrianisation projects from cities around the world, each designed to improve walkability or active mobility. These experiments, conducted in different urban contexts, offer valuable insights into the strategies, methods, and approaches used during their planning and implementation phases. By examining both their successes and challenges, this study helps to uncover what works and what does not when it comes to creating more walkable urban environments. Understanding why certain strategies succeed in some contexts while failing in others is vital for developing solutions that can adapt to diverse urban conditions.

Exploring a variety of case studies highlights how factors like cultural norms, urban density, socio-economic conditions, and governance structures influence the outcomes of pedestrianisation efforts. Every city is unique, and solutions that succeed in one place may not work in another. By looking at these differences, this chapter aims to uncover universal lessons and context-specific insights that can help bridge the gap between theory and real-world application. This balanced perspective not only identifies best practices but also points out common challenges to avoid in future initiatives.

The findings from these global walkability experiments are summarised in a concluding table, extracting key takeaways and lessons learned. This table serves as a practical guide for shaping the policy recommendations of this research and supports future studies in creating more pedestrian-friendly cities. By learning from both the successes and failures of past projects, this chapter aims to inform better, more effective, and equitable strategies for improving walkability in different urban settings.

4.1 Selection of the pedestrianisation examples

The case studies analysed in this research were carefully chosen to represent a diverse range of pedestrianisation processes. This diversity allows for a more thorough comparison and helps to draw valuable lessons from different experiences. A key selection criterion was the active involvement of both the public and business owners in the planning and implementation of place-making projects. Over the past few decades, pedestrianisation and place-making have become increasingly important in urban planning. To create welcoming, meaningful, and successful spaces for pedestrians, it is vital to incorporate the perspectives and experiences of the people who use them (Cilliers & Timmermans, 2014). Urban and mobility planning offer various opportunities for engaging citizens in the planning process, using a wide range of methods such as surveys, workshops, and collaborative decision-making.

Citizen engagement in planning can take different forms. One example is consultation, where input is collected from stakeholders, but their feedback is not always included in the final decisions. On the other hand, participation and co-construction represent more active forms of engagement, where stakeholders play a significant role in shaping both the process and the outcomes. The examples in this analysis highlight different levels of citizen and stakeholder involvement.

In some projects, citizens and other stakeholders were directly engaged in the design and implementation phases. In contrast, other initiatives followed a more 'top-down' approach, where local governments led the process and citizens were only involved through surveys or observations conducted after implementation to assess the results. For instance, as part of this research, a survey of residents in Palermo was carried out to gather public perspectives on pedestrian accessibility within the historic Old Town. This survey serves as a useful point of comparison with the case studies analysed in this research.

Another important criterion for selecting the case studies was their spatial and contextual diversity. This included factors such as city size, historical background, and land use. By examining projects from a variety of settings, the analysis provides a broader understanding of the factors that influence pedestrian accessibility and the potential applications of pedestrianisation initiatives.

Some of the case studies focus on smaller cities, while others are from large metropolitan areas with higher populations. They also cover a mix of settings, including historic sites, residential neighbourhoods, and modern shopping districts. Despite these differences, all the projects share a common goal: improving pedestrian accessibility and encouraging the use of public spaces.

By exploring this diverse range of case studies, the analysis offers valuable insights into the challenges and opportunities associated with pedestrianisation. These examples demonstrate how varying approaches can be adapted to different contexts, providing useful lessons for future urban planning and mobility initiatives.

To structure the analysis better, the selected cases were categorised based on the type of intervention. This classification considers the scale, permanence, and strategic approach of pedestrianisation efforts. “Comprehensive city-wide strategies” involve large-scale, systemic transformations that reshape urban mobility by prioritising walking and reducing car dependency across entire cities or large districts. Such strategies are typically supported by long-term policies, extensive infrastructure changes, and strong regulatory frameworks to ensure permanent modal shifts. Pontevedra, Ghent, Oslo and Helsinki are chosen as case studies for this class. On the other hand, “tactical or incremental pedestrianisation strategies” focus on specific zones, streets, or temporary interventions that enhance pedestrian environments without transforming the entire city. They are often more flexible and experimental, allowing cities to test pedestrianisation measures before committing to permanent changes. Milan, Bogota, Istanbul and Copenhagen are chosen as examples of those strategies. In the following section, case studies are listed according to this classification.

4.2 Istanbul – 'Tarihi Yarımada' pedestrianisation project, Türkiye

Istanbul, Europe's most populous city (16.047.000), faces severe traffic congestion due to rapid urbanisation and increased car ownership. Despite a high volume of daily trips (30.3 million), walking remains the most popular mode of transportation, followed by public transit, private cars, and company/school buses[2]. While public transport is heavily reliant on buses, there is a growing rail network as well (Erdil, 2022). Istanbul, a major economic and cultural hub, initiated pedestrianisation projects in 2005, focusing on the historic peninsula, '*Tarihi Yarımada'*. Led by Istanbul Metropolitan Municipality and Fatih Municipality, with key contributions from the Transportation Coordination Centre (UKOME), EMBARQ Türkiye, Mimar Sinan Fine Arts University, and Gehl Architects, the project involved comprehensive analyses of land use, pedestrian movement, and transportation, which are explained below.

While pedestrianisation efforts continued, the city also developed a Sustainable Urban Mobility Plan (SUMP) in 2022. This plan aims to enhance the quality of life by transitioning from a car-centric to a people-oriented transportation system.



Figure 7. Focal points of SUMP, Istanbul.
Source: Erdil, 2022.

4.2.1 Spatial framework of the project area

Istanbul's Historic Peninsula (Fig. 7) is a UNESCO World Heritage site representing a rich combination of civilisations. As the former focal point of the Roman, Byzantine, and Ottoman empires, it now confronts the complexities of contemporary urban life. The area's historical significance, combined with its role as a vibrant commercial and cultural centre, has made it a focal point for urban planning and development challenges.

[2] 41% are made by foot, 16% by private vehicles, 15% by company/school buses and 28% by public transport during peak hours (EU Urban Mobility Observatory, 2022).

The Historic Peninsula has been the subject of urban planning since the early years of the Republic. The Elgötz plan of 1933 was the first effort in the subject, but it remained unrealised. Between 1936 and 1951, Professor Henri Prost focused on beautifying the city, laying the groundwork for the peninsula's conservation. However, rapid urbanisation, industrialisation, and immigration in the 1950s and 1960s dramatically altered the peninsula's character. Zoning policies introduced under Prime Minister Adnan Menderes, along with population growth, had caused severe damage to the historic urban fabric. The once predominantly residential area transformed into a commercial hub as housing turned into workshops and shops. This shift, combined with the emergence of new commercial centres outside the peninsula, led to a decline in residents and a reorientation towards tourism, commerce, and cultural activities (Istanbul Site Management Directorate, 2011).

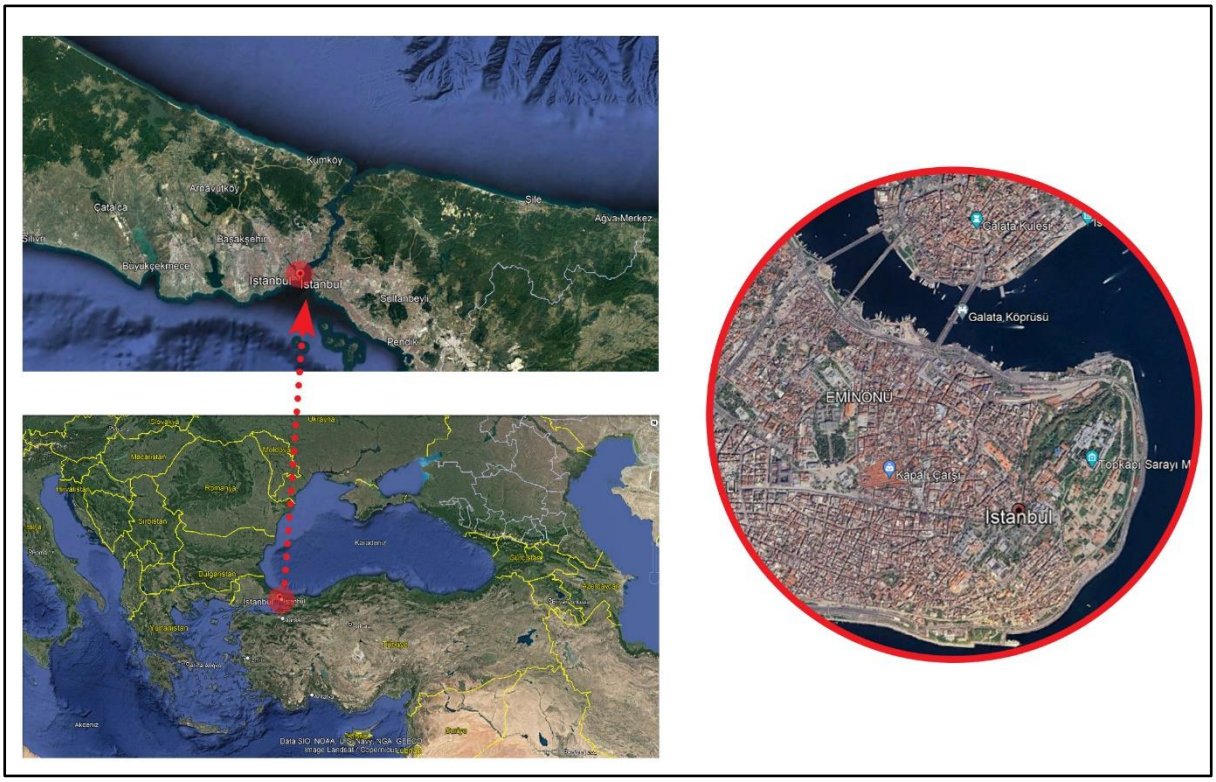


Figure 8. Istanbul Historical Peninsula, Türkiye.
Source: Google Maps, 2024.

Given the importance of preserving the historic character of the peninsula, a series of regulatory plans have been developed since the 1980s to address the challenges of urbanisation while safeguarding its cultural heritage. These plans have focused on limiting traffic, expanding pedestrian spaces, and restoring key historical landmarks to maintain the area's unique identity. In 1985, four areas within the peninsula were inscribed on the UNESCO World Heritage List, a recognition of their exceptional universal value. These areas showcase remarkable Byzantine and Ottoman architecture, along with urban planning that reflects the historical significance and cultural richness of the region.

The Historic Peninsula also hosts a vibrant commercial core, historically known as Eminönü and the Grand Bazaar. These areas have long served as bustling hubs for wholesale and retail trade, contributing to the economic vitality of the city. In addition, the peninsula is home to prestigious universities, which draw in a substantial student population. However, despite the presence of these academic institutions, there is a lack of integration between the universities and the surrounding neighbourhoods, which limits the sense of connection between students and the local community. As a result, relatively few students opt to live within the Historic Peninsula, which diminishes its potential to cultivate a dynamic and youthful atmosphere that could further enrich the area's cultural and social fabric. This disconnection highlights the need for more inclusive planning strategies to bridge the gap between education and urban life, fostering a more vibrant, interconnected urban environment.

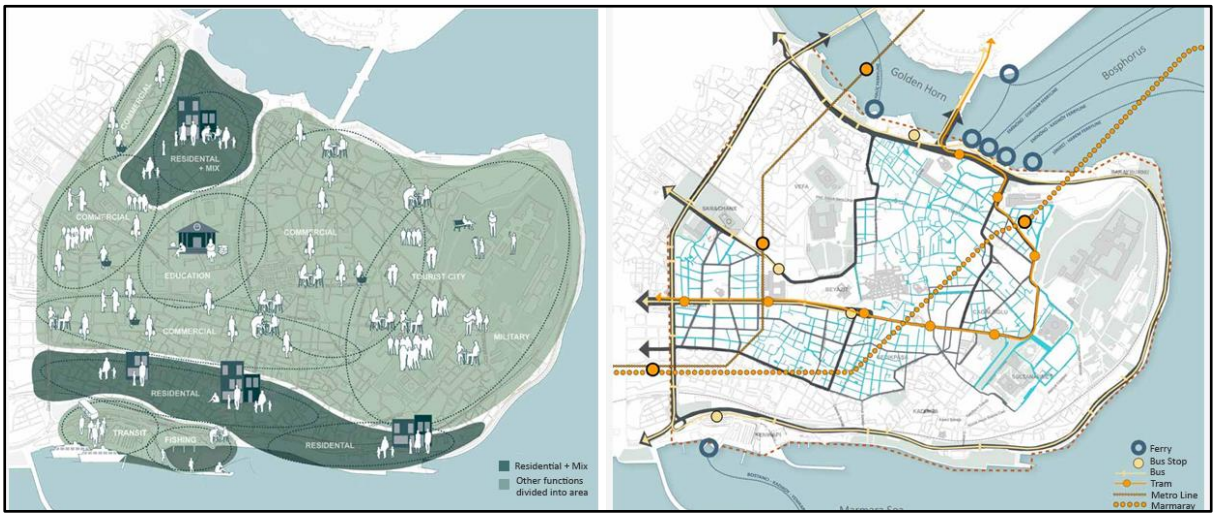


Figure 9. Distribution of land use in the Historic Peninsula (left), Transportation connections in the Historic Peninsula (right). Source: Çörek Öztaş & Akı, 2014.

Laleli, an important neighbourhood of the Historical Peninsula, has undergone a dramatic transformation in recent years, evolving from a residential area into a major commercial hub. Driven primarily by demand from former Soviet Union countries, the district has become the region's largest export centre. This surge in trade has accelerated redevelopment, with residential buildings replaced by multi-story commercial complexes.

On the other hand, the peninsula's commercial success and educational institutions attract a high volume of traffic. Eminönü serves as a crucial transportation hub, connecting land, sea, and rail networks. However, the peninsula faces increasing pressure from Istanbul's overall car-dependency. Traffic congestion, particularly along the coastline and surrounding areas, coupled with a lack of parking, creates significant challenges. The T1 tram line offers some relief, but the area's transportation system requires further improvement.

Recent infrastructure projects, such as the Marmaray and the Taksim-Yenikapı subway line, have enhanced accessibility. These developments, combined with improved pedestrian spaces, are essential for creating a more sustainable and people-oriented urban environment.

4.2.2 Pedestrianisation process

Since 2005, the Istanbul Metropolitan Municipality has initiated a series of pedestrianisation projects aimed at enhancing the quality of life within the Historic Peninsula. The driving force behind these efforts is UKOME, a governing body established under the Metropolitan Law of 2004 to oversee transportation and traffic matters within the city.

To mitigate the negative impacts of vehicular traffic on tourism and commerce in the Historic Peninsula, UKOME has implemented several regulations aimed at encouraging and supporting pedestrian-friendly spaces. In 2010, the "Istanbul's Common Living Areas and Social Life" report, prepared by EMBARQ Türkiye and Gehl Architects, conducted an in-depth examination of the social dynamics within the region's historical peninsula. The study specifically focused on factors such as security perception, user satisfaction, and economic activity, mapping existing issues and opportunities to improve the area. A representative sample of streets, roads, squares, and parks was analysed to assess the urban quality and the relationship between everyday living spaces, vehicle traffic, and pedestrian movement. Central to the study was the idea of human-centred planning, aiming to determine the current state of social life and explore ways to enhance liveability and social interaction in the region.

The findings from this report led to significant urban changes, with 295 streets across the districts of Eminönü, Tahtakale, Beyazıt, Laleli, Gedikpaşa, and Hocapaşa being transformed into pedestrian zones. Along with this transformation, key infrastructure improvements were implemented, including adjustments to traffic signals, the installation of granite paving, and the enhancement of waste management systems. These measures aim to create a more walkable and enjoyable environment, not only for tourists but for residents and local businesses as well.

To regulate the use of these newly pedestrianised areas, several guidelines have been established to ensure that the areas remain accessible and functional for all users. During the daytime, from 10:00 AM to 6:00 PM, streets are exclusively accessible to pedestrians, with vehicular traffic being restricted during these hours. However, only official vehicles, including those belonging to embassies, police, postal services, banks, fire departments, and ambulances, are allowed entry during this period. Commercial vehicles, on the other hand, are permitted to load and unload, but only outside of the restricted 10:00 AM to 6:00 PM timeframe. Additionally, certain streets have been designated as no-vendor zones to maintain the flow of pedestrians and ensure the area remains orderly.

Enforcement of these regulations is carried out by the Fatih Municipality police, ensuring that the guidelines are upheld effectively. Furthermore, tourist buses operate on designated routes and stops as determined by UKOME, helping to manage traffic and ensure that the movement of visitors does not disrupt the pedestrian experience. These coordinated efforts demonstrate a commitment to enhancing the urban environment of the Historic Peninsula, balancing the needs of residents, businesses, and tourists while preserving its unique cultural and historical significance.

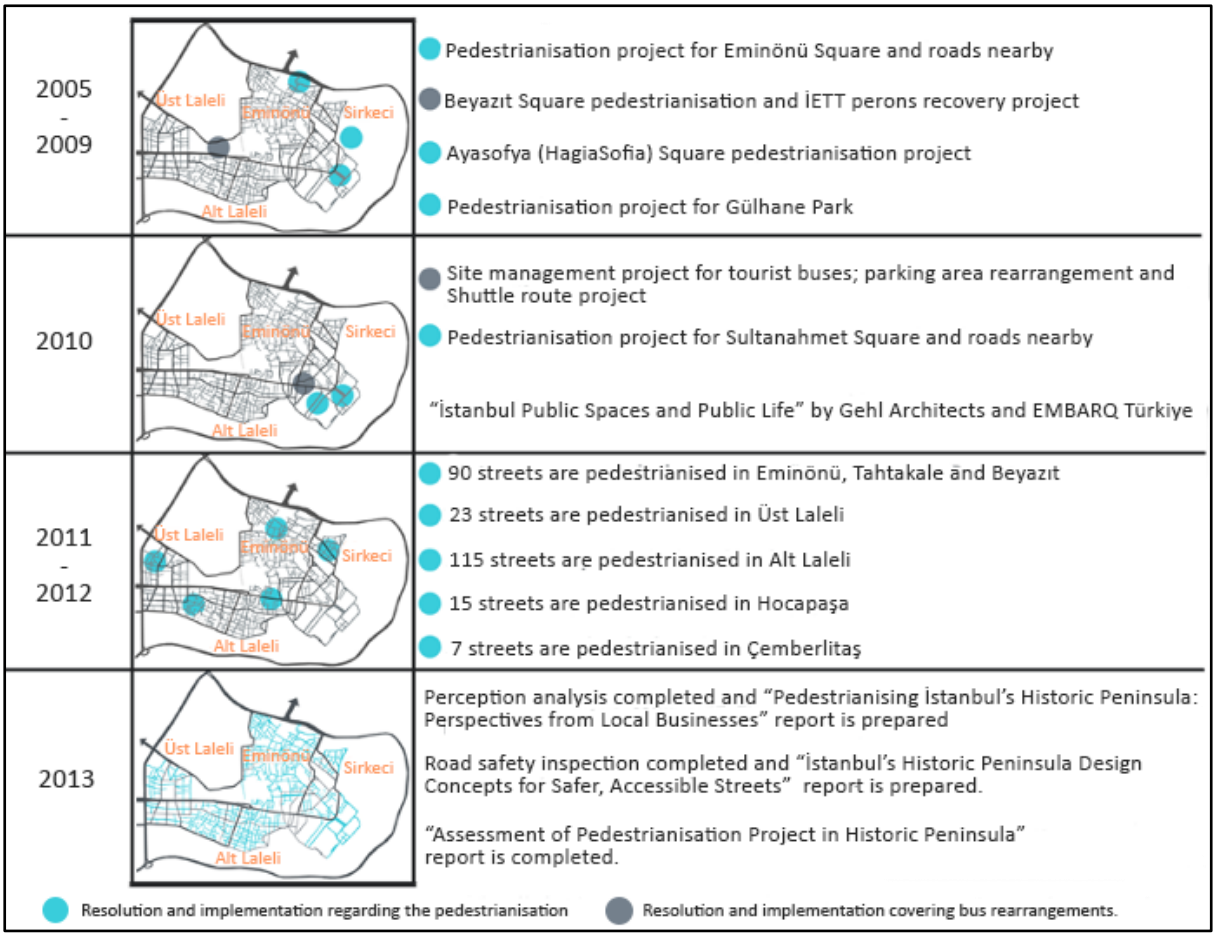


Figure 10. Pedestrianisation progress between 2005 – 2013.
Source: Çörek Öztaş & Akı, 2014.

4.2.3 Results and monitoring of the project

A comprehensive evaluation phase followed project completion to assess the implementation's outcomes. This process involved both quantitative and qualitative methods, including analysis of physical changes within the area and gathering feedback from students, shop owners, and residents.

Demographic and economic characteristics

The residents' survey has respondents of 53% female, 47% male, and 4% with mobility disabilities. The students' survey, on the other hand, has 45% female and 55% male respondents, while 1% with mobility impairments.

Among the business owners surveyed, the vast majority were male (94%), with the largest age group being 31–40 years old (35%), followed by 41–50 (27%) and 20–31 (25%). Educational attainment levels among this group were notably lower than the general population, with 55% having completed only middle school or less. Economically, most of the business owners were tenants rather than landlords. The predominant sectors of employment were retail and wholesale trade, followed by food, beverage, and accommodation services.

Perceptions of pedestrianisation: commercial impacts and street vending

The commercial impact of pedestrianisation received mixed evaluations. Regarding delivery and collection logistics, 50% of business owners reported benefits, while 37% expressed dissatisfaction, indicating a nearly even split in perception. A more unified concern emerged regarding the proliferation of street vendors after the intervention. A substantial majority (77%) of business owners expressed dissatisfaction with the increase in street vending activity, and 53% reported having observed a noticeable rise in the number of street vendors. Respondents suggested various regulatory solutions, including stricter municipal controls, vendor rent schemes, or the establishment of designated vending zones.

Mobility patterns and accessibility

Mobility behaviour was analysed through survey responses from residents, students, and employees to understand how the pedestrianisation project influenced transportation choices and accessibility. Public transport modes, such as railways and ferries, emerged as the most used across all groups. For students, buses were the primary transport mode, while private car usage remained minimal (4%). Employees and business owners predominantly relied on public transportation (63%), with personal vehicles being the second-most common choice.

Car parking was identified as a persistent challenge for those using private vehicles, due to both limited availability and high parking costs, which collectively discouraged car use in the area. Although current levels of bicycle usage were low, there was notable interest in improved cycling infrastructure, indicating latent demand.

Accessibility and walking distances post-pedestrianisation

Perceptions of pedestrian accessibility varied. Among residents, 55% indicated that walking conditions were comfortable in the area. Regarding walking distances, most students reported short travel times between public transport stations and their university: 37% walked for 2–5 minutes, and 35% for 6–10 minutes. Similarly, 76% of employees and business owners indicated that pedestrianisation had not increased their walking distances. More generally, of all public transport users accessing the Historic Peninsula, 13% walked for less than a minute, 40% for 2–5 minutes, 32% for 6–10 minutes, and 9% for 11–15 minutes.

Broader urban impacts

While pedestrianisation improved conditions within the Historic Peninsula, it also generated new mobility challenges in adjacent areas. Increased traffic congestion was reported in the surrounding "buffer zones," especially at intersections where pedestrianised streets meet major vehicular roads. These shifts highlight the importance of integrating pedestrianisation efforts with broader mobility and traffic management strategies.

To mitigate these issues, careful planning of buffer zones is essential. These areas should be designed to facilitate a smooth transition between the pedestrianised area and the rest of the city, while ensuring pedestrian safety. Furthermore, the concentration of pedestrian activity within buffer zones, particularly along the T1 tram line, highlights the need for effective traffic management strategies in these areas.

The perceived benefits of the projects were asked to people, primarily focused on improved quality of life and urban environment. Increased safety was the most commonly cited benefit across all survey groups. Enhanced visual quality and improvements in street aesthetics were widely observed. Pedestrianisation was seen as enhancing the appeal of the area's heritage in terms of the strengthened attraction of historical buildings. An increase in pedestrian-friendly spaces was noted as an expected result of the project.

On the other hand, street lighting, traffic signalisation and mass transportation were often perceived as stable or worsened.

Overall, while the pedestrianisation project has brought about positive changes to the Historic Peninsula, addressing issues related to public transportation, street lighting, and signage is essential for maximising its benefits.



Figure 11. An example street from the project, before (left) and after (right).
Source: Tekir, 2013.

Due to the short implementation period of the project, certain problem areas have emerged. However, mostly these problems can be eliminated with feedback and public participation. Additionally, recent initiatives, such as the Laleli Project within IMM's broader SUMP, have created a continuum to the area's pedestrianisation efforts.

4.3 Pedestrians and cyclists of the Ciclovía Bogotana project, Colombia

Bogotá, Colombia's densely populated capital, shares the urban challenges of many large cities: insufficient public spaces and safety concerns. Rapid population growth, surpassing 7.5 million residents, has contributed to uneven development and urban sprawl, negatively impacting daily life for its citizens. To address these issues and promote equitable access to urban opportunities and services, Bogotá must re-evaluate its street infrastructure and transportation systems (Global Designing Cities Initiative, 2016). As in many other cities in the world, the COVID-19 pandemic has led Bogotá to re-evaluate its transportation strategy, shifting its focus towards more sustainable, equitable and resilient mobility solutions. With a huge portion of its population reliant on private vehicles and persistent traffic congestion, the city recognised an urgent need to prioritise public transit, cycling, and pedestrian infrastructure.

As the recipient of the 2022 Sustainable Transport Award, Bogotá has secured its position as a global leader in urban mobility innovation. The city's commitment to improving mobility for children, students, and families underscores its dedication to creating a more inclusive and child-friendly urban environment. By addressing road safety concerns and expanding cycling and electric bus networks, Bogotá is taking proactive steps to reduce traffic congestion, improve air quality, and enhance public health (Ramírez & Calderón, 2022).

These initiatives align with broader sustainable development goals and demonstrate the city's ability to adapt to emerging challenges while building a more resilient and equitable future. Bogotá's experience offers valuable insights for other cities seeking to transform their transportation systems and create more liveable urban spaces.

Many of Bogotá's public space revitalisation efforts are grassroots initiatives driven by community engagement, often characterised as tactical urbanism. Ciclovía is one of the most important examples of 'reclaiming the streets for people' in Bogotá. Every Sunday, numerous major roads in Bogotá are closed to cars, creating a car-free zone for cyclists, pedestrians, and skaters.

4.3.1 Spatial framework of the project area

The metropolitan area of Bogota has 11.658.000 inhabitants with a 1.3% increase from 2023 (Macrotrends, 2024). The city is situated on a high-altitude plateau within the Eastern Cordillera of the Andes Mountains. This elevated basin, known as the Bogotá Savannah, is part of the Altiplano Cundiboyacense. At 2,640 meters above sea level, it is one of South America's highest capital cities, surpassed only by La Paz and Quito. The capital has one of the highest traffic congestion rates in the world, according to the Global Traffic Scorecard study by Inrix (Rigitano, 2019).

Bogota is one of the cities with the highest presence of smog, due to its geographical position, but it is also one of the capitals of cycling mobility, thanks to the Ciclovía project. La Ciclovía runs through most of Bogotá's 20 districts, including the historic district of La Candelaria.

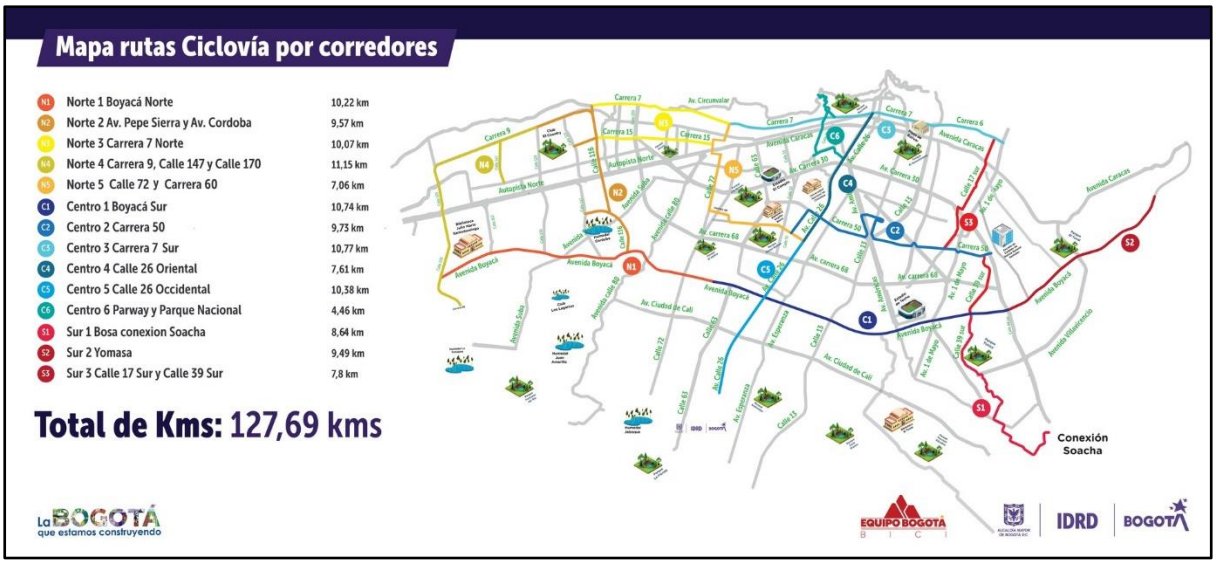


Figure 12. Cycleway Map of Bogota.
Source: (District Institute of Recreation and Sports - IDRD, n.d)

In total, Ciclovía is along the main roads of the city, which are interconnected in a circuit of 127.69 kilometres in length, of which 7.05 kilometres are cycle paths.

4.3.2 Pedestrianisation process

Ciclovía, Bogotá's iconic car-free event, emerged from a grassroots movement in the 1970s. In response to growing car dependency and the decline of public spaces, a group of citizens organised a "Great Pedal Demonstration" in 1974, temporarily reclaiming city streets for cyclists and pedestrians. The success of this initial event catalysed the creation of a permanent car-free initiative.



Figure 13. Inauguration of the Ciclovía 1976.
Source: Martin G., 2016.

Initially managed by the city's transit department, Ciclovía expanded in scope and impact under the leadership of the District Institute of Recreation and Sports (IDRD) in the 1990s. This transition marked an important moment, as the focus shifted from mere traffic management to creating a vibrant public space that promoted health, recreation, and social interaction. Through strategic planning and implementation, IDRD transformed Ciclovía into a beloved city tradition. The event expanded, infrastructure improved, and programming diversified to host a wider audience.

Today, the initiative spans 127 kilometres of city streets and attracts an average of 1.5 million participants weekly. Currently, every Sunday, between 7 am and 2 pm, many of the biggest roads are shut to cars and left open to pedestrians, cyclists, and skaters. Beyond simply providing space for physical activity and active mobility, Ciclovía is a vibrant public event that fosters community, health, and well-being. With aerobics classes, fresh juice vendors, and a lively atmosphere, the streets come alive as a public space for everyone for social interaction, relaxation, and urban experience.



Figure 14. The third annual Ciclovia Salinas, where a long section of Alisal Street was closed to motor traffic for four hours, allowing hundreds of citizens to enjoy a car-free day.
Source: Mitchell, 2016.

4.3.3 Results and monitoring of the project

Bogotá's Ciclovía, a weekly car-free event, has emerged as a global model for sustainable urban development. It has been replicated in other Colombian cities and worldwide, inspiring similar initiatives in cities like Buenos Aires, Bengaluru, San Francisco, Tokyo, and Kyiv (Rigitano, 2019). Originating as a grassroots movement in the 1970s, it has evolved into a cornerstone of the city's identity.

By reclaiming streets for pedestrians, cyclists, and skaters, Ciclovía has significantly improved quality of life, public health, and environmental sustainability. Ciclovía significantly improves air and noise quality. On typical weekdays, Bogotá's air pollution levels, particularly PM 2.5 particulates, are dangerously high, reaching 65 µg/m³. However, during Ciclovía, these levels plummet to 5 µg/m³, well below the World Health Organisation's recommended limits. Noise pollution also decreases by 75%.

Thanks to the project, the use of bicycles, walking, running, and skating was promoted in different classes of society. Advertising campaigns were created in various media for this promotion. The initiative has contributed to a dramatic reduction in traffic congestion, air pollution, and noise levels. Additionally, Ciclovía has created a keen sense of community, promoting social interaction and physical activity. Studies have shown that regular participation in Ciclovía encourages increased bicycle use, particularly among women. The event has also played a crucial role in shaping Bogotá's urban landscape, with the city investing in expanded bike lane infrastructure to accommodate growing demand. The popularity of Ciclovía has promoted the expansion of Bogotá's bike lane network to approximately 600 kilometres (Taylor, 2024).

Gil Peñalosa, a city planner in Canada who promoted the expansion of Ciclovía when he was Bogotá's commissioner of parks and recreation in the 1990s, claims that "People suddenly realise their city is smaller than they think it is, so as soon as good cycle lanes are offered, people take them up." This is one of the most important effects of Ciclovías on the public's approach to active mobility.

Ciclovía's success highlights the transformative impact of prioritising people over cars. By creating vibrant, car-free spaces, cities can significantly enhance public health, improve air quality, and foster a stronger sense of community. These events have proven to be an effective way to reclaim public space, offering residents an opportunity to engage in physical activity, socialise, and experience the city from a different perspective, free from the usual dominance of vehicular traffic.

However, Ciclovía has not been without its critics. Some business owners have voiced concerns about potential revenue losses during the event, as the closure of streets may affect customer access to shops and services. Additionally, drivers often express frustration over traffic disruptions, particularly on Sundays when Ciclovía takes place. Despite these criticisms, the dedicated support and active participation of the public have largely mitigated such concerns. Approximately one-quarter of Bogotá's population participates in Ciclovía each week, showcasing the widespread appreciation for this initiative (Dunnell, 2019).

Ultimately, Ciclovías are not only a means of encouraging walkability and cycling as viable modes of transport in cities worldwide, but they also serve as a powerful tool for improving the overall quality of life. By creating inclusive, free, and accessible public spaces, Ciclovías foster a deep sense of community, increase opportunities for social interaction, reduce social divisions, and transform the way urban spaces are used. The positive impact of these events extends far beyond transportation, contributing to the development of healthier, more connected, and liveable cities.

4.4 Strøget district in Copenhagen, Denmark

In October 1962, the Copenhagen City Council made the historic decision to transform a major district, stretching from Frederiksberggade to Østergade, into a pedestrian-only street, which was inspired by the vision of architect and planner Jan Gehl. This pilot project, known as "Strøget," was initially implemented as a two-year trial (Copenhagen Portal, 2012).

The success of the trial period, marked by cleaner air and increased pedestrian satisfaction, led the city council to permanently pedestrianise Strøget in February 1964. This innovative initiative established Strøget as the world's first and longest pedestrian street, paving the way for similar projects in cities around the globe.

Today, the Strøget District in Copenhagen stands as a global model for successful pedestrianisation. This network of pedestrian streets, reclaimed from car traffic, has transformed the city centre and revitalised public spaces. Despite initial scepticism from car-oriented residents, the pedestrianised streets quickly gained popularity among Copenhagers of all ages.

Gehl's approach emphasised a gradual transition, recognising that significant changes can meet with resistance. By implementing incremental improvements over time, Copenhagen successfully integrated pedestrianisation into the city's fabric. This phased approach has proven effective in fostering acceptance and long-term sustainability (Project for Public Spaces, 2005).



Figure 15. Pedestrians in the Strøget District (left), public space used daily in the Strøget District (right).
Source: Project for Public Spaces, 2005.

4.4.1 Spatial framework of the project area

Copenhagen is the capital and the most populated city of Denmark, with a population of 659.352 (City of Copenhagen, 2025). The city has experienced a remarkable period of urban and cultural development since the early 2000s. Promoted by strategic investments in infrastructure and institutions, the city has gained its position as Denmark’s economic, cultural, and governmental centre. As a leading financial hub in Northern Europe, Copenhagen boasts a thriving economy, particularly in the service sector. The city has made significant upgrades in information technology, pharmaceuticals, and clean technology, driving innovation and economic growth.

Strøget, a vibrant pedestrian shopping district in Copenhagen's city centre, is a renowned tourist attraction and a symbol of the city's commitment to urban revitalisation. This 1.1-kilometre-long pedestrian zone is located between City Hall Square and Kongens Nytorv, encompassing several interconnected streets. The creation of Strøget dates back to 1962 when a section of the city centre was closed to traffic. This bold experiment, inspired by post-war German initiatives, faced initial doubt but quickly gained popularity among Copenhagen residents. Over the years, Strøget has expanded, incorporating additional streets and squares. This gradual approach has facilitated public acceptance and ensured the long-term sustainability of the project.



Figure 16. Copenhagen cityscape.
Source: Shi, 2022.



Figure 17. Strøget District before and after the pedestrianisation.
Source: Global Designing Cities Initiative, n.d.

Strøget is a vibrant pedestrian street, attracting thousands of visitors daily (The Ottawa Citizen, 2008). The area comprises a diverse range of shops, including high-end brands, souvenir shops and more. Numerous cafes and restaurants are located on the street, offering dining options for different age groups. The district is also well-connected to Copenhagen's public transportation network. Several bus lines stop near the area, and Kongens Nytorv is a major metro station. Additionally, the nearby Nørreport station provides access to the S-train network.

Strøget's success as a pedestrian zone has inspired cities worldwide to adopt similar initiatives. By prioritising pedestrians and creating a vibrant urban environment, Copenhagen has demonstrated the positive impact of pedestrianisation on city centres.

4.4.2 Pedestrianisation process

Before 1962, Copenhagen's city centre was heavily congested with vehicular traffic, and parking spaces were in high demand as the number of private vehicles rapidly increased. In 1962, Copenhagen embarked on a groundbreaking experiment by transforming its main district, Strøget, into a pedestrian-only street.

This decision sparked intense public debate, with many expressing doubts about the feasibility and desirability of such a radical change (Global Designing Cities Initiative, n.d.). Critics argued that the city was not accustomed to a pedestrian-oriented culture and that the loss of car traffic would harm businesses. Danish people believed that Copenhagen was not compatible with such an idea due to its cold and rainy climate. Opponents of the pedestrianisation project argued that it was incompatible with Danish culture, suggesting that Danes lacked the outdoor social habits associated with Mediterranean cities. Critics contended that Copenhagen's residents were not accustomed to the leisurely pace of life and public interaction commonly found in southern European urban environments, and the slogan was “We are not Italians!” (Gemzøe, 2013).

Especially in the 60s, pedestrian-only zones were not popular when cars were having their golden age. However, the project's proponents were determined to create a more vibrant and people-friendly urban environment. Thus, the pedestrianisation of Strøget, Copenhagen's historic main street, marked a significant turning point in the city's urban development. The experiment quickly proved to be a popular and successful initiative. The area became a bustling hub of activity, attracting more visitors, shoppers, and residents. Businesses thrived, and the overall quality of life in the city centre improved.

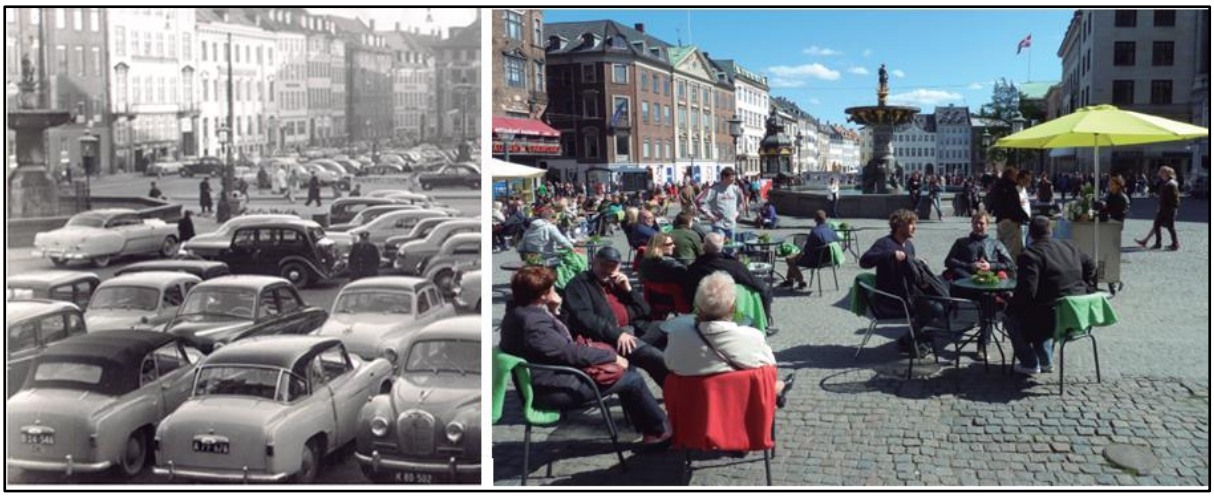


Figure 18. Gammeltorv-Nytorv before 1962 (left), Gammeltorv-Nytorv today (right).
Source: The City Engineers' Office of Copenhagen.

The key elements of the experiments were the removal of all traffic from the street, the removal of kerbs and pavements, the addition of new paving, and the consolidation of street furniture to facilitate pedestrian movement.

In 1968, Professor Jan Gehl and his team, mostly from the School of Architecture in Copenhagen, conducted pioneering research in Copenhagen to understand the impact of pedestrianisation on urban life. Through detailed observations and data collection, they studied how people used public spaces and the changes that occurred after the removal of cars.

The research revealed a dramatic shift in public behaviour. The city centre, once dominated by shopping and limited outdoor activities, has transformed into a vibrant hub for socialising, cultural events, and recreation. The number of people spending time in these spaces increased significantly, demonstrating the public's appreciation for pedestrian-friendly environments.

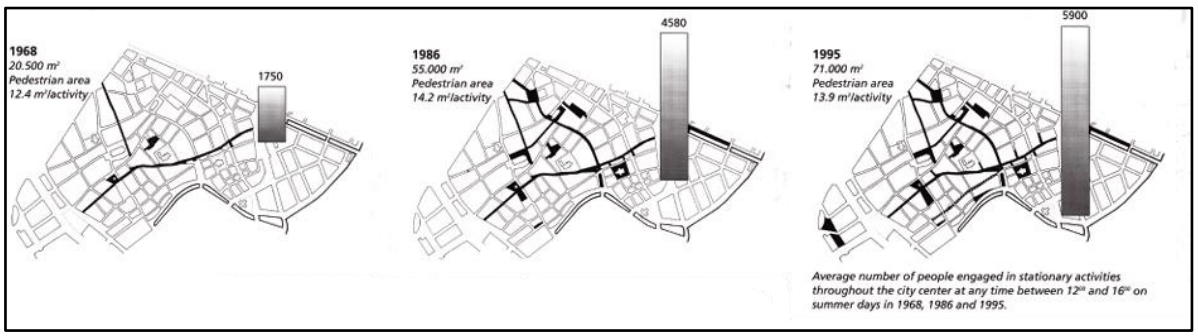


Figure 19. The city delivered almost four times more car-free spaces from 1968 to 1996, and the result was almost four times more activity.
Source: Public Space - Public Life, Copenhagen 1996, Jan Gehl & Lars Gemzøe, Danish Architectural Press.

Gehl's research methodology involved a combination of field observations and data analysis. By carefully documenting the activities of pedestrians, the researchers gained valuable insights into the ways people use public spaces and the factors that influence their behaviour. The findings from Gehl's studies have been influential worldwide, inspiring cities to adopt similar pedestrianisation strategies. The data collected has provided valuable information for urban planners, architects, and policymakers, supporting evidence-based decision-making and the creation of more people-centred cities.

4.4.3 Results and Monitoring of the Project

Today, the Strøget district is a global model for pedestrianisation and reclaiming space from cars for people and public use. There have been lessons learned from this example, which took place more than 50 years ago.

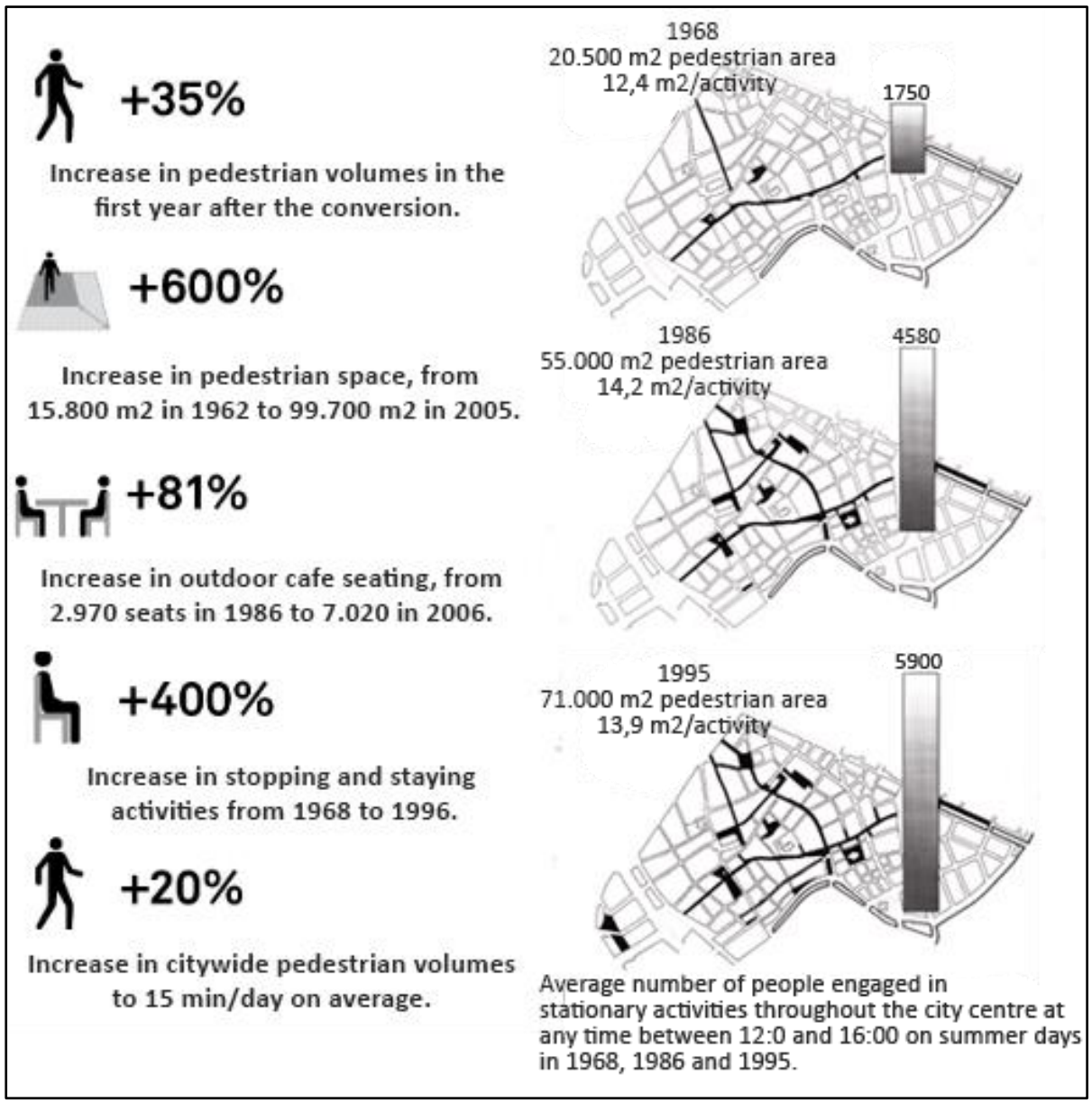


Figure 20. The changes in numbers throughout the year in the district.
Source: Global Designing Cities Initiative, n.d.

First, the studies of Gehl and his researchers played a pivotal role in informing urban planning decisions in Copenhagen. The findings were spread through scientific publications and books, reaching a wide audience of policymakers, planners, architects and even citizens. The research methods developed by Gehl and his team have been adopted by cities worldwide.

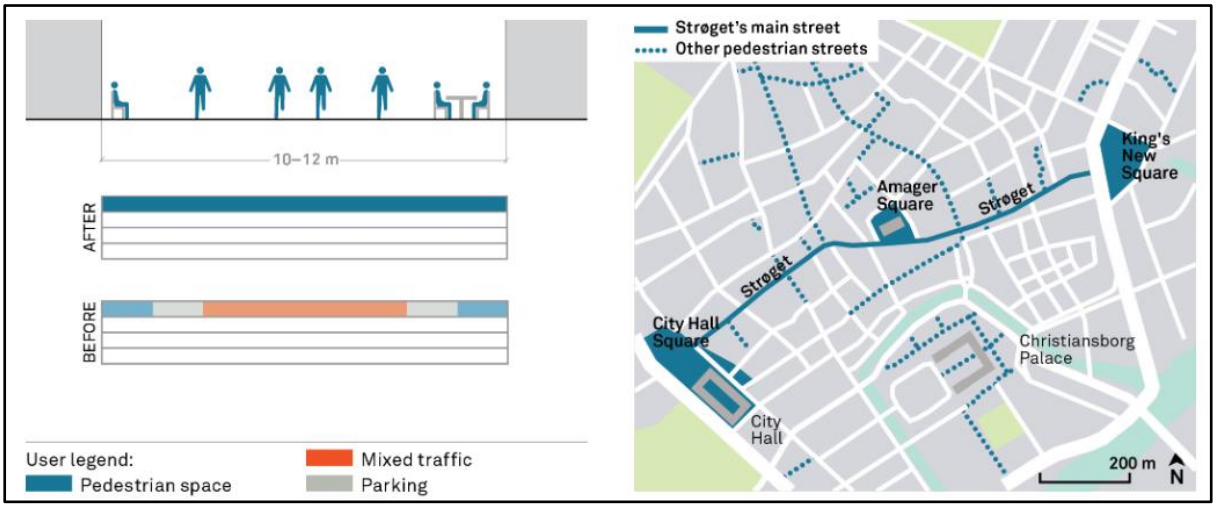


Figure 21. The change in streetscape in Strøget before and after the pedestrianisation (left), the localisation of the pedestrian area in the district (right).
Source: Global Designing Cities Initiative, n.d.

The Gehl Architects study highlights key findings from the pedestrianisation of Strøget, showing a clear increase in pedestrian activity and public demand for such spaces. This transformation has not only encouraged a wider range of activities but also created a stronger sense of community and improved quality of life. Additionally, it has boosted the local economy by attracting more businesses and visitors, reinforcing the value of pedestrian-friendly environments in creating vibrant and sustainable urban centres.

One of the biggest takeaways from Strøget is that concerns about pedestrianisation harming businesses are inaccurate/unjustified. On the contrary, pedestrian activity benefits local commerce. The study also emphasises the importance of data-driven urban planning and how high-quality public spaces can transform city life. Copenhagen's experience underscores the role of walkable neighbourhoods in fostering community connections and improving public safety and quality of life, concepts central to modern urban planning approaches like the 15-minute city.

4.5 Piazze aperte & strade aperte of Milan, Italy

The *Piazze Aperte* (Open Squares) program (2018), a collaborative initiative between the City of Milan, Agenzia Mobilità Ambiente Territorio (AMAT), Bloomberg Associates, and the Global Designing Cities Initiative, seeks to revitalise public spaces and promote sustainable urban development, expand pedestrian areas, and enhance the quality of life by creating a sense of community in neighbourhoods of Milan.

Piazze Aperte uses a tactical urban planning approach, characterised by experimental and temporary interventions, which brings flexibility in design and implementation processes. Another important benefit of tactical urbanism is the possibility of gathering feedback for adjustments as needed because of its temporary nature.

Since the beginning, the program has successfully transformed over 28.000 $^{m2\ of}$ public spaces. Through the installation of new street furniture, such as benches, bike parking, and outdoor dining areas, these spaces have become more inviting and accessible to residents and visitors (Comune di Milano, 2020).

Piazze Aperte has also encouraged community engagement and participation. It empowered residents to actively contribute to the design, development, and preservation of their public spaces, which is also promoted by tactical urbanism.

After its success, the program has inspired the City of Milan to expand the implications, and the city launched a call for proposals, inviting residents to suggest new public spaces for transformation. This participatory approach has helped to identify additional opportunities for finding new public spaces and understanding the needs of locals (Comune di Milano, 2020).

These interventions have not only enhanced the aesthetic appeal of Milan's public spaces but have also created more inviting and accessible environments for residents and visitors. By prioritising pedestrianisation and sustainable mobility, Piazze Aperte contributes to a more liveable and sustainable city.

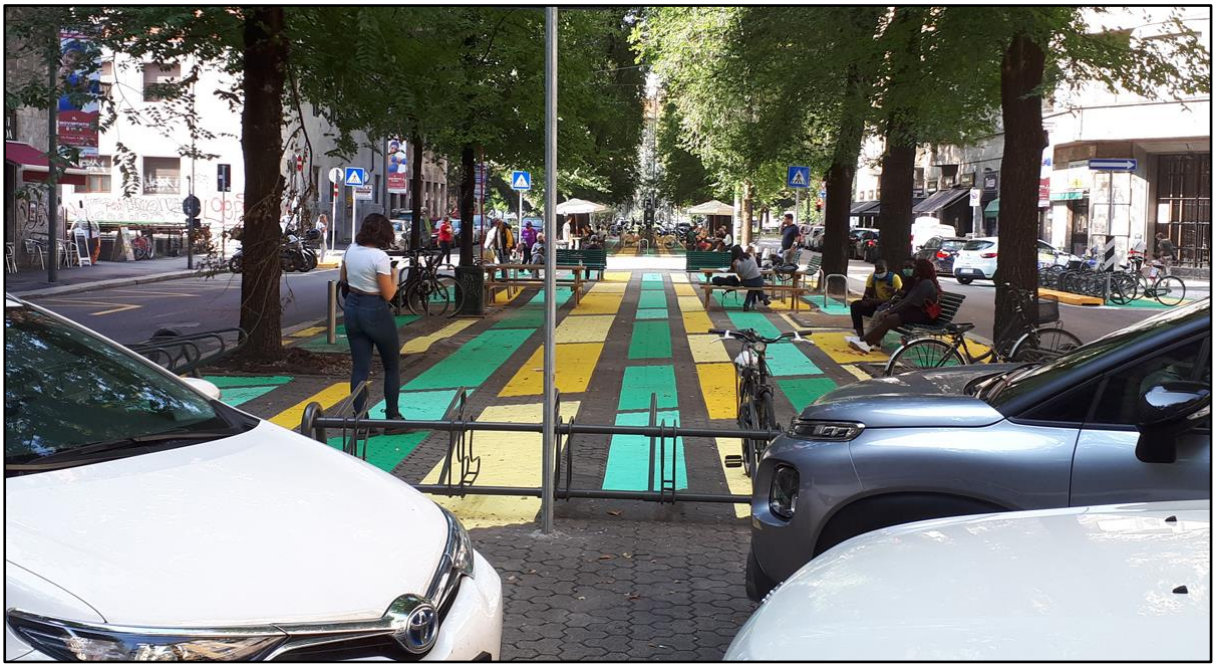


Figure 22. Via Pacini, an example of 'Piazza Aperta'.
Source: BG/Sport & Impianti, 2021.

4.5.1 Spatial framework of the project area

Milan is the second most populated city in Italy after Rome, with its 1.371.850 inhabitants and is the capital of the Lombardy region. The metropolitan city of Milan is one of the most populated metropolitan areas in all of Europe, with 3.160.631 inhabitants (World Population Review, 2024).

Located in Northern Italy, Milan is a major transportation hub. As a junction point on the east-west Po Valley transversal connecting Turin and Trieste, the city serves as a crucial node for road and motorway traffic. Milan is also a significant railway centre, with connections to other major Italian cities such as Turin, Venice, Genoa, and Bologna. Additionally, the city has three international airports, strengthening its position as a transportation hub.

On the other hand, the city's reputation as a centre for fashion, design, and business has made it a desirable destination for young people and entrepreneurs seeking personal and professional growth in the last decades. However, the popularity of Milan for people searching for economic opportunities is not something new. Between 1951 and 1971, the city experienced a substantial influx of residents, with over 450,000 new inhabitants settling in Milan and its surrounding areas (Barra, n.d.) because of its advanced industrial development. This population growth caused significant housing problems in the city and its surroundings.

Today, there is an oversupply of newly constructed and overpriced housing that has made homeownership increasingly difficult for many residents, particularly for people with lower incomes. There is also an excessive urban sprawl associated with housing development, which has raised concerns about environmental sustainability (Sartori, 2012).

From the urban development aspect, Milan has undergone a significant urban renewal, characterised by ambitious development projects aimed at revitalising entire neighbourhoods and enhancing the city's international image since the early 2000s. Notable projects include Bicocca, Fiera Milano, CityLife, and Porta Nuova, which have attracted renowned architects such as Renzo Piano, Norman Foster, César Pelli, Massimiliano Fuksas, Arata Isozaki, Daniel Libeskind, Zaha Hadid, and Ieoh Ming Pei. Lastly, the UniCredit Tower, a towering landmark completed in 2012, is a symbol of Milan's urban renewal. As part of the Porta Nuova Project, this skyscraper stands at 231 meters, making it the tallest building in Italy. (Dezza, 2018).

Apart from the development and revitalisation projects, there have been many different pioneering sustainable urban projects in Milan. The city has adopted a comprehensive approach integrating green spaces, pedestrian zones and cycling infrastructure by transforming formerly congested areas into public spaces and promoting a sense of community. The urban planning approach of Milan prioritises mixed-use developments, reducing commuting distances and aiming to increase the quality of life of its residents (Serna, 2023).

The city's extensive network of electric buses and trams has significantly reduced air pollution and carbon emissions, while the bike-sharing projects have encouraged cycling as a mode of transportation. There have been incentives for congestion pricing that discourage private vehicle use and promote public transportation instead.

4.5.2 Pedestrianisation process

The Piazze Aperte program originated in Dergano, a suburb of Milan, with a lack of vibrant public space. The city administration transformed Piazza Dergano into a community gathering place by using simple measures like paint, planters, and benches. Residents embraced the new space, demonstrating the potential for urban revitalisation through community engagement. Inspired by this success, Piazze Aperte expanded to other Milanese neighbourhoods, repurposing underutilised spaces and creating inviting environments to foster community and improve quality of life.

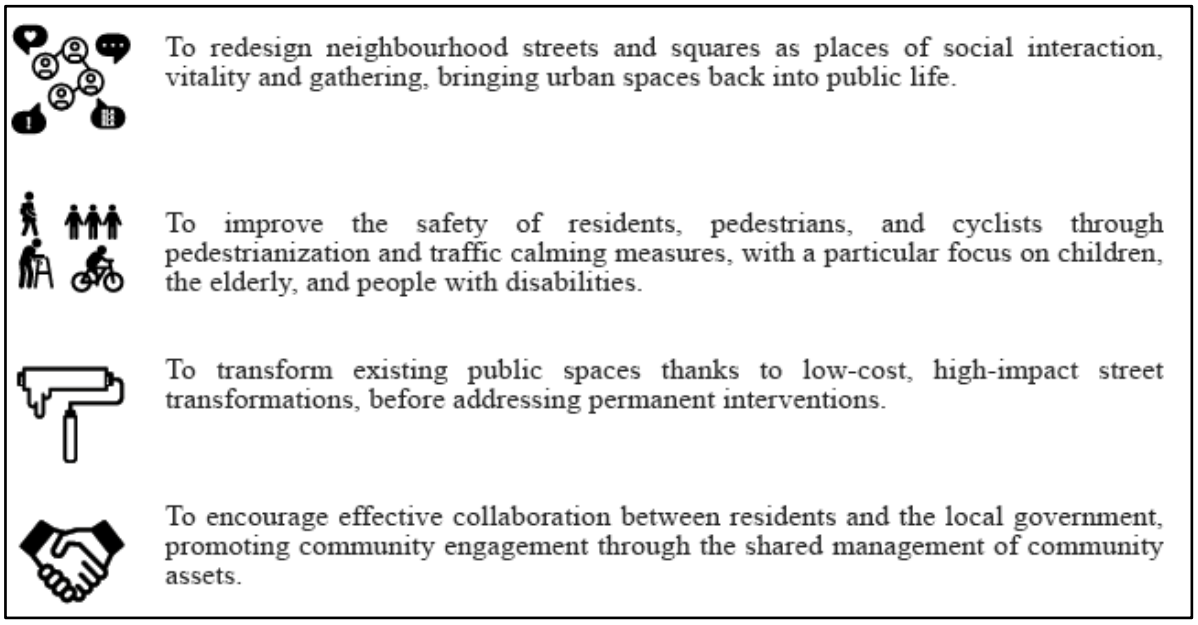


Figure 23. Aim of the Piazze Aperte Program of Milan.
Source: Comune di Milano, 2022.

There have been diverse types of interventions regarding different needs of spaces. One of them was the creation of new squares and pedestrian areas by changing the roadway network and street design, including limiting vehicular access to certain areas. This intervention is mostly used for creating safe and comfortable public spaces for residents.



Figure 24. Piazza Dergano before and after the interventions through Piazze Aperte.
Source: Comune di Milano, 2022.

Another type of intervention is the activation of underused and unequipped public spaces by furnishing, improving, and adding new functions to encourage community spirit and promoting cultural activities that add value and life to space.



Figure 25. Piazza Gaspari before and after the interventions.
Source: Comune di Milano, 2022.

The third intervention type is the creation of cycle lanes and improving cycling infrastructure in 30 km/h zones, one-way streets and areas identified in the Sustainable Urban Mobility Plan of Milan. This intervention aims to encourage people to cycle not only as a free-time activity but also as a mode of transport.



Figure 26. Infrastructure improvements were made for cyclists according to the Piazze Aperte Program.
Source: Comune di Milano, 2022.

Finally, the most important intervention regarding this research is the extension and enhancement of pedestrian areas by reducing car lanes, removing underused parking spaces, adopting traffic calming measures, creating more 30 km/h zones, and improving pedestrian crossings. All these interventions aim to improve the pedestrian experience by increasing their safety and comfort, which finally led to increased walkability through the city.



Figure 27. Via Pacini after the pedestrianisation and enhancement for public use.
Source: Comune di Milano, 2022.

The program aims to apply these interventions through community engagement and public participation. It encourages residents to participate in activities and events that promote social interaction with each other and the public space itself. This approach has been useful in promoting a sense of shared responsibility for the care and maintenance of public spaces. To create this collaborative environment, the program utilises a method named 'Collaboration Agreement', which is a written tool that the City of Milan and its active residents define the aims, objectives and expected results of the Piazze Aperte Program. Thus, it provides a framework for shared responsibility and ensures that the needs and priorities of the community are reflected in the design and programming of public spaces (Comune di Milano, 2022).

After the success of the Piazze Aperte Program, the COVID-19 pandemic presented a unique opportunity for Milan to continue and improve its sustainable mobility initiatives. In response to the crisis, the city launched the Strade Aperte program, a series of emergency cycling measures aligned with the SUMP. The sudden lockdown that has blocked all activities and the forced reduction of public transport use have led the city to accelerate what has already been started with the Piazze Aperte Program towards more sustainable mobility.

Milano 2020 – Strade Aperte's adaptation strategy aimed to restructure the daily travel demand in the city to decrease car dependency. It focused on enhancing and diversifying transportation options, expanding public transport and promoting sustainable modes like cycling, walking, and sharing.

To promote active mobility, the city implemented an "extraordinary plan" for new emergency bike routes. These routes connected various parts of the city and were integrated with traffic-calming measures to create safer and more liveable neighbourhoods. The new bike lanes were implemented quickly and efficiently using temporary signage, demonstrating the city's adaptability and commitment to sustainable transportation.

Despite creating 300 kilometres of bike paths, the dataset, shared by the municipality, reveals that these paths are frequently composed of short, individual sections, often only a few meters long. This fragmented nature can pose challenges for cyclists navigating the city. Although the challenges of implementing a fully integrated cycling network, Milan has witnessed a significant increase in cycling. The city's bike-sharing services, including BikeMi and private options like RideMovi and Lime, have played a crucial role in popularising cycling as a convenient and sustainable mode of transportation (Sport e Impianti, 2021).



Figure 28. Corso Buenos Aires (left), Via Lazzara Palazzi (right).
Source: BG/Sport & Impianti.

In addition to promoting cycling, the Strade Aperte programme also focused heavily on improving walkability as a key mode of transport. Walking is seen as the foundation of urban life, with pedestrian networks forming the core of neighbourhoods where people meet and spend time in their daily lives.

The programme used Milan's Territory Management Plan (PGT) to identify areas where pedestrian spaces could be improved. Measures such as traffic calming and better traffic control were introduced to make walking safer and more enjoyable. The main aim was to connect neighbourhoods, improve access to essential services, and create more outdoor spaces for activities, prioritising walking and other active modes of transport.

As part of broader efforts to transform Milan into a more sustainable and pedestrian-friendly city, the Città 30 initiative was launched to reduce speed limits on approximately 60% of urban roads, lowering them from 50 km/h to 30 km/h. This intervention is not merely regulatory but is embedded in a holistic urban mobility strategy that redefines the hierarchy and function of streets. Key measures include reclassifying roadways based on their intended function (e.g., access versus transit), reducing car traffic in residential and commercial zones, and establishing *isole ambientali* (environmental islands), where speed is reduced and priority is given to active modes of transport. Complementary actions involve enhanced speed enforcement, redesigning intersections and public spaces, and increasing greenery and street furniture, all of which align with the broader goals of improving perceived and actual safety for pedestrians and cyclists, as discussed in this thesis.

In parallel, the Strade Aperte (Open Streets) programme expands upon the logic of Piazze Aperte, moving from tactical interventions to a more systemic urban design approach inspired by the principles of the 15-minute city. While the 15-minute city model emphasises proximity to essential services, its success also hinges on safe and comfortable pedestrian environments. Strade Aperte contributes to this goal by reconfiguring street space to prioritise walkability and cycling, actively discouraging unnecessary car use. This strategy involves spatial analyses of accessibility and walkability across Milan, identifying priority areas for intervention based on population density, existing infrastructure, and gaps in service reachability.

A clear example is the intervention in the Porta Venezia–Lazzaretto district, where urban redesign prioritised pedestrian and cycling movement over private vehicles. Measures such as expanded sidewalks, protected bike lanes, and reduced car access improved the area's permeability and safety.

Taken together, Milan’s Città 30 and Strade Aperte initiatives illustrate the growing recognition of walking and cycling as essential components of resilient, post-pandemic urban mobility systems. These programmes serve as models for integrating low-speed environments, public space improvements, and accessibility-based planning, reinforcing the idea that urban mobility transformation requires spatial, regulatory, and socio-cultural alignment, an approach also central to the framework developed in this research.

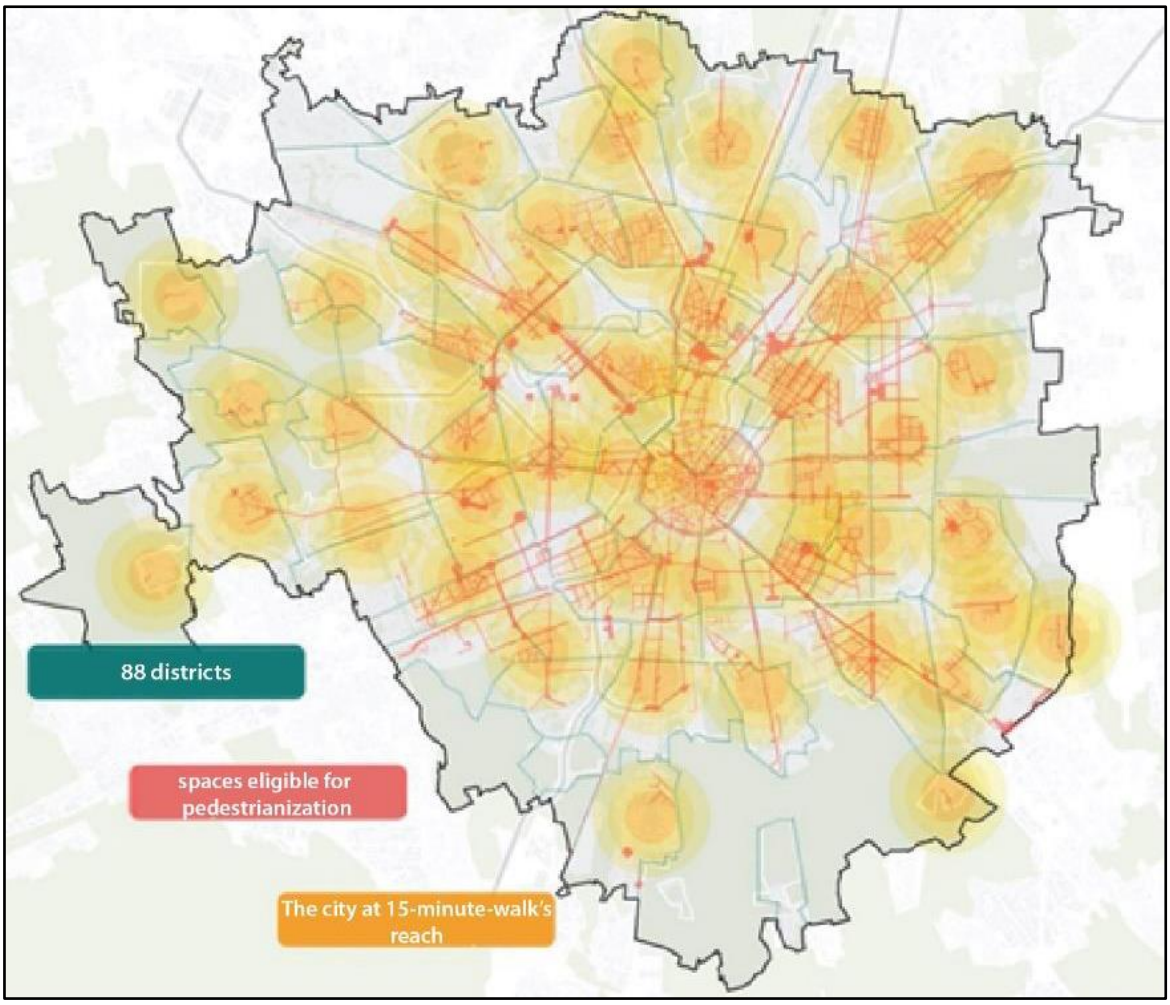


Figure 29. The expanded pedestrian network, as projected according to PGT.
Source: PGT 2030 of Milan.

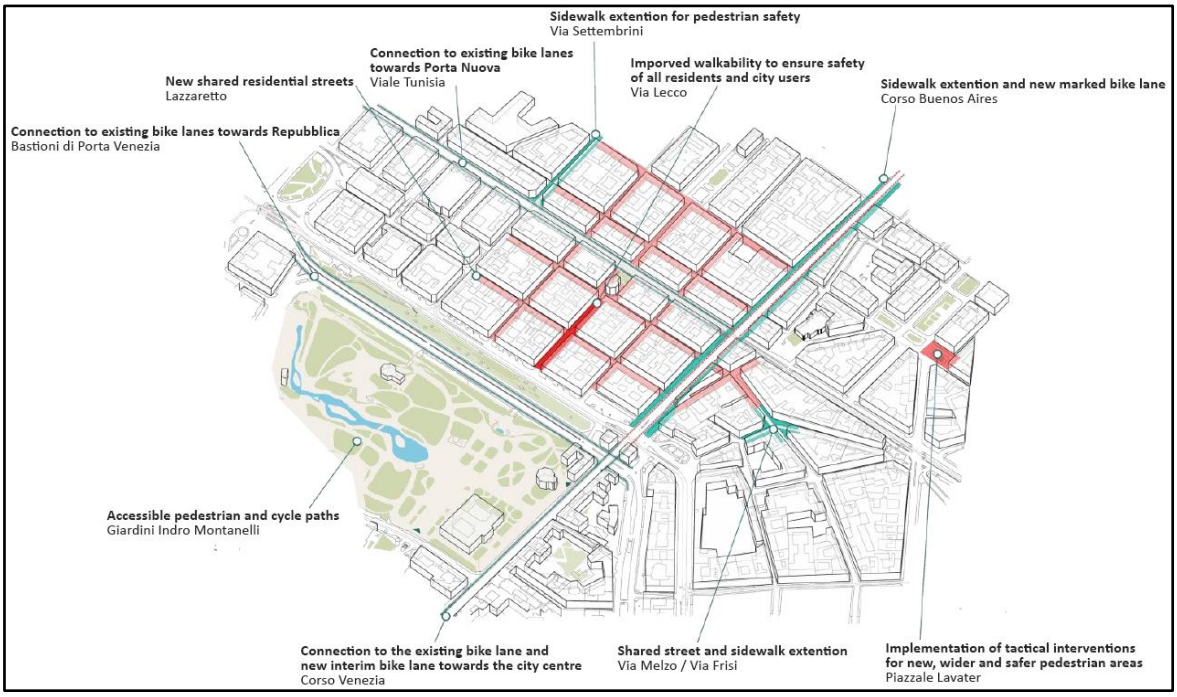


Figure 30. Interventions proposed within Strade Aperte for the Porta Venezia-Lazzaretto district.
Source: Comune di Milano, 2022.

4.5.3 Results and monitoring of the project

The Piazze Aperte program has evolved significantly since the beginning, transforming temporary interventions into permanent public spaces. This initiative has played a crucial role in revitalising Milan's neighbourhoods, particularly during the COVID-19 pandemic, by ensuring the quality and accessibility of public spaces for the community.

Through the creation of new, open spaces, Piazze Aperte has significantly increased the walkability of Milan's neighbourhoods. These revitalised spaces have not only enhanced the quality of life for residents but have also contributed to the city's overall sustainability and liveability. Promoting cycling and walking not only as a free-time activity but also as a primary mode of transport was one of the most important contributions of the program.

There have been surveys and monitoring of the interventions for each neighbourhood to see the change in pedestrian/cyclist flows and use of the public squares. Some of the results that took place between 2018 and 2021 were published by the municipality. The figure below shows the list of tactical urbanism initiatives that happened in different neighbourhoods that are proposed for the call made by the program.



Figure 31. Tactical urbanism measures from 2018 to 2021 in different neighbourhoods.
Source: Comune di Milano, 2022.

Thanks to those interventions, today, one in two Milanese residents has a square/plaza within 15 minutes (800 meters) from their home.

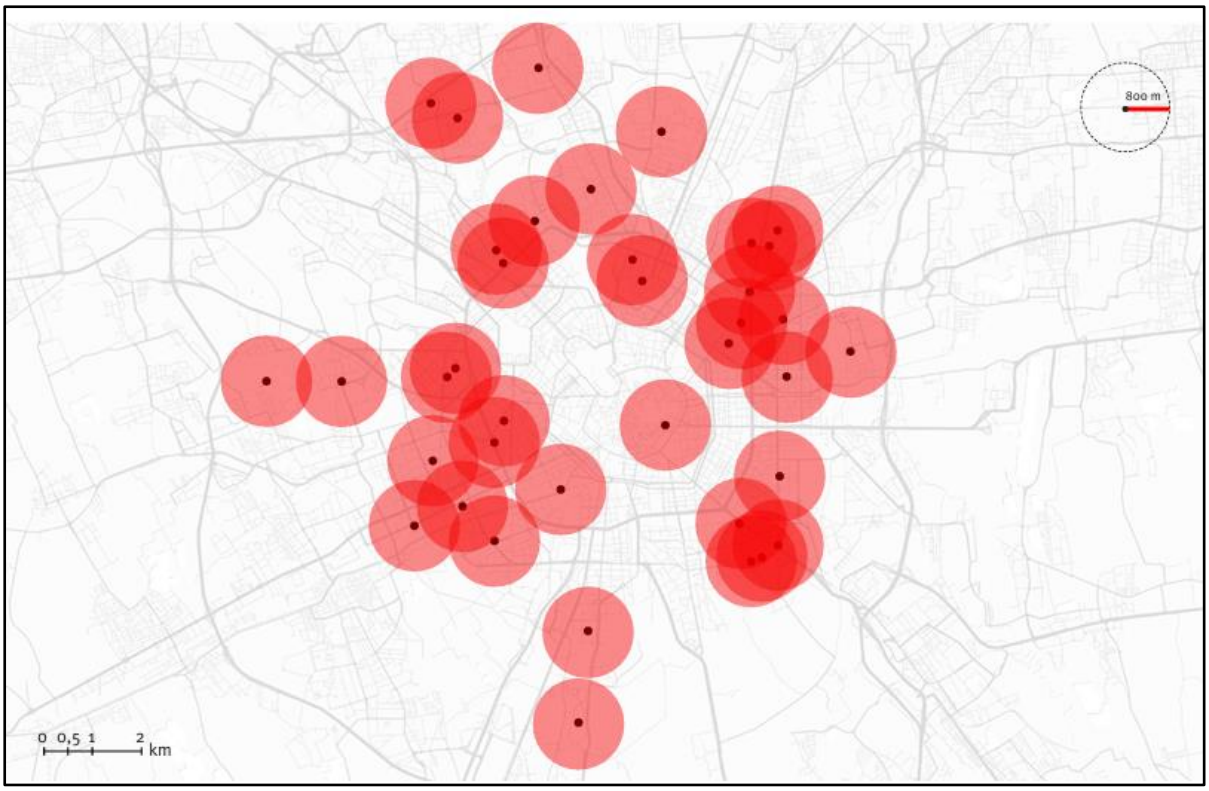


Figure 32. The location of the interventions took place in Milan between 2018-2022.
Source: Comune di Milano, 2022.

One of the examples of pedestrianisation within the program is shown below as before and after the interventions. Piazzale Stazione Genova is a pedestrian area between Via Ventimiglia and Via Barbavara, just outside the historic train station near the Navigli. The pedestrian area has expanded from 1.200 to 4.000 $m^{2,}$ besides the improved pedestrian circulation, added benches, bike racks and planters. There have also been restrictions on private vehicles, and public transport stops have been relocated to accommodate the increased pedestrian traffic. In 2020, further enhancements were made, including the addition of 30 new flowerpots and the repainting of the pavement. These changes have significantly improved the pedestrian experience in this popular area.



Figure 33. Piazzale Stazione Genova before and after the implications.
Source: Comune di Milano, 2022.

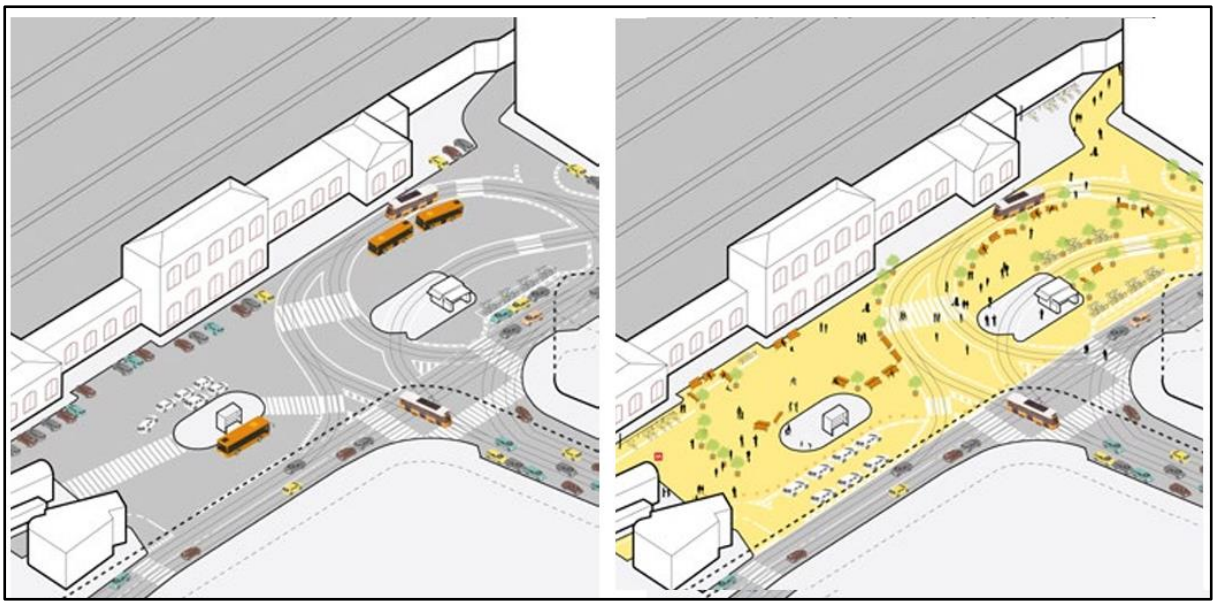


Figure 34. The design process of Piazzale Stazione Genova according to Piazze Aperte.
Source: Comune di Milano, 2022.

Piazze Aperte serves as a powerful example of how community-driven urban revitalisation can transform cities. By empowering residents to actively participate in the design and management of public spaces, this initiative has demonstrated the positive impact that community engagement can have on creating more vibrant and sustainable urban environments.

4.6 Pontevedra pedestrianisation project, Spain

The city of Pontevedra in the Northwest of Spain has long been admired for its well-preserved old medieval town and beautiful cobbled streets. Yet, beyond its rich history and architecture, Pontevedra has achieved global acclaim for its revolutionary approach to urban planning, which turned its centre into an entirely car-free zone decades ago. Pontevedra has emerged as a visionary leader in sustainable urban mobility. This bold transformation has not only enhanced the city's liveability but has also positioned the city as an influential case study for communities worldwide seeking to prioritise people over vehicles.

4.6.1 Spatial framework of the project area

Pontevedra is a city in the autonomous community of Galicia, in northwestern Spain. It is the capital of both the Comarca and the Province of Pontevedra. The compact city has 65.000 inhabitants in a 4,5 km^2 area. On the other hand, the municipality has 82.000 inhabitants in a 117 km^2 area. The population in the surroundings of Pontevedra live in several small urban centres, some of them close to the capital. The population is scattered in small settlements spread over the landscape. In the district, there are food, automotive, construction and tourism industries. Several high-level universities and sports centres complete the socioeconomic scenario. The primary sector is related to forestry.

Pontevedra is famous for its innovative pedestrianisation interventions and its rich historical centre. The historical square of Pontevedra is the second most famous in Galicia, after Santiago (Turismo de Galicia, 2024).

Pontevedra, also known as ‘the Good City’ (named attributed by the French author Jean Froissart in his chronicles in the 14th century) (García Iglesias, 2016). The city is also an important stop on the Portuguese Way path of the Camino de Santiago. There are many important squares of medieval origin and monumental buildings, including Basilica of Saint Mary Major (16th century), the Baroque Church of the Bilgrim Virgin (18th century), the ruins of the Gothic Convent of San Domingo (13th century), the Gothic Church of San Francisco (13th century), the Baroque Church of San Bartholomew (end of the 17th century) and the Gothic Convent of Santa Clare (14th century). The city has a marina close to its historic centre, increasing its charm. Today, Pontevedra is experiencing a renaissance, celebrated as a global model for walkable cities and a prime location for child-friendly living, earning it the title "City of Children". The city's commitment to sustainability and safety has been recognised with numerous awards, including the European Intermodes Urban Mobility Award (2013), the Dubai International Best Practices Award for Sustainable Development (2014), and the European Commission's first prize for urban safety (2020).



Figure 35. Pontevedra, Spain.
Source: Culmia.com.

4.6.2 Pedestrianisation process

Pontevedra has established a large pedestrian area over the years that covers the historic centre and most of the shopping streets, also with many other measures such as traffic calming measures, cycle and walking priorities and park and ride. The city pedestrianised its 300,000 mt^2 city centre in 1999, bringing economic, social and health benefits to its residents. Pontevedra expanded its pedestrian zones beyond the city centre in subsequent years. The city was a pioneer in Spain, implementing a 30 km/h speed limit in its core in 2010, and further reducing it to 10 km/h in 2019. Xosé Cesareo Mosquera, Pontevedra's head of infrastructure, described the city before its transformation: "It was a sad and stressed city, people felt like they had to escape to live on the outskirts." The city's revitalisation, initiated at the turn of the century, has since established it as a global example in urban planning and sustainable mobility (McAskie, 2021a). The current mayor, Miguel Anxo Fernandez Lores, came into office with plans for a car-free city more than 20 years ago and has always had the philosophy of "Owning a car does not give you the right to take up public space."

Strategically located on the Camino de Santiago pilgrimage route, Pontevedra was once a dynamic commercial hub in northwestern Spain. By the late 1990s, however, the city was struggling with the consequences of heavy car dependency, including severe congestion and a high rate of traffic accidents. Mayor Miguel Ángel Fernández Lores, elected in 1999, pioneered a radical transformation. The city's historic centre was pedestrianised, on-street parking eliminated, and through-traffic rerouted. While these changes faced initial resistance from residents and businesses concerned about the impact on commerce, the city persevered (Hernández-Morales, 2022).

Traffic patterns are primarily influenced by human behaviour. To optimise urban mobility, Pontevedra analysed the possible ways to determine the minimum vehicular requirement for optimal city function. The results indicated a significantly lower demand for private vehicles than initially anticipated. The city implemented a strategic approach to reduce car dependency and promote sustainable transportation modes. By providing sufficient peripheral parking and discouraging vehicle entry into the city centre, Pontevedra successfully shifted travel behaviours. The 'park and walk' model became common among visitors, while residents adopted car-free lifestyles. Through strategic traffic management and infrastructure enhancements, the city diverted vehicular traffic away from the core, leading to a substantial reduction in vehicle numbers. Daily car traffic decreased from 52,000 to 17,000 within two decades, transforming Pontevedra into a pedestrian-oriented urban environment.



Figure 36. The streets with higher motorised traffic density in 1999 (right) and today (left), after the implementation of car-free regulations in urban spaces.
Source: Council of Pontevedra, 2017.

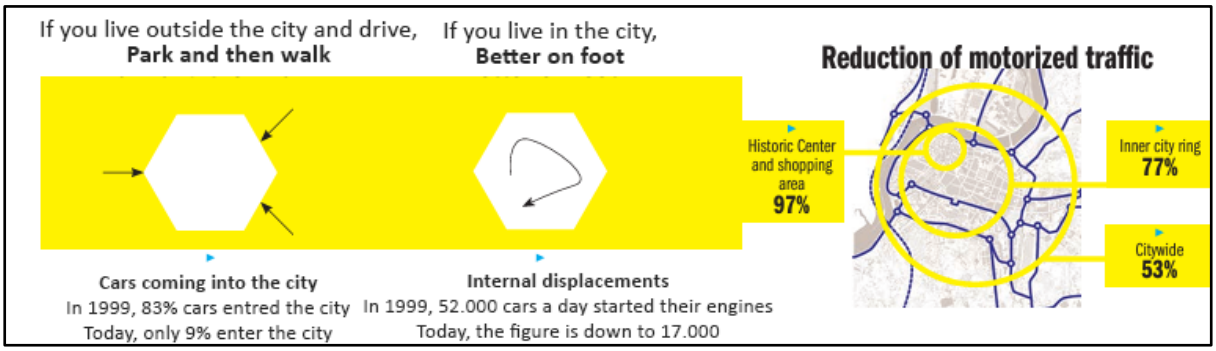


Figure 37. The reduction of cars in the city centre.
Source: Council of Pontevedra, 2017.

On the other hand, the streetscape in the historic centre was altered carefully according to this new mobility approach. A key example of this transformation is Benito Corbal Street. Once characterised by heavy traffic, the street has been repurposed to prioritise pedestrians, with a significant increase in pedestrian space and a reduction in road width. This change, along with other traffic calming measures, has made the street safer and more inviting for residents and visitors alike.

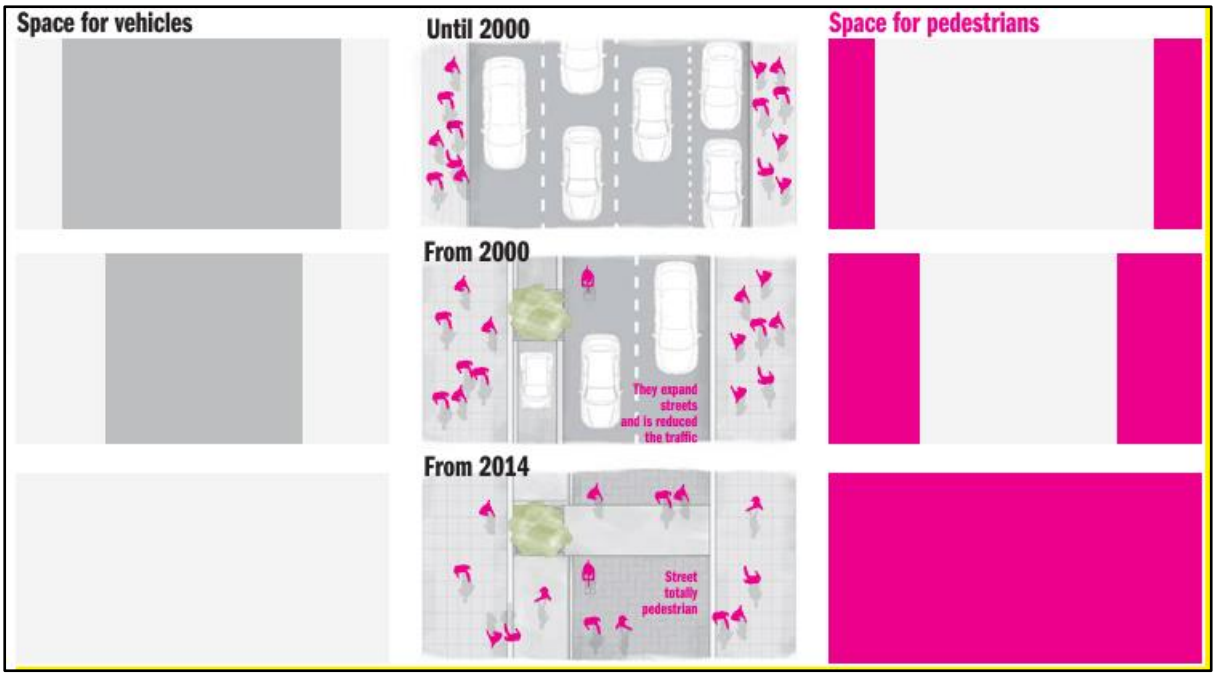


Figure 38. Benito Corbal Street is the paradigm of change.
Source: Council of Pontevedra, 2017.

Streets vary in width and function; they provide diverse mobility needs from pedestrian-only zones to high-traffic corridors. The configuration of space, pavements and street furniture significantly impacts urban life. Besides, street furniture should be thoughtfully designed to complement the surrounding environment. Thus, there have been studies to understand the street types in the historic centres for making interventions for each category according to the new urban model.



Figure 39. Types of streets according to the urban model.
Source: Council of Pontevedra, 2017.

Pontevedra's walkability success lies in its holistic transport strategy that prioritises pedestrians and cyclists, complemented by intermodal integration and effective traffic calming policies. Through a mix of infrastructural changes, regulatory measures, and public engagement, the city has managed to reduce car dependency and foster a pedestrian-oriented culture. A key innovation is the "Metrominuto" map, which presents walking distances and times in a format resembling a metro map, promoting walking as a viable and appealing alternative for short trips, especially from peripheral parking areas (Ares, 2013). This model offers transferable lessons for larger cities, particularly those with strong public transit systems.



Figure 40. Metrominuto of Pontevedra.
Source: Council of Pontevedra, 2017.

4.6.3 Results and monitoring of the project

Pontevedra's transition to a pedestrian-oriented urban model has generated substantial improvements in quality of life, public health, and environmental sustainability. By prioritising walking, cycling, and implementing comprehensive traffic management strategies, the city has successfully reduced road fatalities, congestion, and air pollution. The implementation of a citywide 30 km/h speed limit, coupled with traffic calming measures such as speed bumps and roundabouts, has significantly enhanced road safety. Today, the road deaths have fallen to zero in all the areas where the intervention was completed. Between 1997 and 2006, a total of 30 deaths were registered in urban areas. From 2007 to 2013, there were only 3 fatalities, and none of these events took place in the transformed areas.

Pedestrianisation efforts have been vital in reclaiming public space for pedestrians, fostering a more inclusive and accessible urban environment. The creation of pedestrian-friendly zones has contributed to a revitalised city centre, increasing economic activity, and enhancing the overall quality of life for residents and visitors. By prioritising people over cars, Pontevedra has demonstrated that a car-centric approach is not necessary for a thriving urban economy.

Furthermore, the city's commitment to sustainable transportation has created significant environmental benefits and behavioural changes. Thanks to the new parking and intermodality policies, the traffic entering the city has reduced by 92% in the centre. Today, Pontevedra’s citizens walk almost 70% of their journeys. A substantial reduction in car use and traffic congestion has led to a corresponding decrease in greenhouse gas emissions and improved air quality (60% decrease). Pontevedra's success in balancing economic growth with environmental protection serves as a compelling case study for other cities seeking to create more sustainable and resilient communities (Council of Pontevedra, 2017).



Figure 41. 'Then and now' situation in various places of the city.
Source: Council of Pontevedra, 2017.

4.7 The Walkable Helsinki program, Finland

Helsinki, the capital of Finland, is a vibrant coastal city known for its modern architecture, rich culture, and stunning natural beauty. Helsinki's high quality of life is characterised by its clean environment, excellent public services, strong emphasis on education and healthcare, and a high standard of living for its residents. Additionally, to become a global model for a liveable city, Helsinki launched the Walkable Helsinki program by aiming to enhance pedestrian accessibility within its city centre. Through a citizen-led survey conducted by Maptionnaire, the city tried to understand residents' perspectives on walkability and identify areas for improvement (Urban Sustainability Exchange, n.d.). On the other hand, the Helsinki Urban Environment Committee decided on an experimental expansion of the pedestrian, sitting, and cycling areas in the city centre according to The Helsinki City Strategy 2021–2025 (City of Helsinki, 2022). In this example, both the survey and the street experiments are discussed for a holistic narrative of the pedestrianisation vision of the city.

4.7.1 Spatial framework of the project area

Helsinki, Finland's capital and largest city, stands as a dynamic urban centre celebrated for its high quality of life, rich cultural offerings, and economic importance. Situated on the Gulf of Finland, it serves as the central hub for politics, education, finance, culture, and research in southern Finland. With a population of approximately 675,000 within the city limits and over 1.5 million in the metropolitan area (Fig. 21), Helsinki is the most populous urban centre in the country. The metropolitan area includes the cities of Espoo, Vantaa, and Kauniainen, forming a thriving urban network (Kukkonen et al., 2018). The city's strategic location, bordering Estonia, Latvia, Sweden, and Russia, has historically fostered connections and strengthened its role as a regional gateway, influencing both its cultural and economic landscape.

Helsinki's demographic profile reflects a growing diversity, with Finnish and Swedish as the official languages, but a significant immigrant population representing many different nationalities. This multicultural mix adds to Helsinki's vibrant atmosphere, enriching the city with a variety of traditions, languages, and perspectives. As a major economic centre, Helsinki's economy is primarily driven by the service sector, public sector activities, and industries such as metal and chemical processing. The city's strategic location and state-of-the-art infrastructure have also positioned Helsinki as a key shipping hub, further enhancing its regional and international connectivity. This combination of economic strength, cultural richness, and historical significance makes Helsinki not only a vital national centre but also an influential player on the global stage.

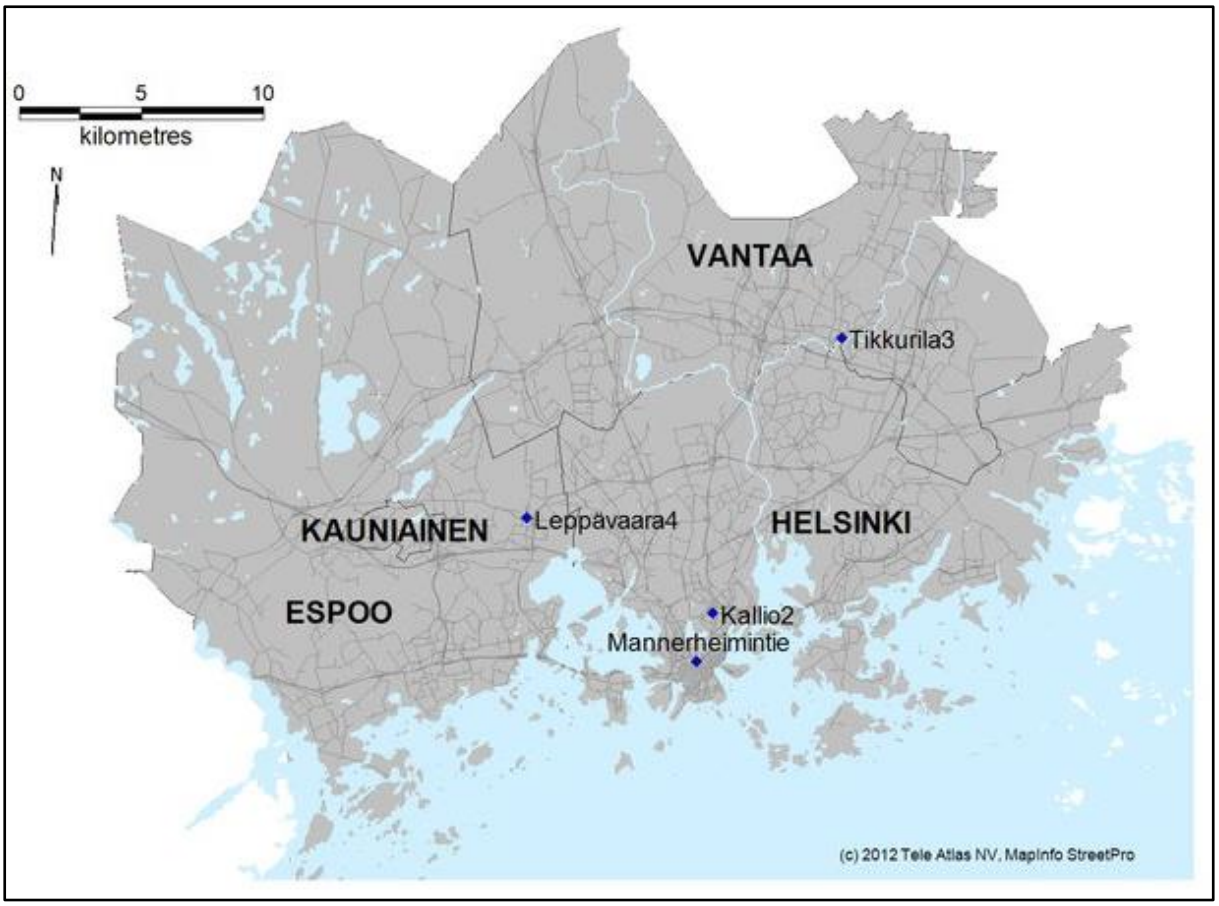


Figure 42. The cities in the Helsinki Metropolitan Area (Helsinki, Espoo, Vantaa and Kauniainen). Source. Kukkonen et al., 2018.

Helsinki's commitment to sustainability and quality of life has put it among the world's most liveable cities. The city's focus on education, healthcare, and social services has contributed to a high standard of living for its residents.

4.7.2 Pedestrianisation process

Thanks to the Walkable Helsinki Program, the city has successfully involved citizens actively in its decision-making process. By conducting a comprehensive walkability survey, the citizens engaged in identifying challenges, proposing solutions, and shaping the city's future.

In the survey, residents are asked to assess the current state of walkability in the city centre and ways to improve walkability. The main idea was to provide a straightforward way for citizens to get involved in the planning and decision-making processes in the preliminary stages. The project was launched in 2018 with a workshop regarding the design of the contents that took place in the survey, together with a group of architects, urban planners, coordinators, and mobility researchers. According to the results of the workshop, the survey was developed with questions regarding the everyday movements of pedestrians (by drawing), their wishes for improvements and the plans that are already in process.

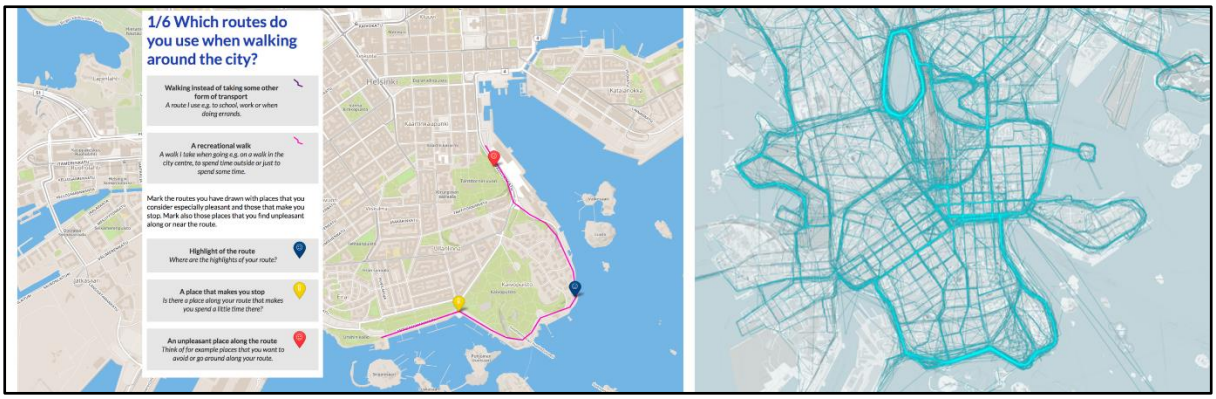


Figure 43. A question from the walkability survey of "Walkable Helsinki" (left), A map of recreational walks according to the survey (right).
Source: Urban Sustainability Exchange, n.d.

The survey had 1600 respondents marking 8700 routes on the city map. These results helped to understand the diversity of pedestrian routes and the reasons why people prefer to walk along those routes. Most of the responses highlighted the need for a reduction of cars and traffic in the city centre and improvements to the safety of crosswalks. All these results were registered in GIS format, so urban planners were able to design interventions that improved walkability in Helsinki's city centre.

The findings from the walkability survey have informed several key initiatives in Helsinki. These include a feasibility study for constructing an underground traffic diversion route and an evaluation of the potential for expanding pedestrian zones in the city centre.

On the other hand, there have been street experiments in various parts of the cities to increase pedestrian areas for certain periods. Esplanadi streets, Kasarmikatu, Erottajankatu, and Korkeavuorenkatu in front of the Design Museum and on Lönnrotinkatu went through a significant transformation in 2023 to create a more pedestrian-friendly and vibrant urban space. The project aimed to revitalise the area, promoting a thriving business environment, enhancing pedestrian comfort, and creating a stronger sense of community.

The Esplanade project embraced a collaborative approach, actively involving a diverse range of stakeholders, including residents, business owners, and city officials. Through a series of workshops, public feedback sessions, and consultations, the city gathered valuable insights and perspectives from those who would be directly affected by the project. This participatory process played a crucial role in shaping the design and implementation of the project, ensuring that the final plans were tailored to the needs, preferences, and aspirations of the community. By underlining open dialogue and inclusivity, the project aimed to create a public space that resonated with the people who use it daily, fostering a sense of ownership and connection to the area.

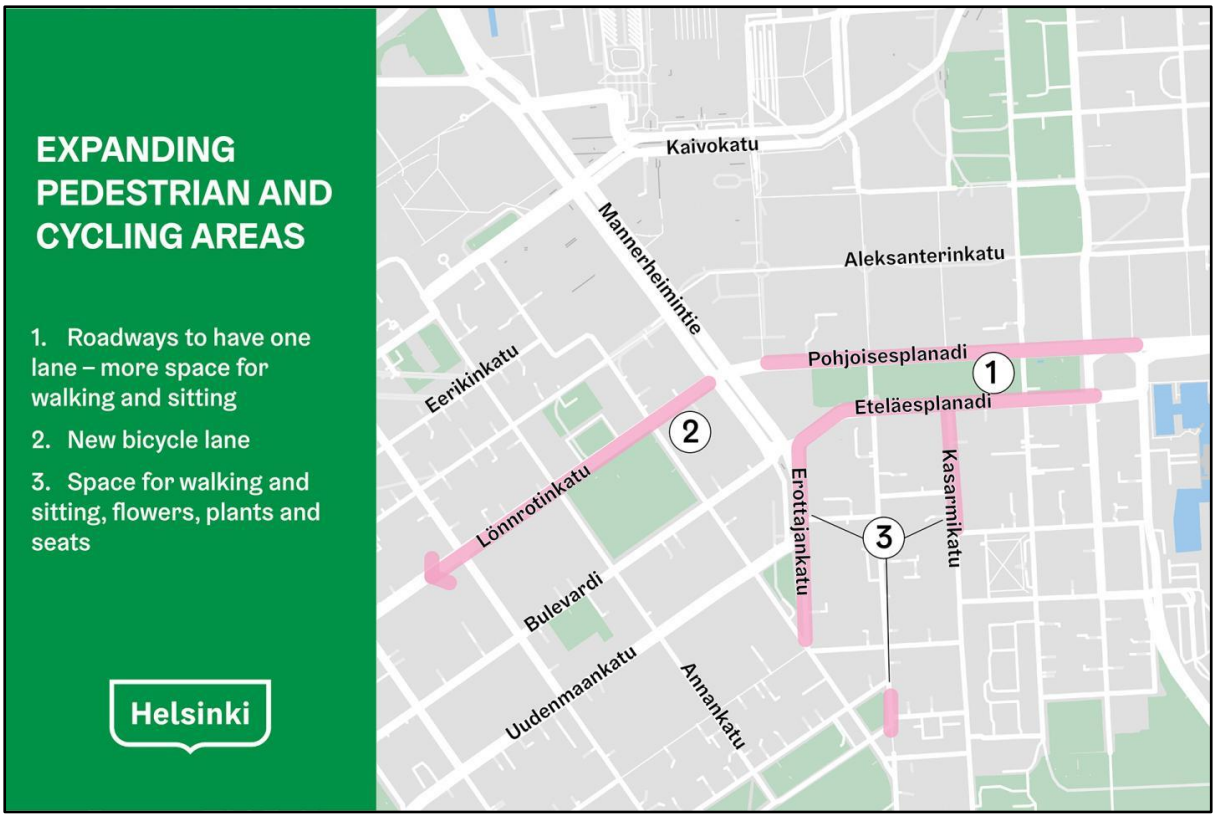


Figure 44. Areas where street experiments are located.
Source: City of Helsinki, 2022.

The transformation of Esplanadi and Lönnrotinkatu streets represents a significant shift towards prioritising pedestrians in the heart of the city. Both streets have been converted into one-lane roadways to create a more inviting and welcoming atmosphere for pedestrians. This change allows for more spacious walkways, enabling residents and visitors to move freely and comfortably through the area. To ensure that service vehicles can still access the area without disrupting the pedestrian flow, designated loading and unloading zones have been strategically maintained on both streets, balancing the needs of logistics with the overall pedestrian experience.

On Pohjoisesplanadi, the pedestrian area was expanded with the use of temporary structures, allowing for greater flexibility in the space. Similarly, the reclaimed space on Eteläesplanadi, which was once dedicated to vehicular traffic, has been repurposed for cyclists, creating a dedicated cycling path that ensures safe and efficient movement for those on two wheels. This careful reallocation of space not only improves the functionality of the area but also enhances its overall accessibility.

To elevate the aesthetic appeal of the streets and create a more inviting environment for the public, new street furniture and plantings have been introduced. These additions offer comfortable spaces for pedestrians to rest, socialise, and enjoy the vibrant atmosphere of the area. The project also focused on reducing traffic congestion, allowing for smoother pedestrian movement, and improving safety for both pedestrians and cyclists, who now have a designated space to navigate the area without interference from vehicles.

A crucial aspect of the renovation process was the active involvement of business and property owners, residents, and other local stakeholders. Through several workshops, participants were able to share their views, experiences, and needs, offering valuable input into the design of the new streetscape. These workshops addressed various topics, including the specific needs of local operators, the use of space, the placement of fixtures, and the selection of plants for Esplanadi streets. The feedback collected during these sessions formed the foundation for the long-term development of the city centre, ensuring that the redesign aligns with the desires and requirements of the community.

As a result of this collaborative process, the street space was expanded with the addition of elegant granite pavements and terraces featuring wooden decks, which provide inviting spaces for people to gather and interact. The new street furnishings and plantings were chosen with great care, following the guidelines established in previous studies of the space's history. These choices reflect the community's desire for a distinctive and festive atmosphere, as business owners and residents specifically requested furniture that would give the area a unique and celebratory character.

Drawing inspiration from early 20th-century landscaping, the plant selection for the Esplanade project showcases a mix of both traditional and contemporary species. The carefully curated palette of plants is not only visually appealing but also complements the architectural styles of the surrounding buildings, contributing to a harmonious and aesthetically pleasing urban landscape. By blending historical references with modern sensibilities, the transformation of Esplanadi and Lönnrotinkatu streets successfully creates a space that serves both functional and cultural purposes, enhancing the urban experience for all who visit.



Figure 45. Plants and modern furniture used to divide traffic from pedestrian areas.
Source: WSP, 2023.



Figure 46. The streetscape as the outcome of the experiment (up), the area reclaimed from cars to give pedestrians (below). Source: WSP, 2023.

4.7.3 Results and monitoring of the project

The survey resulted in valuable insights into residents' walking patterns, preferences, and challenges. This data-driven approach enabled city planners to develop interventions that addressed specific needs and priorities.

According to the results, policymakers saw that residents strongly desire to reduce car traffic and improve pedestrian safety. The city responded by implementing measures to prioritise pedestrians to create safer crossings. Additionally, the survey highlighted the need for enhanced pedestrian infrastructure, such as wider pavements, accessible crossings for people with reduced mobility and well-maintained pavements. In terms of urban green space, residents emphasised their importance for the well-being and quality of life. And finally, the respondents emphasised the importance of improved integration in transit for them regarding pedestrian routes and transit networks.

The Walkable Helsinki program demonstrates the transformative power of citizen-centred planning. By actively involving residents, the city was able to develop initiatives that truly reflected their needs and priorities. This approach not only led to more effective solutions but also fostered a sense of ownership and community engagement.

In terms of the transferability of the lesson learned in this exercise, there are several takeaways. To create successful pedestrianisation initiatives, cities must prioritise citizen engagement, utilise data-driven approaches, and adopt a multi-faceted strategy. By involving residents in the planning process, cities can ensure that initiatives align with community needs and preferences. Data collection and analysis are essential for informed decision-making and identifying areas for improvement. A comprehensive approach that includes traffic management, infrastructure improvements, and urban greening can create a more walkable and sustainable urban environment. Collaboration with community organisations, businesses, and other stakeholders is crucial for building a shared vision and developing a sense of ownership among residents. Following these steps could be a good start for developing operative and well-accepted pedestrianisation interventions for cities.

Examining the Esplanadi street experiment as a case study, there have been evident benefits for the urban spaces and their use by residents (City of Helsinki, 2022). The pedestrianisation project in the Esplanade area has produced significant benefits, including increased pedestrian traffic, improved quality of life, and economic growth. By creating a more inviting and accessible public space, the project has attracted more visitors and businesses, revitalised the area and contributed to a more vibrant city centre. These positive outcomes align with Helsinki's broader goals of sustainable urban development, as outlined in the Helsinki City Strategy 2021-2025.

According to the Helsinki city centre business report (2019), about 11–15% of the people travelling to the city centre are by car. To decrease this number, the city centre needs an integration of all forms of transportation. After the experiments, trips made by cars through the city centre in an east-west direction are estimated to decrease by 10%, and the car traffic in the Esplanadi will decrease by about one-fifth. To increase this impact, the number of parking spaces will be reduced to about one-third, and the number of lost parking spaces will be insignificant compared to the total parking capacity in the city centre. Most people are already arriving in the city centre by public transport, which is still improving, for example, with new rail connections, which effectively connect the city centre to neighbouring areas (City of Helsinki, 2022).

The impact on businesses operating in the area is likely to be moderate. While the reduction in car traffic and expansion of pedestrian areas may initially present challenges for some businesses, the overall economic impact is expected to be positive. Businesses can adapt to the changing environment by expanding their operations into the newly created pedestrian spaces.

Studies have consistently shown that pedestrian-friendly urban environments can boost economic activity and enhance the overall attractiveness of a city. Thus, increased pedestrian activity can potentially offset any losses for businesses due to reduced vehicle traffic in the area. Furthermore, the perception of customer reliance on cars is often overestimated. Many people are willing to walk or use public transportation, especially when the urban environment is favourable to these modes of travel. The success of Helsinki's pedestrianisation efforts demonstrates that prioritising pedestrians can create a more vibrant and attractive city centre, benefiting both residents and businesses.

The pedestrianisation initiatives in Helsinki have led to a noticeable increase in visitor traffic to the city centre, particularly during the summer months. While visitor numbers remained stable in 2022, there has been a significant increase in the amount of time visitors spend in the pedestrianised areas.

The goal of these initiatives is not to attract large crowds but to create inviting and comfortable spaces for people to enjoy the city. By providing opportunities for resting, relaxation, and social interaction, the pedestrianised areas have become popular destinations for both residents and visitors.

While it may take time for people to adjust to new routes and discover the benefits of the pedestrianised areas, the long-term impact is expected to be positive. As people become more familiar with the changes, they are likely to integrate these areas into their daily routines and discover the benefits of these welcoming urban spaces.

4.8 The (almost) Car-free City Project Oslo, Norway

In recent years, Oslo, Norway, has made significant strides towards creating a more sustainable and liveable city centre. Driven by concerns about climate change and population growth, the city has implemented ambitious plans to reduce car traffic and prioritise pedestrians and cyclists through the Car-free Liveability Programme.

Recognising the need for urgent action, Oslo decided on a comprehensive pedestrianisation initiative. The city's leadership understood that reducing car dependency was essential for achieving its environmental goals and creating a more pleasant urban environment. By closing streets to cars and repurposing the reclaimed space for pedestrians, cyclists, and green areas, Oslo has demonstrated a commitment to putting people first. This transformative approach has not only improved air quality and reduced noise pollution but has also created a more vibrant and accessible city centre.



Figure 47. A car-free street in Oslo.
Source: Oslo.kommune.no

4.8.1 Spatial framework of the project area

Oslo is the capital and most populous city of Norway. It constitutes both a county and a municipality. Oslo's 2024 population is now estimated at 1.100.868 (World Population Review, 2024). The city is the governmental and economic centre of the country thanks to its advanced trade, industry, shipping, and finance activities.

The city has undergone a remarkable process of urbanisation in recent decades and has experienced significant population growth, coupled with a strong emphasis on sustainable development and urban planning (Næss, Næss, & Strand, 2009).

Oslo's urbanisation process has been characterised by a strong emphasis on sustainability and quality of life. The city's commitment to public transportation, cycling infrastructure, and green spaces has made it a model for other cities seeking to balance urban growth with environmental protection. However, addressing the challenges of housing affordability and traffic congestion will remain important priorities for Oslo's future development.

Located between lush forests and the picturesque Oslo Fjord, the city offers a unique balance of natural beauty and urban amenities. Oslo's commitment to environmental sustainability is evident in its low-density urban fabric, extensive green spaces, and well-preserved natural areas. Oslo has successfully revitalised its waterfront, transforming former industrial areas into vibrant mixed-use neighbourhoods. This transformation has involved reconnecting the city centre with the waterfront through infrastructure improvements and the creation of new public spaces. The iconic Oslo Opera House and the controversial "Barcode" business district are prominent examples of these urban regeneration efforts (The Academy of Urbanism, 2015).



Figure 48. Oslo, Norway.
Source: Kayak, 2024.



Figure 49. Oslo Opera house and Barcode.
Source: Carsten Pedersen, 2015.

Despite its many successes, Oslo faces challenges such as housing affordability and traffic congestion. Addressing these issues is crucial for ensuring the city's continued growth and sustainability. Thus, the Municipality of Oslo launched the Car-free Liveability Programme in 2016 (Chollet, 2024).

Regarding the program, the Municipality has worked with the entire city centre within Ring 1. But there have been 'priority areas' to ensure the visibility of the projects and initiatives. Therefore, only the prioritised areas are examined in this example.

The first one is Pipervika XL, which is the area around Oslo City Hall. This area already has a strong pedestrian traffic and a vibrant city life, but this pedestrian flow is limited around Spikersuppa and Olav V's gate. The idea is to reduce the heavy car traffic at Fridtjof Nansens plass (nearby) to make the area a more welcoming urban space for possibilities, activities, and events.

The second priority area is 'Cultural District', which is also called Myntgata district. The City of Oslo has acquired the Myntgata district, transforming it into a vibrant and inviting urban space. This redevelopment project aims to create a dynamic area that meets the needs of all age groups, from children and young people to seniors. To enhance pedestrian accessibility and create a more pedestrian-friendly environment, Øvre Slottsgate is being converted into a pedestrian street. Additionally, the area between Myntgata, Kontraskjæret, and Karl Johans gate will become a focal point for urban life in Oslo.

Finally, the third area, 'The Recreation Trail,' stretching north from Youngstorget towards Grünerløkka, has become a thriving corridor within Oslo. Its recent extension, connecting Youngstorget to Kvadraturen, Grev Wedels plass, Torggata, and Dronningens gate, has solidified its position as a vital artery of urban life.

4.8.2 Pedestrianisation process

The Car-free Liveability Programme started as an initiative by the City of Oslo to enhance urban life by reducing car traffic and promoting pedestrian-friendly spaces. It involved collaboration among various stakeholders, including municipal authorities, private businesses, non-profit organisations, and residents. The program aimed to create dialogue and exchange ideas to foster increased city life through events and activities.

The key strategies are set as the removal of car parking to give more space to people, activation of hidden urban spaces, improving connections to the city centre and increasing cultural and sports activities through grants.

To implement these strategies, there were several steps to follow in Oslo. First, conducting studies to identify suitable areas for pedestrian-friendly transformations, considering factors like traffic patterns, community needs, and urban design. Then, involving residents, businesses, and organisations through workshops and meetings to gather input and suggestions for the pedestrianisation plan. After removing vehicle access, redesigning streets to prioritise pedestrians and cyclists, and adding amenities like seating, greenery, and improved lighting. And lastly, continuously assessing the impact of pedestrianisation on city life, traffic flow, and community satisfaction, adjusting as necessary.

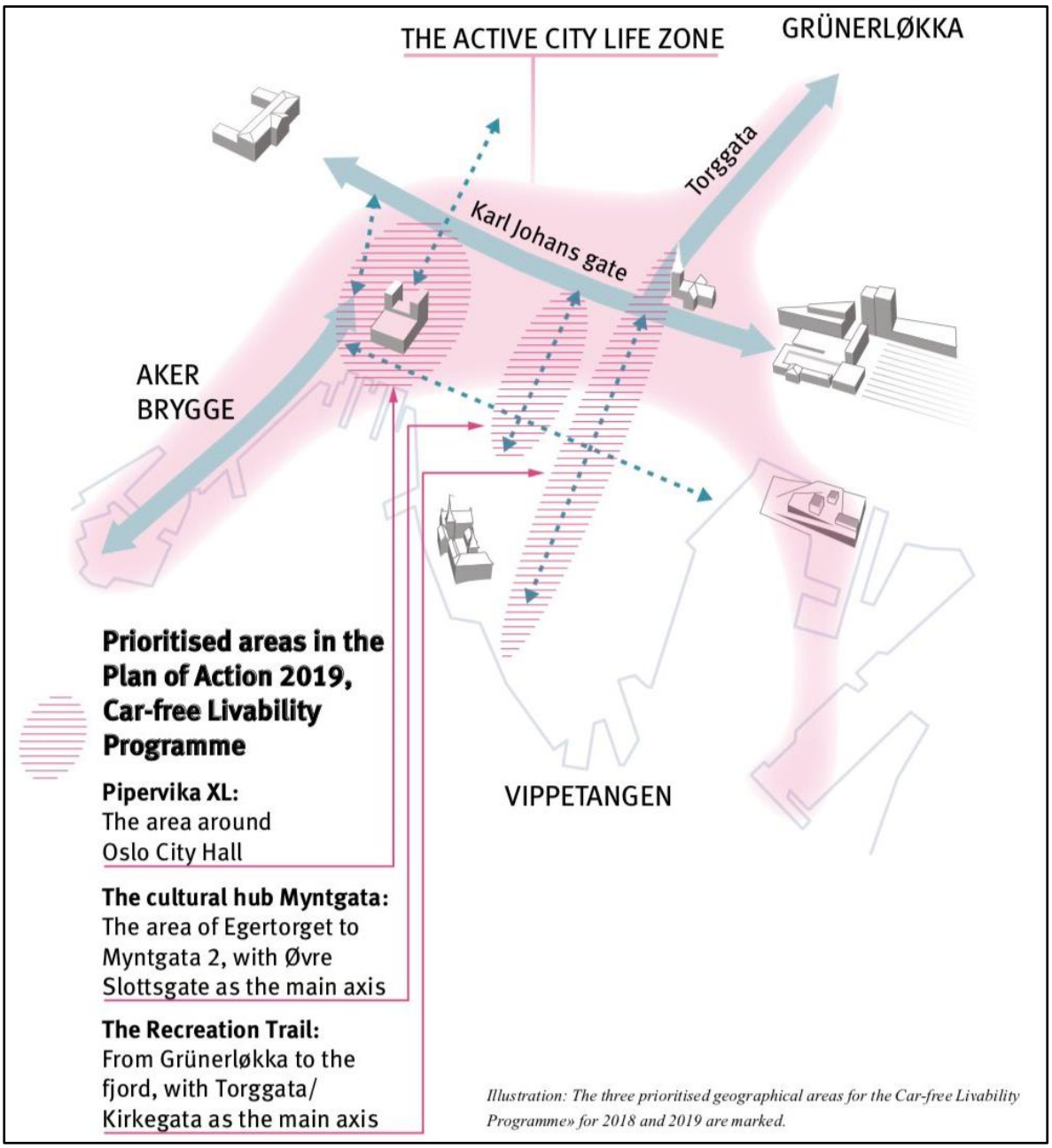


Figure 50. The three prioritised areas for the program.
Source: Oslo Kommune, 2019.

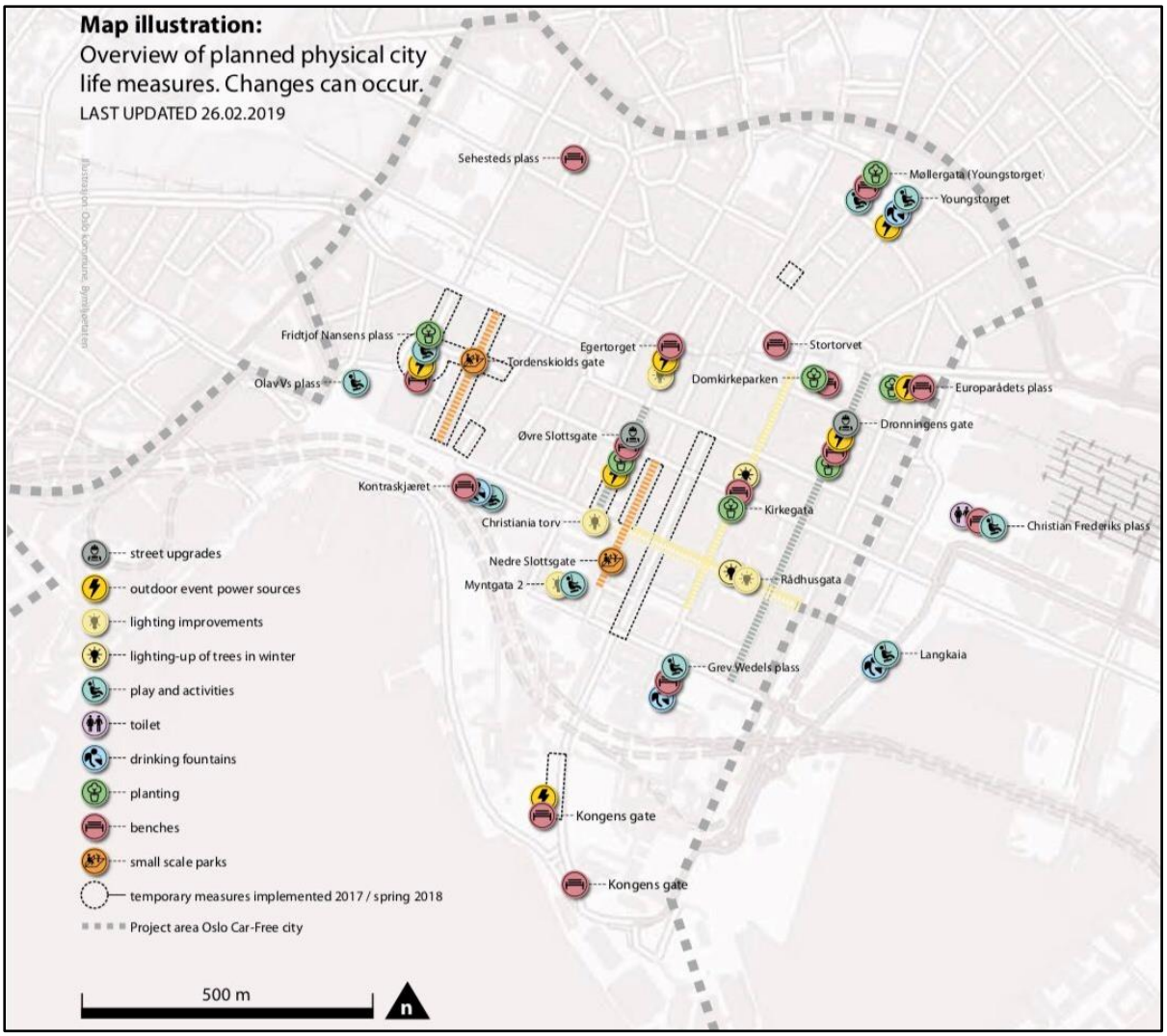


Figure 51. The proposal for planned physical city life measures.
Source: Oslo Kommune, 2019.

As in the Copenhagen example, Jan Gehl was included in this pedestrianisation program too. The first study was conducted by Professor Jan Gehl in 1987. After 25 years, the 'Public Space Public Life' survey was conducted in Oslo by Gehl Architects from 2012 to 2014, which assessed the quality of city life and urban spaces and turned into a benchmark for the program.

The survey highlighted several areas for improvement in Oslo's city centre. There is a lack of seamless connections between urban spaces, and city districts can hinder pedestrian flow and accessibility. Public amenities and street furniture are not comfortable enough to create a welcoming urban space. There is a scarcity of basic amenities like restrooms and water fountains that affect the overall experience. The city centre is not fully accessible to whole residents, especially for children and elderly citizens. And finally, there is a limited connection to fjords and nearby districts that restricts the city centre's appeal and accessibility.

In 2018, the Oslo City Council approved the "Programme of Action for Increased City Life," a comprehensive initiative aimed at revitalising the city centre. Building on the findings of the "Public Space Public Life" survey, this program sought to address the diverse needs of the urban environment through a targeted approach. The plan divided the city centre into 13 distinct areas, each identified for its unique characteristics and specific strategies designed to enhance urban life. By tailoring the approach to the individual needs of each area, the program aimed to foster a more vibrant, accessible, and engaging city centre that would cater to a wide range of activities and encourage greater social interaction.

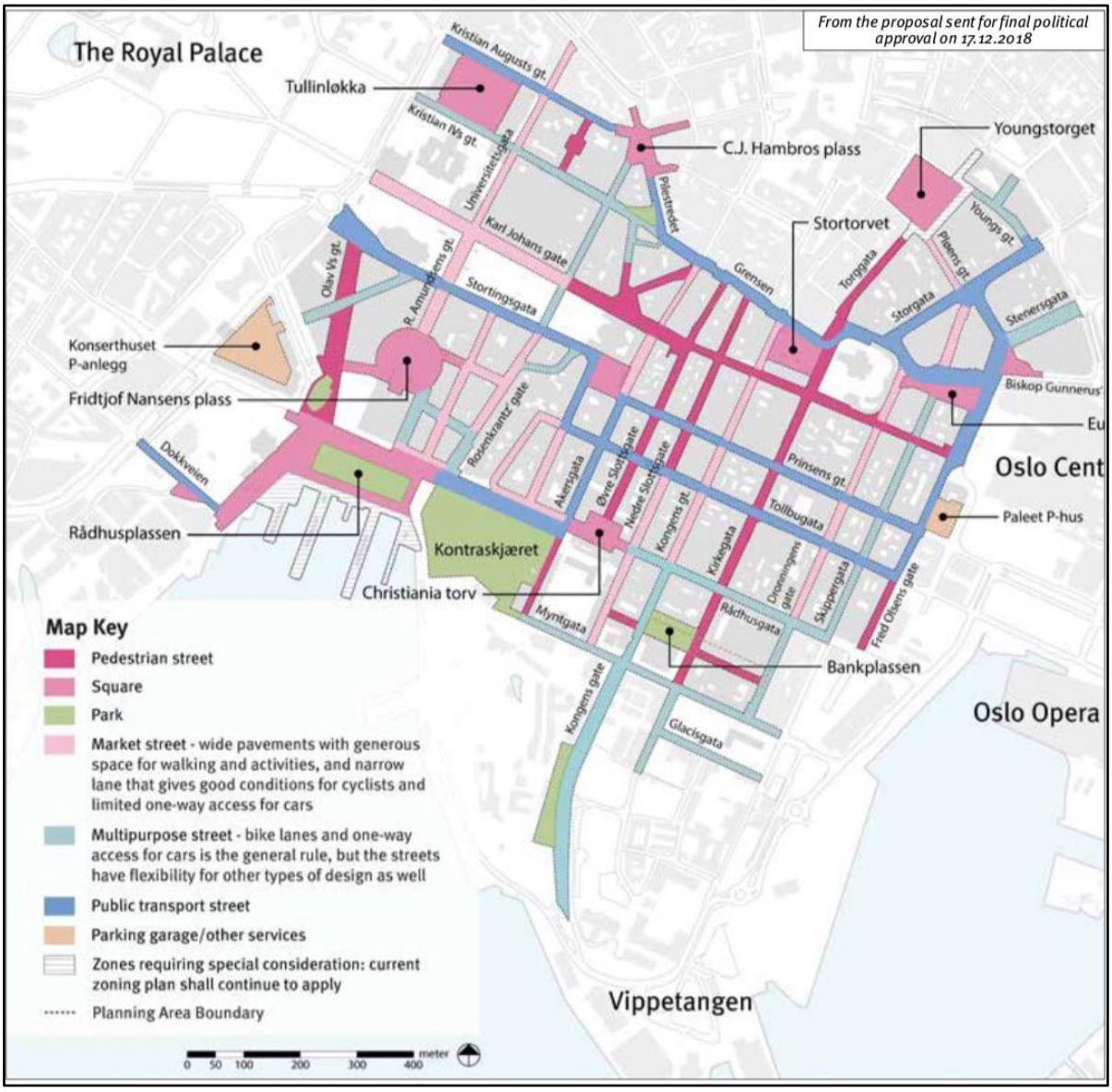


Figure 52. The holistic proposal for the centre in 2018.
Source: Oslo Kommune, 2019.

4.8.3 Results and monitoring of the project

The program contributed to Oslo's recognition as the European Green Capital in 2019, highlighting its commitment to sustainability and innovative urban planning. There have been notable results contributing to this recognition in recent years.

Most importantly, there has been a 10% increase in pedestrian traffic in the city centre that was observed in 2018 compared to 2017 after the interventions, indicating a growing preference for walking over driving. The removal of approximately 750 parking spaces allowed for the creation of more green spaces, benches and public seating as mentioned in the survey by the citizens. That helped to make the city centre more inviting and accessible for residents and visitors. The program was also beneficial for cyclists and encouraged more people to bike as a mode of transport, thus reducing car dependency in the city.

On the other hand, this program was a valuable tool for community engagement. Thanks to initiatives such as the City Life Festival and City Life Saturdays, community interaction and cultural activities that bring people together were held. Thus, the vibrant urban life was brought to the district as aimed at the beginning of the program.

In the long-term planning, the program has created the groundwork for ongoing urban development strategies of Oslo that prioritise people over cars, aiming for a more liveable and sustainable city with a strong feeling of community.



Figure 53. The collage of human activities in the district after the interventions that bring people together from different ages.
Source: Oslo Kommune, 2019.

4.9 The circulation plan and living streets of Ghent, Belgium

In the late 20th century, Ghent, a medieval city with a population of 260,000, faced significant challenges due to traffic congestion, pollution, and a decline in quality of life. These issues led residents to leave the city centre and move away.

To address these problems, Ghent launched a comprehensive mobility concept, known as the "Circulation Plan," which was implemented in 2017. The primary objectives of the plan were to create a car-free city centre, improve quality of life, enhance safety and accessibility, and achieve climate neutrality by 2050 (Surrer, 2021).

Through a combination of spatial planning, tactical urbanism, and investments in cycling and walking infrastructure, Ghent has successfully transformed its urban landscape into a more people-friendly environment. The city's experience serves as a valuable model for other cities seeking to reduce car dependency and promote sustainable mobility.

This example analyses the specific strategies and initiatives implemented in Ghent's Circulation Plan and Living Streets project, examining their impact on pedestrianisation and urban revitalisation.



Figure 54. A cyclist rides through the city centre in Ghent, where three-quarters of residents are in favour of plans to expand the pedestrian zone.
Source: Linda Nylind/The Guardian.

4.9.1 Spatial framework of the project area

Ghent, located in the East Flanders province of Belgium, is the largest city in the region with a population of approximately 260,000 residents, including a student population of 75,000 (Local Governments for Sustainability, 2022). As the third-largest city in Belgium after Brussels and Antwerp, Ghent has a rich historical heritage and a vibrant urban environment.

Renowned as both a port city and a university town, Ghent offers a unique blend of cultural attractions, educational opportunities, and economic vitality. Its strategic location along the Scheldt River has played a significant role in its historical development, while its university campus contributes to a youthful and dynamic atmosphere.

Today, Ghent is renowned for its UNESCO-listed bell tower and the Gravensteen fortress, reminders of its glorious past. While the city's former glory may have faded, its residents maintain a keen sense of identity and a rebellious spirit.

The city has implemented a sustainable urban mobility plan, which has doubled the size of the pedestrian area in the city centre. And, in 2020, Ghent put in place a Low Emission Zone that covers the whole city centre. Ghent is also a pioneer in the fields of sustainable fashion, liveable streets, food policy, cycling policy and resident participation.

Ghent has become a hub for cultural innovation, with initiatives like Nucleo[3] repurposing empty spaces into artist studios and inviting the public to participate. The city's large student population contributes to its lively atmosphere, with a diverse range of cultural events and entertainment options. Recognising its potential for youth engagement, Ghent was named the 2024 European Youth Capital (Locatelli, 2024).



Figure 55. The historic city of Ghent nearby city canals.
Source: Kevin Faingnaert/National Geographic.

[3] https://nucleo.be/info#missie

Ghent is a compact city where many attractions and services are within walking distance from each other. The historical centre has a blend of medieval architecture and modern urban planning, characterised by its picturesque canals and landmarks such as the Belfry and the Castle of the Counts. In the late 19th century, the most important event for the restoration of the historical centre was the World Exhibition of 1913, which resulted in beautification projects that transformed the area and the creation of new public spaces. Today, this area serves as a vibrant cultural hub, attracting tourists and locals while maintaining its historical charm (Boussauw, 2014).

When comparing the historic centre with the rest of the city, it is visible that the historic centre prioritises the preservation and restoration of medieval architecture, focusing on enhancing cultural heritage and tourism. On the other hand, the rest of the city has seen more extensive urban renewal and social housing projects, as it happens in other European cities. Especially during the 19th century, outside of the city's medieval walls, there was the rapid development of new districts with geometric street patterns marked by industrial growth.

The historic centre of Ghent prioritises the preservation and restoration of medieval architecture, focusing on enhancing cultural heritage and tourism while integrating modern amenities. In contrast, the rest of the city has seen more extensive urban renewal and social housing projects, addressing issues like poor housing quality and intercultural tensions. Additionally, the historic centre experiences stricter regulations on development to maintain its character, whereas other areas may adopt more flexible approaches to accommodate growth and modernisation.



Figure 56. Typical residential street in the nineteenth-century belt (left), Historical centre, restored in the early twentieth century (right).
Source: Boussauw, 2014.

Current urban development projects in Ghent emphasise the supply of additional housing, particularly for middle and lower-income classes, and small-scale social housing initiatives. The city is also focusing on enhancing public transport and cycling networks, as well as revitalising 19th-century neighbourhoods facing social issues. Notable projects include the development of the "Old Docks" area and the urban activity zone "The Loop," which combines residential, office, and retail spaces. Ongoing debates also concentrate on balancing tourism with dwelling (locals) and improving public transport accessibility in suburban areas.

4.9.2 Pedestrianisation process

Ghent's journey towards sustainable mobility began in the 1990s with the implementation of a cycling policy. In 1999, Ghent doubled its bicycle use by promoting cycling campaigns, providing bike parking, and connecting the city's districts with the city centre. In 1997, the city council introduced a groundbreaking mobility plan for its inner city. The core of the historic centre was transformed into the largest uninterrupted pedestrian zone (35 acres) in Flanders, encircled by a parking route (P-route) connecting 10 car parks with approximately 5,000 parking spaces. These were the beginning of a comprehensive effort to revitalise the city's urban landscape and promote sustainable transport. Frank Beke, the former mayor, introduced that mobility plan in 1997, which was threatened and protested by business owners who were afraid to lose their customers, concerned elderly people and many more residents. The council was aware that the plan to ban all cars from an area of about 35 acres was a radical move for the public. But his successor, Daniël Termont, said that, if he reintroduced cars into the historic centre, he would be the one threatened by the public. Overall, 72% of the public were in favour of Termont's new plans that suggest expansion of the pedestrian zone by 15 hectares (Rutter, 2016).

Over the following years, Ghent experienced a significant population increase, including incoming university students. This influx of residents and tourists contributed to increased traffic congestion and insufficient infrastructure. Taking those realities into account, Ghent continued its urban transformation with a master plan for the pedestrian-friendly reconstruction of the historic centre.

Mobility research conducted in 2012 revealed the extent of the city's transportation challenges. More than half of all journeys in Ghent were made by car, with 50% of city centre traffic being transit traffic. Walking and cycling accounted for only a third of all trips, while public transport usage was limited to 9%. Even though initially this policy was a success, the city faced increasing traffic congestion and car dependency (Van de Velde & Holemans, 2020).

The P-route, originally intended as a solution for car traffic, became heavily used, exacerbating congestion. Public transport delays and difficulty finding parking spaces became increasingly common, while cyclists faced challenges navigating the traffic-filled streets.

In response to these pressing issues, Ghent developed an ambitious mobility plan in September 2015, which comprises the Parking Plan and the Circulation Plan. It aimed to improve accessibility, quality of life, and sustainability within the city. Mobility was recognised as a key driver for creating a vibrant and sustainable urban environment. Once again, the Mobility Plan was met with many protests by the public, according to Filip Watteeuw, Mobility Deputy Mayor in Ghent. He mentioned that for each new implementation, there was a need for effective communication with the public all over again (Harris, 2024).

The Mobility Plan, which was put into practice in 2017, had various aspects aiming at improving transport and pedestrian mobility in the city. First, the parking plan introduced encourages peripheral parking and utilising park and ride facilities in accordance with public transport. Also, more parking spaces were reserved for residents.

The pedestrian zones have been expanded to encompass a larger area of the city centre. Six additional new pedestrian districts were created. Approximately 80 streets were reconfigured, over 2,500 road signs were adjusted, and 14 locations were permanently closed to most motorised traffic.

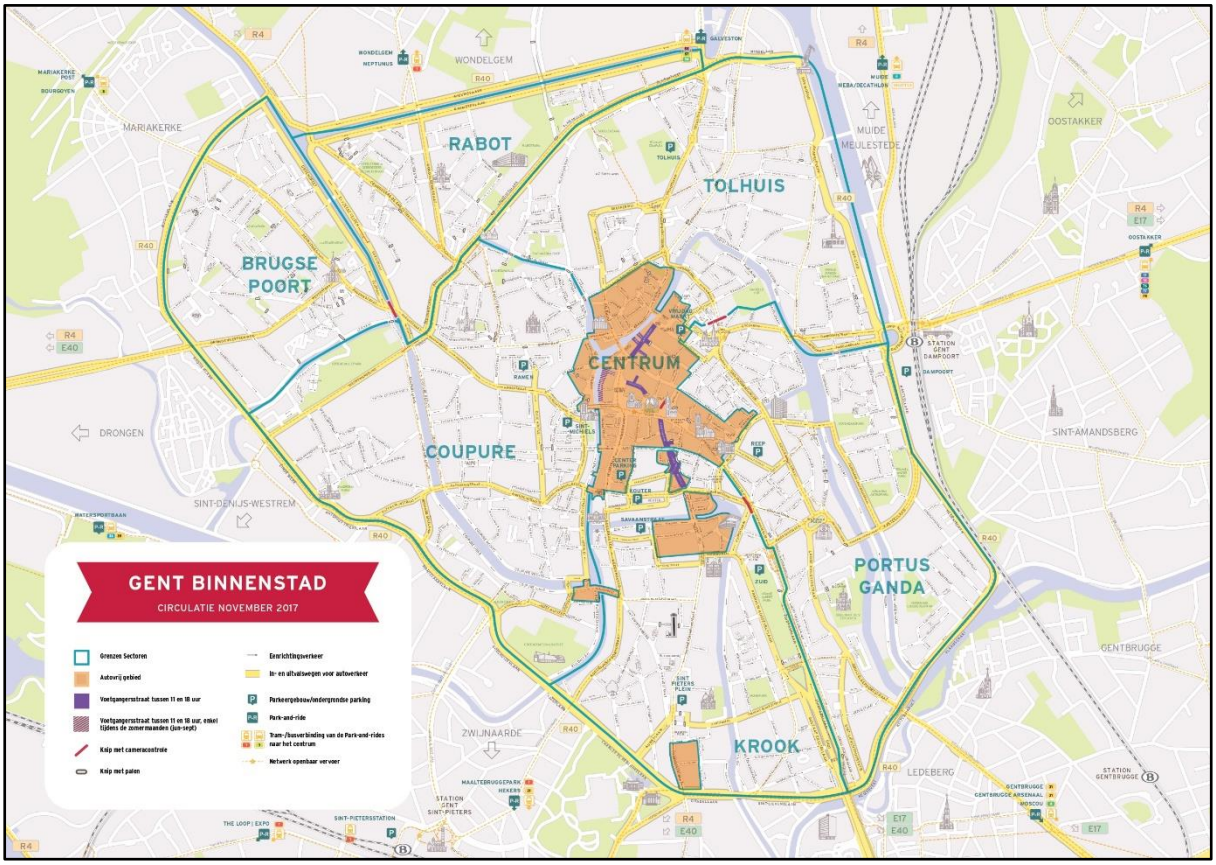


Figure 57. The Circulation Plan of Ghent, 2017.
Source: TheSquare.Gent, 2019.

The plan aimed to drive traffic away from the city centre, creating more space for pedestrians, cyclists, public transport, and green areas. Thus, certain areas were designated as restricted traffic zones, limiting car access only to essential purposes. Besides, traffic was rerouted through ring roads, providing alternative routes for those who needed to enter the city centre by their personal vehicles.

On the other hand, Ghent invested in expanding the cycling network to encourage more people to choose cycling as a transport mode. There have been efforts to improve the efficiency and accessibility of public transport services. Lastly, the city implemented a 30 km/h speed limit.

Apart from the Mobility Plan, there have been projects reclaiming space for people. For example, the Living Streets project played a crucial role in fostering community engagement and addressing concerns related to the city's transformation. By temporarily closing off streets to car traffic and repurposing them for community use, the project promoted social interaction, improved quality of life, and addressed issues such as poverty and gentrification.

Living streets are temporary car-free zones that repurpose roadways for alternative uses, such as playgrounds, community gardens, or gathering spaces. Originating in Ghent as a two-street experiment in 2013, the initiative has expanded to encompass over 25 residential streets across the city. The residents are responsible for the design and implementation of living streets themselves, with minimal restrictions from the city council. They are encouraged to collaborate and brainstorm innovative ideas for using their newly accessible street space. While the city council provides necessary permits and resources, the primary focus is on empowering residents to shape their own neighbourhoods (McAskie, 2021b).



Figure 58. Changes in the streetscape after the Living Streets Program in Ghent.
Source: Living Streets Ghent.

4.9.3 Results and monitoring of the project

Today, the Ghent Mobility Plan has proven to be a great success. An evaluation report published in 2019 highlighted several positive outcomes.

Since there are fewer cars in the inner city, parking spots and more spaces reclaimed from cars have been converted into green areas.



Figure 59. Maaseikplein before and after its renovation.
Source: Van de Velde & Holemans, 2020.

In general terms, the number of traffic accidents in the city centre decreased by 25 per cent. Air quality has significantly improved due to the reduction in vehicle emissions. The plan has alleviated traffic congestion, improved travel times and reduced stress for commuters.

Car use decreased by 17%, demonstrating a behaviour shift towards more sustainable transport modes. Daily public transport use increased by an average of 6%, with even higher rates during peak hours. Cycling saw a remarkable increase of over 50%, proving the effectiveness of the new infrastructure.

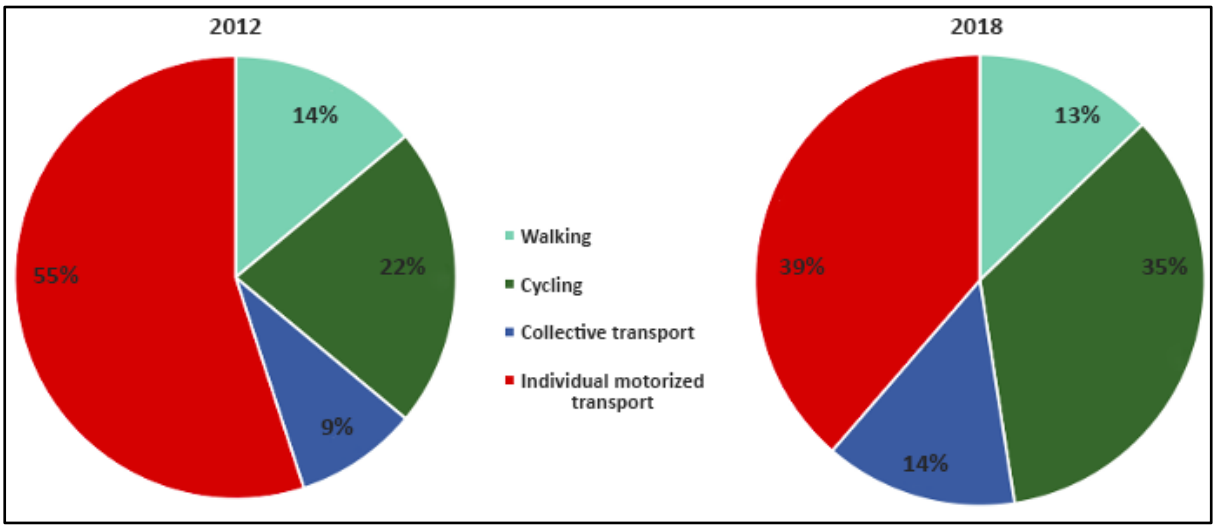


Figure 60. Modal split before and after the implementation of the mobility plan of Ghent.
Source: Van de Velde & Holemans, 2020.

These results underscore the effectiveness of Ghent's mobility plan in achieving its goals of reducing traffic congestion, improving air quality, and creating a more liveable city.

A Guardian article (Obordo, 2020) highlighted the positive experiences of Ghent residents following the mobility changes. Many residents reported selling their cars, adopting electric car-sharing services, and enjoying the improved walkability and cycling infrastructure. The reduction in traffic noise and pollution, combined with the safer and more pleasant environment, has significantly enhanced the quality of life in Ghent.

4.10 Evaluating the outcomes of pedestrianisation initiatives

This section presents a comparative analysis of pedestrianisation projects from diverse urban contexts. By examining a range of case studies, including projects in both large metropolitan cities and smaller urban areas, as well as top-down and citizen-led initiatives, this analysis aims to identify common themes, best practices, and lessons learned. Through a systematic comparison of project outcomes, this section will contribute to a deeper understanding of the factors influencing the success of pedestrianisation initiatives and provide valuable insights for policy recommendations aimed at the Palermo case study.

The following table presents a categorisation of the selected case studies based on six key attributes:

- Type of Initiative: To indicate whether the project was primarily driven by government agencies (top-down), community-led (bottom-up), or a combination of both (collaborative).
- Pedestrianisation Scope: To specify the extent of pedestrianisation, such as partial or complete closure of streets to vehicles.
- Implementation Timeline: To provide information about the duration of the project and any significant milestones.
- Public Engagement: To assess the level of public involvement in the project, including consultation processes, community workshops, and feedback mechanisms.
- Key Outcomes: To highlight the main achievements and benefits of the project, such as increased pedestrian traffic, improved air quality, and economic development.
- Challenges and Lessons Learned: To discuss any difficulties encountered during the project and the valuable lessons that can be applied to future initiatives.

By comparing case studies from a variety of cities, both large metropolitan areas and smaller urban centres, this analysis explores the key factors that contribute to the success of pedestrianisation initiatives. Several elements emerge as important guidelines for future projects, particularly in areas like public engagement, methods for spatial intervention, and managing the overall process.

Early Involvement and Communication: Involving the public from the very beginning is critical to building support and addressing any concerns. When residents feel included in the planning and implementation phases, they are more likely to back the initiative. Transparent communication is equally important—being open and honest with people creates trust and understanding. Sometimes, personal, one-to-one interactions with locals can be particularly effective in ensuring their concerns are heard and addressed.

Tailored Solutions: Successful pedestrianisation projects recognise the unique needs and preferences of each community. Designing plans that reflect the local context helps ensure the changes are both effective and well-received. Cookie-cutter solutions rarely work; instead, adapting strategies to fit the character and needs of specific neighbourhoods can make a real difference.

Top-Down and Bottom-Up Approaches: While leadership from policymakers and urban planners is important, pedestrianisation initiatives are most effective when they combine top-down planning with bottom-up engagement. By involving residents in the decision-making process, cities can foster a sense of ownership and encourage public support. This collaboration ensures that policies reflect both expert knowledge and local perspectives.

Economic Impact: One common concern is the potential effect on local businesses. While some business owners worry that pedestrianisation may harm their trade, research shows the opposite is often true. Creating safer, more attractive streets encourages people to spend more time in the area, boosting footfall and benefiting local economies. Transparent communication about these benefits can help alleviate concerns.

Traffic Management: Carefully managing traffic is essential for the success of pedestrianisation. Without proper planning, removing cars from the streets could lead to increased congestion on surrounding roads, frustrating both residents and commuters. By analysing traffic data and studying existing patterns, cities can develop alternative routes and traffic flow strategies to minimise disruption. This kind of careful planning ensures that pedestrianisation delivers its intended benefits without creating new problems.

Incremental Changes and Flexibility: Gradual implementation can help residents adapt to new policies while reducing resistance. Introducing changes step by step allows people to explore alternatives, such as cycling or public transport, while also providing time to test and refine the approach. Creating new public spaces and activities as part of the process can further ease the transition. Gathering regular feedback from residents is crucial for responding quickly to concerns or challenges shows that the city is willing to listen and adjust as needed.

Learning from Success Stories: Examples like the Living Streets programme in Ghent and Strade Aperte in Milan highlight the power of tactical urbanism. These initiatives introduced temporary changes, such as pop-up pedestrian zones and cycling lanes, and closely monitored public responses. By testing ideas on a small scale, these cities were able to refine their strategies and create lasting, positive changes in their urban environments.

By considering these factors carefully, cities can design pedestrianisation initiatives that go beyond simply banning cars. Effective projects create vibrant public spaces, improve residents' quality of life, and promote sustainable urban development. Tailored approaches, strong public engagement, and incremental implementation can ensure these initiatives leave a lasting, positive impact on communities.

Table 6. Categorisation of the pedestrianisation case studies.

Ciclovia	Pontevedra - Metrominuto	Tarihi Yarım Ada	Project Scope and Context
Bogota - Colombia	Pontevedra - Spain	İstanbul - Türkiye	Location
A grassroots movement to a permanent initiative.	Top–down policies.	Primarily top-down policies with public feedback after implementation	Type of Initiative
Closing streets for certain times to traffic.	Complete pedestrianisation of the city centre.	Complete pedestrianisation of selected streets.	Pedestrianisation Scope
Continues with new locations since the demonstration in 1974.	Pedestrianisation started in 1999, and Metrominuto was established in 2011.	2005 – 2014, but there are follow-up projects today.	Implementation Timeline
A grassroots movement began with public claims and has continued through public feedback.	An assembly was organised with local people. There was a counterreaction at the beginning from the public.	Feedback mechanisms (surveys) for later projects.	Public Engagement
127 kilometres of city streets, and attracts an average of 1.5 million participants weekly.	92% reduction of cars in the historic centre in 25 years. 1.3 million m^2 pedestrianised area. 66% reduction of emissions. 0 deaths from car accidents in the last decade.	Increased pedestrian flow, better pedestrian accessibility from station areas to the historic centre, and visual improvement of streets and public spaces.	Key Outcomes
Grassroots initiatives can drive change. A sense of community helps to create a shared sense of ownership of public spaces.	Always have plans ahead for how to make more valuable use of the space. Prioritise the majority and seek input from the community. A compact city is essential for walkability. Demonstrate the feasibility of reducing car traffic without sacrificing essential services.	Traffic arrangements must be organised better for the alternative routes assigned. A buffer zone could be a solution for congested areas. For street vendors and other disruptive elements, street surveillance must be better	Challenges and Lessons Learned

Piazze/Strade Aperte Program	The Circulation Plan Living Streets	Car-Free Liveability Program	Pedestrian-Only Streets	Walkable Program and Summer Street Experiments
Milan - Italy	Ghent - Belgium	Oslo - Norway	Copenhagen - Denmark	Helsinki - Finland
Citizen engagement and tactical urbanism.	Circulation Plan: a top-down measure Living Streets: bottom-up	The municipality initiative collaborated with locals and business owners.	Top-down planning	Citizen-centred planning: Public engagement with government agencies, urban planners.
Tactical interventions and street experiments that can be turned into permanent ones if successful, according to monitoring and data analysis.	Circulation Plan: permanent closure for vehicles. Living streets: temporary closure/car-free pop zone.	Different actions in various locations.	Street experiments turned into permanent.	Street experiments and tactical urban development.
Piazze Aperte: 2019 Strade Aperte: 2020 Both continue.	First pedestrianisation at the centre: 1997 Circulation plan: 2017	2016 - 2023.	First experiment in 1962. Continues today.	Walkable Survey: Ongoing since 2018. Summer Street Experiments: Since 2022
Collaboration Agreement between the public and the authorities. Public surveys to get feedback for making temporary changes permanent	Living Streets let residents decide and work together to design their own streets while consulting and collaborating with city services.	Active public involvement through workshops, street engagement, and community-building projects.	Initially, strong public opposition has turned into dedicated support, evidenced by surveys.	An interactive survey, data management on GIS for responses. Workshops and public meetings.
22.000 m^2 of new pedestrian spaces. 38 tactical interventions. 380 new bike lanes. A 30 km/h speed limit for about 60% of the whole urban road network.	The restricted traffic area/pedestrian area is extended (by 128% overnight). There are fewer accidents, higher air quality, lower noise levels and higher pedestrian flow.	10% increase in pedestrian traffic. Expansion of green spaces and pedestrian areas, doubling the pedestrian space.	600% increased pedestrian space and 20% increase in pedestrian volumes.	Pedestrian flow and the time people spend in public areas increased. Access by car decreased by 10%.
Community-driven urban revitalisation is important for the acceptance of interventions. Community engagement is key to creating vibrant and sustainable urban environments that are owned by people.	Allowing people to design for their neighbourhood is the key to success. Door-to-door communication is needed. Focus less on mobility and more on social cohesion.	Engaging residents in planning and implementing pilot projects ensures better acceptance, tailored solutions, and positive outcomes. Real-time feedback is important for effectiveness.	By creating peaceful yet vibrant pedestrian areas, outdoor activities, social interaction, and boosted local businesses are promoted.	Proved that the perception of customer reliance on cars is overestimated. Data is vital. There are many pedestrian paths used by the public, but before the surveys, they were invisible to authorities.

PART II

Exploring Barriers and Opportunities for Walkability in Palermo: Targets, Solutions, and Policy Recommendations

CHAPTER 5

The City within its Metropolitan Area

5. The City within its Metropolitan Area

Palermo, a city famous for its rich history and cultural heritage, presents a unique case study for understanding the challenges and opportunities of walkability in a car-dependent urban context. Located in Southern Europe, where mobility and transportation issues continue, Palermo offers a valuable perspective on the complexities of urban planning.

While Southern Italian culture is deeply ingrained with the tradition of *'la passeggiata'* (Setti, 2024), a stroll mostly without a specific destination, walking as a primary mode of transportation remains less common. This contrast highlights the need for interventions to promote active mobility and reduce car-dependency.

As mentioned in the first chapter, Palermo ranks among the most traffic-congested cities in the world (Inrix, 2022), which underscores the urgent need for sustainable transportation solutions. The city's car-dependent culture and infrastructure present significant challenges to promoting walkability and reducing congestion.

In this section, Palermo is scrutinised in terms of its demographic characteristics, territorial structure, urban functions, and transportation network. This analysis serves as a foundation for subsequent studies aimed at enhancing walkability in this car-dependent urban environment.

5.1 Demography of Palermo

For a comprehensive understanding of Palermo's urban context, the demography section examines the information at various levels: the metropolitan city, the metropolitan area, and the municipality of Palermo.

5.1.1 Demography of the metropolitan city of Palermo

In Italy, around third (36,2 %) of the overall population is concentrated in the 14 metropolitan cities (CM) and among these the Metropolitan City (CM) of Palermo is the sixth in terms of the population (1.200.253, as of 2024), behind Rome, Milan, Naples, Turin, and Bari. Among those 14 metropolitan cities, Rome, Genoa, and Palermo hold a much larger share of their respective provinces' population – 65.8%, 68.7%, and 53%, respectively. This imbalance has social, urban planning, and service-related consequences. Regarding spatial dimension, the Metropolitan City of Palermo is the third largest in Italy, covering 5.009 square kilometres (about 10.7% of the total CM territory). It also has 82 municipalities, which is the sixth highest number among all CMs in Italy (Dolce, Barbera, Rosone, and Patti, 2020).

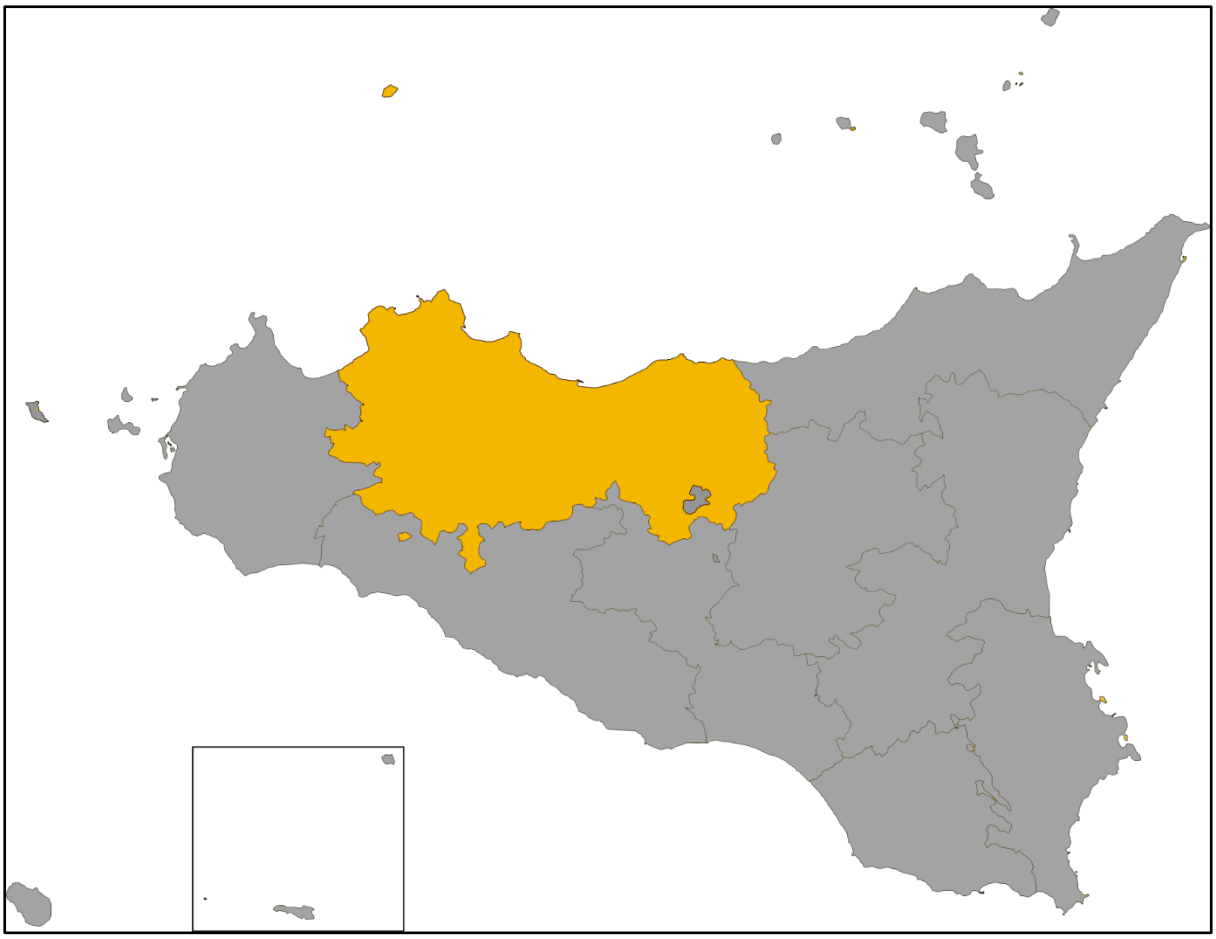


Figure 61. Metropolitan City of Palermo in the Sicily Region.

Palermo itself, with its surrounding provinces, is densely populated, reflecting a concentration of both residential and economic activities. In contrast, the broader metropolitan area falls into two distinct categories: the municipalities located along the coastline, which have a moderate population size, and the municipalities situated around the mountain regions, where population density is exceptionally low.

This uneven distribution of residents across the metropolitan area poses significant challenges, particularly in terms of housing. The densely populated urban core of Palermo faces pressures related to overcrowding, while the less populated municipalities struggle with maintaining or attracting growth and development. As a result, the region experiences an imbalance that complicates both housing provision and urban planning strategies.

This demographic imbalance serves as an important indicator for local decision-makers, highlighting the pressing need to address the disparities in housing availability and the challenges that come with mobility across the metropolitan area. For policymakers, this uneven distribution requires tailored solutions that account for both the dense urban environment and the more sparsely populated outskirts, ensuring that the needs of all areas are met sustainably and equitably.

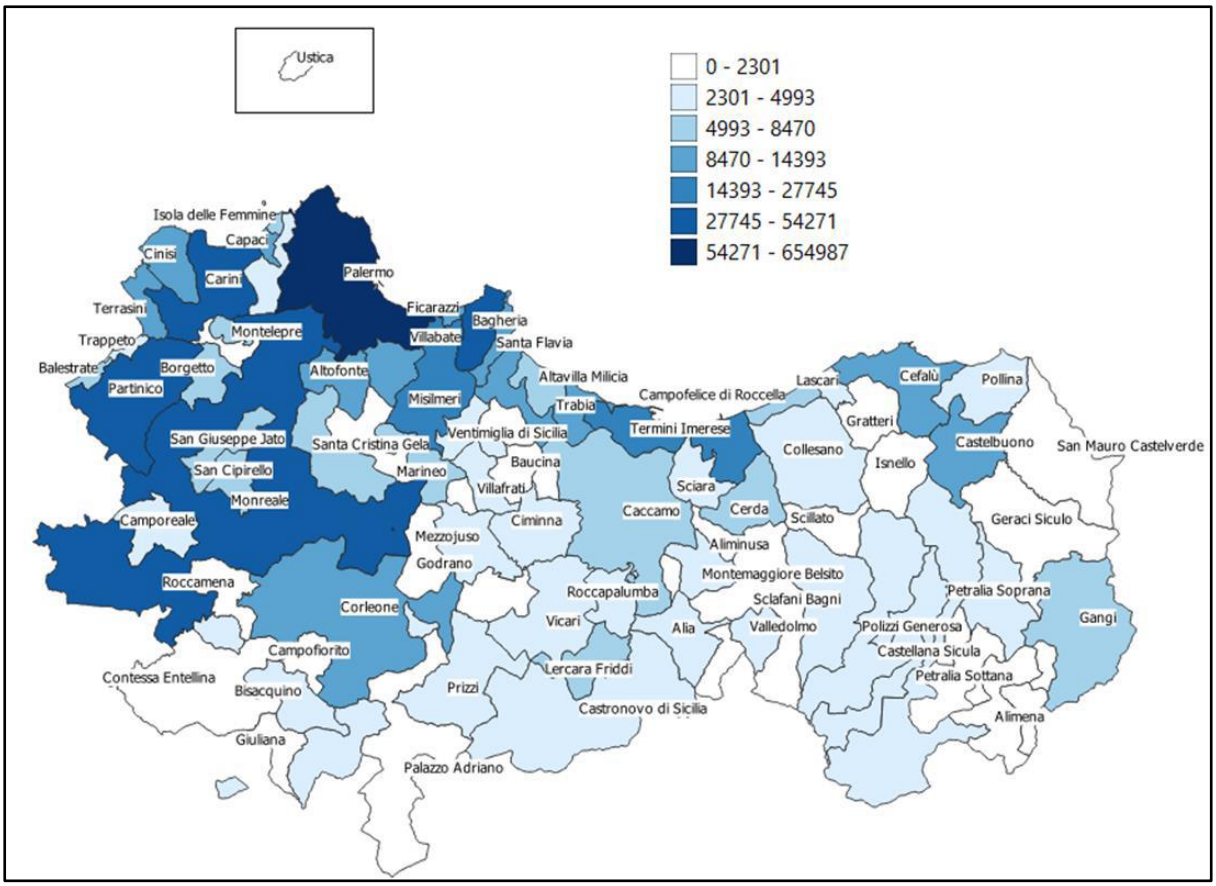


Figure 62. Population distribution among metropolitan municipalities of Palermo.
Source: ISTAT.

Considering the data on land use presented in Figure 63, a clear pattern emerges that correlates with the previously discussed distribution of the population across the region. Municipalities located along the coast exhibit a substantial portion of their land occupied by residential and commercial buildings, indicating a high degree of urbanisation and development. These coastal areas, with their larger populations, have experienced significant growth, which is reflected in the spatial arrangement of built-up areas. In contrast, the inland municipalities, which are characterised by smaller populations, display much lower levels of urbanisation. There is little ongoing development in these areas, highlighting the relative stagnation in urban growth outside the coastal zones.

However, an interesting exception arises with the municipalities situated in the Madonie mountains. In this specific region, despite its generally lower population density, there has been a noticeable uptick in economic activities. This increase in economic activity has led to some degree of urban development, though it remains limited compared to the rapid growth seen along the coast. This dynamic points to a localised shift in land use patterns, driven by specific regional factors, particularly the rise of economic opportunities in the Madonie area.

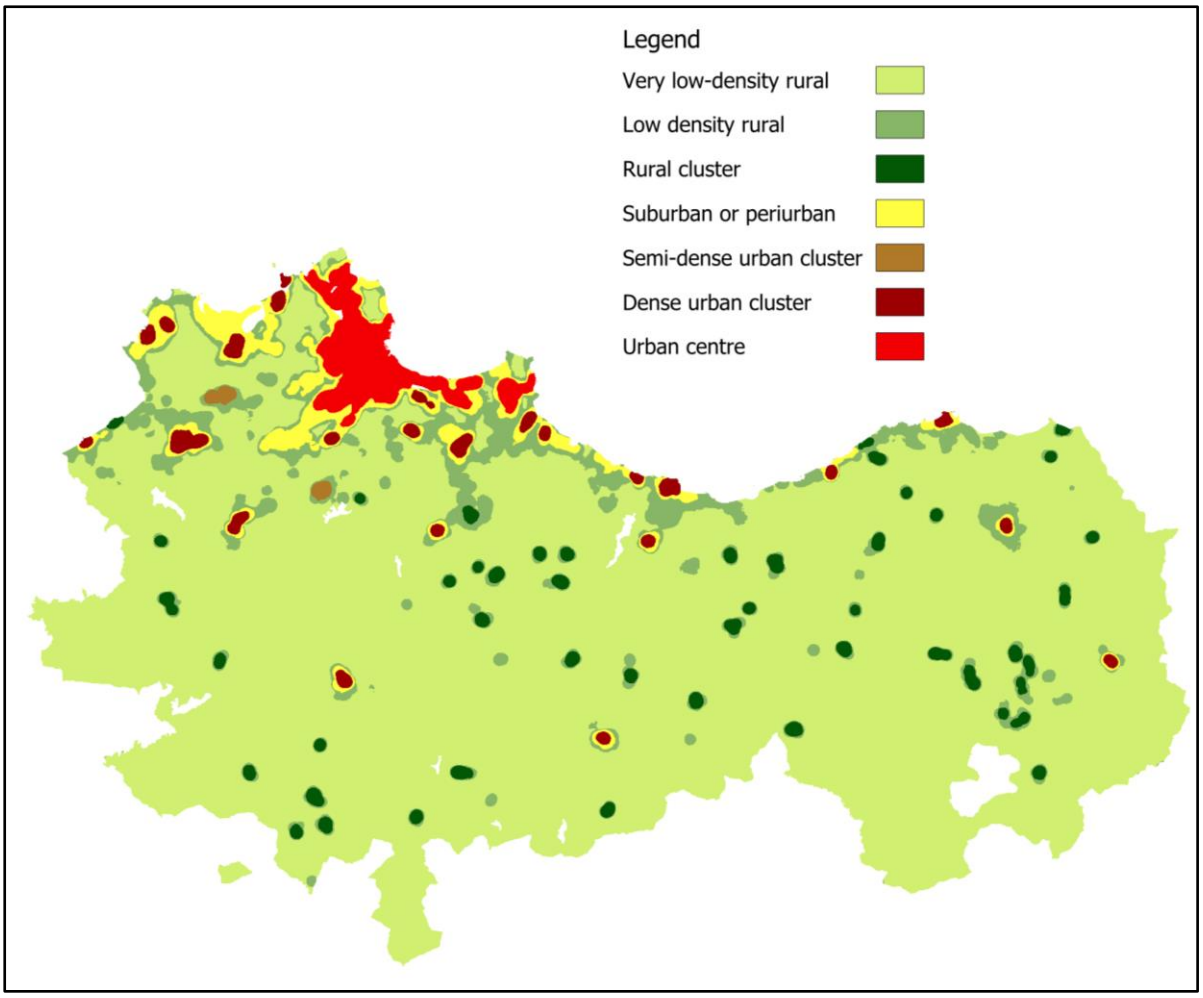


Figure 63. Artificialisation degree of land in the Metropolitan City of Palermo, 2021.
Source: ISPRA.

In terms of demography, Italy faces a significant demographic decline, with a shrinking younger population and a growing elderly population. Sicily, traditionally a younger region, is ageing even faster. This trend, combined with youth emigration, is altering the relationship between generations and impacting social and economic growth. Palermo has the edge over other national metropolitan cities with a higher share of young people (0-14 years) and a lower share of the elderly. However, it still faces a rapidly ageing population. While northern CMs show stable trends, southern CMs experience a rapid rise in the elderly population. Besides, Palermo has a negative migration balance (-4.5), which is one of the highest in Italy. Elderly dependency ratio, which indicates the number of elderly (65+) for every 100 people of active age, has increased from 25% in 2000 to 31.9% in 2019 in Palermo. Especially low-density and non-coastal areas experience severe population ageing, with over 300 elderly people per 100 young people. On the other hand, Palermo City and neighbouring municipalities such as Carini, Ficarazzi, Villabate, have a lower elderly dependency ratio, with some even having a prevalence of young people (Dolce, Barbera, Rosone, and Patti, 2020).

For strategic planning in metropolitan cities like Palermo, continuous monitoring of demographic trends is crucial. Analysing both natural population changes and migration patterns will help define effective public spending strategies to support families and address the ageing population. It is also important to consider effectively supporting youth to decrease their migration to other regions with better employment opportunities and a higher quality of life.

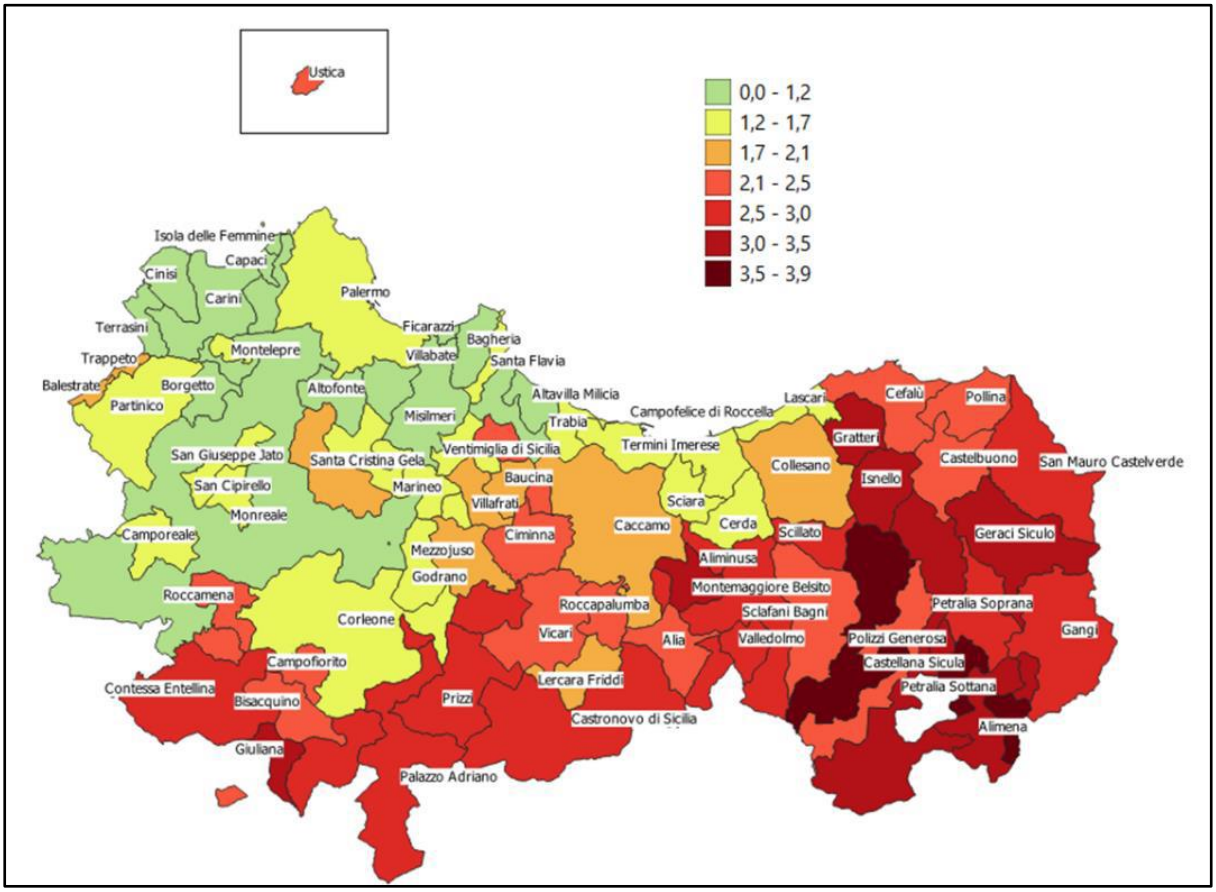


Figure 64. Ageing Index Municipal Distribution, 2019.
Source: ISTAT.

As of 2024, the Functional Urban Area (FUA) of Palermo, defined by the OECD and the European Commission as a spatial unit based on functional linkages such as commuting flows and economic interdependencies, encompasses 31 municipalities and is home to approximately 985,000 residents. This broader metropolitan configuration reflects significant spatial and demographic disparities, particularly in terms of population density. While the urban core of Palermo maintains a high density of around 4,100 inhabitants per square kilometre, the surrounding suburban municipalities average only 659 inhabitants/km², revealing a pronounced contrast in urban form and land use intensity.

Demographic shifts have reinforced the suburbanisation trend around Palermo. Between 1991 and 2011, the city's population declined by about 6%, while surrounding municipalities grew by over 20%. Although this slowed in the following decade, recent factors, such as the COVID-19 pandemic, rising living costs, and changing housing preferences, have renewed migration toward the urban periphery. This has intensified pressure on regional mobility systems and public services, underscoring the need for integrated planning to ensure balanced growth, accessible services, and sustainable transport.



Figure 65. Functional Urban Areas of Palermo.

Between 2011 and 2021, the FUA's population declined by 1.7%, mainly due to internal migration, while the natural growth rate remained stable (-0.1%). The presence of foreign residents is low (3.1%) compared to similar metropolitan areas, and their distribution is not concentrated in the central city. Despite suburban expansion, public services (healthcare, education, transport, and utilities) remain centralised in Palermo, increasing accessibility issues. Many municipalities face deficiencies in water supply, waste management, and transportation, highlighting the urgent need for mobility improvements and public service reorganisation at the metropolitan level (Il Dipartimento della Programmazione della Regione Siciliana, 2024).

5.1.2 Demography of the metropolitan area of Palermo

As a sub-region of the Metropolitan City of Palermo, the Metropolitan Area of Palermo is also the largest in the Sicily Region, which extends over a surface area of 1.391 km^2 and has a population of 1.069.754 inhabitants. The metropolitan area of Palermo includes the city of Palermo and 26 other neighbouring municipalities from Partinico (west) to Termini Imerese (east). These 27 municipalities also encompass Ustica, a small island northwest of Palermo with unique characteristics that set it apart from the mainland municipalities (Piraino, 1988; Di Leo and Esposito, 1991; Grasso, 1994). Among those 27 municipalities, Bagheria, Monreale, and Carini are the most populated after Palermo. There are strong social and economic relations between the capital (Palermo) and the neighbouring municipalities.

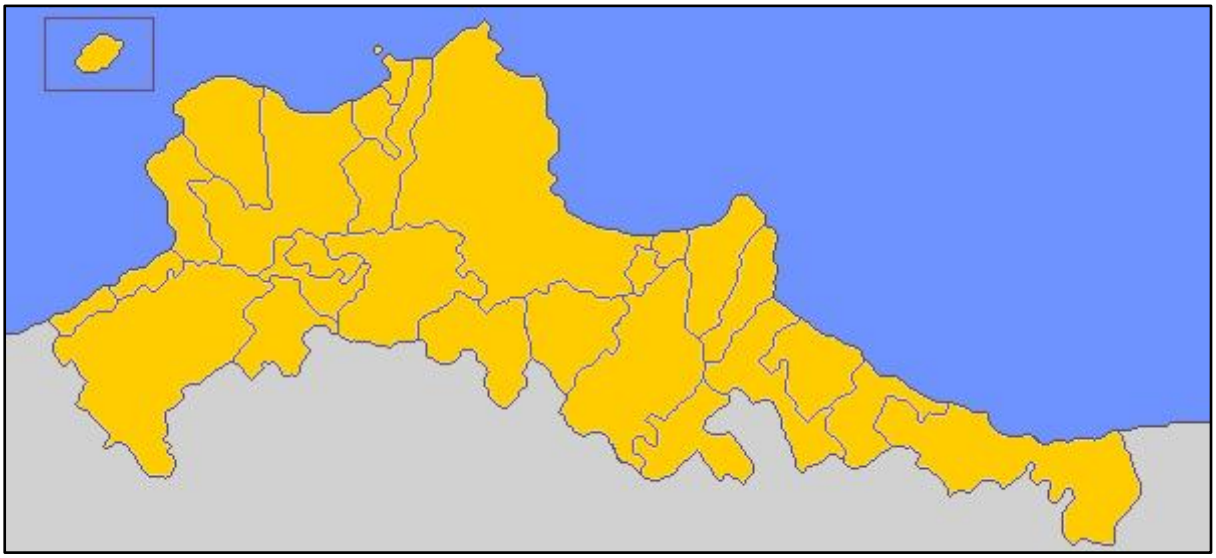


Figure 66. Metropolitan Area of Palermo.

Although being designated a metropolitan area in 1995, Palermo has yet to fully embrace this status (Di Leo 1997; Schilleci 2005, 2008a, b). However, the Regione Siciliana (Sicilian regional authority) recently enacted a reform paving the way for the official establishment of the Città Metropolitana (Metropolitan City) of Palermo (Lotta 2015).

While Palermo has undoubtedly faced challenges and periods of marginalisation (Cannarozzo, 2000; Pinzello, 2003; Rossi Doria, 2003; Rossi Doria et al., 2005; Lo Piccolo, 2009; Lo Piccolo et al., 2013), it is important to recognise its enduring significance in the Mediterranean basin for centuries (Picone, Lo Piccolo, and Schilleci, 2021). Also, it is crucial to note a key distinction: although Palermo's national ranking has slowed in recent decades, it remains the undisputed leader within its Metropolitan Area. The second-largest town, Bagheria, maintains a significantly smaller population. Interestingly, the ratio between Palermo and Bagheria has narrowed over time, shifting from 18:1 in 1921 to 12:1 in 2011.

While Palermo's population has remained relatively stable, the nearby towns have seen growth. Looking at the population percentage variation from 1971 to 2011, towns like Isola delle Femmine (+176%) and Carini (+129%) show remarkable increases, concerning Palermo's slight population growth (+2%). This phenomenon partially aligns with Edward Soja's (2011) density convergence theory. While Palermo's population density increased slightly (+91 per sq. km) between 1971 and 2011, surrounding areas like Villabate experienced a dramatic rise (+2,490 per sq. km), effectively doubling its original density, to the point of surpassing Palermo as the highest-density town of the area.

5.1.3 Demography of the municipality of Palermo

The Municipality of Palermo, the capital and the most populated city of the Sicily Region, is the fifth biggest city in Italy with 630.167 residents and is recognised as the functional and economic centre of Sicily (ISTAT, 2023).

Palermo's population trajectory is like many major Italian cities. At first, the city experienced a period of rapid and steady growth, ensuring its position as the fifth most populous city in Italy. However, this growth has slowed down in the last decades.

Overall, Palermo has an ageing population with a notable decreasing trend in the number of children by more than half from 29% to 13.8% between 1971 and 2022, while the elderly population more than doubled from 9% to 22.7%. Palermo's employment rate remains significantly lower compared to cities in the centre-north of Italy, with the male employment rate at 52.5% and the female employment rate at 34.6%. The unemployment rate decreased slightly to 20.6% in 2022 compared to 2021, but rose by 2.9 percentage points compared to 2019. Despite the decrease in unemployment from 2021, there was a notable increase of 18.8% compared to pre-pandemic levels in 2019, indicating challenges in post-pandemic economic recovery (Municipality of Palermo, 2023).

The city is partitioned into 8 circumscriptions, each characterised by distinct socio-demographic and socio-spatial features, making them significant contributors to inequalities in Palermo. These disparities among neighbourhoods have various underlying factors. One of the most important reasons is the distribution of services and amenities throughout the city, which are aggregated mostly in the central neighbourhoods. Besides, the findings based on 2011 census data (ISTAT, 2023) reveal a significant concentration of employees, particularly in service-related sectors, spanning from the historic centre to the northern and southern areas of the city. For these causes, even though there is a population loss (more than 25.000 compared to 2011) towards the suburban areas (Lotta, Picone, and Schilleci, 2017), the core city is still the daily destination of thousands of commuters.

Economic structure and activities

Italy's national unemployment rate declined between 2001 and 2011 but rose again by 2019 (9.8% in December) following the delayed impact of the global economic crisis compared to countries like the United States. This trend was mirrored across Sicilian towns, including the Province of Palermo (now the Metropolitan City of Palermo), where unemployment fluctuated from 20% in 2004 to 19% in 2018 (Picone, Lo Piccolo, and Schilleci, 2021). Despite slight improvements, Sicily's 2011 unemployment rates remained among the highest in Italy. Within the Palermo metropolitan area, municipalities like Capaci (31%) and Villabate (29%) reported significantly higher unemployment, while even Palermo itself had a 23% rate, much higher than Northern cities like Milan or Venice (approx. 6%), though comparable to Southern counterparts such as Naples and Catania (26%) and Cagliari (17%).

The employment structure across the metropolitan area (MA) remains traditional. Fishing, while still relevant in some towns, has declined. In Santa Flavia, for instance, employment in agriculture and fishing dropped from 40% in 2001 to 26% in 2011. Agriculture overall holds little strategic weight compared to other Sicilian regions. The tourism sector shows limited growth in most towns except Palermo, which experienced a post-COVID boom, gaining global visibility through media exposure such as the TV series White Lotus (Sanderson, 2024). Wholesale trade (Sector G) remains relatively resilient but does not signify structural innovation. According to Scott's (2008) interpretation of post-metropolitan economies, Palermo diverges from typical global urban economic transformations.

Income levels further highlight economic disparities. Picone, Lo Piccolo, and Schilleci (2021) report that Palermo, despite having some of the highest taxpayer incomes in Sicily, shows extreme contrasts within the metropolitan area. Coastal municipalities generally report higher incomes, while inland towns fall behind. Palermo's per capita income (€11,073) contrasts sharply with its average taxpayer income (€19,867), reflecting high unemployment. This gap is more moderate in Northern cities like Venice (€17,207 vs. €22,223), suggesting broader access to stable employment. These figures underscore persistent economic inequality across the region.

Finally, within Palermo itself, economic activity is spatially uneven. Central districts such as Libertà, Malaspina, and the Old Town exhibit much higher concentrations of businesses and employees than peripheral neighbourhoods.



Figure 67. Analysis of businesses in Municipality of Palermo from PGTU (2015).

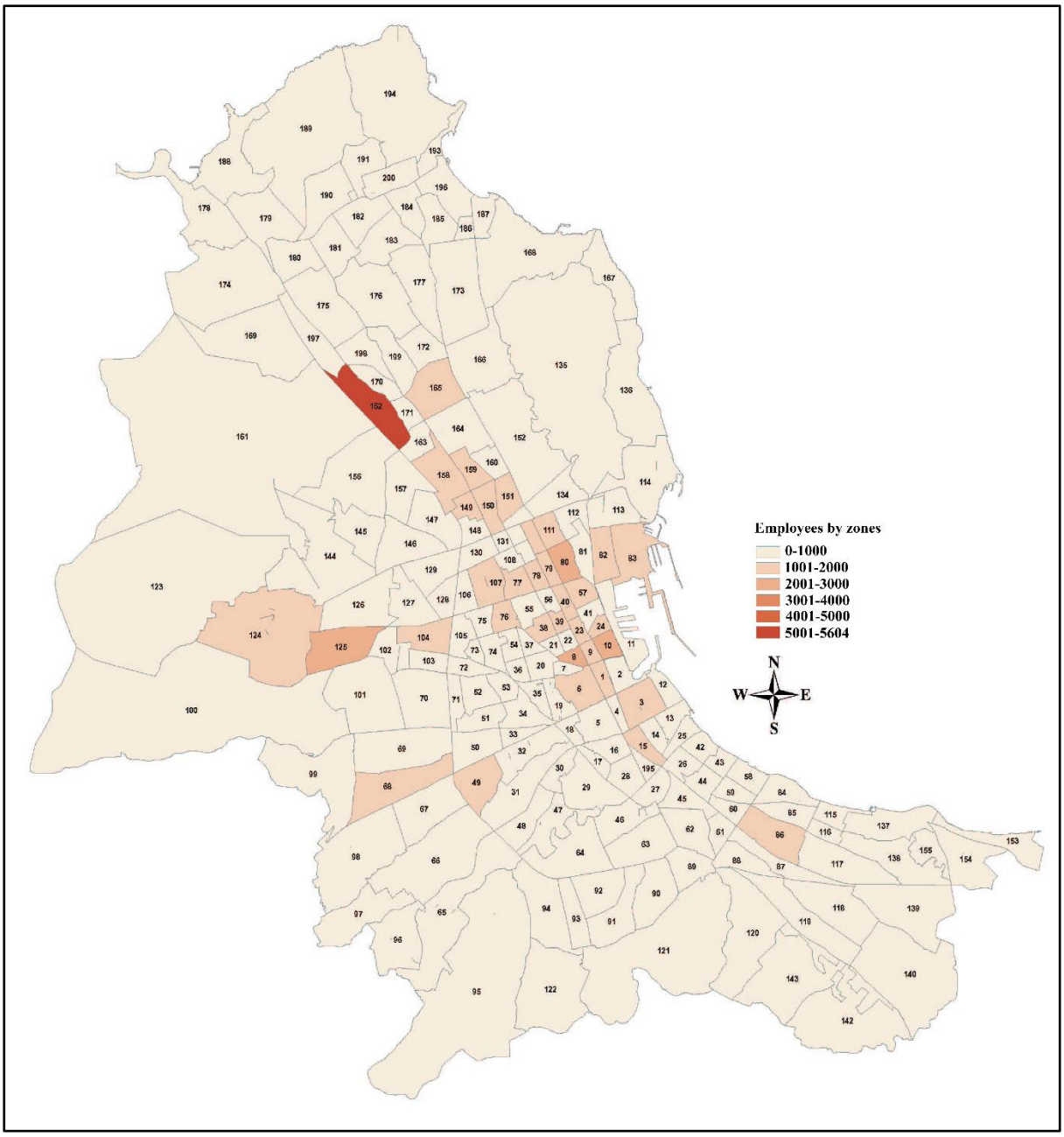


Figure 68. Analysis of employees in the Municipality of Palermo from PGTU (2015).

Analysing this Figure is crucial for understanding the daily traffic patterns generated by workplaces and employees, including vehicle and public transport usage. This information helps identify areas with the highest traffic volumes and can inform targeted transportation planning initiatives.

5.2 Territorial dynamics: Urban structure and commuting

This section provides a comprehensive analysis of Palermo's territorial dynamics, examining its metropolitan city, metropolitan area, and municipal boundaries as interconnected elements. The study offers insights into the region's urban structure while exploring commuting patterns and their relationship with spatial organisation. By understanding these dynamics, the section highlights key factors shaping mobility and settlement patterns, contributing to a broader understanding of the city's development.

According to the urbanisation theories, Picone (2006) suggests that Palermo might be reaching a late 'disurbanisation' stage. Its path demonstrates the classic urban life-cycle model proposed by Van den Berg et al. (1982). Initially, as a medium-sized city attracting population, it led to a period of centralisation. After that, Palermo entered a process of suburbanisation with population shifting towards surrounding areas.

The urban structure of the Metropolitan Area of Palermo reflects characteristics commonly associated with urban sprawl, as described by Bruegmann (2005). These features can be explained as inefficient use of land and resources caused by high land consumption, the dispersed nature of development that increases management costs regarding infrastructure and services, the lack of essential amenities and their dispersion that necessitates long commutes and creates heavy traffic congestion for peak hours.

Regarding the urbanisation pattern of the Metropolitan Area, peri-urban areas initially served residential purposes, followed by industrial development. This trend is evident in the increasing "coverage ratio", meaning urbanisation, particularly near the coastal areas and municipalities closer to Palermo. This process has gradually captured the historic 'agro' (agricultural lands) surrounding the city (Picone, Lo Piccolo, and Schilleci, 2021).

5.2.1 Commuter flows and transport

Developing sustainable mobility strategies requires a thorough understanding of the interplay between urbanisation, land use, and transportation. The spatial configuration of a city's land use and transport systems plays a fundamental role in shaping travel behaviour, influencing mode choice and trip distances (Wee and Maat, 2003). Higher-density areas tend to support greater public transport use, while lower-density areas rely more on private cars (Dargay and Hanly, 2003).

In the Palermo metropolitan area, commuter flow analysis provides key insights into territorial dynamics. The capital city attracts a substantial daily influx from Bagheria, Partinico, and Termini Imerese while also sending a smaller number of commuters to these areas. This pattern suggests that these municipalities have stronger economic activity compared to others, such as Corleone, which exhibits limited outward commuting (Dolce, Barbera, Rosone, and Patti, 2020).

Urban areas can also be classified based on commuter flows, with one significant approach being the concept of Metropolitan Rings. This method, adopted in the Anci-Cittalia study, considers a city and its surrounding areas as a single functional system, emphasising their economic and social interdependencies beyond administrative borders. It relies on two key indicators, population density and economic ties, to assess the degree of integration with the core city.

The first metropolitan ring includes areas with strong economic and mobility connections to the central city, forming a highly integrated zone. The second ring consists of municipalities that maintain weaker but still relevant links to the core, often overlapping with the remaining provincial territory not included in the first ring (Dolce, Barbera, Rosone, and Patti, 2020).

According to Anci-Cittalia, Italy's 14 metropolitan cities follow four distinct typologies, with Palermo classified as an "Expanded Metropolitan Area." This classification reflects a high degree of integration across significant distances, where the boundaries between the first and second rings are less distinct. Palermo's first metropolitan ring extends 36 km from the core, encompassing 37 municipalities with a combined population exceeding one million, while the second ring includes 44 additional municipalities.

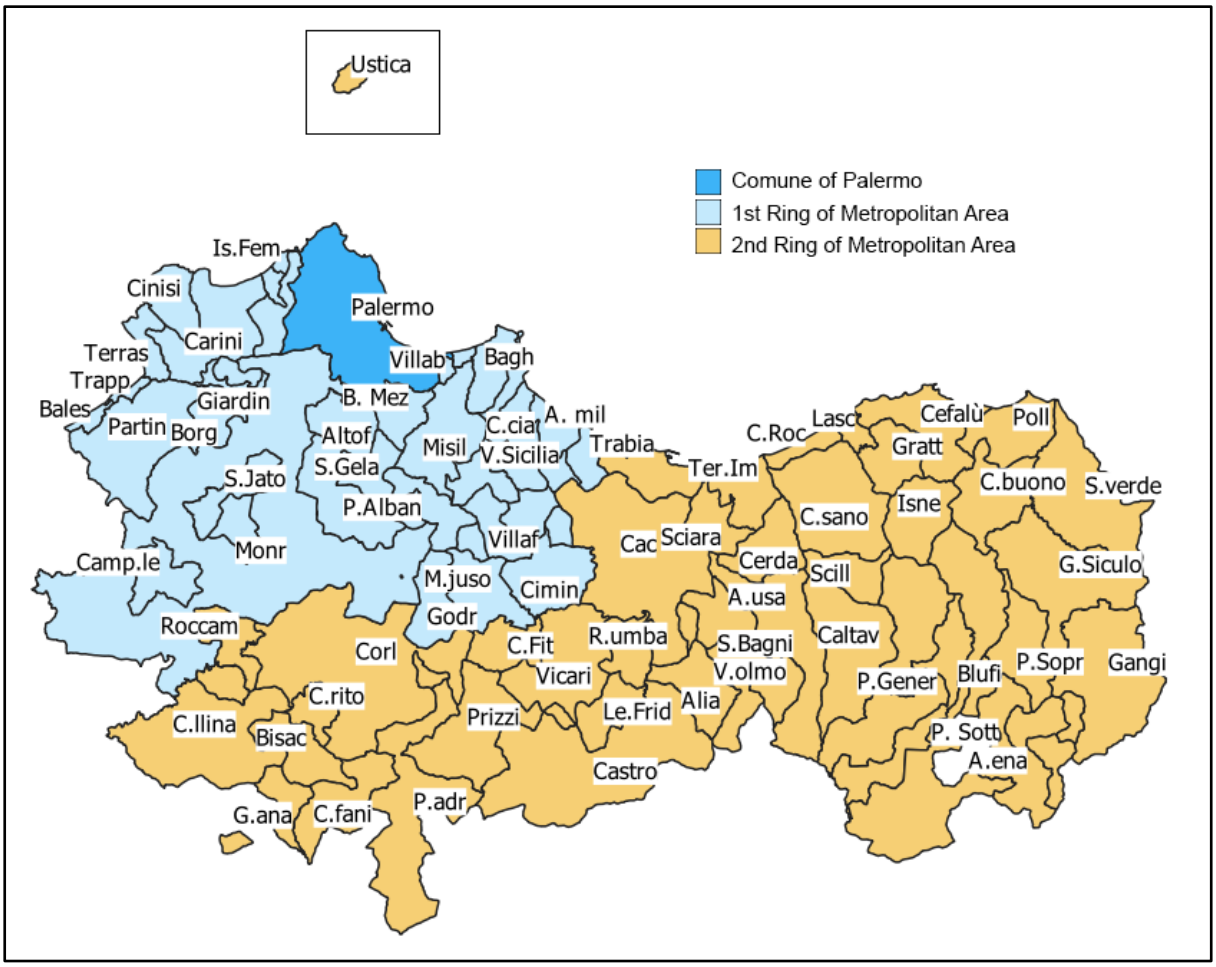


Figure 69. Metropolitan Rings of Palermo according to Anci-Cittalia
Source: ISTAT.

Moreover, as mentioned in the Metropolitan Dossier (Dolce, Barbera, Rosone, and Patti, 2020), Palermo Metropolitan City is examined according to the 'self-containment index', which explores how many people work within the borders of their own municipality. The analysis shows that Palermo has an exceedingly high self-containment rate (78.5%), meaning that almost 8 out of 10 employed residents in Palermo work within the city borders. Besides, it is seen that Palermo has a strong pull on the workers within a 20 km radius. On the other hand, in the municipalities within 10 km, the self-containment drops to 30.4% and for those between 10-20 km, it is 37.6%. These results show that Palermo attracts workers from nearby areas.

Beyond 20 km, the self-containment increases to around 50%. This suggests that Palermo's influence weakens at this distance, and the other municipalities start to play a role in attracting labour. On Fig. 70, it is clearly seen how Palermo attracts employees from nearby municipalities, but further municipalities have their own systems.

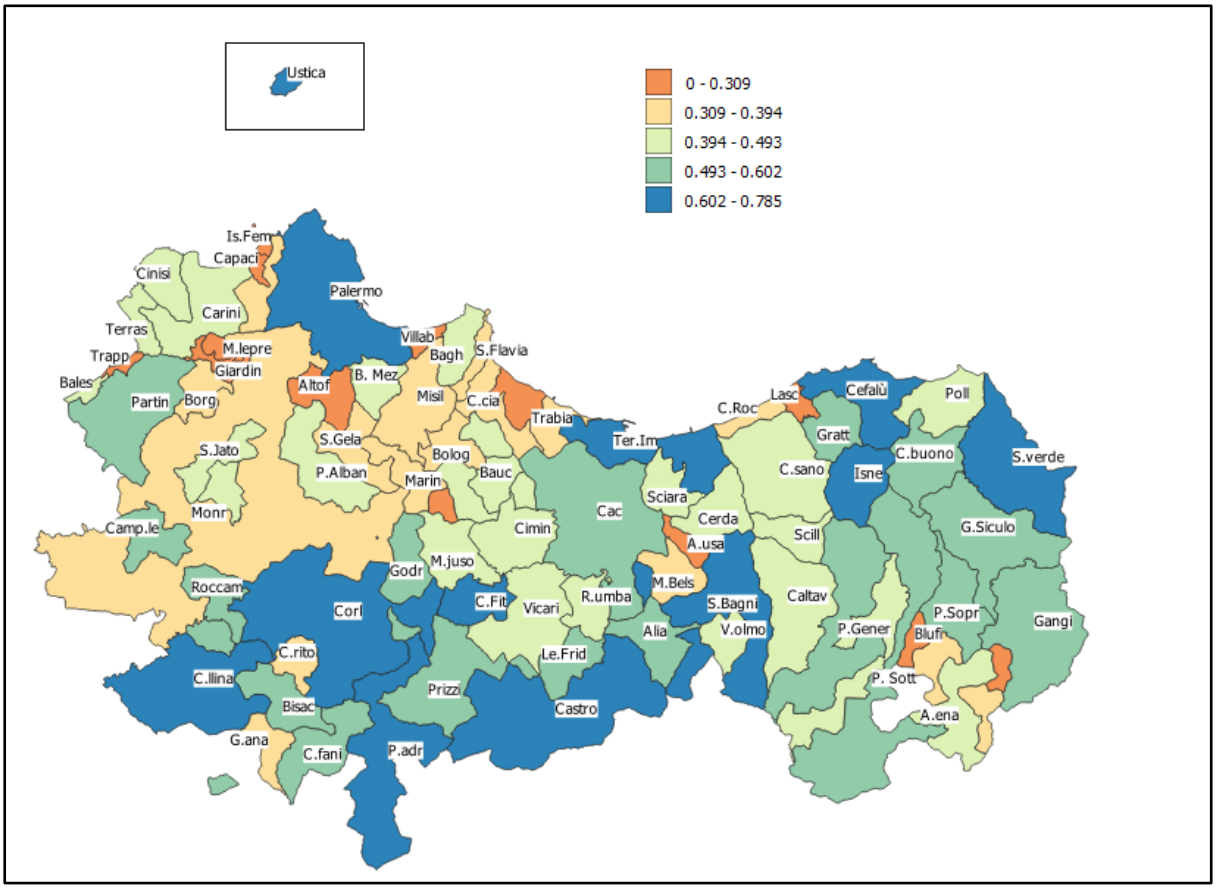


Figure 70. Map of self-containment index in Metropolitan City of Palermo, 2012.
Source: ISTAT.

As can be seen in the Figure below, even on a territorial scale, the amount of traffic flows is greater near the capital and in the municipalities of the first and second belt of the same.

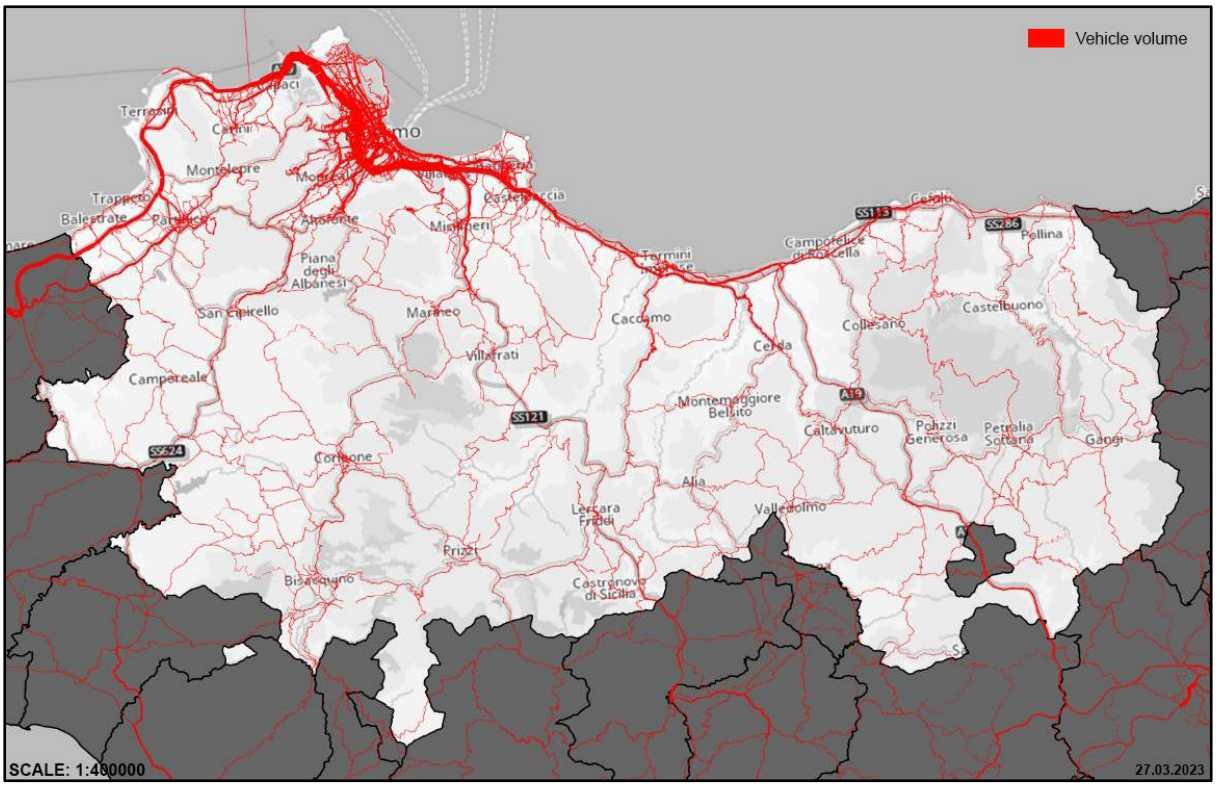


Figure 71. Private vehicle flow in the morning rush hour.
Source: SUMP, 2024.

Figures 70 and 71 provide valuable insights into commuter patterns, particularly the daily inflow of workers and students to Palermo, which significantly impacts traffic congestion. Understanding these movements is essential for designing an effective mobility strategy that meets the needs of the entire metropolitan area.

Despite this, the public transport network at the metropolitan level remains inadequate to efficiently serve demand. The Figure below illustrates travel times to Palermo by train and bus from municipalities within the metropolitan area. The railway network only covers a limited number of municipalities, making bus services a crucial alternative. However, bus travel times are often long and inconsistent due to traffic conditions and limited priority measures. The lack of a well-integrated, high-frequency public transport system prevents accessibility, making private car use the most viable option for many commuters. Addressing these gaps through improved rail connectivity, better intermodal coordination, and dedicated bus corridors is essential for reducing car dependency and enhancing regional mobility.

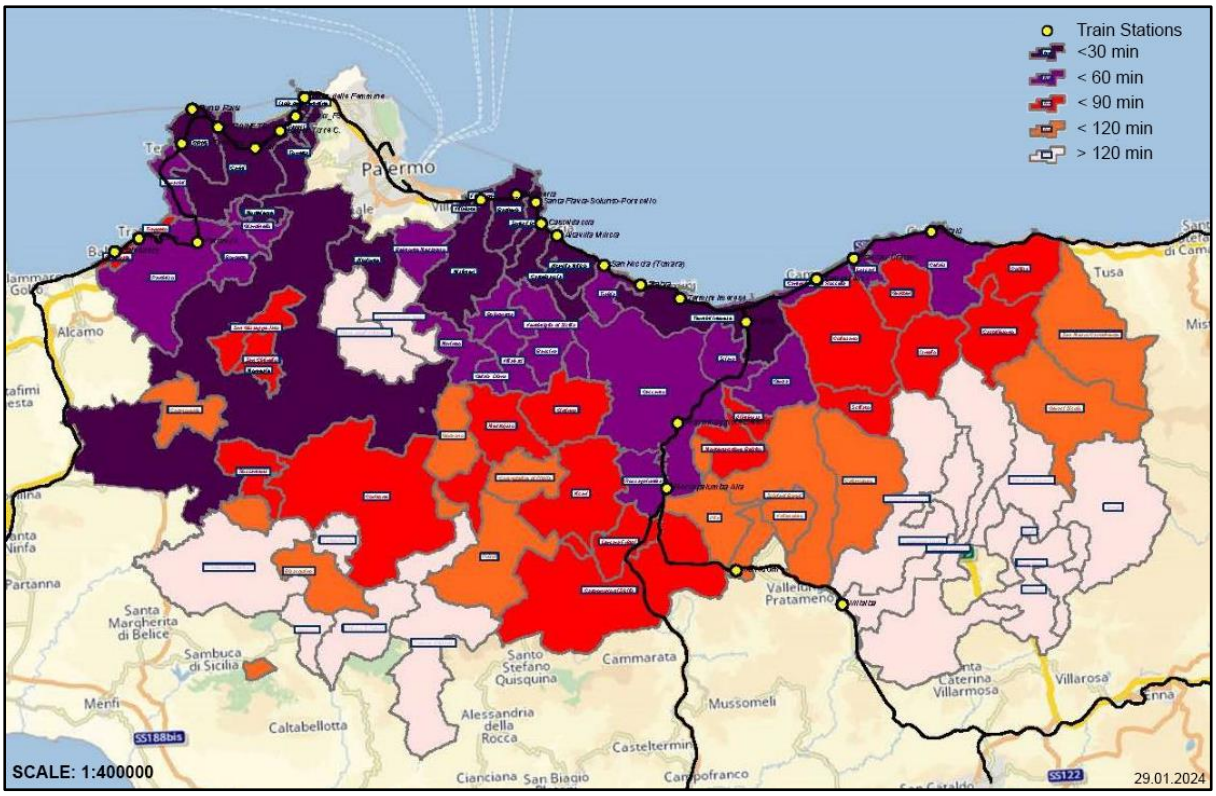


Figure 72. Average travel time to Palermo municipality by train or bus from other municipalities.
Source: SUMP, 2024.

Considering these factors, Palermo faces persistent congestion, traffic bottlenecks, and parking shortages due to its car-dependent urban model and inefficient public transport system. Despite the city's growing appeal from tourism and ongoing regeneration since the 1990s (Vinci, 2019), there is an urgent need for a well-structured mobility network that connects key areas.

Table 7. Inrix-2022 Global Traffic Congestion Scorecard.

2022 Impact Rank (2021 Rank)	Urban Area	Country	2022 Delay per Driver (h)	Change from 2021	Change from Pre-COVID
1 (1)	London	UK	156	5%	5%
2 (6)	Chicago	USA	155	49%	7%
3 (2)	Paris	FRA	138	-1%	-16%
4 (18)	Boston	USA	134	72%	-10%
5 (5)	New York City	USA	117	15%	-16%
6 (8)	Bogota	COL	122	30%	-36%
7 (22)	Toronto	CAN	118	59%	-13%
8 (13)	Philadelphia	USA	114	27%	-20%
9 (32)	Miami	USA	105	59%	30%
10 (9)	Palermo	ITA	121	11%	-12%

Source: Pishue, 2023.

Palermo has been ranked among the most congested cities in Europe according to various sources (TomTom International BV, 2024; Pishue, 2023), and it has approximately 3500 cars per square kilometre (Vinci and Di Dio, 2016), which is the second highest in Italy after Naples. Despite having a bus network of around 341 km, the effectiveness of the service is deterred by congestion (low commercial speed by 12 km/h) (Di Dio et al., 2015) and limited bus availability (one of the oldest fleets in the country with 50% of Euro 0 and Euro 1 vehicles) (Vinci and Di Dio, 2016). The railway service operated by Trenitalia provides an alternative, but its schedule frequency does not match the metropolitan standards. Consequently, private vehicles and motor vehicles dominate the modal split with 78% (active mobility 13%, public transport 9%). Therefore, Palermo is among the Italian metropolitan cities furthest from the sustainable mobility objective set by the European Union for 2030 (Kyoto Club - CNR-IIA, 2023).

5.3 Urban functions

This section provides a comprehensive analysis of Palermo's urban functions, examining both the metropolitan area and the municipality level. To gain a comprehensive understanding of resident mobility patterns and inform future planning efforts, it is essential to analyse the distribution of services across the metropolitan area. By examining the availability and accessibility of numerous services, we can identify areas of need and develop targeted strategies to enhance the overall quality of life for residents.

5.3.1 Urban functions in the metropolitan area

The National Strategy for Internal Areas (SNAI) provides a valuable framework for assessing the current state of service provision. SNAI is a vital part of the European Structural Funds for the 2014-2020 programming cycle, and its primary objective is to support regions with limited access to essential services and infrastructure. This strategic initiative aims to bridge the development gap and enhance the quality of life in these underserved areas (Camera dei deputati, 2018). In the classification of SNAI, the populations of the municipalities are not considered. The criteria focus on the distances from the key services (high school, hospital with emergency care, a major train station) and accessibility.

Areas with all three services are called "hubs." Municipalities near hubs (less than 20 minutes away) are considered well-connected. Municipalities further away are classified as "internal areas" based on travel time:

Table 8. Classification of municipalities based on their distances from hubs.

Classification of municipalities	Distance from “hubs”
Intermediate Areas	20-40 minutes
Peripheral Areas	40-75 minutes
Ultra-peripheral Areas	Over 75 minutes

Over 60% of Italy's land area and 7.6% of its population are considered ‘internal areas’. In the metropolitan city of Palermo, there are different services delivered on various levels (Dolce, Barbera, Rosone, and Patti, 2020).

Table 9. Services and delivery levels in the Metropolitan City of Palermo.

Service Level	Services
Provincial Level	School offices, Integrated water service (ATO)
Sub-provincial Level	Territorial development services
Specific Services	Employment Centres (11), Waste Management (3 companies), Courts (2), Port Authorities (6), Healthcare (1 ASP, 10 districts), Rural Development (4 LAGs, 14 LSLs), Municipal Cooperation (8 Unions), Economic Development (4 Consortia/Agencies)

Below, Fig. 723 highlights Palermo Province's role as a major service hub for the Sicilian Region, due to its status as the capital city. Municipalities close to Palermo benefit from this proximity, with good connections to essential services. Those further away, classified as 'internal areas,' lack these services and face limited accessibility to the main service hub.

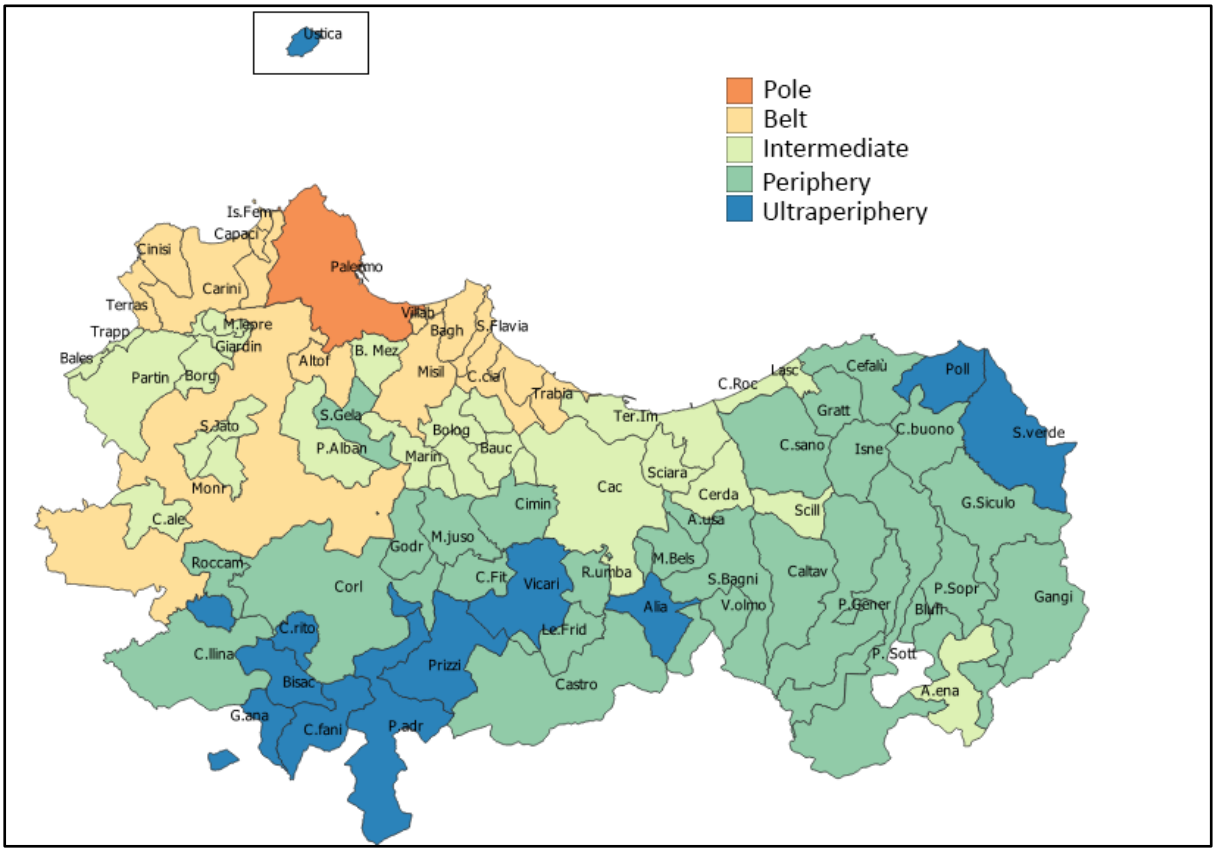


Figure 73. Municipalities in the Metropolitan area of Palermo by distance from the service delivery hubs. Source: Dolce, Barbera, Rosone, and Patti, 2020.

The Metropolitan City of Palermo has 13 distinct local labour systems (LSLs) – groups of neighbouring municipalities with shared socio-economic ties and work commutes. These LSLs vary in size and population. The largest by far is the Palermo LSL, but national statistics classify it as a "Territory of Hardship" due to challenges in education and the labour market. Beyond Palermo, the remaining municipalities fall into two distinct categories:

This analysis reveals a diverse landscape within Palermo's Metropolitan City. While the Palermo LSL dominates in terms of population, it faces its own set of challenges. Meanwhile, other LSLs highlight potential for growth or struggle with remoteness and a declining population.

5.3.2 Urban functions in the municipality of Palermo

Palermo's heterogeneous urban character is shaped by its rich history and dynamic evolution. Hence, it has mostly an integrated urban structure, where various functions are intertwined. Palermo has 49 km of coastline, 368 hectares of urban green spaces, 1,600 hectares of agricultural areas and 113 hectares of abandoned or underused industrial areas (Città di Palermo - Assessorato all'urbanistica e alla Rigenerazione Urbana, 2023). Mostly, the dense residential zones are in the core area, such as Liberta, Malasipina, and Noce. Therefore, functions as high schools and post offices are also located near residential zones.

Yet, the historical centre remains the most vibrant and functionally prominent area of the city. Covering 2.4 km² and home to 25,000 residents, it retains its historical significance. However, while urban decay persists in certain parts, the primary concern is the number of buildings at risk of collapse due to structural deterioration.

The historic centre of Palermo dates to the Phoenician period and has expanded significantly since the Arab period, leading to extensive urbanisation and changes in the landscape (Cappadonia, Di Maggio, Agate, and Agnesi, 2020). In the last couple of decades, there have been many attempts to revitalise the historic centre due to its potential to represent the city effectively. These revitalisation and redevelopment efforts for the historic centre have been a foundation of Palermo’s urban development strategy. These initiatives have aimed to enhance the architectural quality, urban fabrics, and streets, while also promoting social and economic regeneration and sustainable development, including mobility (Vinci, 2019).

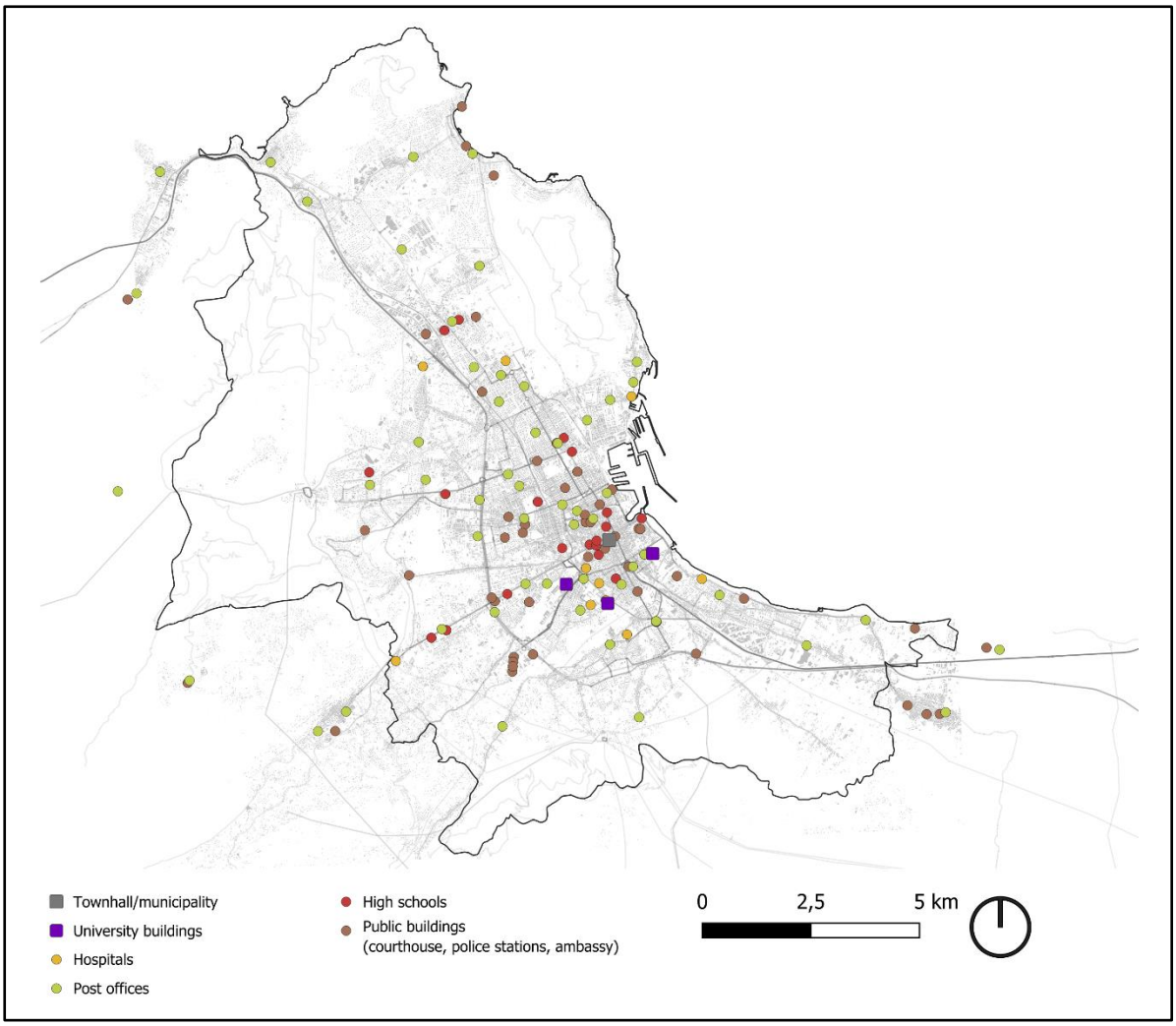


Figure 74. Distribution of city-level amenities and functions in Palermo.

Another important cornerstone for the redevelopment of the urban fabric is the "Arab-Norman Palermo" itinerary, including the Royal Palace and Palatine Chapel, Zisa Palace, Palermo Cathedral, recognised by UNESCO (UNESCO World Heritage Centre, 2015). The management and conservation of those sites require strong planning and policies against socio-economic decay of the historic urban centres, which led to the reorganisation of the historic centre.

These initiatives demonstrate Palermo's commitment to sustainable urban development and its ability to balance heritage preservation with modern-day needs. The city's transformation has not only enhanced its appeal as a tourist destination but has also improved the quality of life for its residents. Palermo's growing popularity as a tourist destination has required the revitalisation of its major transportation hubs, including the port and airport.

Palermo International Airport, officially named Punta Raisi "Falcone e Borsellino" Airport, serves as a vital transportation hub for the city and the broader metropolitan region. Located approximately 35 kilometres west of Palermo in the municipality of Cinisi, it is the third-busiest airport in Southern Italy and ranks ninth nationwide in terms of passenger volume. The airport honours anti-mafia magistrates Giovanni Falcone and Paolo Borsellino, symbolising its importance not only in mobility but also in civic memory. It is well-connected by both road and rail, accessible via the A29 motorway and the Trinacria Express train service, which links the city centre to the airport in around 30 minutes (Redazione - PalermoVia, 2016).

Currently, the airport is undergoing a significant modernisation initiative with a total investment of €68.4 million, aimed at expanding its operational capacity, enhancing user experience, and integrating sustainable design features. The first phase of the project has been completed, delivering upgraded passenger areas and improved infrastructure. Future phases will include the expansion of the terminal building with new check-in desks and security gates, improved accessibility through new ramps and elevators, and environmental upgrades such as energy-efficient lighting and a photovoltaic system to reduce carbon emissions (GES.AP SpA, 2024). These enhancements are expected to significantly strengthen the airport's role in regional connectivity and economic development.



Figure 75. The Punta Raisi Airport today (above) and the projected passenger terminal (below).
Source: Mobilita.org, 2018.

Along the airport, the port of Palermo is another important urban function, offering diverse services and having convenient access to the city. Palermo's port has played a significant role in the city's development throughout history. Its strategic location on the Mediterranean coast has made it a popular destination for trade, tourism, and cultural exchange. Throughout its history, Palermo's port has faced challenges and opportunities. The port's infrastructure has undergone significant modernisation and expansion, adapting to changing needs and technologies (Autorità di Sistema Portuale del Mare di Sicilia Occidentale, 2018).

Today, the port serves as an important centre for passenger and cargo traffic, contributing to the city's economic vitality. It offers regular ferry connections to various Italian and international destinations, handles significant freight traffic, and is a popular destination for cruise ships. The port's role has extended beyond trade and commerce. It has also served as a cultural core, facilitating the exchange of ideas, goods, and people. In recent years, Palermo has focused on revitalising its port area and enhancing its attractiveness as a tourist destination. This includes improvements to infrastructure, public spaces, and cultural amenities. The goal is to create a more vibrant and welcoming environment for visitors and residents.

The most important project that took place in the port is the 'Molo Trapezoidale', which is the pier of the port area. The Trapezoidal Pier redevelopment project aims to redevelop the urban port area of Palermo by creating a mixed-use space that includes an archaeological park, urban lake, pedestrian paths, a panoramic theatre, large parking lots and moorings for mega yachts (Marina Convention Centre, 2022). It has nine new buildings for commercial and catering activities, focusing on local Sicilian products and includes a conference hall/convention centre and spaces for public use. The convention centre is one of the most essential elements of the intervention, thanks to its ideal location near the historical centre and easy access to the airport and central train station. It is equipped with premium products to host important conventions and events.

The project emphasises environmental compatibility, enhancing green spaces, and improving accessibility while preserving historical elements like the Castle walls. The key features of the external areas project include the creation of a large green space of over 12,000 m^2, an urban lake for visual and physical connection to the Castle and expanded pedestrian areas. There were also works on street furniture, aligning them with the landscape, a rainwater collection system, and accessibility improvements for pedestrians and vehicles. All those redevelopment interventions aim to enhance environmental compatibility and promote recreational activities. The project includes the Port Authority of the Western Sicilian Sea, local authorities, and various stakeholders involved in urban planning and redevelopment (Autorità di Sistema Portuale del Mare di Sicilia Occidentale, n.d.).



Figure 76. The convention centre of Trapezoidal Pier.
Source: Marina Convention Centre, 2022.



Figure 77. The dock of Trapezoidal Pier.
Source: Marina Convention Centre, 2022.

Given the importance of tourism and commercial activities for Palermo, the city offers a wide range of functions and services meeting the needs of both residents and visitors. Many of these are concentrated in historical markets like Ballarò, Capo, and Vucciria, where small commercial enterprises, often run by migrant communities, play a crucial role in the local economy. Palermo's retail sector is a key source of employment, with a high concentration of non-food retailers and street vendors, contributing to the city's dynamic street life. Beyond economic activities, public spaces serve as essential hubs for social interaction and cultural exchange, reinforcing the city's rich diversity and strong sense of community (Bonafede and Napoli, 2017).

5.4 Transport network

Palermo's transportation network plays a crucial role in its urban development and accessibility. As a major city in Sicily, Palermo faces unique challenges related to urban mobility, primarily driven by commuting patterns and infrastructure limitations. The city's role as a regional centre for government, education, and healthcare services attracts commuters from surrounding areas, contributing to traffic congestion and strain on public transportation. Understanding the city's transportation network is essential for analysing its urban dynamics, assessing the effectiveness of mobility strategies, and identifying areas for improvement. This section examines the various modes of transportation available in Palermo, briefly, to create a general framework for the next chapters.

5.4.1 Infrastructural development

Over the last twenty years, the municipality of Palermo has adopted measures to promote sustainable mobility to reduce the environmental impact of excessive car use and the city's ageing public transport vehicle fleet. These efforts include expanding and modernising the rail network, introducing a tram system, transitioning part of the bus fleet to natural gas, implementing bike lanes and pedestrian-friendly areas, establishing traffic-restricted zones (ZTL) and toll parking areas (Vinci and Di Dio, 2016).

In 2002, a significant shift occurred with the approval of the "Integrated Plan for Mass Public Transport," marking a new phase in the redevelopment of the transit system, primarily focused on the rail network. This plan, an outcome of various pre-existing projects from public authorities, including RFI[4] (Rete Ferroviaria Italiana), the province of Palermo and the municipality, centred around four major infrastructural initiatives.

[4] The National Owner Of The Rail System

These initiatives included (a) the redevelopment of the existing railway line into a metropolitan service (Railway Bypass); which is also an important object of this research study; (b) the redevelopment of a single track underground line with 8 stops, for a total length of approximately 7 km (Railway ring); (c) three tram lines connecting the main rail stations to peripheral neighbourhoods; and (d) a new subway line crossing the city from North to South. While this last intervention has been suspended, the creation of the tram lines was completed on schedule, and the system will be further developed with additional lines whose construction is expected to start in 2024 (Sezer et al., 2024).

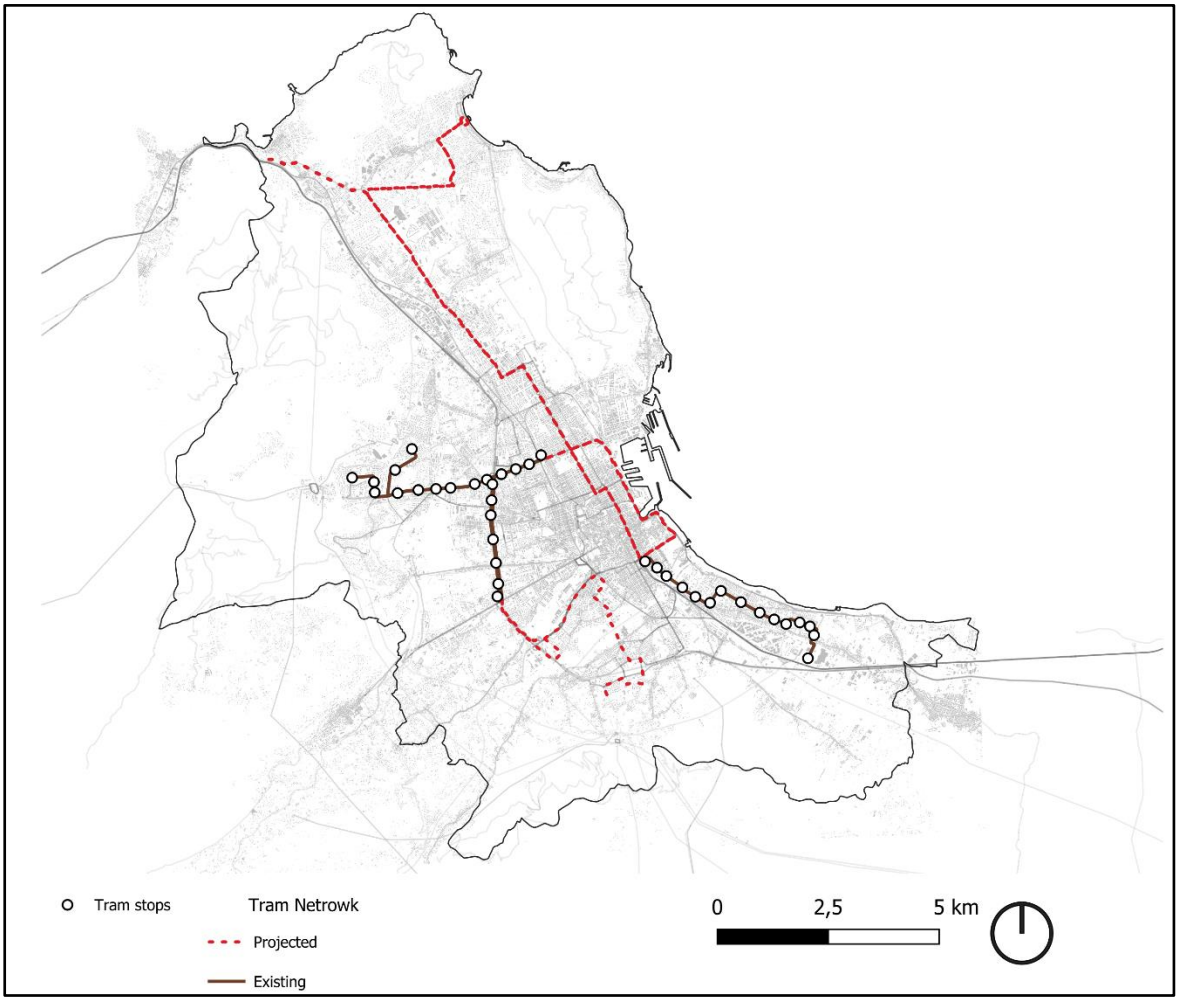


Figure 78. Tram network scenario with projected and existing lines.

The implementations of the Railway ring and the Railway Bypass have faced several challenges over time, and there are still parts under construction. The Railway ring, after delays due to financial issues with the contractor, is now expected to initiate operations in 2024, starting with a section serving the city centre (Politeama station). The full service is expected to be available by 2029. On the other hand, the Railway Bypass, with 30 km of double-track line connecting the airport to the central station, is in operation, but several financial and geological problems have also slowed down the completion of this implementation. Hence, three underground stations are still under construction, and the complete project is expected to be finalised in 2026 (Fig. 81).

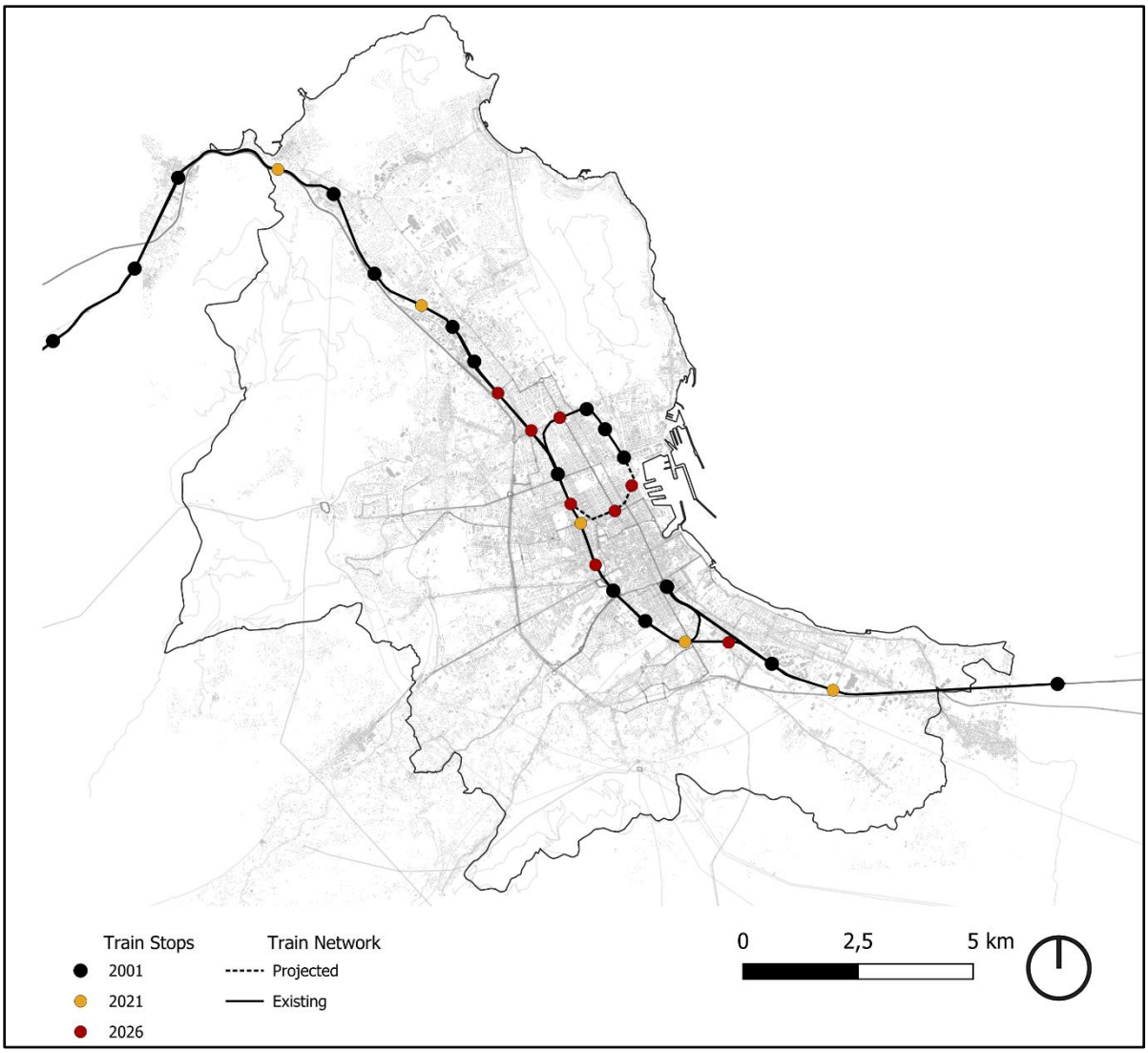


Figure 79. Evolution of Raily Bypass and Rail Ring stations through the years.

The railway network plays a crucial role in mobility transition and for shifting travel behaviour in the metropolitan area, due to its widespread use by commuters to reach the centre and by locals to access urban functions. The Rail Bypass is recognised as strategically important in various planning documents overseen by both municipal and metropolitan authorities. In the preliminary documents for Palermo's future land-use plan, it is seen as central to urban development driven by public transportation that acts like a bridge between core and marginal areas within the city-region.

The interventions started in 2002, were later enhanced in 2013 and 2017 with the approval of the first 'General Urban Traffic Plan' (PGTU) and the first 'Sustainable Urban Mobility Plan' (SUMP). These last two plans were specifically aimed to reduce prominence of cars and to increase active mobility in the city by expending the length of bike and pedestrian networks, replacing outdated bus fleet, creating new bus lanes, and by establishing a wide limited traffic zone regarding the Old Town (Vinci and Di Dio, 2016).

On the other hand, the complexity of the transportation challenges of Palermo comes from the commuters from neighbouring municipalities located in metropolitan areas. Unlike industrial cities where job distribution shapes city-territory relationships, Palermo's expansion is driven by the dispersion of residences due to lower property costs, as explained in the previous sections. This expansion has resulted in the development of new residential areas in areas that were used only in the summer season. Despite the strong agglomeration of commercial activities in the centre, Palermo's periphery continues to extend and continues to reduce the autonomy of neighbouring urban centres.

However, the dispersion of residences across the territory has occurred spontaneously, without comprehensive control or intentional metropolitan planning, as mentioned in the previous sections. As a result, challenges such as high traffic congestion, inefficient public transport services and parking problems have become permanent over time. Traffic flow in the city is regulated by nodes connecting the historic centre with the outer areas. To address these issues, Palermo has implemented urban rebalancing strategies as outlined in the SUMP. These initiatives focus on revitalising abandoned areas, improving infrastructure, and promoting environmental protection. By prioritising residents' needs and reconnecting the city with its historical and natural features, Palermo aims to create a more sustainable and liveable urban environment. The SUMP's focus on these areas aligns with the principles of TOD, which emphasises the integration of land use, transportation, and urban design to create walkable and sustainable communities.

The map below illustrates the pedestrian accessibility to the Railway Bypass in Palermo. This step is important to identify areas where improvements are needed to enhance accessibility and encourage more people to use public transportation. Analysis of the map reveals that many residential areas and the city centre are located at a significant distance from railway stations. Considering the optimal walking time to reach a station is between 7 and 15 minutes, it is evident that many residents face challenges in accessing the railway service.

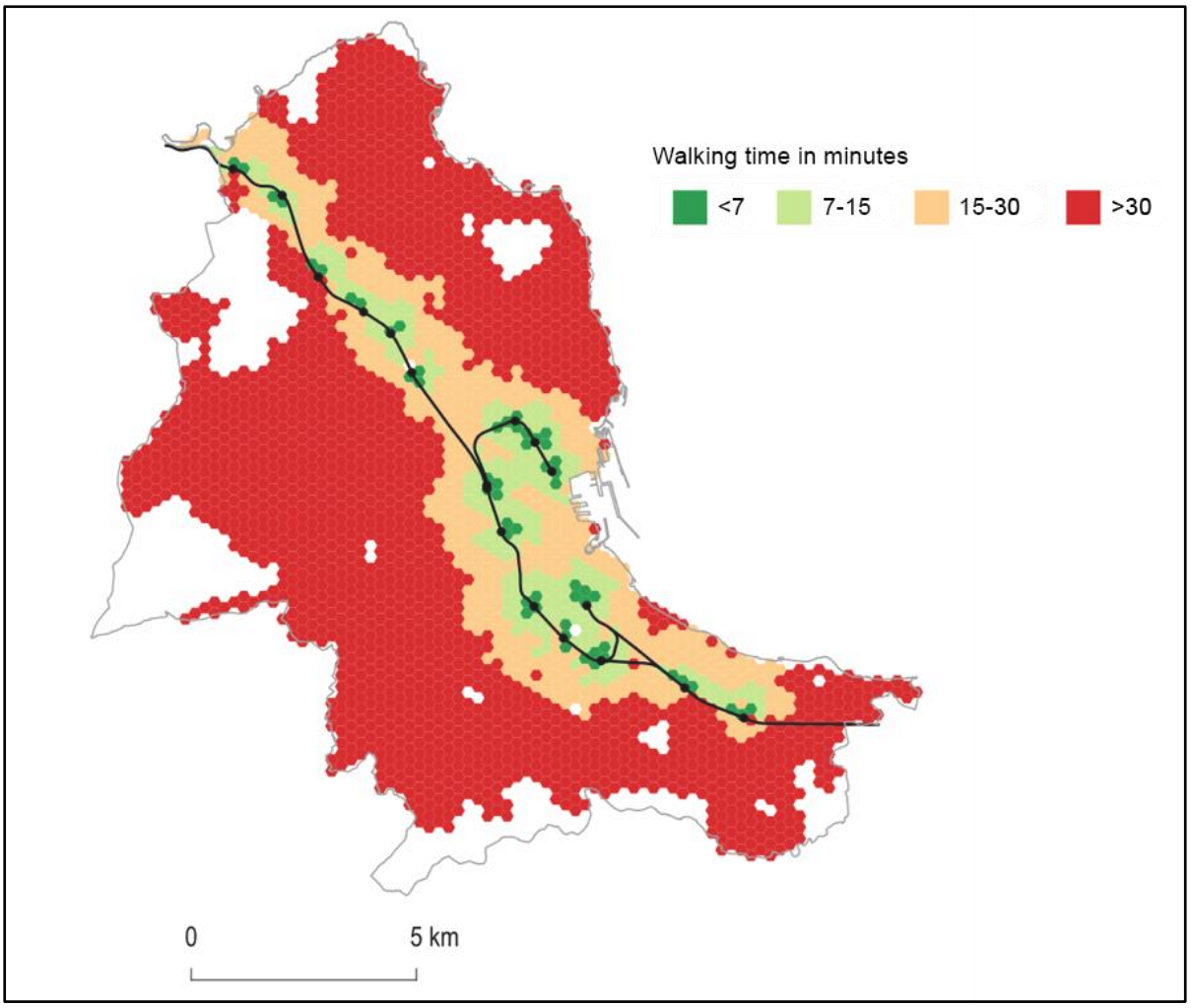


Figure 80. Pedestrian accessibility to railway stations in minutes.

According to the studies (e.g. Dolce, Barbera, Rosone, and Patti, 2020), the Metropolitan City of Palermo received €8.3 billion across 15,645 projects between 2007-2020, and the most funding had come from regional and national sources (76%). The efficiency in spending those funds has been low, regarding the progress of the related projects. Especially the last period, 2014-2020, is worse in completion rate (15%) with respect to the 2007-2013 period (71%).

Over a decade (2007-2020), more than half (56%) of public funding for Palermo's Metropolitan City went towards transportation and network infrastructure. This encompasses airports, railways, ports, roads, cycling paths, and other vital transportation systems. While the earlier funding cycle (2007-2013) saw an impressive completion rate of 94%, progress in the following one (2014-2020) has been slower, currently around 11%. This slower pace aligns with the reality that public works projects, like those often found in transportation, can take considerable time to complete due to their complex nature and administrative impediments. A deeper explanation of transportation infrastructure is given in the "Section Main public transport projects."

CHAPTER 6

A City on the Move: Plans, Policies and Projects to Reshape the Mobility System

6. A City on the Move: Plans, Policies and Projects to Reshape the Mobility System

This chapter provides an in-depth analysis of Palermo's urban planning initiatives, focusing on efforts to improve sustainability and mobility across the city. By exploring existing planning tools, projects, and policies, the chapter aims to build a foundation for informed recommendations that can guide future strategies toward creating a more sustainable, liveable, and accessible urban environment.

The chapter begins by examining Palermo's transportation and mobility plans over the past few decades. This section provides a historical overview of the city's urban planning journey, highlighting the objectives, strategies, and policies that have shaped its development. By examining how these plans have evolved, it aims to shed light on the city's shifting priorities and its long-standing challenges in addressing mobility and sustainability.

The second section focuses on a critical evaluation of specific transportation and mobility projects that have been implemented in Palermo. This analysis looks at the outcomes of these projects and explores both the successes and the challenges faced during their implementation, providing valuable lessons about what has worked well and where improvements are needed.

By combining an assessment of the broader planning framework with a detailed look at individual projects, this chapter offers a comprehensive understanding of Palermo's approach to transportation and mobility. It not only highlights the progress the city has made but also identifies gaps and areas for further improvement.

The insights gained through this analysis are intended to inform future policy recommendations, which will be developed later in this study. By reflecting on Palermo's past and present efforts, the chapter tries to create the foundation for actionable strategies that aim to overcome existing barriers and promote a more integrated, sustainable, and inclusive urban mobility system.

6.1 The evolution of Palermo's transportation policy

In recent decades, Palermo has made significant efforts to improve its transportation system and promote sustainable mobility. While this transition has not been immediate, various plans and strategies have been implemented to address the city's mobility challenges at different scales. This chapter outlines these plans, providing a chronological overview of their development, and explores their respective scopes in reshaping the city's mobility landscape. The table below summarises the key mobility-related plans for Palermo, ordered chronologically, along with their specific objectives and areas of focus.

Table 10. Chronological overview of Palermo's urban mobility plans.

Plan Name	Years	Scope
PGTU (General Urban Traffic Plan)	2013	Aimed at optimising traffic flow and addressing urban congestion, focusing on transportation infrastructure and road network improvements.
Soft Mobility Plan (Mobilità Dolce)	2015	Focused on promoting cycling, walking, and other sustainable forms of transport to reduce car dependency and improve the urban environment.
SUMP (Sustainable Urban Mobility Plan)	2020-2025-2030 (last version in 2024)	Provides long-term strategies for sustainable mobility, integrating public transport, cycling, pedestrian paths, and eco-friendly transport systems.

Before exploring the detailed analysis of Palermo's transport plans and mobility projects, it is useful to first provide a concise overview of the status of each major intervention. The following table serves as a preliminary guide to distinguish the current stage of development of each strategic plan and infrastructure project, whether they have already been implemented, are currently in progress, are planned for future development, or have been cancelled or postponed. This structured summary is intended to enhance clarity and assist the reader in understanding the broader picture of Palermo's mobility transition, allowing for a more informed and contextualised reading of the detailed discussions that follow. By clearly distinguishing between completed and proposed interventions, the table helps to frame the city's progress to date and its future commitments toward a more sustainable, multimodal, and walkable urban mobility system.

Table 11. Status of Major Mobility Projects and Plans in Palermo.

Name of the Plan/Project	Type	Implementation Status	Note
PGTU (General Urban Traffic Plan)	Strategic Plan	Implemented (since 2013)	Defines traffic management and hierarchy, including pedestrian and parking plans.
Soft Mobility Plan (Mobilità Dolce)	Strategic Plan	Implemented (2015)	Promotes walking and cycling, including detailed analysis and proposals.
SUMP (PUMS - Sustainable Urban Mobility Plan)	Strategic Plan	Ongoing / Future-oriented	Most recent version: 2024. Targets 2025 and 2030 scenarios. Guides other projects.
Pedestrian Areas (ZTL expansion in Old Town)	Local intervention	Partially implemented	Several ZTLs are in place. New expansions are planned in the latest SUMP.
Cycle Lanes Network	Infrastructure	Partially implemented	Some lanes built, further improvements suggested in soft mobility and SUMP plans.

Railway Bypass (Passante ferroviario)	Public transport infrastructure	Mostly implemented	Most stations were constructed. Some parts are still in progress (e.g., Lazio Station).
Railway Ring (Anello ferroviario)	Public transport infrastructure	Ongoing / Near completion	Several key stations (e.g., Papireto, Lazio) are still under construction.
Tram Network (existing lines)	Public transport infrastructure	Implemented	Lines 1-4 are completed and operational.
New Tram Network Extensions	Public transport infrastructure	Planned / Under design	New routes and connections are under discussion. Projects mentioned in the latest SUMP.
Interchange Nodes (Mobility Hubs)	Infrastructure	Planned / Ongoing	Focus of future integration efforts per SUMP (especially at Notarbartolo).

6.1.1 General plan of urban traffic of Palermo: A comprehensive mobility plan (2013)

The Urban Traffic Plan (Piano Urbano del Traffico – PUT) serves as an overarching strategic framework aimed at improving road traffic conditions and overall urban mobility in Palermo. It encompasses a coordinated set of interventions that target not only private vehicle circulation but also enhance conditions for pedestrians and public transport users. The PUT is structured into three distinct planning phases: the General Plan of Urban Traffic (PGTU), the Detailed Urban Traffic Plans, and the Executive Urban Traffic Plans. Each phase builds upon the previous one, moving from general strategies to specific, implementable actions.

The General Plan of Urban Traffic (PGTU), which forms the foundational phase of the PUT, provides a holistic vision for Palermo's traffic and mobility systems. It includes a functional classification of the road network, defines technical road regulations, and offers preliminary guidelines for interventions in strategic areas of the city. The PGTU is important for highlighting the priorities for mobility planning and traffic management, particularly by integrating pedestrian needs, public transport optimisation, private vehicle flow, and parking strategies into a unified system.

The subsequent phases, the Detailed and Executive Plans, translate the strategic vision of the PGTU into localised and actionable projects. These plans include detailed designs and proposals for improving specific road segments, intersections, pedestrian zones, and cycling infrastructure. Their goal is to enhance the usability, safety, and attractiveness of urban spaces while aligning with the broader objectives of traffic decongestion and sustainable mobility.

In essence, the PGTU aims to address the multifaceted mobility demands of Palermo's residents, commuters, and visitors. It does so by structuring its interventions across four key thematic areas: (1) the organisation of vehicular traffic, (2) the promotion of non-motorised and public transport modes, (3) the regulation and management of parking systems, and (4) the protection and enhancement of pedestrian spaces. Through this integrated approach, the PUT seeks to establish a more efficient, safe, and equitable mobility network, contributing to the long-term goals of urban sustainability and quality of life.

Table 12. The sections of PGTU.

Plan	Focus
Pedestrian Mobility Improvement Plan	Improvements to squares, streets, itineraries, pedestrian areas, and limited traffic zones (ZTLs)
Public Transport Mobility Improvement Plan	Improvements to lanes, roadways, interchange nodes, interchange car parks, and reorganisation of lines and frequencies
Plan for the Reorganisation of Private Motor Vehicle Movements	Management of general traffic flow, ring road system, and road priority assignments
Parking Management Plan	Regulations for parking streets, ground-level parking areas, charging, and time limitations

Regarding the classification of the road network, the PGTU has revisited the existing classification and introduced a new category of "inter-district roads," which falls between arterial roads and neighbourhood roads. The introduction of this new road category is essential for establishing a clear distinction between the primary routes used for through-traffic and those serving local neighbourhoods. This classification helps to optimise traffic management and improve accessibility within the city.

Palermo's urban road network now includes the following categories:

- Through-traffic roads: Major arteries that carry significant volumes of traffic.
- Inter-district roads: Connecting roads that link different neighbourhoods or districts.
- Neighbourhood streets: Local roads serving residential areas.
- Local roads: Smaller streets within neighbourhoods, primarily for local access.

Pedestrian areas

Beyond the technical standards and regulations in the Road Regulation, the PGTU has outlined specific interventions to improve pedestrian safety and create more welcoming public spaces. The main goals of these interventions include encouraging pedestrian activity in urban spaces like squares and streets, especially in areas with historical, cultural, or architectural significance. The plan also aims to resolve conflicts between pedestrians and other forms of traffic, redevelop key parts of the city with better street furniture, improve the safety and accessibility of pedestrian routes, and ensure that walking is safe and comfortable even outside designated pedestrian areas.

In the plan, pedestrian areas are described as spaces where people can move around freely and safely, with vehicles either prohibited or strictly regulated (e.g., only authorised vehicles allowed with speed restrictions). The primary aim of these areas is to make public spaces more liveable for pedestrians, prioritising local needs like commercial activity and social interaction, protecting artistic and historical landmarks, reducing pollution and accidents, and improving safety and comfort for vulnerable groups such as the elderly, disabled people, and children.

The PGTU also identifies several key requirements for creating and maintaining pedestrian areas. Firstly, motorised vehicle traffic should generally be removed, except in certain conditions. Promoting slow mobility, like walking and cycling, is also essential and should be supported with relevant infrastructure. As discussed earlier, managing the loading and unloading of goods and organising parking for authorised vehicles are important considerations before introducing pedestrianisation. Additionally, removing physical barriers such as damaged pavements, poorly connected or missing ramps, and uneven surfaces is critical for accessibility. Redeveloping safe pedestrian crossings is another important priority.

In terms of comfort and safety, the plan highlights the need to improve public lighting, including adding extra lighting under trees, and to install clear signage and wayfinding tools for both pedestrians and other users. Regular maintenance, including cleaning and care for greenery, is also emphasised to ensure pedestrian spaces remain inviting and functional.

The PGTU proposes a significant expansion of pedestrian areas, focusing especially on the historical centre with its monumental landmarks. This expansion aims to double the total pedestrianised space, increasing it from 41 hectares to over 83 hectares. The plan prioritises areas near historic markets and key landmarks, preserving the city’s character while creating a more walkable and enjoyable environment.

When extending pedestrian areas in the historic centre, several key factors are considered. The first is to focus on the spaces surrounding important historical and architectural sites. Another is to ensure the pedestrian paths and spaces form a well-connected network. Maintaining a balance between pedestrian zones and vehicular traffic is also crucial, as is addressing the needs of both residents and visitors by preserving enough parking spaces.

By expanding pedestrian areas and improving their design and management, the PGTU seeks to create a city where walking is safe, convenient, and enjoyable, while also protecting its historic identity and supporting local communities.

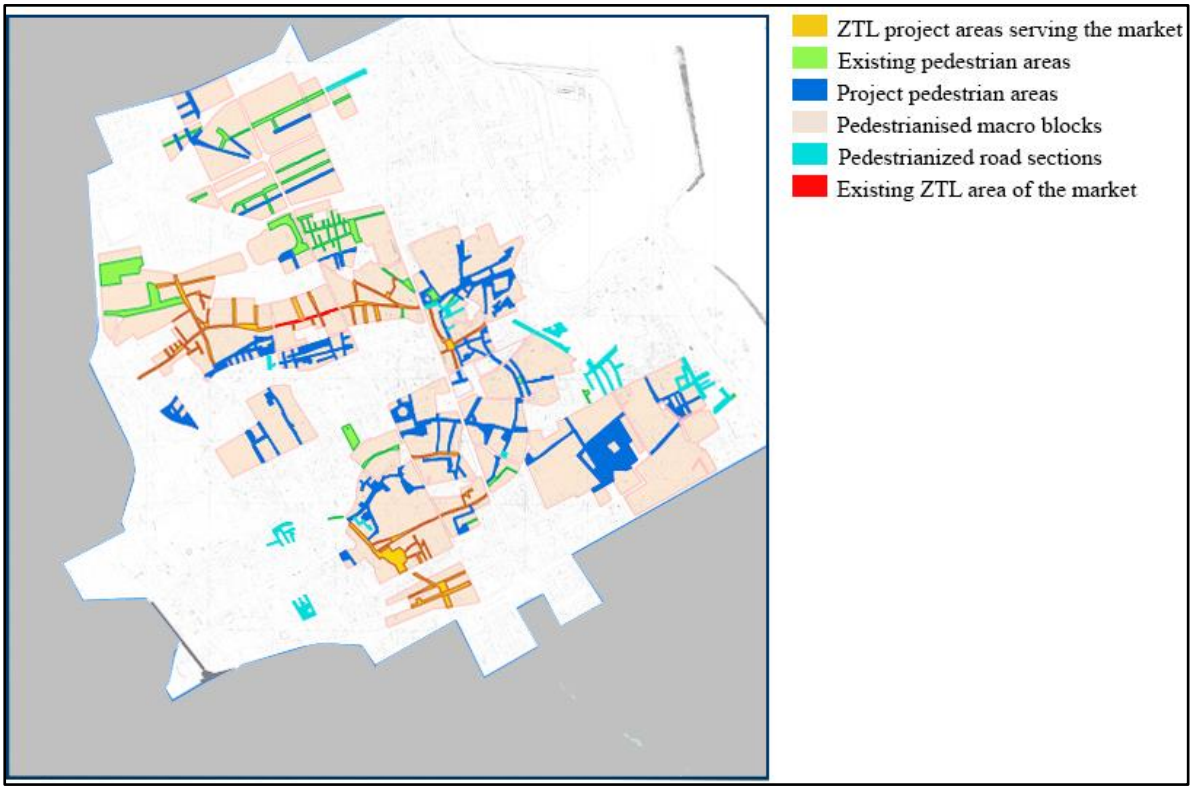


Figure 81. Areas of pedestrianisation and ZTL for the Historic centre and marketplace.
Source: PGTU of Palermo, 2013.

Regarding these pedestrian zones, which will be permanent and accessible 24 hours a day, there are specific regulations for their management. Permitted activities in those areas are free circulation of bicycle traffic (including electric bikes), authorised vehicles (resident vehicles with designated parking areas), service vehicles, delivery vehicles and emergency vehicles. The speed limit for those vehicles is decided to be 30 km/h for pedestrians' safety.

Urban amenities that are found in those areas are street furniture (waste bins, benches, flower boxes, bike racks), paving (specialised for pedestrian mobility and compatible with historical-monumental environment) and signage for tourists and pedestrians. The municipal police corps are responsible for monitoring and enforcing the accessibility regulations for the pedestrian zones. Besides, fixed or mobile barriers may be placed at the entrance to control access.

The quality of the pedestrian areas is as important as their size for the comfort and safety of pedestrians. Therefore, the identification of the pedestrian network to be created through a process of progressive implementation, both in terms of extension of the network and in terms of "quality" of the route, is the first planned activity for the project. Special attention should be given to pedestrian paths that are constructed along designated pavements.

First, it is necessary to ensure the continuity of paths and pedestrian crossings without any interruption. Besides, the crossings must be equipped with ramps and acoustic devices for disabled people. To address the issue of vehicles illegally occupying pavements, the implementation of parking deterrents and raised pavements is considered. These measures can help to protect pedestrian spaces by preventing cars and motorcycles from occupying pavements, ensuring a safe and accessible environment for pedestrians. Additionally, integrating parking deterrents with other street furniture elements can enhance the overall aesthetic appeal of the urban space, creating a cohesive and inviting environment. To ensure smoother traffic flow on key road routes, parking deterrents can be strategically placed to encourage pedestrians to cross the carriageway only at designated pedestrian crossings, thereby enhancing pedestrian safety.

Depending on the specific traffic patterns, road importance, and functional type, traffic calming measures like raised pedestrian crossings and reduced speed limits (30 km/h) can be implemented. A detailed plan (PETU and/or sector plan) is essential to identify and manage specific routes connecting commercial, tourist, and residential areas with transportation hubs (stations, public transport stops, and car parks). These routes should form a continuous network free of hazards, protected by adequate pavements, accessible crossings, and, whenever possible, physical barriers. The minimum pavement width should range from 0.90 m (for wheelchairs, strollers) to 1.50 m (0.90 m for pedestrians, 0.60 m for clearance). Existing pedestrian infrastructure must be adapted to meet these minimum standards through targeted implementation measures.

Public transport

The PGTU aims to enhance urban public transport by increasing commercial speed, frequency and reducing waiting times at stops. This is particularly critical along key routes and in areas with planned interchange parking. The goal is to reduce car traffic, which will develop environmental benefits, energy savings, and the protection of heritage sites.

Inefficient public transport is one of the main barriers preventing Palermo from achieving better sustainable mobility. The average commercial speed of public transport during the daytime (08:00-20:00) is low, approximately 11 km/h. Targeted interventions are needed to increase commercial speed and ensure an adequate number of services to improve the performance of the public transport system, especially regarding traffic limitation measures.

A series of specific measures must be implemented, including the optimal location and proper equipment of reserved lanes and stops/stations for both urban and extra-urban public transport. The aim is to promote alternative transport modes over private car use. To justify the creation of reserved lanes for buses, public transport frequency must be sufficiently high to exceed the capacity of private vehicles, typically 25-30 buses per hour in each direction. The existing bus network in Palermo offers good accessibility, with short walking distances to stops. However, this reduces efficiency, as the wide network results in low average frequencies per line. To improve service efficiency, the network will need to be reviewed while keeping its broad coverage. This might involve removing underused routes or consolidating services where possible. If the bus network becomes more efficient with higher frequency services, a slight increase in walking distance to access stops could be acceptable.

Introducing modern technologies for real-time bus fleet control and management, potentially integrated with centralised traffic light coordination, is a key strategy to improve service regularity. This would help to optimise available resources, ensure more consistent service, and make it easier to coordinate interchanges. Additionally, it would support the development of more complex and efficient transport networks.

The plan also focuses on improving extra-urban public transport to reduce city traffic congestion. This is a complex challenge in Palermo due to its fragmented provincial layout and diverse transport sector expectations. As highlighted in the strategic sustainable mobility plan, stronger communication between local authorities and transport providers is needed to create a shared framework for developing a sector plan after the PGTU adoption. Additionally, rationalising tourist transport is essential for balancing Palermo's liveability with its significant tourist presence. The PGTU proposes a "Tourist Transport Plan" to regulate tourist bus access, focusing on key areas like ports, stations, and high-interest sites, and optimising transport while protecting the city's infrastructure.

Circulation and parking of private motor vehicles

The PGTU provides specific goals for traffic flow improvement, as well as for the circulation of cars and other private motorised vehicles. One of them is separating diverse types of traffic into appropriate routes, simplifying vehicle circulation through intersection management, efficient road usage, and balanced traffic distribution. Based on these goals, the PGTU has proposed several interventions such as improving overall traffic flow, addressing specific issues on Viale Regione Siciliana and other critical areas, and enhancing road signage.

The interventions that the plan aims to implement on the axes of the main grid of the city will focus on making the access routes to the central areas and the Historic centre more fluid. These interventions will include interdistrict routes and the coastal axis from Via Sampolo to Via Messina Marine. The initial phase concentrates on simplification existing routes by eliminating double parking and ensuring their compliance with traffic regulations. In the second phase, parking will be removed from one or both sides of the carriageway through the development and implementation of detailed plans, which will allow for the study of design solutions aimed at identifying new parking spaces, replacing those eliminated from the main road system. Particular attention should be given to the 'Villafranca' and 'Strasbourg' routes, which are heavily congested due to commercial and tertiary activities, where there are also reserved lanes for public transport.

Regarding parking management in Palermo, the goal is to reorganise parking regulations to align with the greater objectives of traffic and demand management. This involves shifting parking away from major roads and inter-district roads, which are designed to serve as primary vehicular routes and prioritise traffic flow.

The PGTU explains specific parking regulations for different road classifications. Parking is prohibited on major roads, while limited parking may be permitted on inter-district roads under defined conditions and with detailed planning. The primary goal is to divert parking from major roads to residential areas, maximising parking availability for residents. This approach is also convenient with the Sustainable Mobility Plan in terms of optimising on-street parking in local streets while expanding off-street parking options.

To achieve this, the PGTU will implement a series of measures, such as issuing parking bans on specific streets, converting nearby streets into designated parking areas, conducting detailed studies to identify suitable parking locations and improving the efficiency of parking spaces on residential streets for a higher capacity.

Cycle lanes

Before outlining recommendations for the development of a cycle network from plans, it is important to underline the current state of cycling infrastructure in both metropolitan and municipal areas. Currently, Palermo’s metropolitan area is lacking dedicated infrastructure for cycling mobility, cycle tourism, and related services such as bike sharing, parking, and cycle stations. Within the municipality of Palermo, there are only scattered and disconnected segments of cycle paths, which do not form a cohesive network capable of supporting everyday commuting, such as home-to-work and home-to-school trips.

On a broader metropolitan scale, there are no planned or programmed interventions aimed at improving cycling infrastructure. This underscores the absence of a coordinated approach to cycling mobility within the region, highlighting a significant gap in both the physical infrastructure and the strategic planning necessary to support it. The limited number of cycle paths and services, coupled with the lack of specific programming, reflect the insufficient attention given to cycling mobility within planning frameworks. However, this also highlights the importance of planning tools such as PUMS and PGTU in the efficient implementation of a well-planned and managed bicycle infrastructure at different scales.

The General Urban Traffic Plan (PGTU) strongly supports the integration and expansion of cycling infrastructure as a core element of Palermo's sustainable mobility vision. In alignment with broader urban planning instruments, such as the Piano Regolatore Generale (P.R.G.), the PGTU places particular emphasis on developing a continuous and comprehensive network of cycle paths that are safe, accessible, and functionally connected to key destinations across the city. This commitment is grounded in Palermo’s advantageous geographic and climatic conditions—mild weather, flat terrain in many central areas, and a compact urban form, which collectively provide an ideal context for encouraging daily cycling as a practical transport choice.

Recognising the potential of cycling to replace short car trips, especially for home-to-work and home-to-school commutes, the PGTU and P.R.G. propose a wide-ranging set of interventions aimed at increasing bicycle use. The main intervention among these is the provision of secure and convenient bicycle parking facilities. The plans envision a systematic deployment of bike racks and storage solutions along high-demand routes, near schools, workplaces, transit nodes, and public amenities. By increasing the visibility, convenience, and security of cycling, these interventions are expected to support a modal shift away from private car usage, thereby reducing traffic congestion, lowering emissions, and contributing to improved urban air quality and public health.

The existing and planned cycle lanes are outlined in the following section. The Favorita Park, known for its pedestrian and cycling use, will be expanded to include dedicated cycle-pedestrian routes, integrated with the wider urban cycle network. Additional details can be found in the Soft Mobility Plan, discussed in subsequent sections. In terms of current infrastructure, the PGTU prioritises the establishment of bicycle parking areas with racks, strategically placed along cycling routes and close to key destinations. The planning process will also include specifications for the construction of cycle paths and necessary traffic-calming measures on local roads.

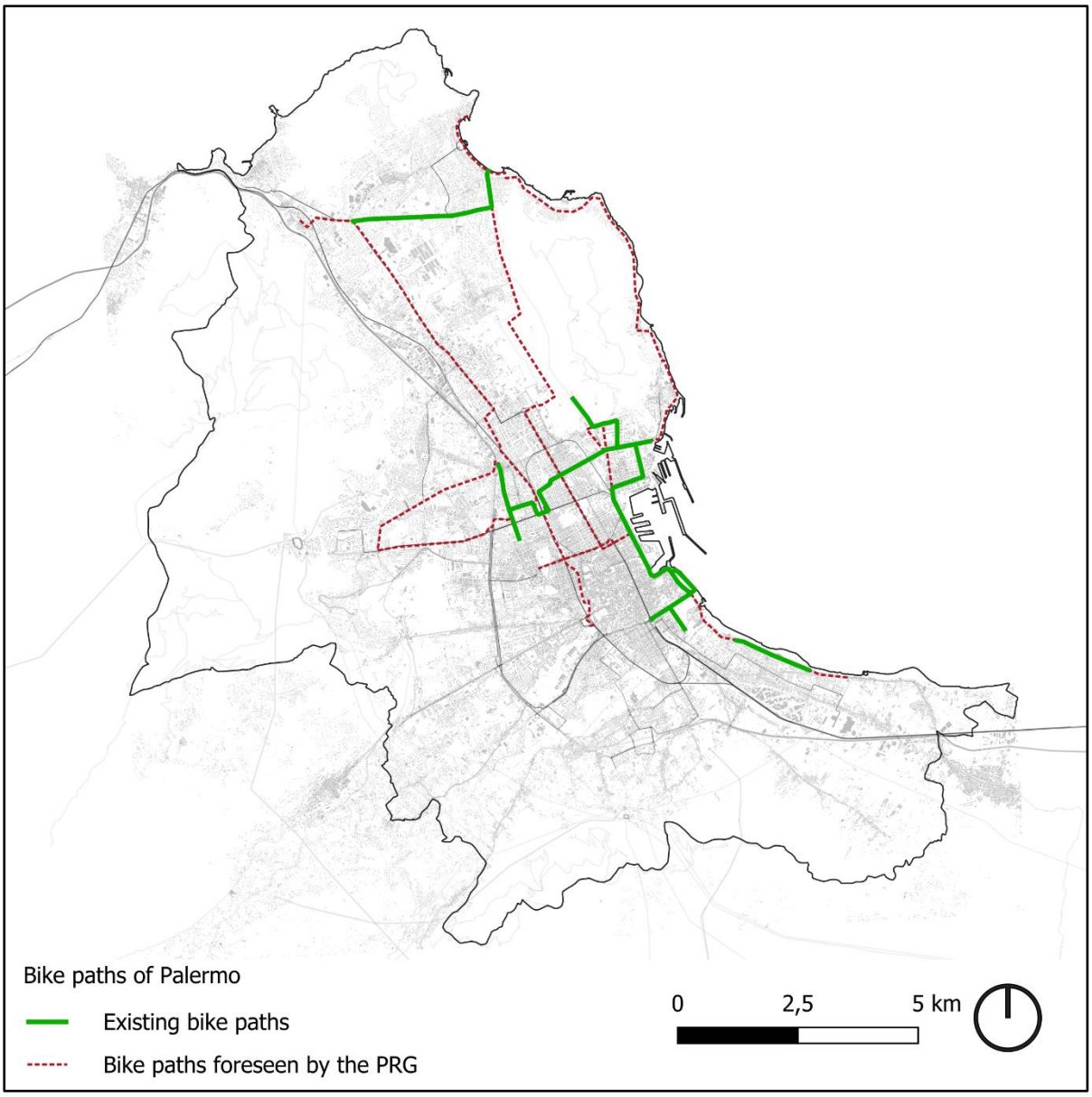


Figure 82. Cycle paths according to PGTU.



Figure 83. Design example for projected bike paths from PRG.

New infrastructures for mobility

In this section of the PGTU, key infrastructure interventions are outlined that are expected to have an important impact on Palermo's urban mobility system. These projects, either under construction or in advanced planning stages, are not newly introduced by the PGTU but represent strategic developments already underway. In the plan, they are grouped into two principal categories: new mobility infrastructures, such as rail and tram lines, parking, and road upgrades; and large-scale urban transformation initiatives. Since this research focuses on transport and mobility in Palermo, only the projects related to this aim are considered.

The following table provides an overview of the primary infrastructure projects that fall within the PGTU's scope, highlighting their type, status, and intended contributions to the broader goal of a more sustainable, efficient, and multimodal transport system in Palermo.

Table 13. The primary infrastructure projects fall within the scope of PGTU.

Project Name	Type of Infrastructure	Description	Status	Primary Objectives
Railway Bypass (Passante Ferroviario)	Heavy Rail	Double-track underground railway line from Brancaccio to Punta Raisi Airport (26 km, 18 stations).	**Under Construction** (since 2008)	Reduce travel time, improve airport-city connectivity, and reduce car use.
Railway Ring (Anello Ferroviario)	Urban Rail / Underground	Circular underground rail line (6.5 km) using part of existing infrastructure; 8 stations (4 new).	**Partially Completed / Delayed**	Improve intra-city connectivity and intermodality; support urban regeneration.
Tram System (Lines 1–3)	Tram / Guided Transport	Surface tram network (15.2 km, 40 stops) connecting peripheries to the city centre via reserved lanes.	**Implemented**	Increase access to public transport, reduce car use, and improve air quality.
Automatic Light Rail Line	Light Rail (Automated)	Planned a line from Via Oreto to Tommaso Natale (17.6 km) along Palermo's central axis.	**Suspended**	Originally intended to increase east-west connectivity, halted due to funding issues.

6.1.2 Soft mobility plan (2015)

The Soft Mobility Plan underlines the transformative potential of cycling and walking as fundamental factors of sustainable urban mobility. In the plan, emphasis is placed on cycling and its ability to reduce urban congestion, lower noise pollution, and promote a healthier population. Additionally, the plan aligns with broader climate objectives by contributing to reductions in greenhouse gas emissions and dependence on fossil fuels.

The plan also highlights the role of soft mobility in tourism development, especially in cities like Palermo, where historic and cultural assets can be made more accessible through sustainable transport solutions. By prioritising walking and cycling, the plan aims to integrate these modes into the urban fabric, enhancing both environmental and social well-being.

The plan explains the legal framework that is essential for implementing soft mobility initiatives, structured across three different levels.

European Framework: The EU prioritises integrating sustainable mobility into urban transport systems through various directives and strategies. The 2008 Green Paper underlines the importance of pedestrian and cyclist-friendly urban planning. This commitment is further supported by EU funding opportunities that target local cycling infrastructure projects.

National Framework (Italy): Italian laws require urban transport plans to integrate cycling infrastructure into overall city mobility strategies. Regulations outline technical standards for designing cycle paths, highlighting safety, accessibility, and connectivity with other transport networks. Additionally, regional policies advocate for the development of intermodal transport hubs, combining cycling facilities with public transport options like trains and buses.

Municipal Framework (Palermo): Palermo's urban planning instruments, including the PGTU (see the previous section), especially focus on soft mobility, advocating for an expanded and well-maintained network of cycling paths. Municipal policies aim to address local challenges such as fragmented infrastructure and low adoption rates of cycling.

Soft mobility analyses of Palermo

The analysis of cycling data in the plan provides a deep evaluation of the city's cycling patterns and infrastructure. Below, the modal split in Palermo is given as shown in the plan.

Table 14. Modal Split in Palermo (Based on ISTAT 2011)

Transport Mode	Private cars	Walking	Public transport	Motorbikes	Bicycle
Share (%)	50.,8 %	23,7 %	12 %	11,9 %	1,4 %

According to the table above, private transport modes were also the most popular among the locals two decades ago. On the other hand, the moderate reliance on public transport options demonstrates a potential for integration with active mobility modes.

The Plan also investigates each cycling infrastructure separately to determine its strong and weak features and to uncover barriers in Palermo's soft mobility network. The typology of the cycling infrastructures in Palermo (in 2015, based on the date of the plan) is tabulated below to give a more precise understanding to the readers.

Table 15. Typology of Cycling Infrastructure in Palermo (as of 2015).

Type	Examples	Key features / Issues
Narrow dedicated lanes	Via Venere, Viale dell'Olimpo	Often mixed with traffic, lack of protection
Scenic coastal paths	Via Messina Marine, Foro Umberto I	Attractive routes but underutilised due to poor connectivity
Urban shared spaces	Via Maqueda, Via Vittorio Emanuele	Serves both pedestrians and cyclists; well-located but lacks formal separation or signage
Paths with maintenance needs	Foro Umberto I, Via Messina Marine	Obstructions, lack of bike racks, poor paving and lighting

Additionally, it is underlined that cultural and practical barriers, such as a strong car-centric culture and the perception of bicycles as recreational tools rather than essential transport modes, also prevent the development of cycling in the city. Despite these issues, Palermo's cycling infrastructure presents significant opportunities for expansion and improvement, with routes like Via Libertà and Corso Tukory offering potential for dedicated cycling corridors.

Planning soft mobility in Palermo

After an extensive analysis of the existing cycling infrastructure, the plan of 2015 outlines the planning strategies for developing a comprehensive soft mobility network in Palermo, again focusing on cycling infrastructure and related facilities. The plan emphasises the creation of a continuous cycling network integrated with other modes of transport. The goals underlined in the plan are:

- Reducing car dependency by promoting cycling as a viable, safe, and convenient alternative.
- Enhancing urban mobility through the systematic development of cycling paths.
- Connect residential areas with employment hubs, schools, and public transport nodes.

The planning strategy highlights creating a comprehensive and efficient cycling network, aiming to enhance mobility options and promote sustainable transport. The focus is on the expansion of new cycling routes, as explained in the plan. This involves extending existing paths to cover critical urban areas and developing dedicated cycling lanes along arterial roads and within residential neighbourhoods. The approach also highlights connectivity between new and existing routes, creating an integrated network that promotes safe and efficient cycling for all users.

Another crucial element of the strategy is the integration of cycling with public transport. To encourage multimodal transport options, the plan proposes establishing bike-sharing programs and installing bike parking facilities at major transit nodes, like train and bus stations. By combining cycling infrastructure with public transit schedules, the strategy aims to make cycling a convenient and practical option for first and last-mile connectivity.

The introduction of mixed-use lanes is also a significant component of the plan. These shared lanes are designed to accommodate both cyclists and public transport vehicles, with clear markings and safety measures to ensure harmony and security for all road users. This approach aims to make efficient use of available road space while promoting sustainable mobility. Moreover, in reserved public transport lanes where bicycles are permitted, a maximum speed limit of 30 km/h will be enforced to ensure safety for all users.

Lastly, the soft mobility plan highlights the need to improve the quality and surface of cycling paths by physical interventions, such as better paving materials. To address this, the cycling path redevelopment plan suggests specific maintenance and enhancement measures aimed at making the paths safer and more user-friendly.

Ensuring Surface Regularity: One key aspect of enhancing cycling infrastructure is ensuring the smoothness and regularity of surfaces. This involves increasing the quality of interlocking paving surfaces or replacing them with asphalt for improved smoothness, repairing brick pavements by replacing damaged elements, particularly near driveways, and restoring asphalt surfaces to maintain optimal conditions for cyclists. For cycle paths integrated into sidewalks, it is essential to ensure high-quality pavement for both pedestrians and cyclists to prevent conflicts, such as pedestrians accidentally using cycling paths.

Another important intervention is managing tree roots that disrupt pavements. Trees causing uneven surfaces should be replaced with species better suited for urban settings.

Ensuring Path Continuity: To create a compatible cycling network, the continuity of paths must be prioritised. Enhanced visibility can be achieved by colouring cycling crossings in road intersections, which makes paths more noticeable to all road users. Safety measures, such as raised pedestrian crossings and refuge islands, should also be considered for elevated cycle lanes, offering additional protection and convenience for cyclists.

Clearing obstructions from cycling paths is another critical step. Removing barriers like waste bins, recycling containers, and other structures ensures a clean and user-friendly cycling environment

Table 16. Strategic Goals of Palermo's Soft Mobility Plan.

Strategic goal	Planned action
Reduce car dependency	Expand and integrate the cycling network
Connect cycling with public transport	Bike sharing systems, secure parking at stations
Improve infrastructure quality and safety	Better paving, signage, continuity, management of tree roots and obstructions
Encourage multi-modal active transport	Mixed-use lanes, speed limits, and multimodal trip planning
Leverage tourism and walkable heritage areas	Signage-based routes in the pedestrianised Old Town connect cultural landmarks

Improvements for each cycling infrastructure

The proposed plans aim to enhance the safety, usability, and connectivity of Palermo's existing cycling network. Emphasis is placed on improving pavement quality, signage, and the removal of obstacles while ensuring strict enforcement against unauthorised uses. The table below highlights the specific interventions planned for each cycling path, emphasising the focus on usability, safety, and enforcement.

A series of maintenance and improvement measures have been planned to enhance the functionality and safety of Palermo's bicycle paths. Key interventions include resurfacing and realigning pavements on routes such as Via Venere, Via Margherita di Savoia, and Acquasanta-Giachery-Notarbartolo-Giotto to improve usability and accessibility. Obstacles like advertising boards and traffic light poles will be removed from Via Messina Marine and other routes to ensure a smoother cycling experience. Improved road markings, directional signage, and dedicated signalised crossings will be implemented, particularly in Foro Umberto, to strengthen connectivity with pedestrian zones and key cycling routes like the Cala Marina. Additionally, stricter enforcement will be applied across various paths, including Via Maqueda and Via Vittorio Emanuele, to prevent unauthorised parking and commercial invasion that disrupt the cycling infrastructure. These upgrades aim to create a safer and more cohesive cycling network, encouraging greater adoption of sustainable mobility.

In the plan, after explaining in detail the interventions for each cycling path, the categorisation of road segments for cyclists based on traffic and safety parameters is given. These categories include dedicated cycle or cycle-pedestrian paths, greenways separated from motorised traffic, nature trails in rural areas, traffic-free or low-traffic roads with minimal vehicular traffic, and "Road 30" zones with reduced speeds and sections for non-motorised vehicles. The plan ends with design principles based on successful examples from other cities and existing regulations, providing recommendations to enhance the usability and safety of the current cycling infrastructure.

Cycling in pedestrian areas

The goal of pedestrianisation, pursued by the Municipal Administration according to the current PGTU, has enabled the allocation of extensive urban spaces in the historic centre to users of soft mobility. This initiative has effectively created a network of protected cycle-pedestrian paths, restricted from vehicular traffic.

As a result, the pedestrianised areas of the historic centre, together with certain streets characterised by lower vehicular pressure, now form an integral part of the urban cycling network. With the help of an appropriate signage system, cyclists can navigate routes designed to discover and admire the monumental complexes within the historic centre.

Future expansions of pedestrianisation in the historic centre will further enhance and expand the city's cycle-pedestrian network. These efforts will identify new cycling and walking routes to connect significant parts of the urban area. For example, pedestrianising the lateral lane of Via Volturno could link the pedestrian zones near the courthouse (including the underground parking facility) and the historic "Capo" market with the pedestrianised areas surrounding the Teatro Massimo, such as the "Olivella" pedestrian area, Via Magliocco, and Via Maqueda.

Lastly, the plan includes the development of pedestrian and cycling zones, which aim to expand pedestrianised areas to include cycling-friendly pathways. Incorporating cycling infrastructure into car-free zones not only enhances non-motorised mobility but also fosters the creation of vibrant, accessible urban spaces where pedestrians and cyclists can coexist comfortably.

6.1.3 Sustainable urban mobility plan (2024)

The sustainable Urban Mobility Plan (SUMP) for the City of Palermo is a mandatory planning tool for local entities with more than 100.000 inhabitants for a medium-long term horizon (10 years It aims to establish a consistent methodology for strategic planning that enhances the efficiency of the entire system while promoting sustainable urban mobility.

The SUMP aligns with the European Commission's vision for sustainable urban mobility. It is a superior planning tool to the Urban Traffic Plan (PUT) and focuses on long-term strategic planning, while the PUT is a short-term management plan. The SUMP involves investment and policy changes, while the PUT primarily focuses on operational improvements within existing infrastructure. The latest version of SUMP (Palermo), covering from 2020 to 2030, was published in April 2024 by the Comune of Palermo (Comune di Palermo, 2024a).

In the general framework, the mobility and reorganisation scenario of the city has 4 objectives that are tabularised below and explained in detail in the rest of the chapter. Assessing these objectives is important to understand the compatibility with the policy recommendations that are given in the last chapter.

Table 17. SUMP Strategic Objectives and Corresponding Measures.

Objectives	Key measures proposed in SUMP
Improve accessibility and urban liveability	Integrate public and private transport; enhance transport efficiency
Reduce car traffic and increase public transport demand	Expand tram and rail networks; traffic limitations (ZTLs); promote modal shift
Strengthen regional rail and its urban integration	Reorganise extra-urban connections; develop railway bypass and ring projects
Increase proximity and decentralisation of services	Locate essential services in peripheral areas to reduce long-distance trips

To achieve these objectives, the plan has 3 focal points. The first point is to identify boundaries between areas served by private and public transport, with appropriate interchange facilities. These boundaries should be adaptable with improvements of public transport, development of urban spaces and evolving attitudes of citizens regarding their mobility. The second point is adopting flexible strategies that contribute to achieving objectives without imposing irreversible conditions on future phases. The last point is to prioritise organisational solutions and technologies to improve systems integration and infrastructural performance rather than large-scale projects.

It is mentioned that the Multi-Criteria Analysis (MCA) method was used to create scenarios and to feed the decision-making process of the plan. The focus was on identifying sustainable transport measures and analysing their impacts on transportation, the environment, the economy, and implementation time. Demographic and settlement estimations were considered when constructing the scenarios. The analysis process involved examining the knowledge framework, objectives, strategies, and actions outlined in the guidelines. Each scenario was analysed within 4 areas of interest: effectiveness and efficiency of the mobility system, energy and environmental sustainability, road mobility safety, smart mobility, green economy, and social cohesion. Macro-objectives and specific objectives were classified within these areas, followed by the identification of intervention policies.

The analysis of SUMP shows that Palermo is still a highly car-dependent city. But the scenarios indicate that tram usage will increase significantly in the following years, while car use will decrease slightly. This aligns with the objectives outlined in the framework of the plan. The simulation also shows that the use of railways may grow starting in 2029, further reducing car and motorbike use. However, the analysis system may overestimate the substitution effect between the tram and Metro modes.

The data shows that the target of reducing car and motorcycle use from 78% in 2018 to 43% by 2028 is achievable, considering the shift to electric mobility. The analysis indicates a significant reduction in these modes, with cars remaining the main mode despite a slight increase in motorisation rate. New tram and automatic light rail lines are expected to have the greatest impact on modal split, reducing car and motorcycle use.

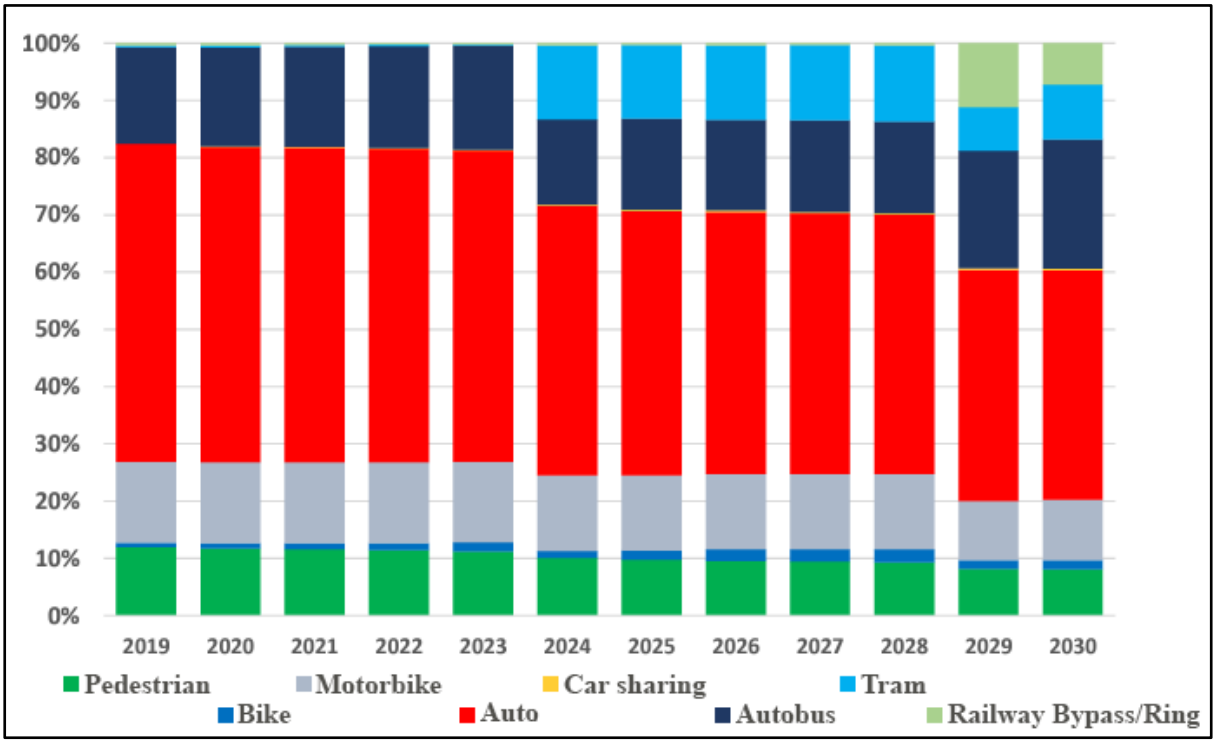


Figure 84. Modal distribution scenario of Palermo from 2019 until 2030 (from SUMP).

The analysis also predicts a slight increase in the motorisation rate in Palermo by 2030, reaching approximately 1,45 cars per 100 inhabitants. This growth is expected to be slower than the average annual growth rate of 0,85%, which was observed between 2013 and 2017. There are several factors contributing to this projected increase in motorisation rate. The most important one is the moderate population growth, which leads to a higher demand for vehicles.

On the other hand, the policies implemented are expected to reduce the percentage of car usage and increase the average speed of TPL (local public transport). Besides, the new tram line and dedicated public transport routes will contribute to the increase in average light public transport speed.

Regarding the environmental impact of the expected policies, the analysis shows a significant reduction in pollutant emissions, with a notable decrease in NOx and PM emissions (-70%) and a more moderate decrease in CO2 (-16%). This suggests that the planned policies and actions are effective in improving air quality.

Traffic-limited zones

Limited Traffic Zones (ZTLs) are highly important for Palermo's transition to a more sustainable and pedestrian-friendly city. By reducing vehicle traffic in historical and commercial areas, ZTLs enhance pedestrian safety and protect environmental and historical assets. This section of the SUMP provides a detailed explanation of ZTLs to avoid repetition in other sections.

Both SUMP and PGTU aim to expand the scope of traffic limitation measures to include areas of the city where those initiatives can contribute to urban and environmental revitalisation. A key aspect of the PGTU is the identification of limited traffic zones, pedestrian areas, and pedestrian-friendly zones. These assigned areas must ensure adequate accessibility and usage while avoiding excessive traffic congestion in surrounding areas. This requires careful consideration of access routes for motorised traffic diverted from these restricted zones.

The Ministerial Directives emphasise the importance of limited traffic zones (ZTLs) in prioritising local needs, especially pedestrian access. These directives highlight the close relationship between ZTLs and Environmental Islands, recognising ZTLs as key tools for removing through traffic from these areas. However, closing large areas to vehicles without careful planning can lead to unintended results. Reduced space for circulation and parking, altered traffic patterns, and potential displacement of congestion and pollution to surrounding areas are potential risks. Effective enforcement and alternative transportation solutions, like shuttle services, are essential to ensure accessibility and user distribution within ZTLs.

For the creation of ZTL, it is also important that, until the provision of rapid mass transport systems is strengthened, to think about solutions based on alternative services are considered that can ensure an acceptable level of accessibility to the regulated area and distribution of users within it. Among these solutions, shuttle lines operated by minibuses (also for the possibility of efficiently using low-emission vehicles) have essential functions, capable of serving the interchange car parks to distribute users in the limited traffic areas, and taxi buses, capable of optimally carrying out the distribution functions at a proficient level of comfort.

The Directives also highlight the importance of predicting individual sets of interventions that can be implemented in the form of specific “functional lots,” in the sense that their implementation must not lead to any worsening of the traffic situation in the areas surrounding the intervention area. To this end, it is necessary to prepare specific Plans (PPTU/PETU and/or specific detailed plans).

The Municipal Administration aims to solve air pollution and traffic congestion by promoting sustainable and eco-friendly transportation options. This includes implementing measures to encourage the use of integrated transportation systems and reduce the demand or need for individual vehicles. These actions are needed to mitigate the recurring elevated levels of pollution set by regulations. The establishment of the ZTL aims to implement a mobility management system in Palermo's historic centre, prioritising public transport over private vehicles. To ensure adequate service levels, alternative transportation capacity must be sufficient to accommodate the portion of demand transferred from private cars. By restricting traffic to less polluting vehicles (currently EURO 3 and above), the ZTL is expected to increase public transport usage by approximately 3,600 passengers per hour.

ZTL Centrale

The 'ZTL Centrale' or 'ZTL 1' is a designated area within the historic centre where traffic restrictions are implemented. As shown in Figure 86, this zone is active on weekdays from 8:00 AM to 8:00 PM. There are several reasons for this immediate action, such as the necessity to protect public health and conserve this particularly vulnerable area, given its size and urban characteristics, from the harmful effects of air pollution caused by vehicular traffic.

The implementation of the ZTL1 has faced challenges due to the large size of the area and the numerous access points, making it difficult for authorities to effectively control traffic. Therefore, to achieve an adequate level of control of the accesses permitted to the ZTL, it is necessary to have the telematic support guaranteed by the access gates, appropriately positioned at the main entrances to the area where there are restrictions on vehicular circulation.

The access control system to the ZTL1 gates, currently in existence, is composed of 5 video control systems and a control centre managed by the Municipal Police Command. This system is designed to ensure control of transit at the access points to the ZTL, allowing free access to users (vehicles) in possession of regular authorisation (mostly residents), as well as the automated management of violations committed by users not authorised to access the ZTL1.

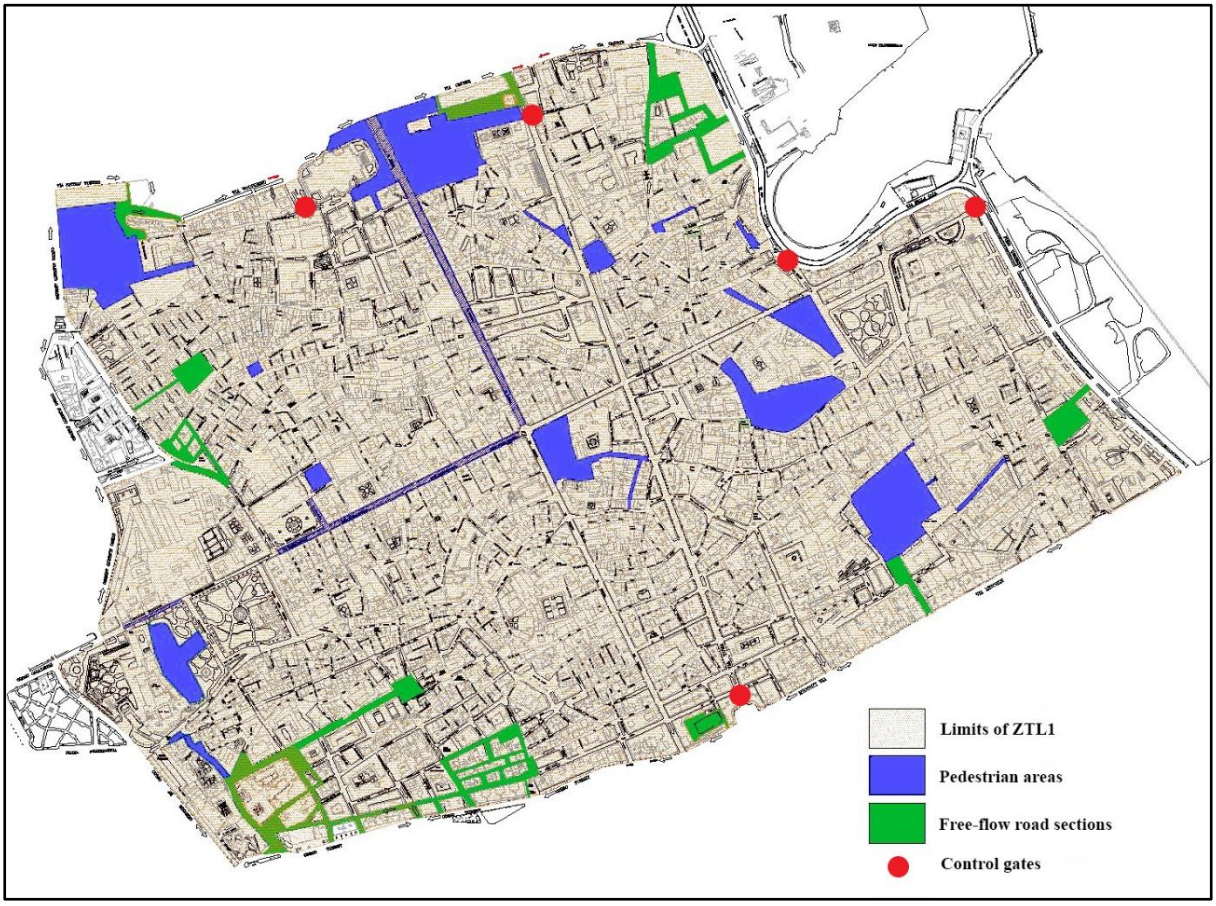


Figure 85. The borders of the ZTL1 are shown with the locations of the control gates.

Furthermore, several areas within the ZTL1, located near its perimeter, have been assigned as 'single access' zones. These areas allow cars to enter and exit from the same point without proceeding further into the ZTL. These parking areas are in Via Rao (for access to the Magione area), Piazza Giulio Cesare, Via Mongitore and surrounding streets (supporting the Di Cristina hospital and the Ballarò market), Piazza Papireto (for access to the Cathedral area), the Castello/S.Alessandro area, and Piazza Kalsa. The presence of these areas, accessible without the limitations of the ZTL 1, guarantees the usability of approximately 400 parking spaces, free of charge, for those who go to the Historic centre of the city.

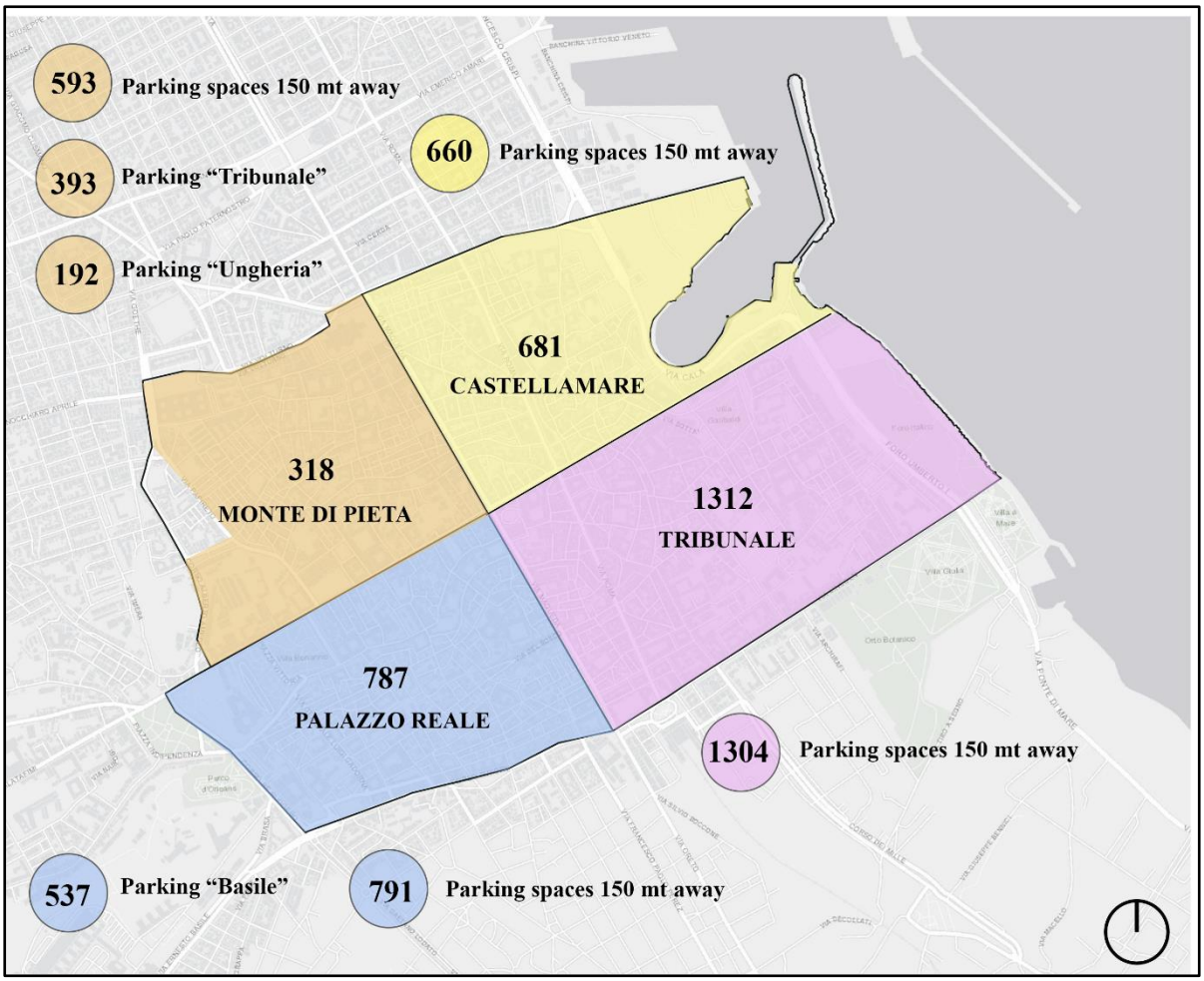


Figure 86. Parking within and near the ZTL 1.

To ensure the maintenance of adequate vehicular circulation following the implementation of the ZTL1 (Zona a Traffico Limitato Centrale), the municipal mobility strategy has proposed the establishment of a double ring road system. This strategic measure aims to mitigate potential disruptions to traffic patterns by providing alternative circulation routes along the perimeter of the restricted zone. The proposed ring roads are designed not only to support essential access for residents, commercial deliveries, and emergency services but also to facilitate broader traffic flows throughout the city without compromising the pedestrian-prioritised objectives of the ZTL1.

The first of these routes is an inner ring, running in a clockwise direction, located immediately adjacent to the Historic Centre. Its primary function is to provide direct and rapid accessibility to the inner districts while minimising the need for through-traffic to penetrate deeper into pedestrian-prioritised areas. This internal circulation loop is intended to manage localised traffic demand and maintain service access to essential points within the urban core, including hospitals, public institutions, and residential zones.

Complementing the inner ring is a second, more external ring, which operates in an anticlockwise direction. This outer loop serves a broader urban mobility function, diverting traffic away from the congested city centre and redistributing it across arterial roads that connect different districts of the city. In doing so, it relieves pressure on the internal network, reduces congestion near ZTL access points, and improves traffic efficiency for vehicles travelling between peripheral neighbourhoods or entering/exiting the city.

This dual-ring structure builds on prior experimental traffic management models applied in Palermo's Historic Centre and is a key element of the integrated approach to sustainable mobility adopted by the PGTU. By separating local and through-traffic flows, the system enhances the overall functionality of the traffic network, ensuring that the goals of the ZTL, like improved air quality, reduced noise, and enhanced pedestrian safety, are achieved without disproportionately burdening other parts of the urban transport system.

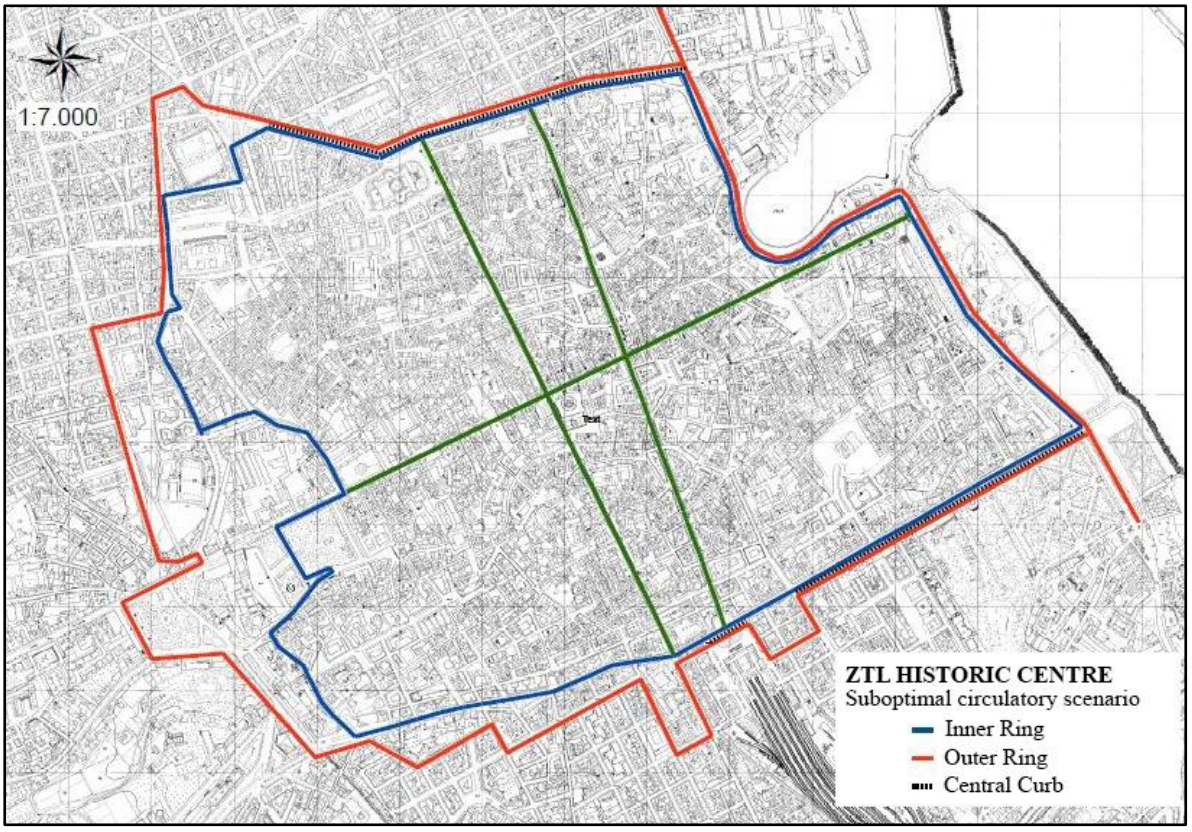


Figure 87. Perimeter routes of the ZTL 1 in the Historic Centre
Source: Comune di Palermo 2013.

In the following phase of the implementation of the PUT, an expansion of the "ZTL Centrale" is expected regarding the area between the northern limit of the ZTL 1 to the Notarbartolo-Duca della Verdura Road axis. The definition of ZTL 2 was carefully considered to ensure adequate access and transit options within the designated area while preventing disruptions to circulation in surrounding districts. To avoid unintended traffic congestion, a dedicated 'entrenchment' itinerary was established, allowing vehicles to bypass restricted zones without affecting overall mobility.

The PGTU outlines possible charging mechanisms and fees that the municipality could introduce for accessing or travelling within the ZTLs. Instead of simply restricting access, charging for ZTL entry is seen as a way to discourage private car use and encourage a shift towards public transport and other alternatives. This approach is connected to the wider goals of the PUT, which focus on reducing air and noise pollution, easing traffic in the Historic Centre, protecting architectural heritage, and making streets safer for pedestrians and other vulnerable road users. The money collected from these charges is also expected to be reinvested in improving and expanding sustainable transport options, ensuring long-term benefits for urban mobility.

ZTL Maqueda

The ZTL Via Maqueda, implemented in 2014, aims to reduce vehicle traffic and prioritise pedestrians in the Old Town, with particular reference to symbolic places and to the different quality of street spaces and their different demands for use. The goal of the project was to view the street as an evolving space where pedestrians could have more room over time. This involved rethinking the area's purpose and function to better suit pedestrian needs and respect the urban landscape. The ZTL Via Maqueda covers an area of approximately 7,000 m^2 and is active on weekdays from 10:00 to 07:00 the following day. The area is close to the vehicular traffic, except for the vehicles of residents and people who have authorisation. Bicycles were allowed at the beginning of the establishment of ZTL, but since December 2023, the Municipality has decided that no two-wheeled vehicle is allowed to circulate along Via Maqueda and Via Vittorio Emanuele (Virga, 2023).

After overcoming an initial phase of distrust on the part of residents and business owners, the ZTL of Via Maqueda has been characterised by an overwhelming success, to the point of having to consider the need to operate a limitation of transit even to bicycles, given the high peaks of pedestrian flows that have been recorded, an indication of a high level of appreciation on the part of local and tourist users. There has also been a clear interest in starting new tertiary activities, marked by the reopening of numerous commercial premises that, before the advent of the ZTL Via Maqueda, were inactive.

ZTL of Historic Markets

The presence of historic markets within the ZTL constitutes an important commercial and social reality to be promoted and encouraged as an element of strong vitality for the life of the areas in which they take place, considering the notable tourist attraction and international importance that characterises them.

In line with the current Detailed Plan of the Historic Centre and the PGTU, the Municipal Council has established Limited Traffic Zones (ZTLs) in the historic markets of Capo, Vucciria, San Agostino, Ballarò, and Via Bandiera. These ZTLs are necessary due to the high volume of pedestrian traffic and exhibition spaces within these historic markets, which significantly limit vehicular traffic.

Pedestrian areas and walkability

In SUMP, it is briefly explained that the local administration has set as its primary objective the issues concerning the limitation of vehicular traffic and the return of particular urban spaces to citizens, according to the General Plan of Urban Traffic. In the implementation of PGTU directives, pedestrian areas have been established in the Historic Centre, within the urban area of great historical importance.

The concerns underlined in both SUMP and PGTU regarding those areas are focused on protecting the environmental heritage, guaranteeing residential and service vehicular circulation, providing the necessary safety routes for pedestrians, to implementing redevelopment policies for attracting the positive interest of the locals, the economy and tourism. It is also highlighted that establishing new pedestrian areas is considered based on the presence of particularly important monumental context, the continuity of pedestrian spaces and ensuring the permanence of roads open to vehicular traffic.

Since the approval of the PGTU in 2013, pedestrianisation measures have led to a significant increase in pedestrian areas, which in was reached approximately 343,416 m^2 by November 2018. This represents a 58% expansion of pedestrian zones.

The pedestrianisation efforts have been concentrated in the Tribunali District of the Historic Centre. This area, rich in historical and monumental architecture, now promotes pedestrian-friendly routes connecting Quattro Canti di Città to Piazza Magione, Kalsa, and Piazza Marina. The new pedestrian paths follow the itinerary of Piazza Pretoria, Piazza Bellini, Discesa dei Giudici, Piazza S. Anna, and then extend towards Piazza Rivoluzione, Piazza Magione, Via dello Spasimo, Kalsa, Via A. Paternostro, Via Merlo, and Piazza Marina.

Pedestrianisation efforts have also been implemented to support the Arab-Norman itinerary, a UNESCO World Heritage Site. This includes the creation of pedestrian areas in Piazza del Parlamento, Via dei Benedettini, and Piazza Sett'Angeli, located near the Palazzo dei Normanni, the Church of San Giovanni degli Eremiti, and the Cathedral. More detailed explanations of the addressed issues and norms related to pedestrianisation initiatives are explained in the PGTU (5.1.2) and Soft Mobility Plan (5.1.3) sections.

Public transport network and interchange nodes

The public transport service by road and tram is managed ‘in-house’ by the municipality of Palermo through the company AMAT Palermo S.p.A. The transport offer ensured by AMAT extends throughout the entire city, reaching, with the road service, some neighbouring municipalities such as Villabate, Isola delle Femmine and Monreale, with an extension of a further 6.3 km outside the municipal administrative boundaries.

The current network of public transport by road extends for approximately 271 km and 58 lines (11-13 km/h commercial speed). This network is made up of a system of lines that distribute demand in the main area, a system of 6 interchange nodes at the borders and inside the central area, and a system of supply lines from the peripheral areas to the interchange nodes.

Table 18. Car parking spaces at interchange Nodes.

1	Central Station	70
2	Oreto Parking Area	120
3	Basile Parking Area	928
4	Emiri Parking Area	620
5	Giotto/Lennon Parking Area	1000
6	De Gasperi/Stadio	100

The total number of km per year scheduled for the service is approximately 13.900.000. Concerning the aforementioned nodes, it is noted that only “Central Station” is inside the dense area of the city, while the others are completely external. Giotto, Basile, Emiri and Oreto offer simultaneously car parking area which allows the ‘park & ride’ system. The Central Station and Giotto nodes are modal interchange hubs due to the simultaneous presence or immediate proximity of other modes of public transport.

To support the traffic-limited zone, the Historic Centre Shuttle was established in April 2016. This service includes 2 free shuttles, the Free Express and the Free Historic Centre, operating every 10 and 11 minutes, respectively. The Free Express shuttle connects the Via Basile parking lot (an arrival point for extra-urban buses) to Piazza Indipendenza, serving as an interchange point. On the other hand, the Free Historic Centre shuttle facilitates travel within the Historic Centre, connecting various points of tourist and cultural related along the UNESCO route.

The current public transport system offers ubiquitous accessibility with many stops, mostly equipped with shelters and seats. However, the high density of stops, often located less than 150 meters apart, can lower the commercial speed due to interference with vehicular traffic and unauthorised use of reserved lanes. Only 12% (34 km) of the network operates on reserved lanes, with only 4.4 km being protected.

The AMAT bus fleet consists of 400 buses with an average age of 12.5 years, which affects the service reliability negatively due to breakdowns. However, a significant fleet renewal has been done since 2019. While the current system offers a good service mostly in central zones, it is limited in the outskirts and nearby neighbourhoods.

The SUMP underlines how important it is to improve road infrastructure, including traffic safety and removing barriers to the service quality in public transport. The current public transport needs further development regarding vehicle volumes, congestion, low public transport use and service irregularities. The plan suggests that increasing travel by public transport and implementing service obligations will help increase density and frequency, creating a positive cycle for public transport.

The strategies for the TPL service in the plan can be listed as below.

- Incentivise the use of public transport to achieve a significant modal diversion in favour of buses, trams, metro and trains.
- Develop tariff integration.
- Improve accessibility standards and reduce average travel times.
- Renew the fleet of vehicles to improve their efficiency and environmental performance.
- Improve connections with the Airport, both from Palermo and from the main urban centres of the hinterland, also through the synchronisation of the TPL timetables with those of the flights.
- Strengthen collective public transport along high-demand routes with high residential and commercial density: In Palermo, by 2023, key routes can be fully served by high-capacity public transport through expanding the rail component, including tram lines, completing the railway ring, and implementing a railway bypass. (The details of the completed tram and railway lines are given in the next section of the chapter.)
- Protect and facilitate vulnerable users.
- Encourage the transition to methane or electric and encourage private companies that manage other public transport (taxis, freight operators, subcontractors) to transition to low environmental impact vehicles.
- Strengthen the public transport service by road to the peripheral areas and improve the connection with the high-capacity transport systems and the possible connections with the municipalities of the metropolitan area.
- Facilitate interconnection between transport systems.

To meet high demand and improve the capacity of public transport, the tram network seems to be a suitable choice. It can replace buses, offering a capacity of over 5.000 passengers per hour compared to buses' 2.000-2.600. Besides, the tram uses its lane, which is a positive side against traffic congestion.

The new city tram network, consisting of existing tram lines and the planned extension, will be able to offer a qualified and efficient transport service in a large part of the city, reaching over a catchment area of over 325,000 residents, a value estimated based on the residence data taken from the 2011 ISTAT census. Innovative ticketing methods, such as electronic tickets, will allow for better monitoring, flexible pricing, and reduced illegal practices. The detailed examination of all projects, including the tram network with new stations, is done in the following section (Chapter 5.2 - Main public transport projects).

6.2 Main public transport projects

This section examines the public transport infrastructure projects that are instrumental in shaping Palermo's transportation and mobility landscape. These projects, which involve significant investments from both the European Union and local government funding, are central to the city's ongoing development of its mobility system. Understanding these infrastructures is crucial to gaining a comprehensive perspective on Palermo's current transportation network, which is a key focus of this research.

Although the primary emphasis of this study is on pedestrian accessibility and walkability, the analysis of transportation infrastructures such as the railway, tram networks, and rail ring is essential for a more holistic understanding of mobility in the city. These infrastructures are interrelated and play a critical role in the movement of people throughout Palermo. The railway system, in particular, is a significant factor in shaping the city's urban form, with a unique impact on the layout and development of the area. By exploring these transport projects, this section highlights how they influence pedestrian accessibility and how their integration into the city's overall mobility framework contributes to the broader discussion on sustainable urban development and the optimisation of transport options.

6.2.1 Railway bypass/link (passante ferroviario)

The ‘Palermo Railway Link’ is modernisation and strengthening projects of the railway network with double electrified track for approximately 30 km between the Palermo Central Station - Palermo Brancaccio Station and the Carini Station and connects the city of Palermo with the international civil airport "Falcone e Borsellino" in Punta Raisi, enhancing urban mobility and lowering road traffic congestion. The route, built partly on the surface and partly underground, runs alongside existing single-track electrified sections.

The rest of this section provides a comprehensive overview of the technical specifications of the stations and the reconstruction of Palermo's rail network. Rather than limiting the analysis to the case study areas of Orleans and Lazio stations, this broader focus is intentionally adopted to offer a holistic understanding of the city's public transport system. Such a systemic perspective is essential not only for contextualising the role of the selected stations within the wider mobility network but also for informing the policy recommendations presented in subsequent chapters, particularly those concerning multimodal integration, park-and-ride strategies, and the spatial alignment of public transport services. Understanding the full extent of ongoing and planned infrastructure interventions allows for a more grounded interpretation of the relationship between mobility systems and Palermo's urban development trajectory.

Table 19. Railway Bypass (Passante Ferroviario) – Project Summary.

Attribute	Details
Type	Heavy rail – double-track underground line
Total Length	±30 km
Total Stations	18 (within the municipal area of Palermo)
Main Axis	Brancaccio – Palermo Centrale – Notarbartolo – Punta Raisi Airport
Construction starting date	2008
Status (2024)	Mostly operational; some segments under construction or delayed.
Stations under construction	Lazio, Papireto
Key objective	Enhance airport-city connectivity, reduce car use, and enable modal shift.
Challenges	Archaeological constraints, construction delays, and urban interference.
Estimated completion	Post-2025 (no confirmed official date)

During the modernisation and renovation of the railway bypass, interventions to upgrade the link have been made, including the construction of 10 new stations, such as Roccella, Maredolce, Guadagna, Papireto, Lolli, Lazio, De Gasperi, La Malfa, Sferracavallo, and Kennedy (Capaci).

The renewals of the links and newly constructed stations were divided into 3 sections as explained below.

Section A: Palermo Centrale/Brancaccio - Notarbartolo.

Section B: Notarbartolo - La Malfa.

Section C: La Malfa – Carini

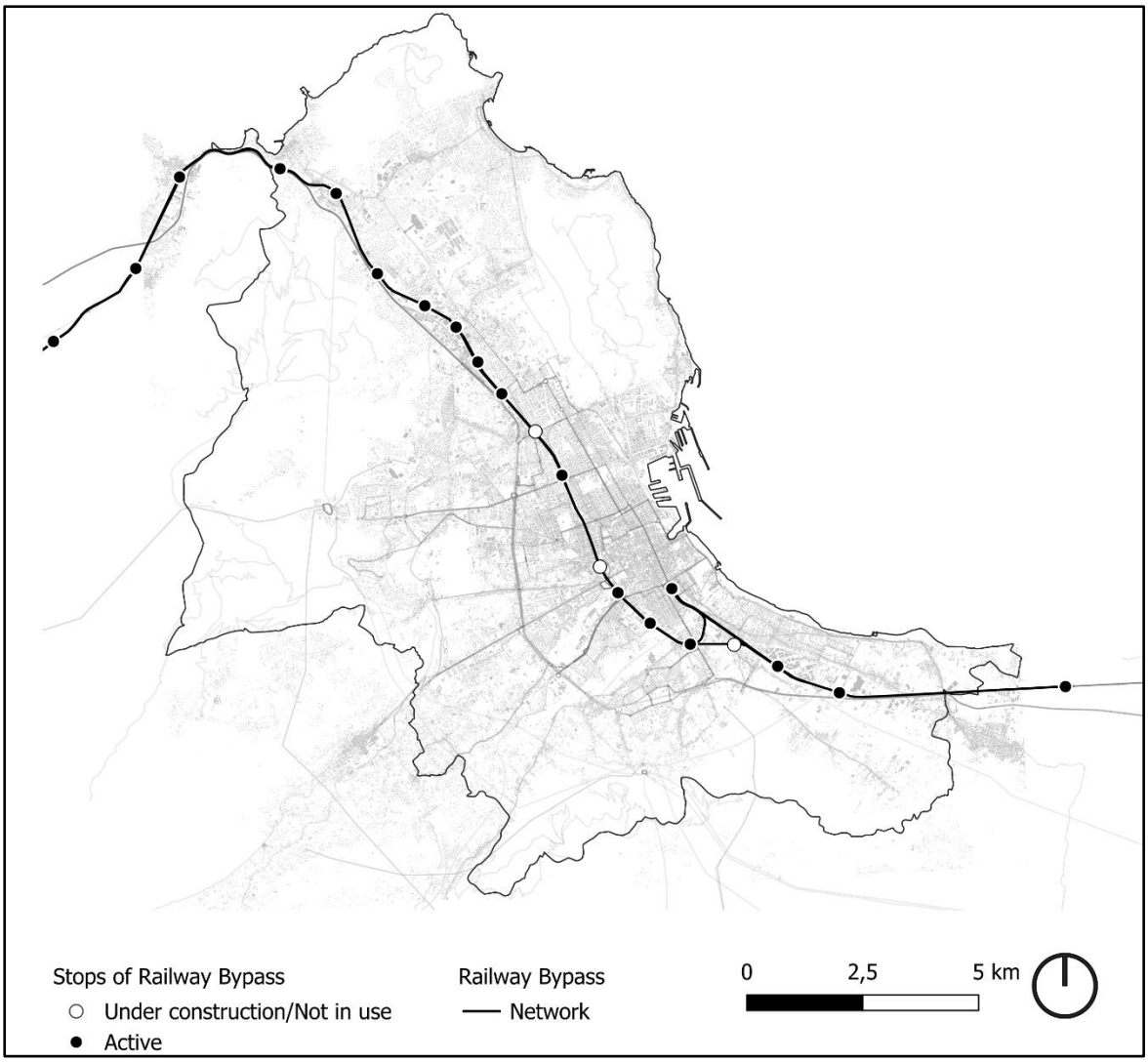


Figure 88. The Rail Bypass network and stations in 2024.



Figure 89. The sections of the renewal of the Railway Link (SUMP of Palermo, 2019).

The works on Sections A and C, started in 2008, are in an advanced stage of execution, while the works on Section B started in October 2013. The Palermo Centrale and Palermo Brancaccio stations will be equipped with a single ACC device, the works on which are in progress.

Section "A": Palermo Centrale/Brancaccio - Notarbartolo

The project, which extends for a total of 8.5 km, involves the doubling of the track (for approximately 6.5 km) from Central Station to Notarbartolo Station, on the Palermo-Piraineto-Trapani-Punta Raisi line, and the doubling of the "Palermo Brancaccio-Bivio Oreto" link connecting the line, on the Messina Trapani line for approximately 2 km.

The doubling project, with sections in variant and sections alongside the existing line, includes the restructuring of the forecourt of the Palermo Centrale Station (with the intervention of speeding up the tracks from 30 to 60 km/h), the restructuring of the forecourt of the Palermo Brancaccio Station (with the construction of a new pavement and extension of the existing underpass), the reconstruction of Vespri station underground (double track) and the adaptation of the Orleans Station.

Apart from doubling-work on section A, there have been 5 new stations planned as well. These stations are Roccella stop (2014) on the Messina-Palermo line, Maredolce stop (2016) on the Messina-Trapani line, Guadagna (2016) – Papireto (under construction) – Lolli (2016) stops on the Central/Notarbartolo stations sections. Among these stops, Maredolce is not in use even though the construction was concluded in 2016.

There have been side projects regarding the improvement of the stations. For example, the proposal to complete the Lolli and Papireto and the installation of safety systems in the Orleans-Notarbartolo tunnel have failed for the second time. This project, valued at €18.5 million, aimed to improve passenger safety and comfort. Despite a careful selection process, no companies submitted bids for the contract, delaying the project and potentially requiring a new tender or direct appointments (Mobilita.org, 2024b).

Again, in section A, the Vespri-Notarbartolo tunnel is a key project, being approximately 3.5 km for the even track and 3.2 km for the odd track. This tunnel consists of two sections: the Vespri-Orleans section with a single tube and double track, including the Vespri and Orleans stops, and the Orleans-Notarbartolo section with two separate tubes. The even track is in the existing tunnel, while the odd track will be built in a newly constructed tunnel. The two tubes merge into a single artificial tunnel before the exit at Notarbartolo station.

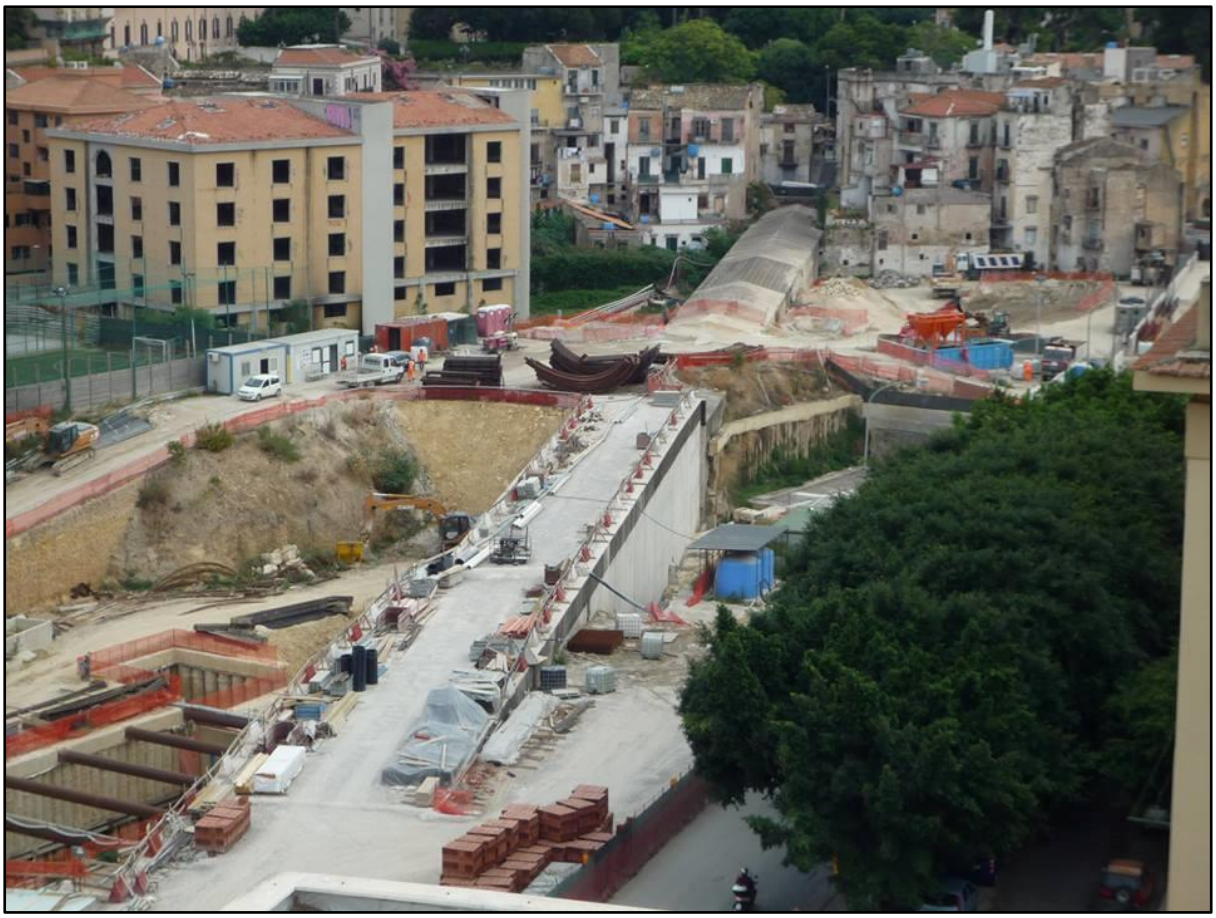


Figure 90. Papireto Station under construction.
Source: Mobilita.org, 2024b.



Figure 91. The location of Papireto station.
Source: Google Maps, 2024.

The Papireto station, conveniently located near city-level uses such as the Cathedral of Palermo, the Dalla Chiesa-Calatafimi barracks, the Norman Palace, other tourist attractions and a high school, will offer citizens and tourists easy access to these destinations.

Section "B": Notarbartolo – La Malfa

The doubling of the track in Section B extends for approximately 5 km, including 2.1 km in a single-track natural tunnel, 1.2 km in an artificial tunnel, and 2 km in a trench. Construction works started in October 2013. The first section from Notarbartolo to De Gasperi (2.6 km) involves building a new deep natural tunnel for the odd-numbered track and adapting the existing tunnel for the even-numbered track.

From De Gasperi to the La Malfa stop (approximately 2.7 km), the project includes taking the San Lorenzo Colli station underground in a trench and extending the work (partly in a trench, partly in an artificial tunnel) up to the De Gasperi stop.

The San Lorenzo station today has 3 surface tracks. After the construction works mentioned above, it was reopened on 7 October 2018 at the same time as the reopening of the Palermo Notarbartolo to Carini section of the Palermo-Trapani railway.

Apart from these renovations, De Gasperi station was opened in 2024, and Lazio station is still under construction. Construction of the Lazio stop is progressing steadily. The project extends approximately 120 metres of Viale delle Alpi, between Via Lazio and Via Umbria.



Figure 92. The De Gasperi station during the construction.
Source: Mobilita.org, 2024c.

The new Lazio station will be built underground, about 26 meters below street level. It will have five floors, with just one ground-level level providing access to the platforms. Construction is expected to be finished in 2027, with an average of 80 workers on site daily (source: Mobilita.org, 2024a). Once complete, the Lazio station is expected to encourage residents of the surrounding high-rise apartment buildings to rely less on cars and use public transportation more frequently.



Figure 93. Lazio station is under construction.
Source: Mobilita.org, 2024a.



Figure 94. The location of Lazio station is in a high-rise residential area.
Source: Google Maps, 2024.

Section "C": La Malfa - Carini

The doubling of this section, which involves the municipal territories of Isola delle Femmine, Capaci and Carini, extends for over 16 km and is included between the La Malfa and the Carini stations.

The doubling intervention develops mainly alongside the existing line, for about 11 km, with underground tracks inside new tunnel sections, for about 2.5 km. For this section, it is also planned to build 3 new stops (La Malfa, Sferracavallo and Capaci) and the adaptation of the 3 existing stops (Cardillo, Tommaso Natale and Ciachea).

The stations planned to be built have already been completed. La Malfa and Sferracavallo stations have been in use since 2018, and Carini station has been active since 2021. On the other hand, renovation of existing stops (Cardillo, Tommaso Natale and Ciachea) were also completed in 2018.

The ACC of Palermo Centrale

The Computerised Central Apparatus (ACC) was activated on December 19, 2015, marking a significant milestone in the modernisation of Palermo's railway infrastructure. This activation took place at the same time as the start of construction on the line doubling project, demonstrating the city's commitment to improving rail transport services.

The expansion of the ACC to include the Palermo Brancaccio station and the Oreto junction further enhanced the system's capabilities and connectivity. This strategic decision aimed to improve efficiency, reduce travel times, and enhance passenger experience along the railway route.

6.2.2 Railway ring (anello ferroviario)

As part of the urban area of Palermo's public transport infrastructure enhancement programs, the 'Metroferrovia di Palermo' (Railway Link and Railway Ring) is planned to be completed. This involves closing the ring of the existing single-track branch between Notarbartolo stations and the 'Giachery' stop, which also includes the 'Imperatore Federico' and 'Fiera' stations. Formally, Fiera station is not an autonomous facility, but is part of Palermo Sampolo station, which is only used for freight traffic. The Figure below illustrates the project as envisioned by local authorities.

The railway extension project in Palermo is a significant step toward improving urban mobility, with the addition of a 2.9-kilometre single-track line connecting key locations in the city centre. This new route extends from the existing Giachery stop to the Port area, Via Emerico Amari, Piazza Politeama, Via Malaspina, and Notarbartolo Station, strengthening connections between essential transit hubs. The project is being developed in two phases: the first, currently under construction, extends the railway to Piazza Castelnuovo, introducing three new stations—Libertà, Porto, and Politeama. The second phase will complete the railway ring by linking Politeama Station to Notarbartolo Station, including the construction of the Malaspina stop.

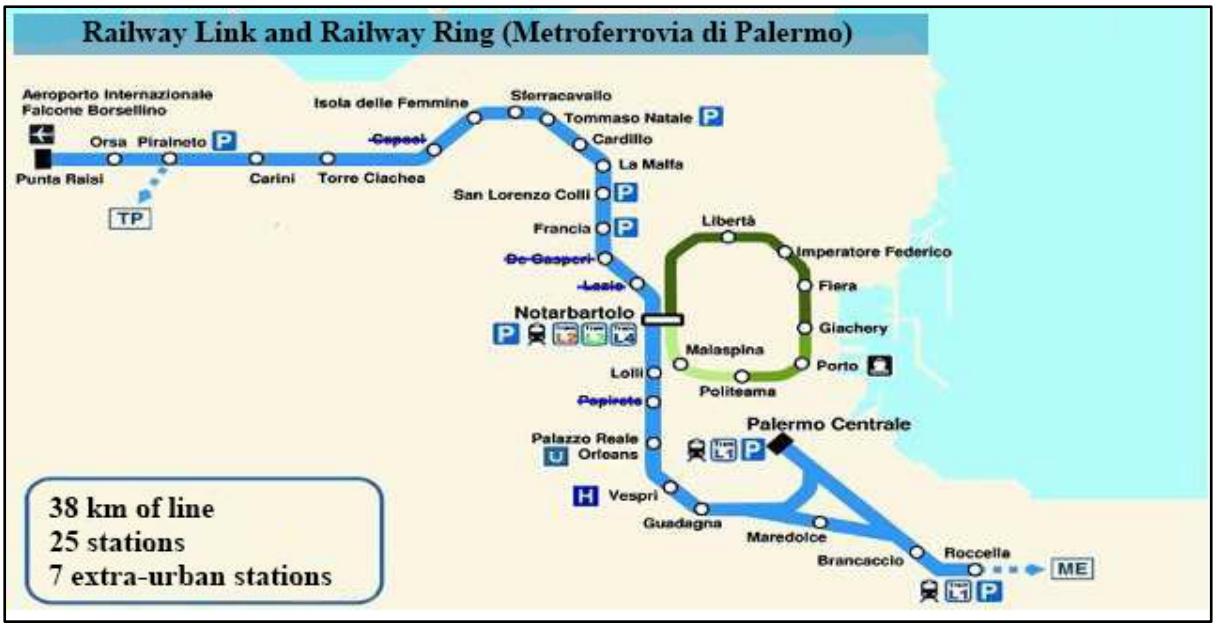


Figure 95. 'Metroferrovia di Palermo' project.
Source: SUMP of Palermo, 2019.

The new railway infrastructure passes through the Dante, Libertà-Politeama, and Sampolo-Ucciardone districts, key urban areas in Palermo's transport network. A major part of the route will run underground, with a tunnel extending from Giachery Station to Politeama Station, integrating the extension into the existing railway ring while minimising surface-level disruptions. The first section follows an L-shaped path, starting at Giachery and running parallel to Via Crispi before turning onto Via Emerico Amari and reaching Piazza Politeama. Initially, the service will operate between Notarbartolo and Politeama, using stops at Libertà, Imp. Federico, Fiera, Giachery, Porto, and Politeama, ensuring enhanced accessibility across the city.

Construction officially began in September 2014, and operational strategies have been carefully planned to improve efficiency and minimise delays. To ensure higher frequency and reduced waiting times, the possibility of simultaneous arrivals at Fiera Station was explored, given the considerable distance between current exchange points. The operational schedule aims for a train every 15 minutes per direction during peak hours, with station stop times set at 45 seconds. Upon completion of the full railway ring, the system will shift to a one-way circular service with a loop time of 17-18 minutes, 1-minute stops at each station, and a train frequency of every 5 minutes. In the worst-case scenario, a passenger needing to return to a previously served station would face a maximum travel time of approximately 18 minutes, considering both journey duration and wait times.

Originally designed for freight transport, this railway infrastructure is now being transformed into a fully integrated passenger service. The Railway Link and Railway Ring have already become essential components of the city's public transportation network, heavily relied upon by residents for daily commuting. Once the transformation is complete, the system will integrate seamlessly with the tram network, the railway bypass, and the planned light rail system (M.A.L.), enhancing efficiency, sustainability, and accessibility.

6.2.3 Tram network

The project of the tram network for Palermo was approved in 2005, and the construction works started in 2007 and were completed in December 2015. The service is managed by AMAT, like the other local public transport services in Palermo. Like other large-scale investments in transport infrastructures and projects, there have been delays and complexities in the timeline of the tram service. Despite those delays, the tram lines were eventually completed and have since become an integral part of Palermo's transportation network.

The tram system in Palermo currently consists of four distinct lines that connect the city’s outskirts to the central areas, providing a vital link for residents and visitors. These lines are integrated with other transportation options, creating a seamless network for travel across the city. Specifically, the tram system connects to the 'anello' (a circular railway line) and the 'passante ferrovia', as well as the AMAT urban and extra-urban bus system. These connections enable passengers to reach the city centre efficiently while facilitating easy transfers between various modes of transportation.

As shown in the following figure, the tram system comprises the following four lines, each serving distinct parts of the city:

Line 1 "Roccella – Central Station": This line is approximately 5.5 km long and features double tracks. It connects the eastern part of the city directly to the Central FS Station, facilitating interchanges between trains, buses, and trams. The Roccella terminal serves as a key interchange point for passengers travelling to and from the city, linking the regional and long-distance railway lines with the tram network.

Line 2 "Leonardo da Vinci": This line runs for about 4.8 km and connects the Borgo Nuovo district (located in the northwest of the city) with the Notarbartolo FS Station. It provides crucial connectivity for residents in this area, improving access to key destinations and transit points in the city.

Line 3 "CEP - Notarbartolo": Stretching approximately 5 km, this line connects the residential CEP district with the Notarbartolo FS Station. It serves as a major route for people travelling from the larger residential area to the central transport hub, enhancing connectivity for residents.

Line 4 "Notarbartolo - Calatafimi": This circular route is about 8 km long and links the expansive Notarbartolo residential area to the eastern part of the city, intersecting with Corso Calatafimi, one of Palermo's major avenues. This line serves as a key connector, offering an alternative route for passengers travelling across the city.

Palermo's tram system features modern, innovative vehicles designed with a completely lowered floor to facilitate easy access for people with limited mobility. Additionally, the trams run on dedicated, protected tracks, minimising interference from private vehicles and ensuring smooth and efficient service. Only at transverse crossings, which are also protected, do private vehicles intersect with the tram routes, guaranteeing high commercial speed for the trams.

To ensure the smooth operation of the system, traffic lights at intersections and pedestrian crossings are synchronised with tram schedules, providing clear and uninterrupted paths for trams. The tram service is monitored and controlled by a centralised system, which oversees the operation of all four lines, ensuring effective management and coordination. For the storage and maintenance of the vehicles, two depot areas are located: one in the Roccella zone with a capacity of 18 covered trains, and another in Via Castellana with a capacity for 12 covered trains. This infrastructure plays a critical role in maintaining the reliability and efficiency of the tram service.

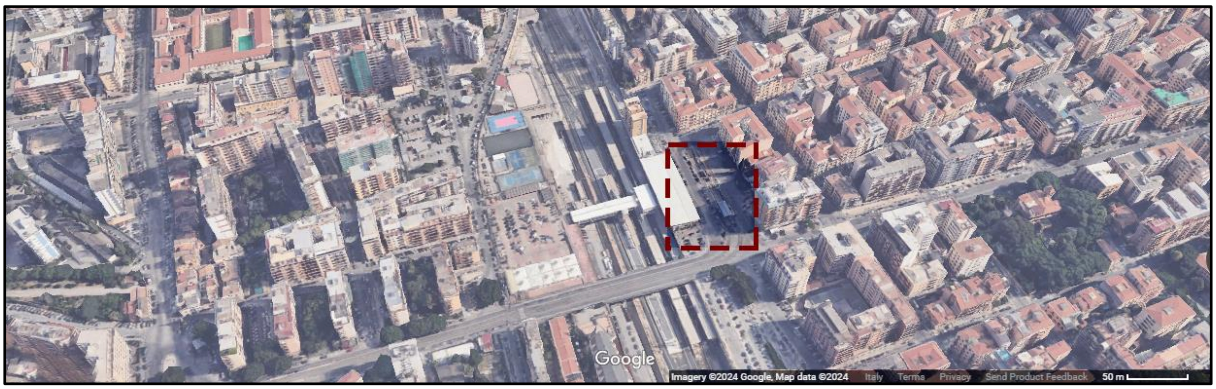


Figure 96. The Notarbartolo Tram station is next to the mobility hub.
Source: Google Maps, 2024.



Figure 97. CEP station, Palermo.
Source: Google Maps, 2024.

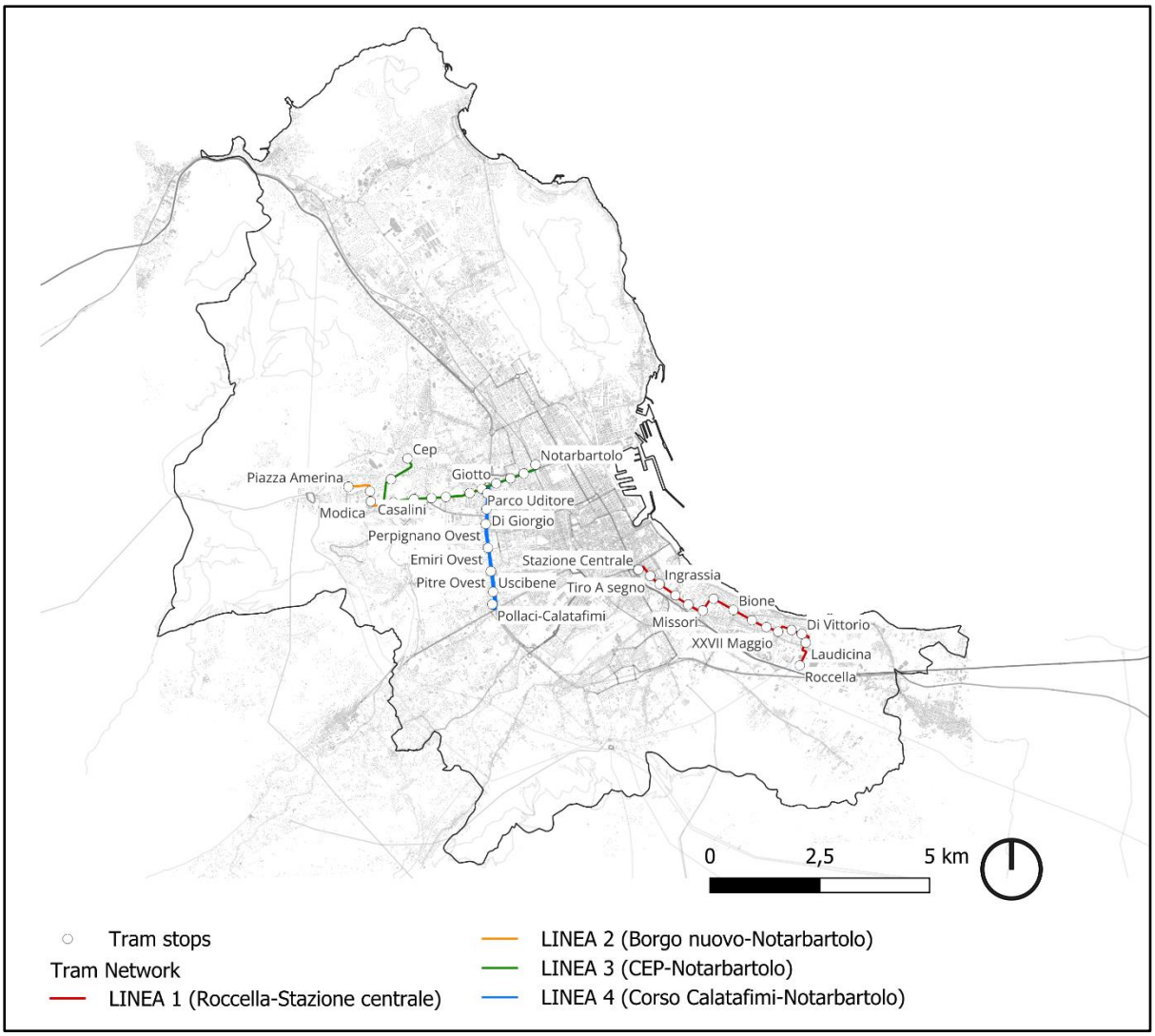


Figure 98. The tram lines that operate in 2024, Palermo.



Figure 99. Roccella Station next to the shopping mall (Forum), Palermo.
Source: Google Maps, 2024

The main operating parameters of the four lines are summarised below:

Line 1 - Roccella - Central Station = 5.536 km (double track)

Line 2 - Borgo Nuovo- St. Notarbartolo = 4.942 km (double track)

Line 3 - CEP - St. Notarbartolo = 5.236 km

Section A: CEP – Rotonda via Castellana = 1.436 km (double track)

Section B: Rotonda via Castellana - Notarbartolo Station: 3.8 km (double track)

Line 4 - St. Notarbartolo - Corso Calatafimi - St. Notarbartolo = 8.242 Km

Section A: Notarbartolo Einstein = 1.2 km (double track)

Section B: Einstein – Calatafimi- Einstein = 5.842 km (single track loop).

Table 20. Tram lines operate in the city of Palermo.

Terminals		Line	Length (m)	Travel Time (min)	Freq. (min)	Pass/h
Roccella	Central Station	Tram 1	5.526	27	9	1.693
Borgo Nuovo	Notarbartolo	Tram 2	4.942	27	18	847
CEP	Notarbartolo	Tram 3	5.236	27	18	847
Calatafimi	Notarbartolo	Tram 4	4.121	18	18	847

Source: SUMP, Palermo (2019).

The project of the new tram network

Until the 1930s, Palermo had an extensive tram service with over 120 km of network. However, starting in 1939, trams were progressively replaced by trolleybuses, while starting in 1966, the definitive abandonment of the tracks that were no longer in use began. In the 1990s, due to the growing demand for public transport, a new debate was started on the methods of urban public transport infrastructure, creating the foundation for the reinstatement of guided transport.

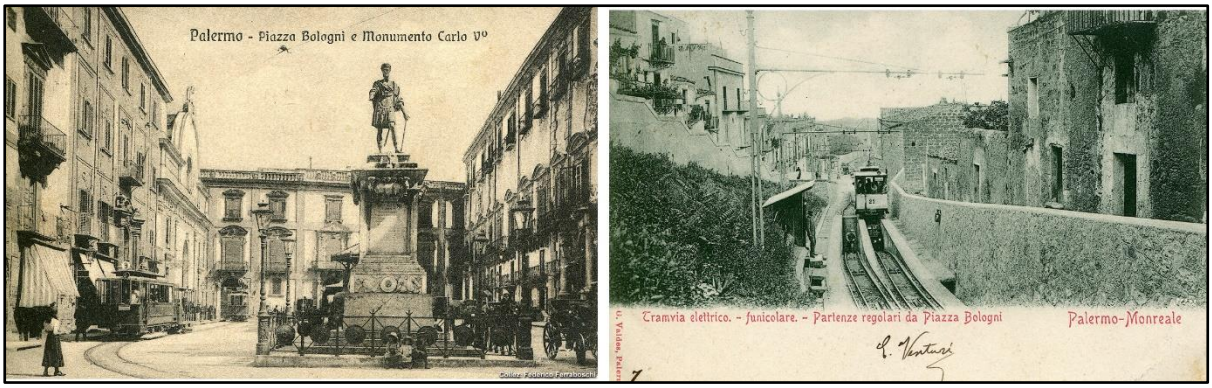


Figure 100. Tram in Piazza Bologni and Monreale, Palermo.
Source: Collection of Federico Ferraboschi (Stagni, n.d.).

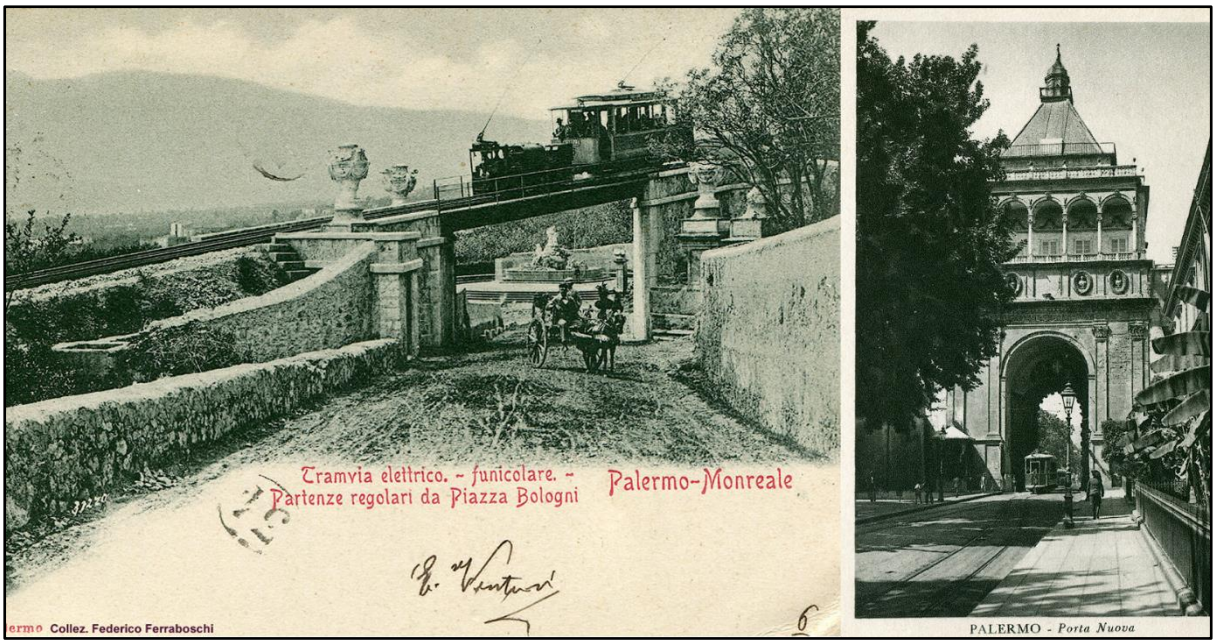


Figure 101. Tram in Monreale and Porta Nuova in Palermo.
Source: Collection of Federico Ferraboschi (Stagni, n.d.).

In 2000, the Tram project took its first steps, and on 30 December 2015, the three sections of 29.3 km long (measured on a single track) were inaugurated, which are now in operation. The Municipal Administration, aware that the tram represents a stable, long-lasting, and reliable local public transport system for the city, has drawn up a Feasibility Study for the expansion of the tram system, providing for the construction of another 7 sections for a further approximately 67 km of single-track measured lines.

The design process for the new tram lines was officially completed with the approval of Management Decision No. 12766 on December 19, 2022 (Mobilita Palermo, 2022). According to the project, Line 5 would connect the Foro Italico and Via Notarbartolo, while Line 6 would extend from the ring road's Orleans station through Borgo Ulivia to Bonagia, utilising a new bridge over the Oreto River. Line 7 would connect the Central Station to the popular seaside of Mondello.

The new tram network in Palermo represents a major step towards sustainable, integrated urban mobility. The project envisions the addition of seven new tram lines (Routes A–G), strategically designed to connect key urban centres, suburbs, waterfronts, and transport hubs. Special emphasis is placed on improving accessibility to major residential areas, hospitals, universities, and tourist attractions, while also relieving congestion in critical traffic corridors such as Via Notarbartolo and Via Leonardo da Vinci.

A significant technical innovation is the adoption of catenary-free (battery-powered) trams for most new sections, minimising visual impact on the urban landscape and preserving historical sites. The plan integrates the tram expansion with improvements in cycling infrastructure, shared mobility services (bike-sharing and car-sharing stations), and structured parking solutions to ensure a seamless intermodal travel experience.

Table 21. Summary of Palermo's new tram network expansion.

Route	Main Connection	Key Features	Length (Single Track)
A	Via Balsamo ↔ Piazza Papa Giovanni Paolo II	Pedestrianisation of Via Roma, redevelopment of Via Libertà, and underground parking construction	~
B	Notarbartolo Station ↔ Giachery	Urban mobility improvement around Notarbartolo hub, traffic decongestion, railway trench mitigation	~
C	Corso Calatafimi ↔ Orleans FS Station	Connection to the historic centre, double underpass at Via Basile junction to solve congestion	6.11 km
D	Orleans FS Station ↔ Bonagia FS Station	Serving hospital centres and suburbs, the new Oreto River bridge	2.27 km
E	Via Croce Rossa ↔ Mondello	Improving accessibility to the Mondello seaside, integration with public services	4.6 km
F	Central Station ↔ Via Libertà (Via Balsamo FS)	Waterfront regeneration, underpasses at Piazza XIII Vittime, reconnection of Castello a Mare archaeological site	~
G	Via Lanza di Scalea ↔ Sferracavallo FS Station	Linking suburban areas, integration with natural green spaces and Capo Gallo Reserve	5.63 km

Drawing inspiration from best practices observed in cities such as Valencia, Freiburg, and Porto (Bailly, 2018; EU Urban Mobility Observatory, 2021; Ibraeva, de Silva, & António Pais Antunes, 2022), Palermo's tram network aims to promote a cultural shift away from car dependency, encouraging more sustainable, efficient, and liveable urban environments.

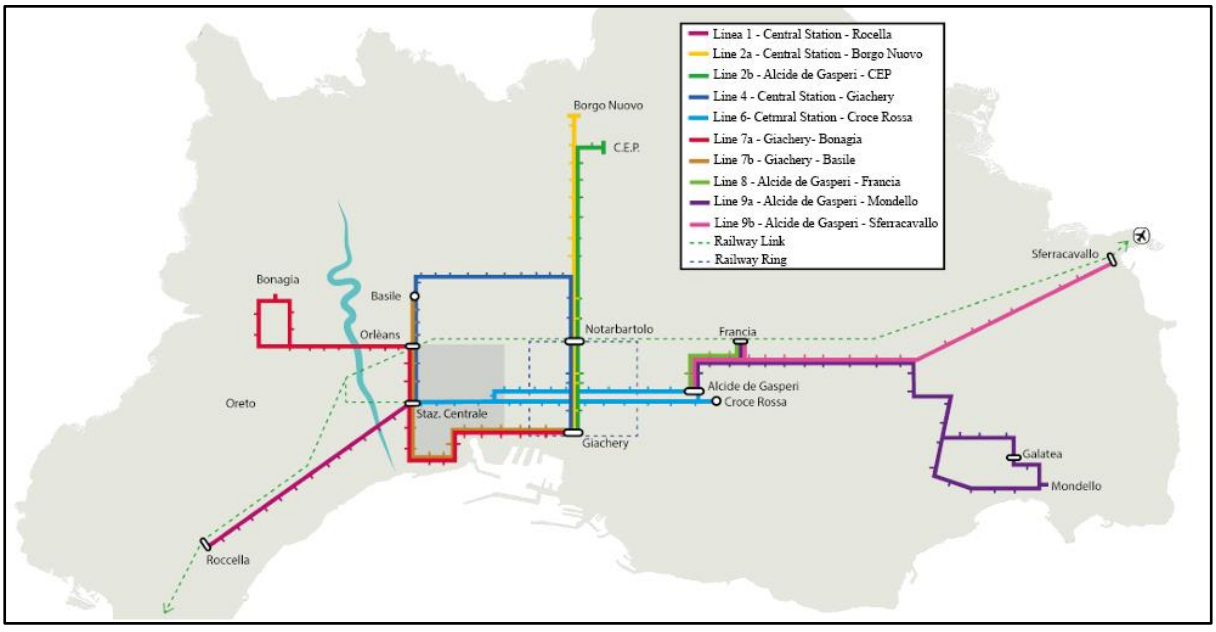


Figure 102. Conceptual drawing of new tram lines.
Source: Ing. Giovanni Cassata, Comune di Palermo.

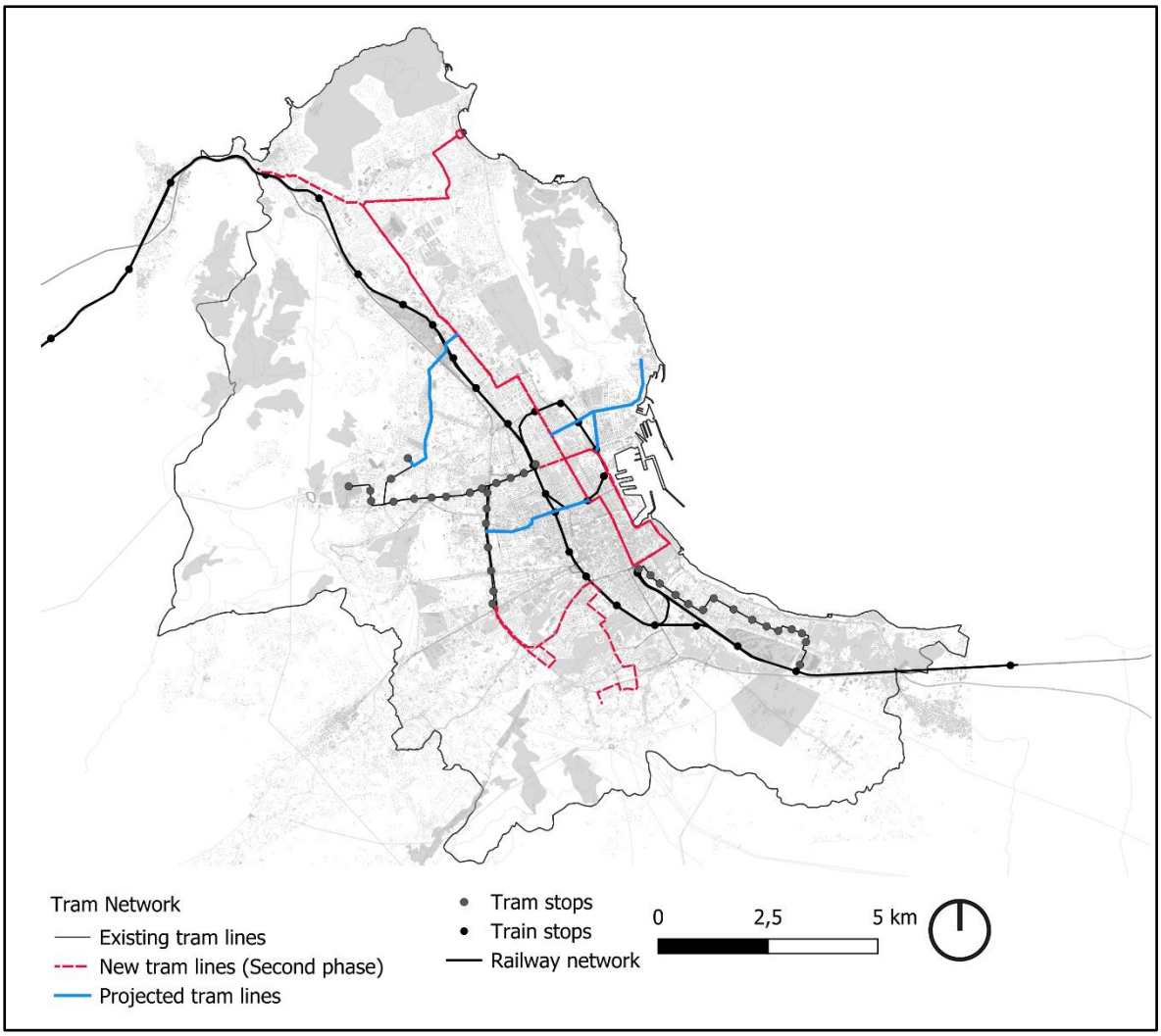


Figure 103. Conceptual drawing of new tram lines with other public transport projects.
Source: Comune di Palermo, 2018.

As seen from the last figures, the expansion of Palermo's tram network serves as a fundamental component of the city's integrated public transportation system, enhancing connectivity between peripheral neighbourhoods and central urban areas. It is strategically designed to interlink with other major transit modes, including the Passante Ferroviario and the city's bus services. Notably, the tram lines intersect with major railway hubs such as Palermo Centrale and Notarbartolo stations, enabling seamless intermodal transfers for both commuters and visitors. This integration is further reinforced through a unified ticketing system, which allows passengers to access trams, buses, and regional rail services with a single fare. Moreover, the planned expansion of the tram network is strategically aligned with projected park-and-ride facilities and coordinated connections to other public transport systems, including the Railway Link and the Railway Ring.

To complement these changes, a new approach to private road mobility has been proposed, featuring:

- A primarily counterclockwise circulation pattern around the ZTL area, following Via Cavour, Via Pignatelli Aragona, Via Cluverio, Via Papireto, Corso Alberto Amedeo, Piazza Indipendenza, Piazza Montalto, Corso Tukory, Piazza Giulio Cesare, and Via Lincoln, with Foro Italico and Via Francesco Crispi remaining two-way sections.
- North-south crossing routes along the seafront and the ring road, both maintaining two-way traffic.
- Two-way penetration routes along Via Basile and Via Belgio, ensuring smooth access to key urban areas.
- One-way penetration routes, with Via Leonardo da Vinci directing traffic from the ring road toward the Port, and Via Lazio facilitating movement toward the ring road.

Promoting sustainable urban mobility in a complex city like Palermo requires a strategic shift away from private car dependency while ensuring adequate parking solutions. The expansion of the tram network, essential for improving public transportation, will inevitably reduce on-street parking due to necessary infrastructure changes. Recognising this challenge, the project proposal includes the development of a network of off-street parking facilities to offset the lost spaces, ensuring a balanced approach that supports both sustainable mobility and accessibility for residents and visitors.

Table 22. New tram-parking design scenario

Lines	Eliminated parking	Newly planned parking	Type of Intervention	Key Locations
Line A	1018	1133	Underground multi-storey car parks	Via Libertà, Piazzale Ungheria, Piazza Giovanni Paolo II, Piazza Don Bosco
Line B	255	190	Underground multi-storey car park	Piazza Buna Lavagnini
Line C	164	160	Multi-storey car park	Piazza Giulio Cesare
Line E	732	1572	Underground and surface parking facilities	Viale Strasburgo, Viale Francia, Via Galatea, Via Mongibello
Line F	300	397	Underground parking lot	Foro Italico
Line G	0	142	Surface parking with a basement level	Via Palazzotto

Source: SUMP of Palermo, 2019.

The new tram lines are designed not just to improve public transportation but also to encourage more sustainable ways of moving around the city. As part of the project, the cycling network will be expanded and better connected, making it safer and more practical for everyday use. At the same time, new bike-sharing and car-sharing stations will be added along the tram routes, giving people more options to combine different types of transport. The table below details the planned improvements in cycling infrastructure and shared mobility services along the lines.

Table 23. Design scenario for cycling and sharing mobility.

Lines	Development of cycle paths (m)	Number of car-sharing spaces	Number of bike-sharing spaces
Line A	12.347	13	9
Line B	-	3	1
Line C	3.016	1	1
Line D	5.190	1	1
Line E	17.235	6	4
Line F	-	6	4
Line G	4.406	2	2
Total	**42.194**	**32**	**22**

Source: SUMP of Palermo, 2019.

The Automatic Light Rail (MAL)

The Automatic Light Metro (MAL), currently in the preliminary design phase, is set to become the backbone of Palermo's future public transport system, linking Via Oreto junction with Tommaso Natale–Partanna Mondello. Spanning 20.77 km with 23 underground stations, the fully automated system is designed to carry up to 100 million passengers annually, with a peak capacity of 24,000 people per hour per direction. Trains will operate every 90 seconds at commercial speeds of 32 km/h.

The initial 6.5 km segment, from Oreto junction to Notarbartolo Station, includes nine stations across the historic centre and is currently in planning. Running in twin tunnels at an average depth of 20 meters with minimal surface impact, the project marks a major shift toward sustainable mobility and will integrate seamlessly with Palermo's wider transport network.. After the implementation of the public transport projects explained previously, the integrated public transport system of Palermo will be divided into four levels.

- Metropolitan: consisting of the 'railway link' that connects important municipalities to the south and north of Palermo with the Palermo Central railway station and the Falcone Borsellino Airport.
- Distribution: inside the new city centre, consisting of the so-called 'railway ring'.
- Penetration: consisting of the automatic light rail that will cross the city along the North-South axis and the tram system that makes the entire city accessible, currently in the final design phase.
- Last Mile: created with road transport, buses, car and bike sharing.

CHAPTER 7

Rail station areas as targets for walkability strategy: A Tale of Two Stations in Palermo

7. Rail station areas as targets for walkability strategy: A Tale of Two Stations in Palermo

Based on the theoretical framework presented in this research, studies clearly show that walkability is one of the most important aspects of mobility in combating car dependency in cities. Improving walkability and pedestrian accessibility presents a multifaceted challenge, as it requires a thorough exploration of the spatial and behavioural determinants that contribute to car dependency. As explored in the previous chapters, the evolution of urban mobility strategies has shifted from a narrow focus on mitigating environmental impacts and reducing travel times to a broader focus on enhancing quality of life and promoting improved liveability for residents.

This complexity is especially apparent in car-dependent cities like Palermo, where many of the intertwined factors must be considered to mitigate car dependency and enhance walkability. To resolve these dynamics, a comprehensive theoretical framework has been established, supported by case studies from various cities that exemplify diverse experiences with walkability.

These previous chapters tried to answer the questions of 'How can urban planning strategies be employed to promote proximity within cities, considering not just physical distance but also accessibility and attractiveness?' and 'What are the key barriers to walkability, both cultural and spatial in urban environments, and how can these factors be addressed through urban planning and design strategies?' in a broader aspect.

Instead, this chapter combines theoretical insights with practical examples to explore how models like TOD and the 15-minute city can work together to enhance walkability around transit stations. The analysis aims to answer questions such as 'How can models like the 15-minute city and TOD be implemented in a way that effectively promotes sustainable travel behaviour and promotes vibrant and equitable communities?'.

7.1 Integration of 15-MC and TOD concepts on catchment areas

Walkability plays a crucial role in the success of public transit systems. Studies have revealed that a huge portion of public transport journeys involve walking, and that travellers spend 45–50% of their travel time as pedestrians. Moreover, the walking experience significantly influences overall passenger satisfaction (Hillnhütter, 2016). But then, the effectiveness of public transport investments often focuses solely on the vehicles and infrastructures themselves, avoiding the crucial aspects of station accessibility and waiting times. Public transport users are pedestrians who need to reach stations to access the service. Therefore, the journey is not complete until they reach their destination, and safety is a paramount concern. To reduce car dependency, it is essential to create a seamless integration between public transport and pedestrian networks. This study aims to explore strategies for achieving this integration and promoting sustainable urban mobility.

In this context, TOD is an essential approach for creating a 15-minute city where commuters can easily reach their destinations within a short timeframe. TOD is crucial for competing with the speed and convenience of private vehicles, which are often perceived as more comfortable. By prioritising TOD, public transport's appeal can be improved, and car dependency can be reduced. This involves providing amenities and facilities comparable to private vehicle use, such as convenient parking, accessible stations, and well-maintained infrastructure.

To create a truly effective public transport system, it is important to adopt a comprehensive approach that considers the entire journey, from the initial access to the station to the destination. By investing in TOD and improving the overall user experience, public transport could be a more attractive and viable alternative to private vehicles. This will not only reduce traffic congestion and pollution but also contribute to a more sustainable and equitable urban environment.

Furthermore, TOD can promote economic development by creating vibrant and walkable neighbourhoods. By locating key amenities such as shops, restaurants, and cultural attractions within a short walking distance of public transport stations, it encourages people to live, work, and play in these areas. This can lead to increased economic activity, job creation, and a more vibrant urban fabric.

To achieve this integrated approach, this research suggests an integration of TOD and 15-minute city concepts. Both the TOD and 15-minute city models are grounded in common guiding principles (Jacobson and Forsyth, 2008; Thomas et al., 2018; Büttner et al., 2022; Khavarian-Garmsir et al., 2023), which are particularly relevant for strategic design, urban policy, and spatial planning. Key to their success is a built environment which rich in diverse functions and amenities, which is attractive to residents and public transport users. Moreover, accessibility to these amenities is vital for both paradigms, achieved through proximity to residential areas, high-quality public spaces, pedestrian-friendly streets, and efficient connections to secondary mobility networks, such as shared mobility options. These measures aim to reduce car dependency and ensure seamless first/last-mile connections to the transportation network when needed.

While both paradigms emphasise long-range connectivity, they differ slightly in their approach to spatial planning instruments. TOD typically requires integration into a metropolitan or regional development strategy, combining various policy sectors and stakeholders, especially transit authorities. In contrast, the 15-minute city often focuses on district/neighbourhood-scale planning, facilitating urban design and community-led co-design processes for implementation.

Many cities have aligned their urban design guidelines with the concept of walkable neighbourhoods, seeing them as promoters for higher urban quality of life and community cohesion (Noland et al., 2017). Given this context, this study aims to evaluate a methodology for identifying and evaluating social, functional, and environmental features affecting the attractiveness of major transit nodes and surrounding built environments, especially in a so-called car-dependent urban context. Using two distinct train station areas as case studies, the methodology provides a comparative assessment across diverse contexts. Evaluation criteria use a wide range of indicators, aiming to address the following sub-questions related to this study's main research questions.

- What components define the attractiveness of a transit node in a complex urban environment?
- To what extent can quantitative and qualitative indicators describe the interaction between place and transit node?
- How can this knowledge inform practical policy guidelines?

Hence, in the following sections, the reasons why two different station areas are chosen, the methodology of the analysis applied to target stations, and the results are given in detail.

7.2 Criteria for the selection of the target areas

Focusing on Palermo's Rail Bypass, the decision to select Orleans and Lazio stations as target areas for analysis was driven by their distinctly different spatial, socio-cultural, and functional characteristics. This intentional choice provides a comprehensive framework for studying walkability across contrasting urban contexts, providing insights regarding pedestrian accessibility into both established and emerging transit-oriented environments.

The decision reflects an intention to address diverse challenges and opportunities for improving walkability. Orleans Station, located next to the historic Old Town of Palermo, owns the complexities of a multifunctional urban setting. Its critical location close to the Old Town and to many important services, combined with its role as a longstanding mobility hub, makes it a focal point for analysis. The station's narrow streets, dense land use, and diverse functions emphasise the need to improve pedestrian accessibility while considering its close connection to the Old Town.

In contrast, Lazio station represents a more modern, mostly residential context. Located in a neighbourhood characterised by broader streets and a mono-functional focus, Lazio provides an opportunity to study walkability in a developing urban area with fewer spatial constraints. As a newer station, its context allows for forward-thinking, innovative planning that prioritises pedestrian-friendly interventions and addresses the needs of residents.

By choosing these two stations, the analysis gains a comparative perspective to understand walkability in two fundamentally different environments: a complex, multifunctional urban hub with limited street space and a newer, residential-focused area with adequate capacity. This dual approach enables the study to explore strategies that accommodate unique challenges while drawing broader lessons for diverse urban dynamics. Lastly, this selection enhances the potential for actionable, adaptable recommendations to improve walkability in cities with varying socio-spatial contexts.

The following section provides a detailed explanation of the station areas, with insights and context.

7.3 Overview of the selected stations' areas

Orleans station, situated at the southwestern edge of the city's Old Town (Fig. 109), has emerged as one of the busiest stations since its establishment in 2001. This can be attributed to its strategic location near various attractions, including the university, the Sicilian Region presidency and assembly buildings, a children's hospital, and prominent cultural landmarks like the cathedral and Orleans Park. The built environment surrounding Orleans station dates to before the 19th century, encompassing a huge portion of the Albergaria district within the Old Town.

Despite its historical significance and association with affluent families and institutional bodies, the district has faced challenges over the years. Dating back to the 18th century, it was the subject of Palermo's initial master plan, the 1885 'Piano Giarusso,' aimed at addressing its deteriorating physical and social conditions. Since then, the area has slowly changed over time, characterised by a blend of rich heritage, including UNESCO World Heritage sites, and persistent social complexities. Additionally, the influence of Orleans Station extends to three other newer residential districts, such as Calatafimi and Oreto.

On the other hand, the 'Lazio' station, currently under construction with an expected cost of EUR 41 million, is in the northern area of the city centre, specifically within the 'Libertà' district. The surrounding area experienced significant expansion during the construction boom known as the 'Sacco di Palermo' in the second half of the 19th century. Despite that the district is highly residential and lacks significant points of interest, the station holds promise for enhancing connectivity within the city and offering greater accessibility to residents in the vicinity

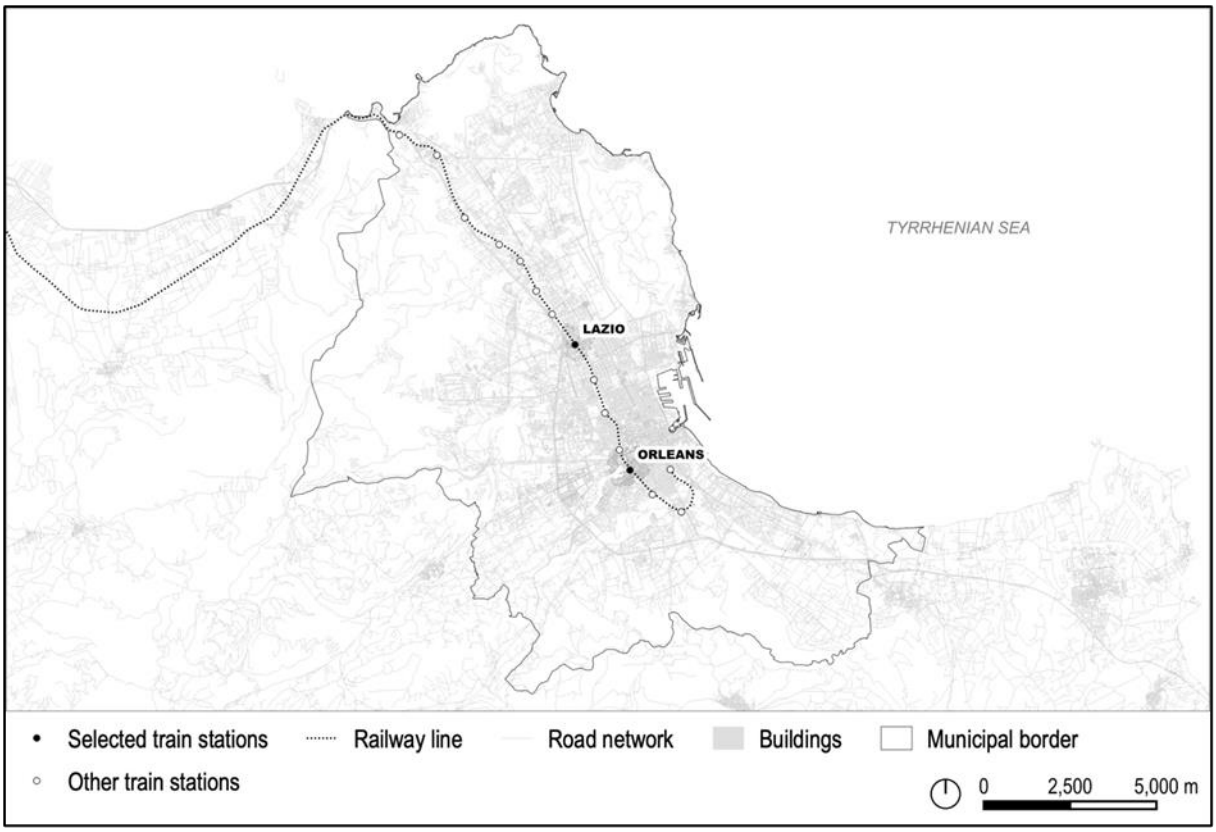


Figure 104. The location of the 'Orleans' and 'Lazio' stations.



Figure 105. Eye-view of the station areas. (Left) The heterogenous, multi-functional context of 'Orleans' and (Right) the dense, mono-functional, residential context of 'Lazio'.

The objective is to describe the strengths, challenges, and opportunities regarding attractiveness and accessibility in two distinct areas of the city, aiming to inform political, strategic, and planning decisions aimed at enhancing connectivity between infrastructure nodes and their surrounding urban environments. The first reason for selecting these two stations is that they belong to different urban contexts developed during separate periods, hence representing diverse demographic backgrounds with distinct urban functional characteristics. Consequently, it is assumed that the study outcomes will encompass a wider spectrum of potential scenarios, thereby enriching the testing of the methodology.

7.4 Methodology of the analysis

This section outlines the methodology employed to integrate the principles of the 15-minute city and TOD into the analysis of walkability within two selected catchment areas. The study aims to explore how these frameworks can be adapted to enhance pedestrian accessibility and reduce car dependency in an urban context like Palermo.

The methodology combines theoretical frameworks with practical applications to assess spatial and socio-demographic factors influencing walkability. A mixed-methods approach was employed, incorporating spatial analyses and statistical data sets. The spatial analysis involved mapping existing land uses, transportation networks, and pedestrian infrastructure within the catchment areas. This step provided a comprehensive understanding of the physical characteristics and connectivity of the station areas.

The study integrates GIS-based mapping techniques to identify gaps in pedestrian infrastructure and highlight opportunities for improving accessibility. Additionally, urban design principles, such as the creation of shared streets and pedestrian-prioritised zones, were applied to develop actionable recommendations tailored to the unique characteristics of each area.

To ensure suitability and effectiveness, the study included best practices from cities with established pedestrian networks, integrating these with the specific cultural and spatial dynamics of Palermo. The analysis also evaluates how proximity, accessibility, and mixed-modal connectivity can be achieved through urban interventions.

Finally, the methodology emphasises the importance of a comparative analysis by applying standardised evaluation criteria across the selected areas. This approach allows for consistent measurement of walkability, identifying both shared challenges and context-specific solutions.

This structured approach offers a solid framework for exploring and improving walkability in various urban contexts, while supporting broader goals of sustainable mobility.

7.4.1 The Principles of TOD and 15 Minute City

The initial phase of the methodology involves grasping the fundamental principles of both concepts. The key points of TOD, as the 15-minute city, highlight pedestrian-friendly environments, cycling infrastructure, connectivity, but with a stronger stress on transit systems, mixed land use, densification, compact urban forms, and modal shift. On the other hand, the principles that the 15-minute city underlines include human-scale urban design, density, diversity, flexibility, proximity, digitalisation, and connectivity. Based on the literature review on established frameworks for both concepts, a new set of indicators is created for application within selected target areas.

Table 24. The principles of TOD and 15-minute city concepts.

Transit-Oriented Development	15 Minute City
Density	Proximity and Density
Mixed-use and complexity	Mixed-use and diversity
Connectivity Transit in the urban pattern	Connectivity Accessibility
Public spaces for human use Safety Shift	Human-scale design Liveable public spaces Placemaking
Diversity in demographics	Diversity in demographics
Smart Mobility	Digitalisation
Timeframe and Programming	Adaptability and flexibility

7.4.2 Indicators for social, functional, and environmental features

Considering both qualitative and quantitative aspects of the methodology, as observed in prior studies (Bertolini, 1999; Vale et al., 2018; Lyu et al., 2020; Papagiannakis et al., 2020), it becomes evident that no single indicator can fully explain the multifaceted nature of a target area. Bearing this in mind, the selection of qualitative and quantitative indicators (Table 25) aims to comprehensively characterise each area in terms of density, functional diversity, mobility and accessibility, street quality, social diversity, digitalisation, and flexibility.

Table 25. The three guiding dimensions of the quali-quantitative analysis, corresponding data sources and typology of indicators.

Dimension	Data (Input)	Indicator (Output)
Social	Statistical Data	Quantitative (Numeric values)
Functional	Direct Observation	Qualitative (Mapping)
Street Quality	Direct Observation	Quali-quantitative (Index)

These indicators above can be categorised as follows:

- Numerical indices describe the socio-demographic profile of station areas, including population density, old-age dependency ratio and education level, offering insights about housing conditions as well. Derived from statistical data gathered at the Census unit level, these indicators facilitate detailed analyses on a small scale and enable easy comparison of results across different catchment areas.
- Functional analysis involves mapping specific types of functions and amenities that enhance the attractiveness of a station area, catering not only to referring residents but also to visitors from other districts of the city. This analysis highlights the density and distribution of urban functions within the districts, emphasising their spatial relationship with the street network and the train station. As mentioned by Bertolini (1999), accessibility revolves around facilitating individuals' engagement in activities both at and around transit hubs. Therefore, considering the diversity of activities and the individuals who utilise them is essential for comprehending accessibility in station areas.
- A hybrid approach is employed in assessing street quality, combining qualitative and quantitative evaluations of street conditions to create a numerical index. This index is then utilised to generate a spatial representation of conditions that could affect accessibility to and from the stations.

Given the significance of walkability within the scope of this research, the assessment of street quality has a pivotal role in the analyses. As underlined by Southworth (2005), the Euclidean method to measure catchment areas (buffer) does not adequately determine walkability; instead, the quality of the pedestrian path network is essential, as emphasised by Jaskiewicz (2001). Different elements of the pedestrian network affect the probability of walking and can be enhanced through strategic design.

Hence, this study focuses on a collection of small-scale indicators concerning urban design characteristics that influence pedestrian safety and comfort. These indicators encompass the pedestrian-road ratio, vegetation, street lighting, slope, speed limit, traffic regulations (ZTL regarding Palermo case study), pedestrian crossings, and the availability of traffic calming measures. Each indicator undergoes individual assessment, summation, and normalisation to derive a final classification for each street. The detailed explanation of the assessment of each indicator is given in the appendix (A).

Street-level analyses play a vital role in linking station areas with walkability, an essential aspect of the 15-minute city concept. After conducting a thorough assessment of these indicators, a quality index is calculated and standardised on a scale from 0 to 1. This standardisation enables the categorisation of streets within each catchment area, aiding in the identification of priority zones for informing policy guidelines and focused interventions.

7.4.3 Creation of catchment areas

There are several ways to define proximity and accessibility, depending on the context and methodology used. In the case study of Palermo, the focus is on areas reachable within 7 to 8 minutes on foot, a decision shaped by both spatial and behavioural factors specific to the city. This timeframe is considered reasonable for accessing or leaving train stations, aligning with typical pedestrian behaviour. Additionally, the average walking time between subsequent stations on the metropolitan rail line is around 15 minutes, making 7–8 minutes a logical midpoint. Furthermore, this range strikes a balance between 5 and 10 minutes, serving as a median value that ensures accessibility analysis remains both practical and representative. By adopting this approach, the study reflects real-world walking patterns and provides a realistic framework for evaluating urban accessibility.

To establish the catchment area of the node, a default walking speed is set to 5 km/h. This value was selected based on a range of empirical and normative references (Majed, Ibrahim, Merilyn Jean Lock, & Jabbour, 2024) that identify 4.5 - 5 km/h as a widely accepted standard for adult walking speed in urban planning and transport modelling. The procedure followed these steps:

- Determining the extent of the walking network by calculating the ‘fastest route’ using the QGIS ‘Network Analysis - Service area’ algorithm. OpenStreetMap's roads served as the network data, chosen for their publicly available nature, facilitating reproducibility.
- Conducting a preliminary verification by comparing the resulting walkable network with isochrones generated using various online API services, such as Iso4App.
- Considering the extent of the built environment affected by the station, particularly focusing on qualitative aspects like the availability and spatial distribution of city-level functions.
- Overlaying the boundaries of the Census Unit to enable finer statistical analysis, observe trends between 2011 and 2021, and facilitate method replication in other territorial contexts.

The following Figure explains in detail the creation process of a catchment area by using the Lazio catchment area as an example.

The leftmost image shows the step for defining the precise 7-minute walking distance from Lazio station, calculated using the fastest route analysis based on the OpenStreetMap network. This is done through the Network Analysis - Service Area algorithm as mentioned above, ensuring an accurate representation of walkable access. To verify the results, the buffer is then cross-checked with Iso4App to check if the two outputs match.



Figure 106. The main elements for the definition of the catchment area are the area 7-8 minutes walking network (left), the built environment around the station (mid), and the statistical unit boundaries (right).

Since this method considers only the road network and not the built environment (such as buildings and urban structures), the second step improves the catchment area by overlaying it with the built environment (the central image). This adjustment considers key urban features, including the availability and distribution of city-level functions, ensuring a more practical and realistic view of accessibility.

Finally, the catchment area is combined with census units in the third step, allowing for detailed statistical analysis. This step helps provide useful insights for the next phase of the research, making it easier to understand urban accessibility in a more precise and structured way, considering socio-demographic aspects.

7.5 Result of the analysis

The catchment area of the 'Orleans' train station is around 104 hectares and, as of 2021, houses a total population of 15,178 residents, having a population density of approximately 145.5 inhabitants per hectare, which is 3.67 times higher than that of Palermo. Over the period from 2011 to 2021, the area experienced a population decline, showing the city's demographic trend, with a decrease of approximately 1.5%. In terms of diversity, there is a balanced gender distribution, and 9.0% of the residents are foreigners, indicating a 50% increase compared to the data from 2011. Moreover, the ratio of individuals aged over 64 to the active population stands at 28 per 100, while the employment rate mirrors that of the city, with 41 employed individuals for every 100 active residents. Additionally, the percentage of adults holding a higher education degree is lower, at 15.9%.

As previously mentioned, the catchment area of the ‘Orleans’ train station encompasses a massive portion of the Old Town urban fabric, with approximately 85% of the buildings constructed before 1960. In terms of the built environment, a considerable portion, accounting for 56.2% of the total 1173 housing buildings surveyed in 2011, exhibited signs of poor conservation. Despite this, the occupancy rate remained considerably high at 92.8%. The housing density in the area is approximately 80.5 houses per hectare, indicative of a densely populated urban context, with 26.9% of the 8396 houses reported as vacant. This vacancy rate translates to 1.87 times more unoccupied houses in the ‘Orleans’ area compared to the city.

Table 26. Set of indicators regarding housing and the built environment of the 'Orleans' station catchment area.

Indicator	Palermo	Orleans
	2011	2011
Housing density [houses/ha]	17.8	80.5
Vacant houses [% over total]	14.3	26.9
Used buildings [% over total]	96.1	92.8
Buildings constructed pre-1960 [% over total]	47.4	84.9
Buildings in poor state of conservation [% over total]	26.6	52.6

Regarding the daily commuting patterns of residents, data from 2011 shows that the majority travelled within the city (96.8%), with only a small percentage (3.2%) commuting to neighbouring towns. In addition to the train station, the existing public transport infrastructure in the area contains 28 bus stops served by 30 bus routes. This underlines the significance of connectivity in the zone, highlighting its essential role in creating mobility. Furthermore, an analysis of the availability and spatial distribution of city-level functions within the ‘Orleans’ catchment area reveals accessibility to various attractive nodes (Fig. 113, left), including educational institutions (universities, high schools), military/law enforcement facilities (police headquarters, barracks), government offices (Sicilian Region Presidency and Regional Assembly), and healthcare services (children’s hospital).

All these analyses show the significant potential of the station regarding attracting users, both residents and visitors. However, they also emphasise the critical need to establish effective accessibility around the node that can be achieved through the development of pedestrian-friendly streets and public spaces. Despite this potential, many of the streets within the catchment area show low-quality standards for pedestrians, failing to provide necessary walkable conditions. For instance, the pedestrian-road width ratio frequently falls below 30%, which is not considered optimal for accommodating multiple pedestrians' movement (Southworth, 2005).

While lighting is present throughout the catchment area, a limited number of streets have speed limits for vehicle traffic, adversely affecting pedestrian safety and comfort. Unlike, there are comparatively more streets with traffic restrictions (ZTL) due to the location of the catchment area within the Historic centre. Vegetation is sparse, except for arterial roads and green spaces such as public gardens and squares. There are no slope variations that pose issues for walking. In terms of shared mobility options, the area features two bike-sharing stations, which could benefit from closer proximity to the station, as well as three car-sharing points.

However, pedestrian safety remains a concern due to the area's ageing infrastructure, particularly within the historical parts. Moreover, the low pedestrian index, indicating the ratio of pedestrian pathways to total street width, suggests a lack of pedestrian comfort, particularly evident in the narrow streets of the Historic centre where pedestrians often contend with vehicular traffic.

The Lazio train station catchment area covers a total of 69 hectares. According to the statistics from 2021, it is home to a population of 15,010 residents, with a population density of approximately 201.4 inhabitants per hectare, significantly higher than that of Palermo. Over the period from 2011 to 2021, the area experienced a decline in population of about 2.9%, mirroring the demographic trend of the city as a whole.

In terms of diversity, there is a balanced gender distribution, and only 2.2% of the residents are foreigners, although this percentage has seen a notable increase since 2011. Additionally, the ratio of individuals over the age of 64 to the active population is 45 for every 100 residents, indicating an older demographic profile respect to the other station. The employment rate in the area is higher than the city average, with 58 individuals employed for every 100 active residents. Moreover, a considerable proportion of adults hold a higher education degree, accounting for 43.1% of the population.

As previously mentioned, the Lazio station area corresponds to an area developed during the second half of the 19th century. Consequently, only approximately 26.5% of the buildings within this area were constructed before 1960. Despite this, the built environment shows some noteworthy characteristics. In 2011, a sizeable portion (56.2%) of the 1,173 housing structures assessed were found to be in poor condition. However, despite their condition, the occupancy rate remained high at 92.8%. The housing density in this area is notably dense, with approximately 93.3 houses per hectare, indicating a landscape dominated by tall residential buildings. Vacancy rates are low, with only 7.1% of the 6,952 houses recorded as vacant. In comparison to the city, the ‘Lazio’ area has half the number of unoccupied houses.

Table 27. Set of indicators regarding housing and the built environment of the 'Lazio' train station catchment area.

Indicator	Palermo	Lazio
	2011	2011
Housing density [houses/ha]	17.8	93.3
Vacant houses [% over total]	14.3	7.1
Used buildings [% over total]	96.1	98.5
Buildings constructed pre-1960 [% over total]	47.4	26.5
Buildings in poor state of conservation [% over total]	26.6	16.6

Regarding the daily commuting habits of the residents, a vast majority travelled within the city (96.5 %) and only 3.5 % travelled towards neighbouring towns in 2011. In addition to the station, the current public transport system consists of 20 bus stops and 25 bus routes. The availability of city-level functions in the Lazio catchment area is low with respect to the Orleans station, and there is a predominance of residential buildings with very few attractive nodes. This underlines the high potential use of the station by residents and a very few visitors.

Overall, the streets around the Lazio station are pedestrian-friendly, benefiting from a densely populated layout that keeps them quiet and well-maintained. However, larger streets serving various functions tend to have higher traffic density. While most streets and public spaces meet safety standards and pavements are wide enough for safe pedestrian movement, there are considerable issues, especially in narrow streets where parking on both sides narrows pavements and causes safety risks. This problem is worsened by the lack of strict parking regulations in the area, which challenges pedestrian flow.

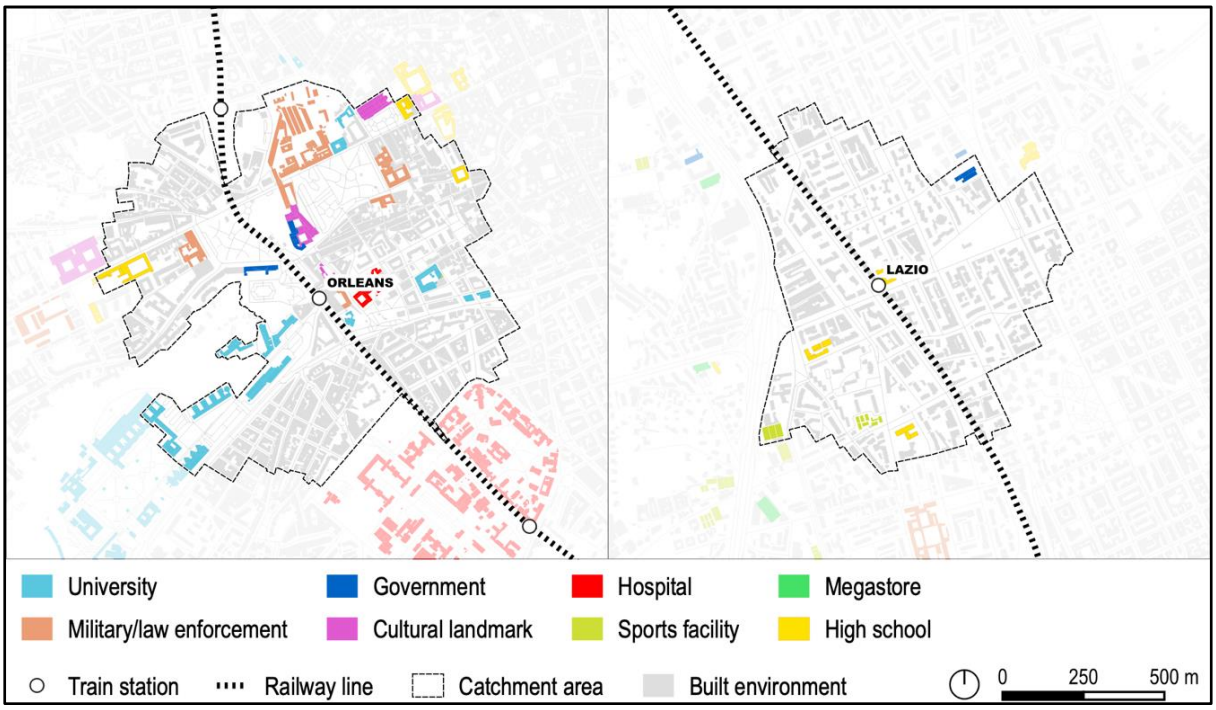


Figure 107. The distribution of city-level functions of the 'Orleans' and 'Lazio' catchment areas.

To summarise the social and functional analyses, both catchment areas represent distinct urban contexts, each shaped by differences in the built environment, socio-economic structure, and functional role within the city. Despite having a similar number of inhabitants, Lazio has a higher population density due to the predominance of residential plots, whereas Orleans features a more diverse mix of land uses. Additionally, Orleans has a higher proportion of non-national residents and a lower percentage of individuals with higher academic qualifications.

The socio-economic divide between the two areas becomes even more apparent when considering employment levels. Lazio has 1.4 times more employed residents than Orleans, highlighting significant economic disparities between the two demographic profiles. Another key difference lies in the functional composition of these areas. Despite its central location, which attracts people from outside the district due to its diverse mix of amenities and services, Orleans has relatively low accessibility for its own residents. In contrast, Lazio functions primarily as a mono-functional residential area, with most services and amenities catering to local needs rather than drawing visitors from other parts of the city.

When examined within the framework of urban mobility theories, various factors may influence the preference for private vehicle use in these areas. Studies have shown that land use (Kenworthy and Laube, 1999), car ownership (Langer et al., 2023), urban infrastructure (Wang et al., 2018), and the built environment (Cao et al., 2023) all play a role in shaping mobility choices. Further insights from research on sustainable urban models (Calthorpe, 1993; Pratt et al., 2007; Papagiannakis et al., 2020; Moreno et al., 2021; Pozoukidou and Angelidou, 2022) emphasise the importance of social and functional diversity in fostering walkability and reducing car dependency. Given its predominantly residential nature and limited functional diversity, Lazio may be more inclined towards a car-centric development model compared to Orleans.

However, it is also important to acknowledge that not all station areas share the same land use patterns or socio-demographic characteristics. Different contexts require different approaches to Transit-Oriented Development, and diverse TOD models exist to accommodate various urban conditions (Pratt et al., 2007). Recognising these differences is crucial when developing strategies for improving accessibility and reducing car dependency in station areas with contrasting socio-spatial dynamics.

It is critical to emphasise the significance of pedestrian infrastructure quality and its essential role in enhancing accessibility and proximity. In this analysis, the Orleans and Lazio catchment areas offer two distinct contexts where targeted interventions could significantly improve pedestrian accessibility. Orleans, with its socioeconomically vulnerable community, presents an opportunity to implement strategic improvements that could have a meaningful impact. Meanwhile, Lazio holds potential for strengthening proximity through better public transportation accessibility and upgraded pedestrian infrastructure. Both areas serve as valuable case studies for assessing the effectiveness of the 15-minute city concept.

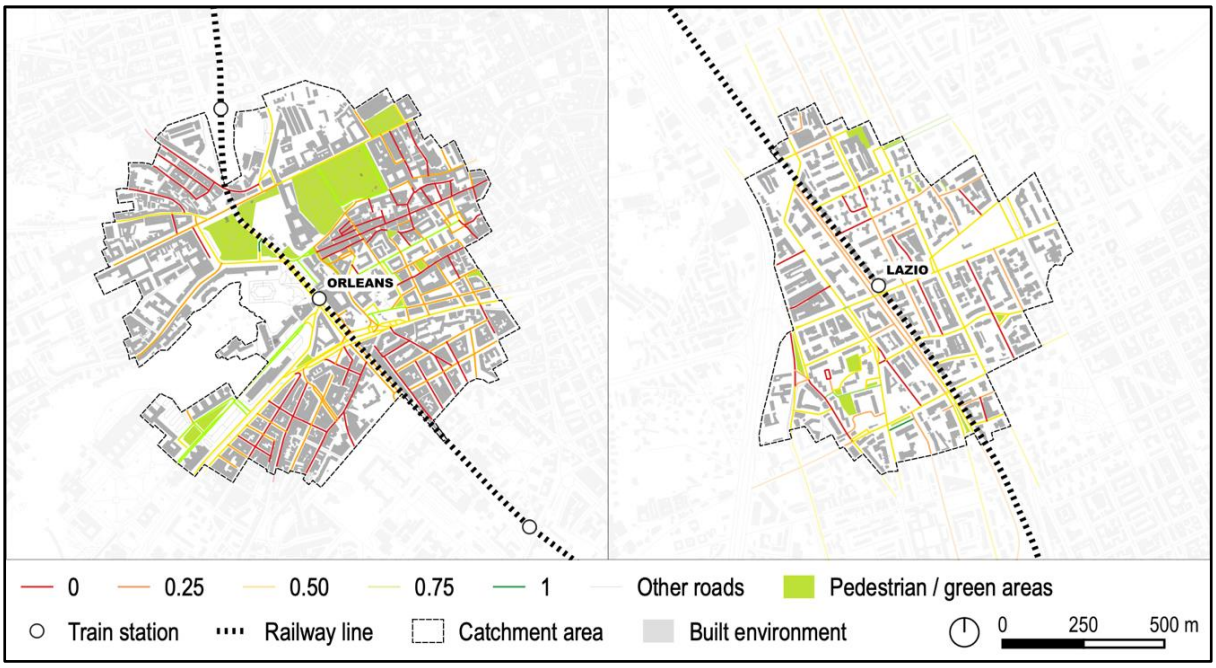


Figure 108. The street quality analysis of the 'Orleans' and 'Lazio' catchment areas.

A comparison of street quality in the two station areas highlights a noticeable contrast in urban layout. Orleans, shaped by its historical background, has a more organic street network with narrower roads, while Lazio follows a planned, structured layout with wider streets. This difference contributes to a slightly higher pedestrian-road ratio in Lazio, where pavements are more clearly separated from the roadway. However, the overall difference between the two areas in this regard is not particularly significant. The pedestrian index for Lazio stands at 0.32, compared to 0.22 in Orleans.

One of the most striking distinctions is the presence of road crossings. Lazio has road crossings on 74% of streets, while Orleans has only 37%, potentially reducing pedestrian safety. Street width also varies, with Orleans averaging 12 metres compared to Lazio's 18 metres. Also, vegetation levels differ significantly; despite parks and squares, Orleans has a lower vegetation index (0.22), whereas Lazio scores 0.48, indicating abundant street greenery that enhances walkability. While Lazio may lack large green spaces, its higher vegetation coverage improves shade and pedestrian comfort.

Overall, the street quality index reflects these differences, with Lazio scoring 0.38 and Orleans 0.27, indicating better pedestrian conditions in Lazio. However, both areas face challenges affecting walkability, including litter, poorly designed bike paths, and shared pedestrian-vehicle spaces that compromise safety. This analysis underscores the need for well-planned pedestrian infrastructure and highlights key areas for improvement. Targeted interventions could enhance accessibility, comfort, and alignment with the 15-minute city principles, ultimately making both station areas more liveable and pedestrian-friendly.

7.6 Walkability enhancement strategies for target areas

This section presents a set of strategies aimed at improving walkability and pedestrian accessibility in the Orleans and Lazio station catchment areas, building on the findings of the previous analysis. Based on the principles of the 15-minute city and TOD, it proposes a strategic framework that addresses both the challenges and opportunities unique to these target areas. By considering spatial, socio-cultural, and functional aspects, the section prepares the foundation for targeted interventions designed to reduce car dependency, enhance pedestrian-friendly infrastructure, and create more accessible, liveable urban environments.

The framework introduced here consists of several key components. It begins with a SWOT analysis, which identifies the strengths, weaknesses, opportunities, and threats shaping walkability in Orleans and Lazio catchment areas. This analysis serves as the basis for defining strategic objectives and outlining a set of interventions tailored to each area's distinct urban conditions. Later, these proposed strategies are translated into practical, site-specific measures in the following sections, ensuring that the approach remains effective for the needs of each location.

7.6.1 SWOT analysis as a foundation for strategic planning

To develop effective and well-targeted strategies for the Orleans and Lazio target areas, a detailed SWOT analysis was conducted, examining the spatial, socio-cultural, and functional factors influencing walkability and car dependency in each area. This comprehensive assessment helps to highlight both the opportunities that can be beneficial and the challenges that must be addressed when designing interventions.

In the case of Orleans, its compact, multifunctional urban fabric and proximity to the historic centre and cultural landmarks are among its greatest strengths. These characteristics provide a strong foundation for encouraging walkability, as the mix of amenities and services within short distances supports the principles of the 15-minute city. However, the area's historical layout also presents certain challenges. The narrow streets, originally designed in a pre-automobile era, now struggle to accommodate high volumes of vehicular traffic. This congestion is increased by the same attractions that make Orleans a vibrant urban space, as they attract visitors from across the city and from outside, raising pressure on both roads and pedestrian infrastructure.

Despite these challenges, Orleans holds significant potential for pedestrianisation efforts. The existing urban fabric, with its dense network of streets and public spaces, offers opportunities to introduce more pedestrian-prioritised zones, expand traffic-calming measures, and improve connections between key destinations. Such improvements could turn Orleans into a cultural and social hub, reinforcing its role as a key area for walkability improvements.

However, any efforts to limit car access in Orleans must also consider potential resistance. Like many urban areas with long-established car-centric behaviours, restrictions on vehicle movement may face opposition from local businesses, residents, and commuters who rely on private transport. Addressing these concerns through thoughtful planning, public engagement, and gradual implementation strategies will be essential for ensuring successful and sustainable improvements to pedestrian accessibility.



Figure 109. Swot analysis for the catchment area of Orleans Station.

For Lazio, the SWOT analysis highlighted several key strengths, particularly its wider streets and the greater spatial flexibility they provide for urban improvements. Unlike Orleans, Lazio's urban structure allows for more proactive planning and the potential integration of pedestrian-friendly infrastructure without major spatial limitations. This makes it a promising area for implementing walkability enhancements, particularly within the framework of TOD.

However, certain weaknesses create challenges to walkability in Lazio. The area lacks a diverse range of amenities, which limits its ability to function as a self-sufficient, mixed-use neighbourhood. Additionally, the presence of gated communities prevents urban continuity, creating physical and psychological barriers that can disturb pedestrian movement and reduce overall connectivity. These enclosed developments often limit permeability, making it more difficult to establish direct and accessible walking routes.

Despite these challenges, Lazio presents significant opportunities for transformation. Its spatial characteristics make it well-suited for becoming a more walkable, transit-oriented residential zone, aligning with both 15-minute city principles and TOD strategies. By enhancing pedestrian infrastructure, integrating better public transport connections, and introducing mixed-use developments, Lazio has the potential to evolve into a more accessible and sustainable urban environment.



Figure 110. Swot analysis for catchment area of Lazio station.

Based on the SWOT analyses, the two target areas have distinct necessities to achieve a common goal that is improving pedestrian accessibility and walkability. For the Orleans station area, the focus should be on enhancing pedestrian safety and creating shared streets in the narrow, historic urban fabric. Emphasis should also be on activating underutilised spaces and using greenery through innovative solutions like vertical gardens and planters to improve the pedestrian experience. On the other hand, for the Lazio station area, priorities include expanding sidewalks to accommodate pedestrian flow, implementing effective traffic management to address parking issues, and creating public spaces such as small plazas or seating zones. These actions will enhance walkability in the area's wider streets while better supporting the daily needs of residents.

7.6.2 Overall Strategy and Objectives

The strategy for enhancing walkability in the Orleans and Lazio catchment areas focuses on addressing each location's unique needs while working toward a larger goal: transforming Palermo into a more accessible, people-focused city. The vision is to make walking the preferred mode of transportation, ensuring that pedestrians feel safe and comfortable and that public spaces are lively and engaging. This approach aims not only to improve movement but to foster a sense of community and connection.

An essential aspect of this plan is improving pedestrian experiences. In both Orleans and Lazio, the goal is to enhance streets by widening sidewalks where it is suitable, upgrading crossings, and adding green spaces that improve both the look and the environment. Public spaces will be redesigned with seating, better lighting, and landscaping that encourages people to spend time, interact, and experience the city. This is not just about enhancing pedestrian mobility but creating an urban environment where walking is enjoyable. Strengthening connections between key areas, like transit hubs, residential neighbourhoods, and cultural landmarks, ensures the urban fabric is well-connected and integrated.

Alongside walkability, the strategy includes measures for sustainable mobility. Introducing cycling infrastructure and improving public transport connections will provide people with more alternatives to car use. Rather than just reducing cars, the focus is on creating practical and appealing options for mobility.

However, each area has its own needs. Orleans, with its historic, dense layout, narrow streets and city-level functions, requires interventions that improve accessibility without disrupting its character. On the other hand, Lazio, with its more spacious streets and residential uses, offers opportunities for larger pedestrian zones, better cycling networks, and new public spaces that enhance community life.

The proposed interventions are carefully tailored to each area's challenges. In the catchment area of Orleans, the plan focuses on creating a more walkable and accessible environment while preserving the district's historic character. Pedestrianising key streets will make them safer and more inviting, particularly in areas with high foot traffic and commercial activity. In narrower streets, shared-space designs will allow pedestrians, cyclists, and vehicles to coexist more comfortably in a low-speed environment. Strengthening connections to public transport is also a priority, with improvements to pathways leading to transit hubs, better wayfinding, and redesigned access points to make public transport a more convenient choice.

In the catchment area of Lazio, the approach prioritises enhancing walkability by introducing spacious pedestrian zones that encourage people to move freely and comfortably. Expanding the cycling network will provide safe and efficient routes, making cycling a more convenient alternative to car travel. Well-designed public spaces, such as plazas and seating areas, will serve as gathering points, fostering a sense of community and encouraging social interaction. These improvements, shaped by the SWOT analysis and spatial strategies, offer a thoughtful and place-sensitive framework for making the catchment area a more accessible, vibrant, and pedestrian-friendly environment.

This section of the research is crucial as it attempts to build policy recommendations and strategies to increase pedestrian accessibility. By analysing the catchment areas through the lens of this set of indicators, the research creates a holistic view of how urban spaces function and how they can be enhanced to promote sustainable mobility. While the study does not aim to predict the ultimate success of implementing these strategies, it is an effort to provide valuable insights that can guide future planning initiatives.

Strategic plan for the Orleans catchment area

The Orleans catchment area presents a diverse urban environment where different streets serve distinct functions, requiring a tailored approach to pedestrianisation and mobility enhancements. To determine the most suitable interventions, whether full pedestrianisation, shared spaces, or improvements to high-traffic streets, several key factors must be considered. These include proximity to major landmarks that generate high pedestrian flow, street width and overall urban fabric, traffic volume and connectivity, current land use (particularly streets with commercial and mixed-use functions), existing pedestrian activity, and integration with public transport networks.

The strategic plan for Orleans identifies three main street classifications as pedestrian-only streets, pedestrian-prioritised streets, and enhanced streets (this classification is explored in more detail in the following chapters), each requiring different interventions to balance pedestrian accessibility with vehicular circulation. The map below illustrates the proposed street classification for improving pedestrian accessibility within the catchment area.

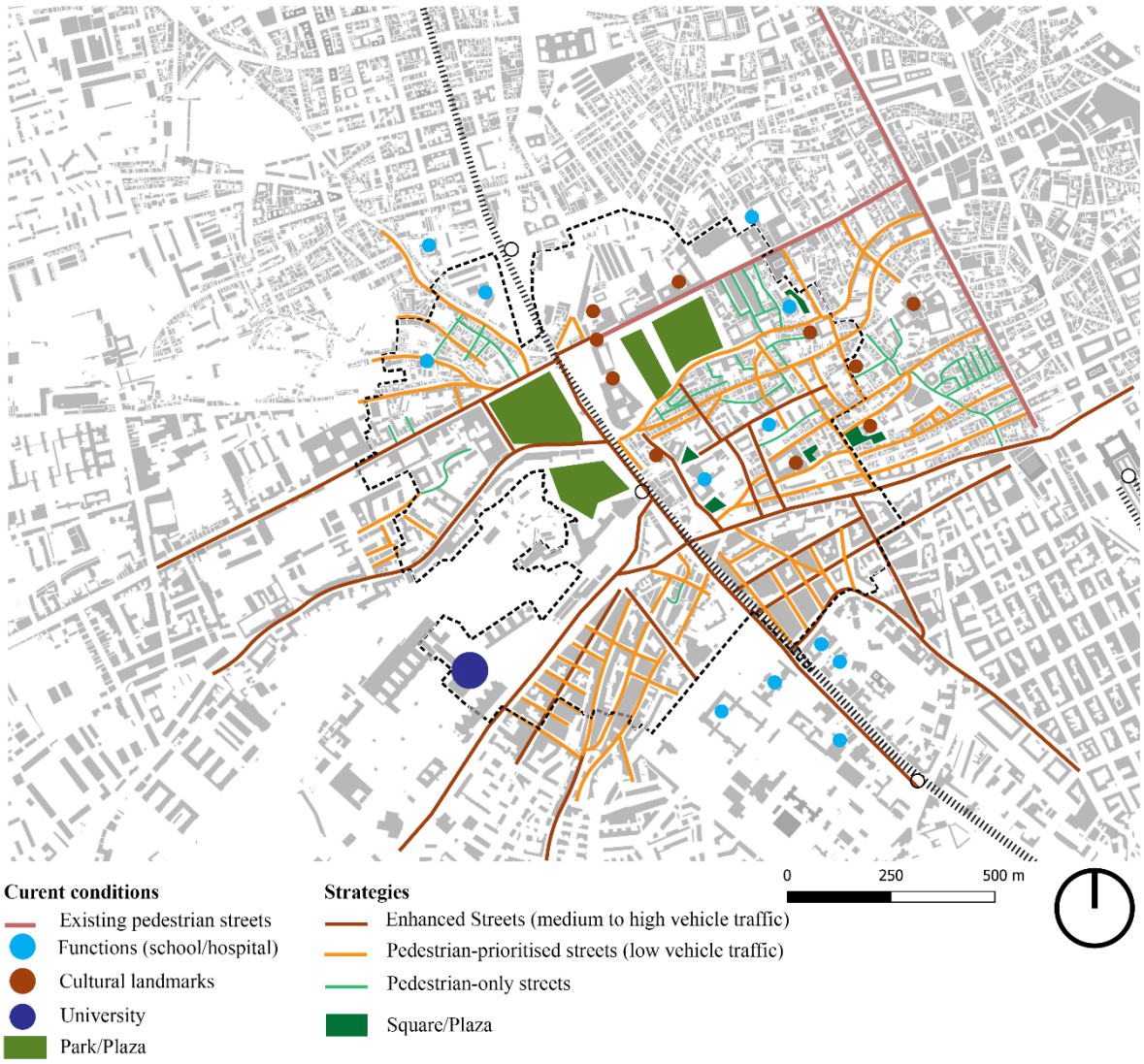


Figure 111. Strategic plan of the Orleans catchment area.

Enhanced streets are arterial roads or main roads with medium to high vehicular traffic, such as Corso Re Ruggero, Via Ernesto Basile, and Corso Tukory. These streets accommodate high levels of vehicular traffic while also serving key destinations such as the train station and university. While full pedestrianisation is not feasible, targeted interventions can significantly improve walkability. Measures such as widened pavements, safer pedestrian crossings, dedicated cycling lanes, and better integration with public transport will help prioritise pedestrian safety and accessibility without disrupting essential traffic flow. Specific design improvements and safety measures for these roads are discussed in the following section.

On the other hand, pedestrian-prioritised streets are where pedestrians and vehicles share the same space, while the design approach aims to give precedence to pedestrians. In residential neighbourhoods near Montegrappa and Zisa, a shift towards pedestrian-prioritised streets is proposed. These areas feature medium-width streets that primarily serve residents but still accommodate some level of vehicular movement. Instead of full pedestrianisation, the focus will be on introducing traffic-calming measures such as speed restrictions, raised crossings, extended pavements, and strategically placed street furniture. These interventions will help reduce vehicle dominance while ensuring that residents, particularly children and elderly pedestrians, can navigate the area safely and comfortably. By maintaining controlled vehicular access while giving clear priority to pedestrians, these streets can strike a balance between mobility and liveability.

Within the Albergheria district, located in the historic centre, several streets are identified for full pedestrianisation. This area is located between two major pedestrian corridors and has significant cultural landmarks, including churches and the Royal Palace, attracting both residents and tourists. Given its historic character and narrow streets, typically between 2 to 5 metres wide, many of these streets are already unsuitable for regular vehicular traffic. As a result, certain streets, particularly small alleys such as Vicolo Leone and Vicolo Pistone, will be entirely closed to cars, reinforcing a pedestrian-first environment. These interventions will create a safer, more accessible, and culturally vibrant public space while preserving the heritage character of the area. Details of these pedestrianisation measures are further elaborated in Section 7.7.

By integrating these street classifications, enhanced streets for high-traffic corridors, pedestrian-only streets in key historic areas, and pedestrian-prioritised streets in residential zones, this strategy offers a comprehensive approach to improving walkability in the Orleans catchment area. Each intervention is carefully designed to respond to the area's unique urban conditions, supporting both pedestrian accessibility and sustainable mobility. The following sections provide further details on the specific measures planned for each street type.

Strategic plan for the Lazio catchment area

The Lazio catchment area presents a distinctly different urban landscape compared to Orleans, shaped by its predominantly residential character, wider streets, and lower density of city-level amenities. This difference requires a strategy that prioritises creating a safe, community-oriented environment where pedestrian accessibility is seamlessly integrated into daily life. The approach focuses on strengthening neighbourhood walkability, enhancing connections to public transport, and leveraging placemaking opportunities to make streets more inviting and functional.



Figure 112. Strategic plan of the Lazio catchment area

Many of the streets north of Via Principe Paternò are convenient to become pedestrian-prioritised streets, following the principles of living streets (woonerfs). These relatively narrow residential streets can be redesigned to prioritise pedestrians while still allowing low-speed vehicle access. By introducing shared surfaces, extended pavements, and additional greenery, these streets can encourage a more pedestrian-friendly atmosphere, promoting casual social interactions and creating a stronger sense of community.

Given the high concentration of kindergartens and schools, ensuring child-friendly pedestrian infrastructure is essential. Streets directly adjacent to educational institutions have the potential to be transformed into pedestrian-only streets, either permanently or during school drop-off and pick-up hours. Reducing car access in these areas would significantly improve safety for children and encourage families to walk more frequently. Additionally, underutilised car parks near schools could be repurposed as small plazas or green spaces, providing safe gathering points for students and parents while enhancing the pedestrian-friendly nature of the neighbourhood.

Key roads around the transit hub, such as Viale Lazio, Viale delle Alpi, and Via Giuseppe Sciuti, serve as primary connections in the mobility network, and they carry a high volume of vehicular traffic. Given their function as major traffic arteries, these roads would be classified as enhanced streets, where pedestrian safety and comfort are improved without disrupting vehicular flow. Depending on the context, lower speed limits, clearly marked crossings, widened pavements, and improved lighting would help ensure that pedestrians, especially elderly residents and children, can move safely and comfortably through these areas.

One of the key challenges in Lazio is the lack of parks and public plazas, which limits opportunities for recreation and social interaction. To address this, suitable locations for new green spaces should be identified and integrated into the urban fabric. These public spaces can serve as essential gathering points while also acting as buffers that facilitate pedestrian movement between key streets. Tree-lined walkways, small community gardens, and shaded seating areas can make the area more inviting for pedestrians and enhance overall liveability. Another problem, as mentioned before, is the density of gated communities, which acts as a barrier to pedestrians by blocking passages and decreasing the permeability of the streets.

By implementing a combination of pedestrian-prioritised streets, pedestrian-only streets, and enhanced streets, this strategy seeks to transform the Lazio catchment area into a safer, more walkable, and community-driven neighbourhood. These interventions will strengthen connections between residential areas, schools, and transit hubs, making walking not only the most practical mode of transport but also a more enjoyable part of everyday life.

7.7 Action plan and policy recommendations

Based on the analysis and strategies presented above, which integrate the principles of the 15-minute city and TOD alongside pedestrianisation strategies drawn from diverse urban examples (see Chapter 4), a set of tailored policy recommendations and actions has been developed for the target areas. The following section begins by outlining generalised policy recommendations that address common challenges and opportunities. Later, specific street-level examples are provided to illustrate how these recommendations can be effectively implemented in practice, highlighting their potential to transform the urban landscape and improve the quality of life for residents and visitors.

Table 28. Design-related policy recommendations for catchment areas.

Policy Recommendations	Actions
Prioritise Pedestrian Space	Expand Pavements Eliminate Physical Barriers Pedestrian-Only Streets
Enhance Safety	Traffic Calming Measures Safe Crossings Lighting Universal Design
Create a Comfortable Walking Environment	Greening Streets Street Furniture Weather Protection
Activate Public Spaces	Placemaking at Nodes Pop-Up Urbanism Seating and Interaction Zones
Optimise Connectivity and Wayfinding	Direct Pathways Wayfinding Systems
Reduce Vehicle Dominance	Restrict Cars in Critical Areas Manage Parking
Encourage Mixed Modal Use	Integrated Bike and Pedestrian Paths Public Transport Integration
Improve Street Aesthetics	Consistent Design Language Minimise Visual Clutter
Foster Street-Level Activity	Encourage Active Frontages Flexible Spaces
Monitor and Adapt	Smart Infrastructure Community Feedback

<u>Prioritise pedestrian space</u>

Pavements should be wide enough to accommodate multiple pedestrians, at least 2.5–3 meters in high-traffic areas (e.g., near Orleans Station's university zone). Where space is limited (e.g., in historic Orleans) and expanding pavements is not possible, design principles that prioritise pedestrians over vehicles could be applied. Speed limit and physical obstacles that ensure pedestrian security are ways to increase the space for pedestrians over traffic.

In areas like Lazio, where the streets have enough space for different users, solutions such as shared streets (Woonerfs in Dutch) could be applied. Woonerfs are urban design solutions that prioritise pedestrians while accommodating low-speed vehicular traffic (van Veen & Steinberg, 2021) and using benches, trees and planters in the roads acting as obstacles for cars while improving the aesthetics of the streets (Appleyard, Gerson, & Lintell, 1981). They are compatible with residential areas where there is no need for high-speed traffic flow. The key features of shared streets include the removal of traditional kerbs, the use of different paving materials to delineate spaces and the implementation of traffic calming measures to ensure vehicles travel at pedestrian-friendly speeds.



Figure 113. Woonerf example for Lazio station (before and after). 1) Movable planters and design elements to control the vehicle traffic. 2 & 3) Different materials to demarcate different zones for pedestrians' safety.
Source: Global Designing Cities Initiative, 2022.

Physical barriers should be eliminated for safety and comfort reasons. While using obstacles to control the vehicle's speed, it is important to remove physical barriers like utility poles, signage, or poorly placed bike racks that obstruct pedestrian pathways. Putting utility systems underground could be applied in case of necessity.

Near stations, designated streets, or sections only for pedestrians are important measurements that enhance the walking experience. Especially in areas with high pedestrian traffic, such as cultural landmarks in Orleans or residential zones in Lazio, it is important to make people safe towards vehicle traffic to increase pedestrian flow.

Enhance safety

Diverse types of traffic calming measures could be helpful to create safety for pedestrian access. For example, 'horizontal deflection' forces drivers to change their path and reduce speed (like chicanes, roundabouts), 'vertical deflection' changes road height to slow vehicles (like speed humps, raised crosswalks), 'street width reduction' narrows lanes to slow traffic and shorten pedestrian crossings (like bulb-outs, road diets) and finally 'routing restrictions' limit certain vehicle movements to reduce cut-through traffic (like diagonal diverters, closures).



Figure 114. A residential street with speed humps installed to reduce vehicle speeds.
Source: Carmanah, 2018.

Regarding the safety of pedestrians, speed limits and crossings are important actions to consider. By implementing 20-30 km/h speed zones (or lower) within station catchment areas, the possibility of accidents is significantly minimised, and it creates a safer and more comfortable environment for pedestrians, cyclists, and vulnerable groups such as children and

Higher frequency of pedestrian crossings ensures the permeability of wider streets and boulevards. There are diverse types of pedestrian crossings, such as raised crosswalks, creative crosswalk designs, kerb extensions and pedestrian refuge islands could be applied in diverse locations. For example, near the university, schools, and stations where the vehicle traffic is highly dense, well-marked and designed crosswalks could be chosen to draw take attention of drivers towards pedestrians.

Also, lighting plays a vital role in addressing safety concerns, particularly along pedestrian routes and narrow streets. The use of bright, energy-efficient LED streetlights enhances visibility, especially at intersections, crossings, and isolated areas, creating a safer and more comfortable environment for pedestrians during evening hours.

Create a comfortable walking environment

Improving pedestrian comfort can be achieved through a mix of greenery, well-placed street furniture, and weather protection. Elements like trees and planters along pavements provide shade, enhance aesthetics, and help reduce the urban heat island effect. In dense areas with limited space, like the Old Town of Palermo, vertical gardens and hanging planters are practical ways to add greenery without occupying space. Installing benches at regular intervals, around every 50–100 meters, creates resting spots, especially for the elderly. Features like bike racks, trash bins, and water fountains can be added carefully to avoid closing passages. Covered walkways or arcades in key pedestrian areas offer protection from rain and sun, making streets more comfortable and inviting year-round.

Activate public spaces

Transforming areas near stations into vibrant, pedestrian-friendly hubs can significantly enhance walkability and community engagement. Placemaking efforts can include adding public art, kiosks, markets, and cultural events to encourage people to stroll, socialise, and explore the area on foot. In catchment areas close to the Old Town or historical neighbourhoods, integrating historical and cultural narratives into public space design can increase the sense of place and celebrate the area's unique identity.



Figure 115. Parklet example for streets shared by pedestrians, vehicles and public transport. Source: Abbasi Design Studio, 2021.

Temporary initiatives, such as pop-up plazas or parklets, offer innovative ways to reclaim underutilised spaces and test pedestrian-only zones. By converting parking spaces into inviting public areas, these solutions help to create community interaction and street vitality. Additionally, creating small plazas with informal seating, shaded zones, and interactive features like water elements or play areas for children can provide welcoming spaces for rest and recreation, making streets more engaging and accessible for all users.

Stations like Notarbartolo and Palermo Centrale, located in busy and densely used areas, could benefit from the addition of parklets and other seating features. These spaces are currently not appealing to pedestrians and fail to provide a sense of comfort or safety due to the dominance of cars, trams, and other urban pressures. Potential parklet spots near stations can be identified by selecting underutilised parking spaces or kerbside areas close to station entrances or active frontages, such as small businesses.

Optimise Connectivity and Wayfinding

Creating direct and accessible pedestrian pathways is essential for improving connectivity between key destinations like transit stations, schools, and parks. Pathways should feature continuous pavements that give priority to pedestrians over vehicles at driveways and minor intersections. To support navigation, clear and visible wayfinding signage can indicate walking times to important locations, while digital tools integrated into mobile apps can provide real-time navigation and alerts, enhancing the overall pedestrian experience.

Reduce vehicle dominance

To address the challenges of vehicle congestion and limited pedestrian space in Palermo, restricting car access in critical areas through Limited Traffic Zones (ZTLs) and car-free streets is a necessary step, particularly within the historic centre and around key transport hubs like train stations. These measures aim to reclaim streets for pedestrians and reduce vehicular occupation in sensitive areas. A significant component of this strategy involves the elimination of on-street parking, which currently occupies valuable public space and often prevents pedestrian flow, especially in narrow streets within the historic centre.

To compensate for the removal of on-street parking, alternative solutions must be provided to meet the needs of residents, commuters, and visitors. This includes the development of underground parking facilities where spatial and infrastructural conditions allow, particularly near high-demand zones such as the edges of the historic centre and close to train stations. Additionally, underutilised or vacant spaces at the periphery of dense urban areas can be repurposed into shared parking hubs. These hubs can serve as Park-and-Ride facilities, enabling commuters to leave their vehicles outside congested zones and complete their journey using public transport, cycling, or walking. Also, shuttles and other public transport services could be added to support mobility.

To improve multimodality, innovative solutions such as smart micromobility hubs that are included in the car parking spaces can serve as both bike-parking facilities and storage lockers, accommodating bicycles, e-scooters, and personal belongings (EIT, 2024). These facilities can also function as charging stations for electric bicycles and e-scooters, addressing the growing demand for more charging infrastructure. Powered by solar panels, these hubs offer flexibility in placement, as they do not require constant access to the electrical grid, minimising installation difficulties. By integrating these hubs into the public transport network with compatible tariffs, the solution can promote multimodality and provide a seamless, user-friendly experience, encouraging more people to combine cycling or e-scooter use with public transit for their daily commutes.

Integrating these policies requires a careful analysis of Palermo's land use patterns, mobility infrastructure, and traffic behaviour to identify optimal locations for parking facilities. Peripheral parking hubs, combined with efficient shuttle services or well-connected pedestrian routes, can reduce traffic circulation in the core urban areas. This approach not only lowers the pressure on the historic centre but also improves the functionality of train station catchment areas, ensuring smoother pedestrian connections and a better balance between different modes of mobility. According to the analysis mentioned above, suggested parking spaces for the whole of Palermo are given below.

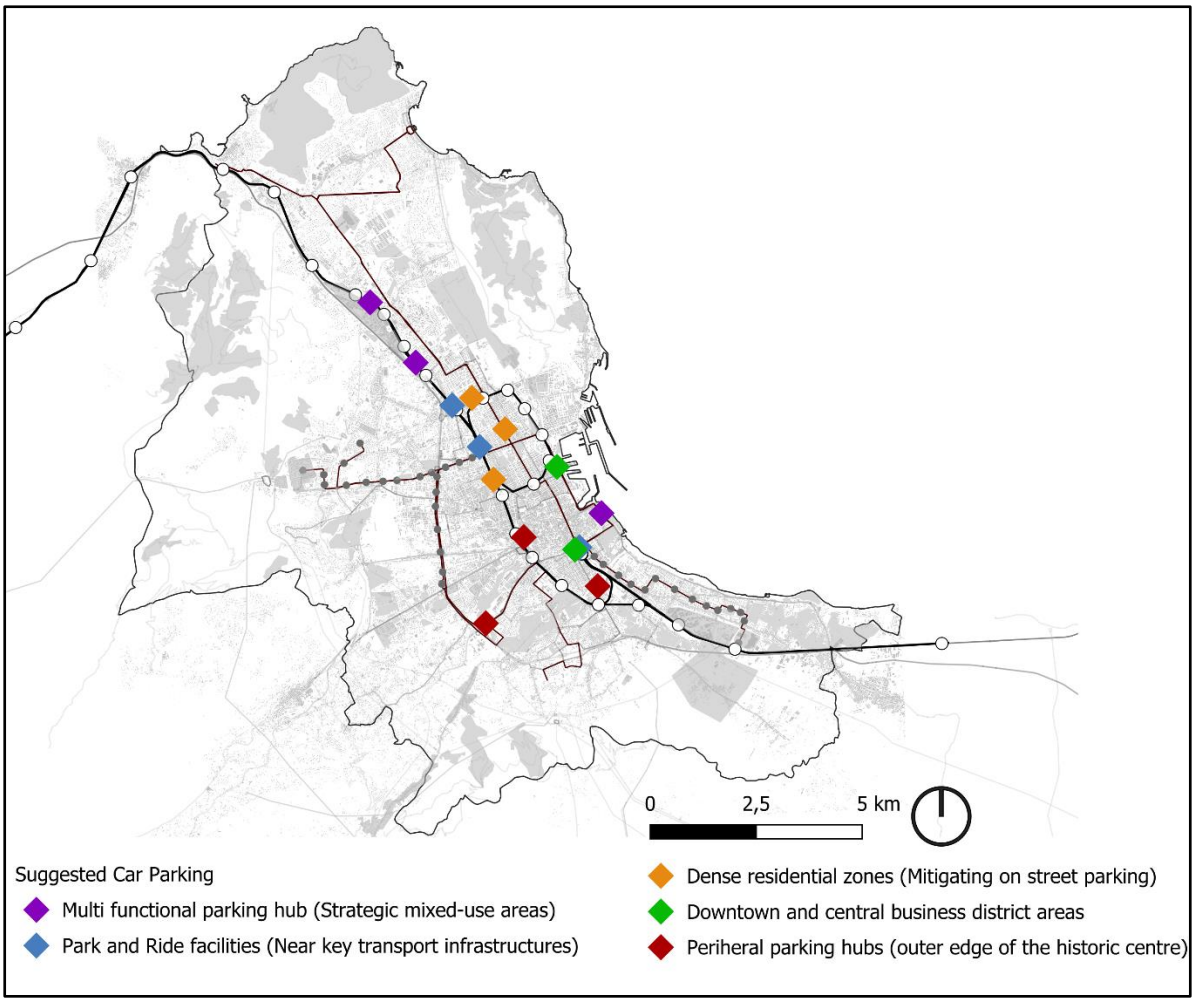


Figure 116. Suggested parking services throughout Palermo

The Figure above shows the locations for suggested parking services for decreasing on-street parking in specific zones in Palermo. These parking services are divided into 5 categories. Peripheral parking hubs located outer edge of the historic centre aim to prevent vehicle invasion into the dense Old Town and can support last-mile connectivity by walking, shuttles, and bikes. For example, a parking space in Via Oreto can serve commuters entering the city from the south, and the one located in Via Ernesto Basile would be useful for students, commuters and visitors accessing the Old Town.

Park and ride facilities located near the key stations, such as Notarbartolo and Central Station, could be efficient solutions targeting commuters who can leave their vehicles at designated hubs and continue by public transit or on foot. Unused and vacant spaces can be utilised for these parking services near the stations. Choosing key locations which are also close to other public transit would increase the efficiency of the service.

In residential areas, parking solutions should aim to reduce on-street congestion and create more space for pedestrians. High-density residential zones, such as Via delle Alpi, Via Sampolo, and Piazza Don Bosco, are particularly suitable for these interventions. In these locations, the development of multi-storey parking structures can provide residents with practical alternatives to on-street parking, helping to lessen overcrowded streets while improving accessibility and pedestrian comfort.

The downtown and central districts require new parking solutions to accommodate visitors, workers, and businesses while decreasing congestion. Locations like Via Roma and the Port area are ideal for central parking facilities due to their high activity levels and strategic connectivity. Given these areas' dense and busy nature, underground or multi-storey structured parking would be the most suitable option, effectively maximising space without compromising the urban landscape.

Lastly, multi-functional parking hubs strategically placed in mixed-use areas can serve as multi-modal transit centres, integrating car parking, cycling infrastructure, and public transit access. The Foro Italico along the seafront presents an ideal location for such a hub, with opportunities to establish green corridors that connect the Old Town and waterfront areas. Besides, locations like Via Ugo La Malfa and Via Belgio offer excellent access for commuters entering Palermo from the west, while also providing convenient connections to existing transit lines, supporting seamless mobility, and reducing congestion in the city core.

Given the distinct land-use characteristics and locational contexts of the case study station areas, the proposed car parking facilities vary accordingly. Lazio Station is located within a predominantly residential neighbourhood, relatively farther from the city centre compared to Orleans Station. In response to the dense residential fabric surrounding Lazio, two different parking facilities are proposed. The first facility, located adjacent to the station, is intended to support a park-and-ride system aimed at reducing the number of private vehicles entering the city centre. The second facility is designed to decrease on-street congestion in the surrounding area, thereby enhancing pedestrian space and improving walkability. In contrast, Orleans Station is in the historic city centre, where the primary need is to prevent further car penetration into the Old Town. A strategically located parking facility is therefore proposed to intercept incoming traffic and to support last-mile connectivity through walking, shuttle services, and bicycle-sharing options, facilitating sustainable access to the core urban area.

Encourage mixed modal use

To encourage mixed-modal mobility, it is essential to integrate bike and pedestrian infrastructure while ensuring a seamless connection with public transport. Pedestrian paths should be separated from bike lanes using distinct markings and buffer zones to minimise conflicts and improve safety. Bike-sharing stations can be strategically placed near station exits and major intersections, ensuring accessibility without obstructing primary pedestrian pathways.

Additionally, aligning bus stops with key pedestrian routes reduces walking distances and facilitates smooth transitions between walking, cycling, and public transit, creating a more efficient and user-friendly mobility network. Another key factor in promoting mixed-modal mobility is ensuring the visibility of available transportation options, particularly for those hesitant to switch from car use. Displaying opportunities such as bus and train connections, bike facilities, and the proximity to key landmarks and destinations can encourage people to consider alternative modes of transport. When these options are made easily accessible and visible, they become more appealing and practical, helping individuals make informed decisions to shift away from car dependency.

Improve street aesthetics

Improving street aesthetics plays a crucial role in creating a more inviting and visually appealing urban environment. A consistent design language should be applied by using uniform, high-quality materials for sidewalks, such as natural stone or durable paving, to ensure both aesthetics and resilience. In historic areas like Orleans, decorative elements such as mosaic pavements can be used to highlight the area's cultural identity and enhance its character. To maintain a clean and navigable streetscape, it is also essential to minimise visual congestion by combining signage, utilities, and other elements into fewer, well-organised structures, creating a more cohesive and user-friendly public space.

Street-level activity

Creating street-level activity is a key element in creating vibrant, engaging, and socially dynamic urban spaces (Heffernan, Heffernan, & Pan, 2013). Buildings close to pedestrian zones should have active frontages that prioritise transparency and interaction, such as shops, cafes, restaurants, or services with large, inviting windows and entrances. These features not only enhance safety through increased visibility and natural surveillance but also improve visual appeal, creating a more engaging experience for pedestrians.

In addition, sidewalks and plazas can be designed as flexible, multi-functional spaces that serve daily pedestrian movement while accommodating diverse activities such as markets, outdoor dining, pop-up events, and cultural festivals. Integrating features like modular seating, shaded zones, and temporary installations allows these spaces to adapt to different uses and times of day, ensuring they remain lively and activated. By combining active frontages with adaptable public spaces, streets become more than mere transit corridors, they transform into hubs of community interaction, economic opportunity, and urban vitality.

Monitor and adapt

Smart infrastructure, such as sensors, can be used to track pedestrian flow and identify areas requiring targeted interventions. Pilot programs, including temporary street closures or modular pavement installations, allow proposed changes to be tested and evaluated before permanent implementation. Additionally, regular engagement with residents and businesses is crucial for gathering community feedback, ensuring pedestrianisation initiatives are well-aligned with local needs and continuously refined to enhance usability and effectiveness. To apply these actions to catchment areas, SWOT analyses are made for each case study, so the right actions can be chosen more carefully.

Based on the SWOT analyses, the two station areas of Orleans and Lazio have distinct needs to achieve a common goal that is improving pedestrian accessibility and walkability. For the Orleans station area, the focus should be on enhancing pedestrian safety and creating shared streets in the narrow, historic urban fabric. Emphasis should also be on activating underutilised spaces and using greenery through innovative solutions like vertical gardens and planters to improve the pedestrian experience. On the other hand, for the Lazio station area, priorities include expanding sidewalks to accommodate pedestrian flow, implementing effective traffic management to address parking issues, and creating public spaces such as small plazas or seating zones. These actions will enhance walkability in the area's wider streets while better supporting the daily needs of residents.

To develop coherent and context-sensitive policies for enhancing pedestrian accessibility and walkability in the selected case study areas, this research employed a dual classification system. This approach aimed to provide a systematic yet flexible methodology for addressing the complex and heterogeneous urban fabric of Palermo.

First, streets were categorised based on their functional typology into three distinct groups: pedestrian-only streets, pedestrian-prioritised streets, and enhanced streets (which are explained in detail in the following sections). This functional classification was designed to reflect the varying degrees of pedestrian priority intended in the reorganisation and redesign of each level of the street network. It considers not only the current use but also the potential transformation aligned with the principles of sustainable mobility and spatial equity.

Secondly, an additional classification was introduced to account for the physical and spatial characteristics of the street network, with a specific focus on street width. Streets were grouped into four categories: 2–5 meters, 6–10 meters, 11–20 meters, and over 20 meters. This typological categorisation acknowledges that the spatial limitations and opportunities offered by different street widths significantly influence the feasibility, nature, and scale of pedestrian-friendly interventions. Narrow alleys in historic cores often require subtle and integrated design solutions, while wider streets may support more ambitious reconfigurations, such as dedicated cycle lanes or multimodal transit corridors.

These two classification systems, one focused on functional use and the other on spatial form, are not treated as independent analytical tools but as complementary frameworks. Their combined application enables a comprehensive and nuanced approach to mobility planning, aligning spatial design with functional priorities. This methodological integration is especially valuable in heterogeneous urban environments like Palermo, where spatial morphology and mobility needs vary dramatically, even within a single neighbourhood.

The utility of this dual framework is particularly evident in the comparative analysis of the Orleans and Lazio station catchment areas. Though both aim to foster pedestrian accessibility and reduce car dependency, they differ substantially in their urban morphology and socio-spatial dynamics. Orleans Station, located within Palermo's historic centre, is surrounded by narrow, irregular streets, a dense built environment, and a high degree of pedestrian activity. These characteristics necessitate interventions that are both spatially sensitive and heritage-conscious, such as shared-space solutions, traffic calming, and paving redesign. In contrast, the Lazio Station area, situated in a more modern, residential urban context, features wider streets and more predictable traffic flows. This allows for more extensive interventions, including the development of park-and-ride schemes, designated cycling corridors, and spatial reallocation strategies aimed at reducing private car usage.

Importantly, even within the same catchment area, streets can differ widely in terms of width, usage, connectivity, and surrounding land use. For this reason, each street segment was analysed individually, enabling a bottom-up, detailed understanding of context-specific needs and constraints. This research also draws inspiration from successful examples, particularly Pontevedra, where a similar approach of classifying streets by function and width formed the backbone of a transformative pedestrianisation strategy.

By systematically integrating functional and spatial classifications, this research provides a grounded and transferable methodology that supports operational feasibility while aligning with broader goals of walkability, sustainable urban mobility, and spatial justice. It enables planners to move beyond one-size-fits-all solutions and develop interventions that are designed according to the diverse conditions of different urban zones, ultimately fostering more inclusive and liveable public spaces.

7.7.1 Implementation of proposed actions in the Orleans catchment area

The catchment area of Orleans Station presents both challenges and opportunities for policy implementation. Located adjacent to Palermo's historic centre, the area has a dense, irregular street network, limiting the scope for large-scale physical interventions. While no formal pedestrian streets exist, several naturally car-free passages already function as important pedestrian links.

A key opportunity lies in the station's proximity to established pedestrian zones like Via Maqueda, which allows for strategic extensions of the existing walkable network. Any proposed intervention must carefully balance enhanced pedestrian accessibility with the preservation of the area's architectural and historical character.

In this context, low-impact urban design strategies, such as shared surfaces, traffic calming, and improved signage, can effectively prioritise pedestrians while maintaining the visual and spatial integrity of the historic environment. The goal is to improve safety, comfort, and connectivity, creating a cohesive pedestrian realm that supports the station's role as a mobility hub within a sensitive urban landscape.

Table 29. Actions for the Orleans catchment area.

Street Classification	Measures for Each Action
2–5 meters (Narrow Streets)	• Shared spaces with pedestrian priority, movable planters, and textured paving. • Car-free zones near cultural landmarks during peak hours. • 20 km/h speed zones and clear signage for reduced speed limits for pedestrian safety • Hanging planters or vertical gardens where horizontal space is limited. • LED street lighting to enhance safety in narrow alleys.
6–10 meters (Moderate Streets)	• Traffic calming measures such as speed humps and bulb-outs. • 20 km/h speed zones and clear signage for reduced speed limits • Mid-block crossings near key destinations like parks and university gates. • Tree planting at street nodes and small squares. • Regular seating (every 50–100 meters).
11–20 meters (Wider Streets)	• Sidewalk expansion to improve pedestrian comfort and flow. • Integrating cycling infrastructure on appropriate streets in alignment with broader mobility plans, while implementing protective measures to ensure cyclist safety. • Pop-up parklets and plazas by repurposing parking spaces. • Raised crosswalks and pedestrian refuge islands for enhanced safety. • Installation of wayfinding systems indicating major landmarks and important uses.
>20 meters (Broad Streets)	• Expanded and enhanced sidewalks and high-quality paving materials to create visually appealing pathways. • Traffic calming and lane reduction by using elements like raised pedestrian crossings and mid-block crossings.

	• Greening along the street to improve aesthetics and comfort by planting rows of trees along sidewalks and central medians to provide shade. • Integrating cycling infrastructure on appropriate streets in alignment with broader mobility plans, while implementing protective measures to ensure cyclist safety. • Pop-up parklets and plazas by repurposing parking spaces with flexible furniture that can host markets, performances, or social gatherings. • Refuge islands in the middle of wide streets to allow safer crossings.

As shown in the table above, different street widths require specific, tailored measures to enhance walkability within target areas. To address this diversity, the streets within the catchment areas have been classified by width, allowing for the development of targeted and effective actions. For streets with a width of 2 to 5 meters, the limited space creates challenges for interventions, yet specific measures are necessary to enhance pedestrian safety against traffic flow. In such cases, the design principles of shared streets offer the most effective solution. Replacing traditional pavements with textured materials can visually signal shared zones, encouraging slower vehicle speeds and enhancing pedestrian comfort. By removing kerbs and prioritising pedestrian right-of-way, these streets can safely accommodate movement and support diverse activities.

To effectively address the diverse needs of different streets, Table 20 provides a detailed classification based on street width. This classification is essential for selecting the most appropriate and impactful interventions for each type of street, ensuring that the designs align with the available space and function. By tailoring the interventions to the specific dimensions and characteristics of each street, the city can create more pedestrian-friendly environments that enhance mobility, safety, and overall urban quality. This approach allows for a flexible yet structured method to improve streetscape design, ensuring that each street type is optimally designed to serve the community's needs.

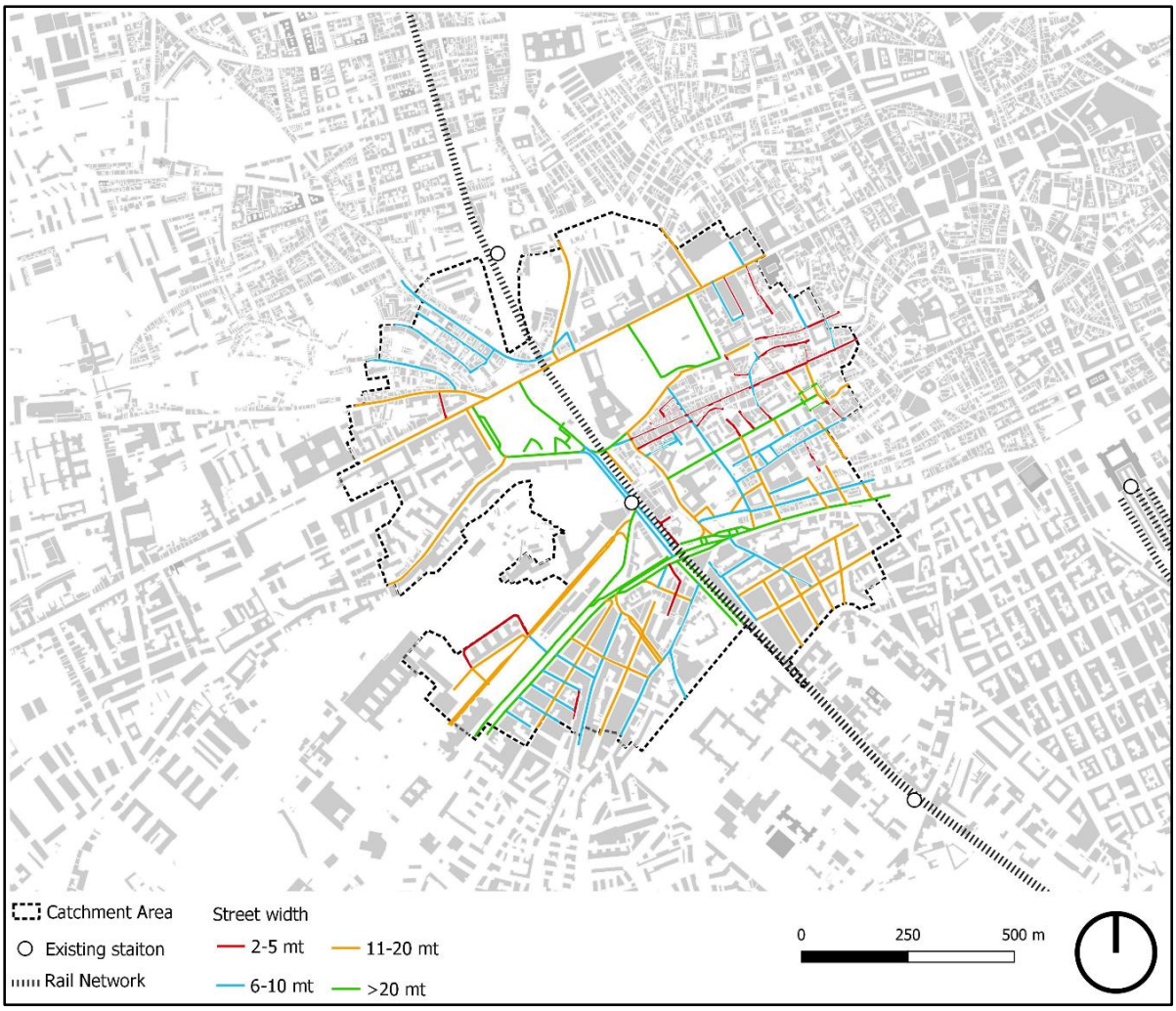


Figure 117. Classification of streets in the Orleans catchment area by width.

For universal accessibility, a 1.8-meter continuous clear path protected from traffic is recommended where space allows. However, in particularly narrow streets (2–3 meters wide) within Orleans' catchment area, such as those where interventions are limited, the use of materials like bricks or stones can help slow down vehicles while maintaining the shared space concept. In these contexts, implementing a low-speed limit is critical to protect pedestrians. Additionally, clear signage at both ends of the street, indicating pedestrian priority, reinforces the shared space message. Also, limiting vehicular access to specific times of the day, such as for deliveries only, can make the street pedestrian-dominant during peak hours. Movable bollards or tools can also help enforce these restrictions while maintaining flexibility when needed. Finally, restricting parking in streets where the space is limited is important.

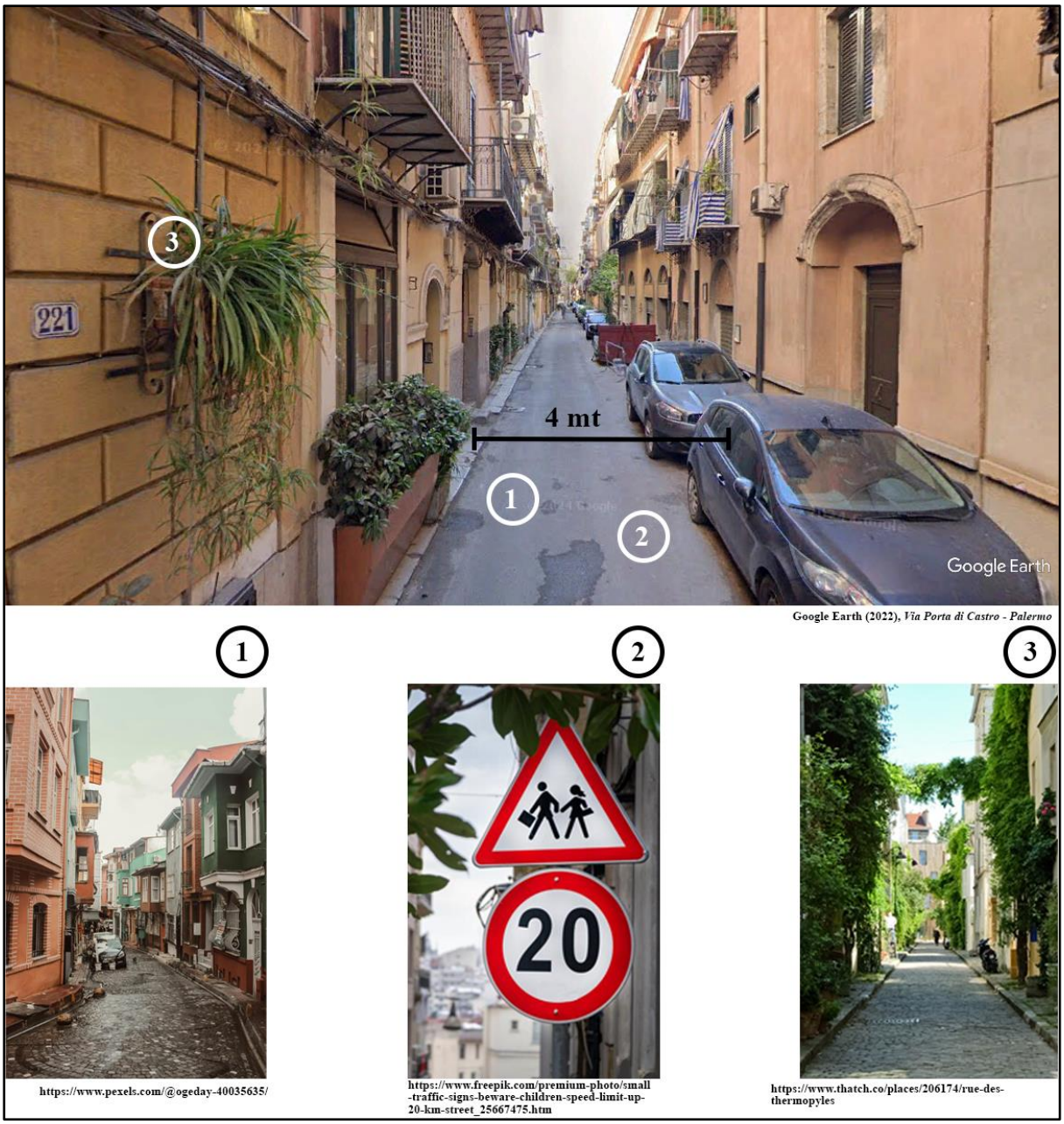


Figure 118. Recommended actions for pedestrian-prioritised or shared streets with a width of 2-5 metres at the catchment area of Orleans station (Via Porta Di Castro).

Streets in the Orleans catchment area, ranging from 11 to 20 meters wide, offer opportunities to enhance pedestrian accessibility and safety. Expanding sidewalks can improve comfort and flow, while dedicated cycling lanes with protective buffers can ensure safer mobility. Underutilised parking spaces could be repurposed into parklets or plazas with seating and greenery, creating more inviting streets. Raised crosswalks and refuge islands at key points would further improve pedestrian safety. Finally, a clear wayfinding system would strengthen connections between the Orleans station and key destinations.



Figure 119. Recommended actions for streets with a width of 11-20 metres at the catchment area of Orleans station (Via Andrea Chiaramonte).

The Orleans catchment area presents a unique challenge due to its proximity to the Old Town and its location within the historic centre, where some streets are particularly narrow. With major city functions like the university and government buildings, the area and its station attract high pedestrian activity. These factors create a strong opportunity to limit or remove vehicle access to the historic core.

7.7.2 Implementation of proposed actions in the Lazio catchment area

The catchment area of Lazio station presents a different set of challenges and opportunities, primarily based on its residential character and wider streets compared to Orleans. As a developing area with a more modern urban layout, Lazio offers greater spatial flexibility for implementing pedestrian-friendly interventions and mobility enhancements. While the area lacks significant city-scale landmarks, its residential nature creates an opportunity to focus on improving local accessibility, enhancing public spaces, and integrating sustainable transportation solutions.

With its wider streets, Lazio's catchment area allows for measures such as sidewalk expansion, the creation of cycling infrastructure, and the introduction of traffic calming features to ensure safety and comfort for pedestrians and children. The area's residential focus also makes it ideal for implementing shared streets, pocket parks, and seating zones to create social interaction and enhance neighbourhood vitality. Any interventions here aim to provide a balance between accommodating residential vehicle access and creating an environment that prioritises pedestrians and sustainable mobility.

Table 30. Actions for the Lazio catchment area.

Street Classification	Measures for Each Action
2–5 meters (Narrow Streets)	• Restricted parking to increase space for pedestrians. • Shared spaces with pedestrian priority, movable planters, and textured paving. • Minimal traffic calming features like low-speed zones. • 20 km/h speed zones and clear signage for reduced speed limits for pedestrian safety • LED street lighting to enhance safety in narrow alleys.
6–10 meters (Moderate Streets)	• Expanded pavements to 2.5–3 meters in high-pedestrian areas (e.g., near schools and parks). • Traffic calming measures such as speed humps and bulb-outs. • 20 km/h speed zones and clear signage for reduced speed limits near schools. • Mid-block crossings near key destinations like parks and schools. • Tree planting at street nodes and small squares. • Regular seating (every 50–100 meters).
11–20 meters (Wider Streets)	• Sidewalk expansion to 2.5–3 meters in suitable cases. • Integrating cycling infrastructure on appropriate streets in alignment with broader mobility plans, while implementing protective measures to ensure cyclist safety. • Pop-up parklets and plazas by repurposing parking spaces. • Raised crosswalks and pedestrian refuge islands for safer mid-block crossings on wider roads.

	• Chicanes to break long, straight streets and slow vehicle speeds. • Installation of wayfinding systems indicating major landmarks and important uses.
>20 meters (Broad Streets)	• Expanded and enhanced sidewalks and high-quality paving materials to create visually appealing pathways. • Marked and protected bike lanes along the street with separators such as planters and kerbs. • Traffic calming and lane reduction by using elements like raised pedestrian crossings and mid-block crossings. • Greening along the street to improve aesthetics and comfort by planting rows of trees along sidewalks and central medians to provide shade. • Pop-up parklets, small plazas and seating zones by repurposing parking spaces with flexible furniture that can host markets, performances, or social gatherings. • Refuge islands in the middle of wide streets to allow safer crossings.

As illustrated in the figure below, the average street width in the Lazio catchment area is significantly greater than in Orleans. This difference in width provides more flexibility for implementing proposed interventions, allowing for a broader range of design improvements. As a result, the proposed actions in Lazio primarily target wider streets, where there is greater potential to enhance pedestrian accessibility, introduce greenery, and improve overall urban quality.

However, despite the comparatively wider streets in Lazio, traffic volumes in many areas remain relatively low due to the predominant residential land use. This lower traffic density presents an opportunity to prioritise pedestrian-oriented interventions. Nonetheless, one of the major challenges in Lazio is the extensive use of public space for car parking, which reduces the availability of walkable areas and restricts pedestrian movement. Additionally, the presence of gated communities creates physical barriers that further limit pedestrian accessibility, diminishing overall urban permeability and connectivity. Therefore, even though there are pedestrian-only streets in Lazio that are more spacious according to the street-width classification than in Orleans, these streets are essential for fostering a sense of community and improving pedestrian accessibility within the target area.

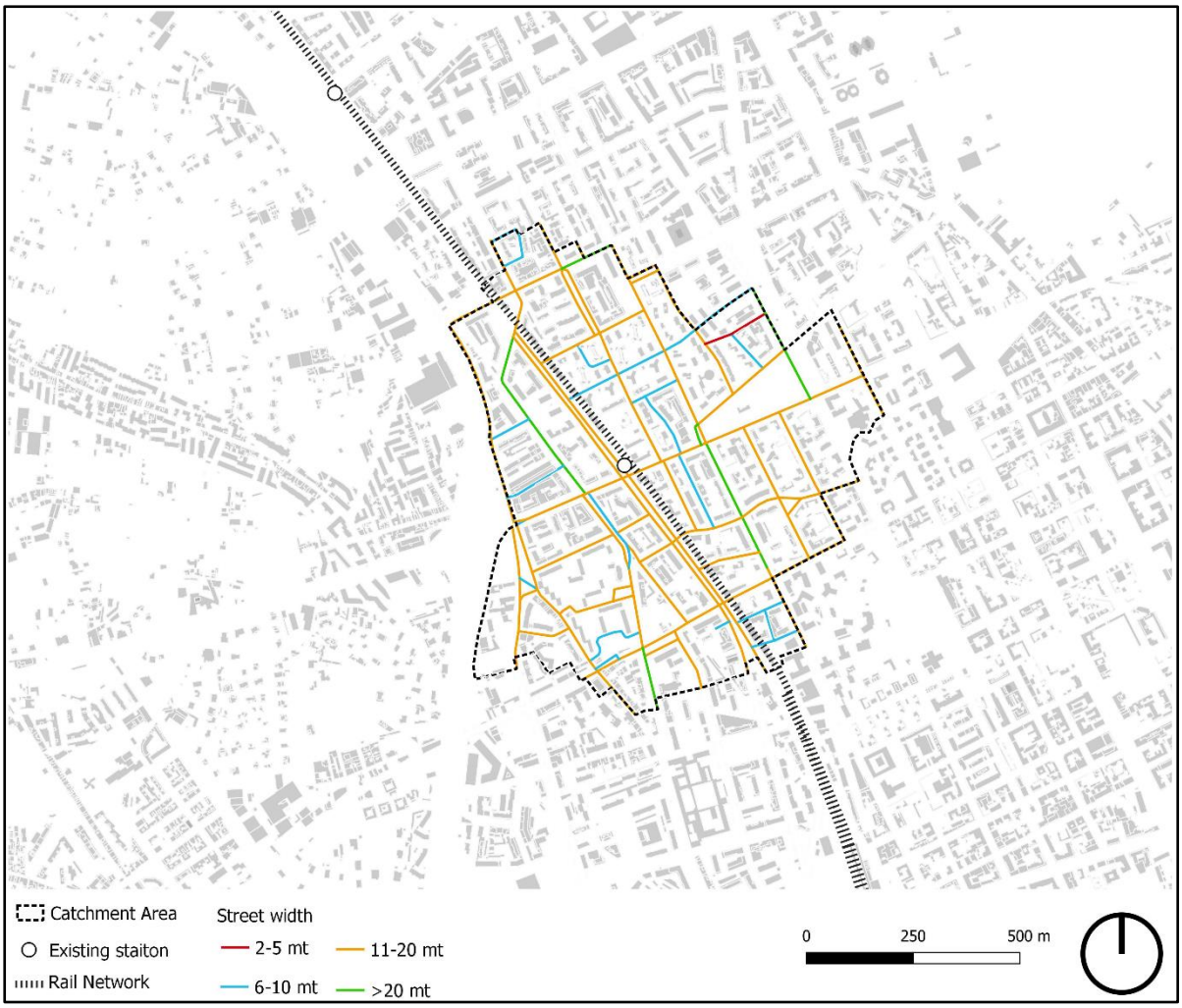


Figure 120. Classification of streets in the Lazio catchment area by width.

The Lazio catchment area, as mentioned earlier, is predominantly residential, with a street network that varies in width and function. Compared to the Orleans catchment area, narrow streets with a 5-meter width are uncommon. However, many streets are not wide enough to make large-scale interventions. These compact streets present a unique opportunity for transformation into 'woonerfs' or living streets that are shared spaces balancing the needs of all users while prioritising pedestrian movement and safety.

By integrating traffic-calming measures and pedestrian-friendly design elements, these woonerfs can enhance the quality of life for residents by creating safer, more inviting environments. Their adaptability makes them particularly well-suited for residential settings like Lazio, where lower traffic volumes and community-oriented urban design principles support the coexistence of pedestrians, cyclists, and vehicles harmoniously.

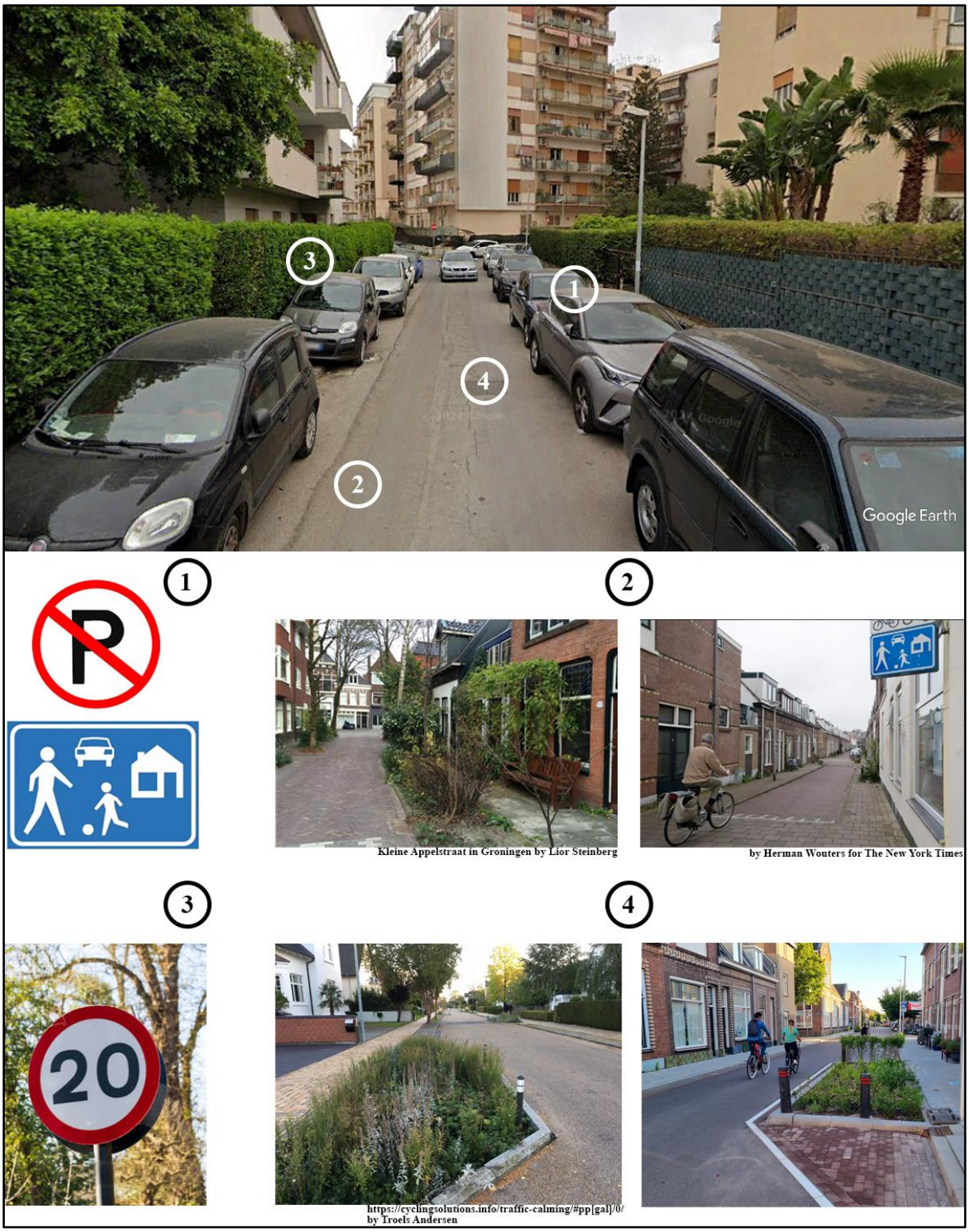


Figure 121. Recommended actions for streets with a width of 5 metres at the catchment area of Lazio station (Via Puglia).

Shared street designs prioritise pedestrian movement by fostering environments where people feel safe, comfortable, and engaged. These spaces are carefully structured to encourage slower vehicle speeds and greater awareness among all users. Marked entry points signal drivers to approach with caution, while strategically placed elements such as planters, benches, and subtle barriers naturally moderate traffic flow. Traditional traffic-calming measures, including speed bumps and chicanes, further reinforce safe driving behaviour, ensuring that vehicles navigate these areas with heightened care. Instead of conventional raised sidewalks and crosswalks, which may be impractical in constrained urban settings, diverse materials and surface textures, such as cobblestones or bricks, are employed to visually and tactilely indicate pedestrian priority, keeping drivers attentive to their surroundings.

Beyond traffic regulation, the success of shared spaces lies in their ability to create more engaging and welcoming urban environments. Thoughtful landscape design and carefully integrated street furniture play a crucial role in this transformation. Greenery, including trees and planters, enhances comfort by offering shade and visual appeal, making these spaces more inviting. Seating areas, such as benches, provide places for people to pause, converse, and interact, turning streets into social hubs rather than mere passageways. Well-placed lighting not only improves safety but also fosters a warm and inviting atmosphere, particularly in the evenings, extending the usability of these spaces beyond daylight hours.

The fundamental principle behind shared spaces is that, in the absence of rigid separations between pedestrians, cyclists, and vehicles, people naturally adjust their behaviour to the shared environment. By promoting a sense of mutual awareness and responsibility, these spaces encourage a more intuitive and harmonious interaction among different users. Elements such as textured surfaces, slight elevation changes, and strategically positioned urban furniture subtly guide movement while reinforcing pedestrian priority. This approach reduces conflicts, creating a more inclusive and dynamic urban setting where movement is fluid and adaptable to the surrounding context.

Shared spaces also reshape the perception of streets, shifting them from being purely functional transport corridors to lively, community-centred places. By prioritising pedestrian accessibility and comfort, these environments support social interactions, encourage outdoor activities, and promote a more vibrant urban life. This is particularly relevant in residential areas like the Lazio station catchment area, where reducing vehicle dominance can significantly enhance the overall quality of life. By slowing movement and reclaiming public space for multiple uses, shared streets create a more open, adaptable, and inviting environment that meets the needs of both residents and visitors. Ultimately, these interventions strengthen social cohesion, encourage sustainable mobility, and contribute to a more liveable, human-scaled urban experience.

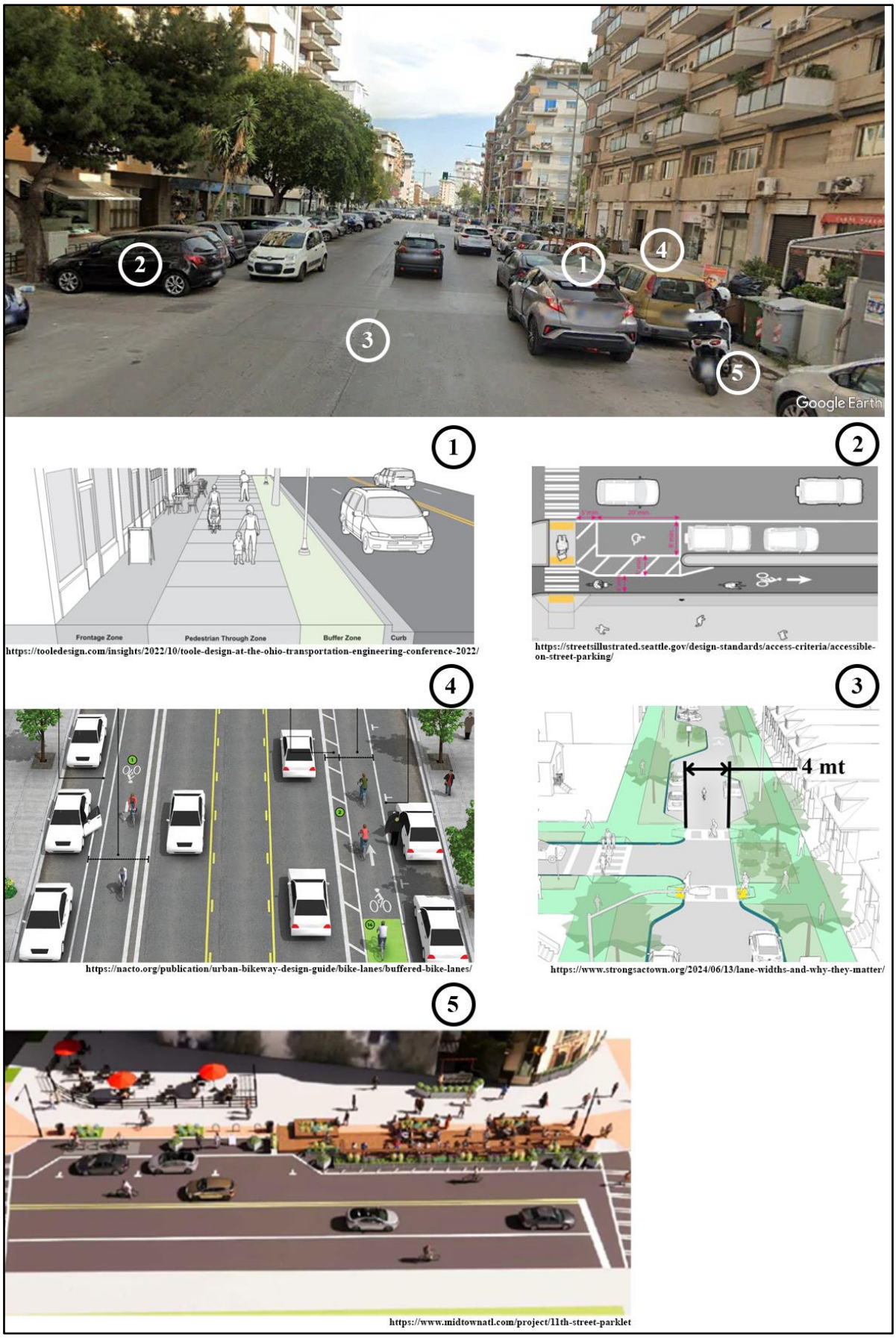


Figure 122. Recommended actions for streets with a width of more than 20 metres at the catchment area of Lazio station (Via Aquileia).

Above, there is Via Aquileia, a wide street (>20 m) within the Lazio catchment area, which presents an opportunity to transform into a pedestrian-friendly environment while balancing its high traffic volume and two-way flow. One key action is to reorganise parking, replacing on-street parking in suitable areas with parallel parking spaces on one side of the street. Parallel parking is safer for pedestrians as it reduces visual obstruction and occupation of pavements. Spaces remaining free from parking can be used for pop-up parklets with seating, greenery, and social spaces for neighbourhood interaction and to increase the vitality of the street.

To further enhance pedestrian accessibility, sidewalks that are already wide enough can be improved by design elements. Buffer zones created between pavements and vehicle roads, that provide trees and lighting, can separate pavements from traffic lanes, improving safety and creating shade. Given the street's convenient width, dedicated bike lanes can be integrated, protected by planters or kerbs, to encourage multimodal mobility. This is also an important action for multimodality. If the stations could be enhanced with park and ride systems, people may be encouraged to use the cycling infrastructure and prefer biking over other modes.

Traffic calming measures such as raised crosswalks, speed humps, and chicanes can slow vehicle speeds and ensure pedestrian safety, particularly at key crossings. Additionally, the installation of energy-efficient street lighting and wayfinding signage would improve visibility and orientation, making Via Aquileia safer and more accessible. These interventions not only prioritise pedestrians but also create a vibrant and inviting public space while maintaining the necessary traffic functionality for main arterial roads.

Actions like pop-up bike lanes around station areas, parklets, and tactical urbanism initiatives, such as improved pedestrian infrastructure, are practical and feasible for the municipality to implement. These visible changes demonstrate the municipality's commitment to pedestrian-friendly mobility and help build public confidence, encouraging greater adoption of sustainable transportation practices.

CHAPTER 8

A Survey to understand a walkable future for the Old Town

8. A Survey to understand a walkable future for the Old Town

The walkability survey conducted in the Old Town of Palermo represents an essential aspect of this research, complementing the spatial analysis based on the principles of the 15-minute city and TOD. While the built environment certainly plays a critical role in enhancing pedestrian accessibility, socio-cultural factors are equally influential in shaping travel behaviour. As supported by studies in the field, socio-cultural barriers and drivers, such as perceptions, habits, and attitudes, are important in determining individual mobility choices (Ajzen, 1991; Gifford & Nilsson, 2014). To effectively promote walkability, it is essential to understand these human dimensions alongside physical and infrastructural considerations.

Achieving a shift in travel behaviour requires a deep understanding of the underlying cultural dynamics that influence how and why people move. For instance, the theory of planned behaviour underscores the importance of attitudes, subjective norms, and perceived behavioural control in decision-making processes (Ajzen, 1991). Additionally, socio-psychological research highlights that habitual car dependency often comes from cultural and contextual factors, such as the availability of alternative modes, social norms, and convenience (Gifford & Nilsson, 2014). Thus, surveying offers a powerful tool to explore these dimensions, capturing people's perceptions, preferences, and barriers to adopting walking as a primary mode of transport.

This chapter focuses on the walkability survey on Palermo's Old Town, encompassing the pedestrianisation process of the area, the methodology, and the resulting insights into residents' mobility behaviours. Finally, policy recommendations informed by survey results and enriched by a review of scientific literature on socio-psychological principles are presented. These strategies aim to address cultural barriers, understand behavioural drivers, and encourage a cultural shift toward sustainable, pedestrian-friendly mobility.

8.1 Storytelling of the Pedestrianisation Process in the Old Town

The Old Town of Palermo is one of the biggest and oldest in Europe, dating from the 7th century BC, with an area of around 250 hectares (Lo Piccolo, 1996). In the last decades, the Old Town has undergone significant population decline and disruption of its built fabric. The Old Town of Palermo has undergone significant population decline and deterioration of its historic fabric over the past few decades. In 1951, 25% of the city's population (125.294) was living in the Old Town, but by 2011, this figure had decreased to 3.5% (23.384). While recent urban regeneration efforts, including infrastructure improvements and enhanced mobility, have contributed to a slight population increase of 4.5%, challenges remain. The fragility of the historic built environment and the presence of informality are still significant obstacles to the full revitalisation of the Old Town.



Figure 123. The Old Town of Palermo.

Especially in the last two decades, there have been pedestrianisation initiatives and efforts in various parts of the Historic Centre of Palermo. This movement originated from grassroots activism advocating for improved public spaces and quality of life, starting in 2008. Over time, these grassroots efforts transitioned into official mobility measures aimed at promoting active modes of travel to establish more sustainable mobility patterns. This shift is significant in a city where 63% of the population relies on private cars for transportation (Cavalcante Schussel, 2019).

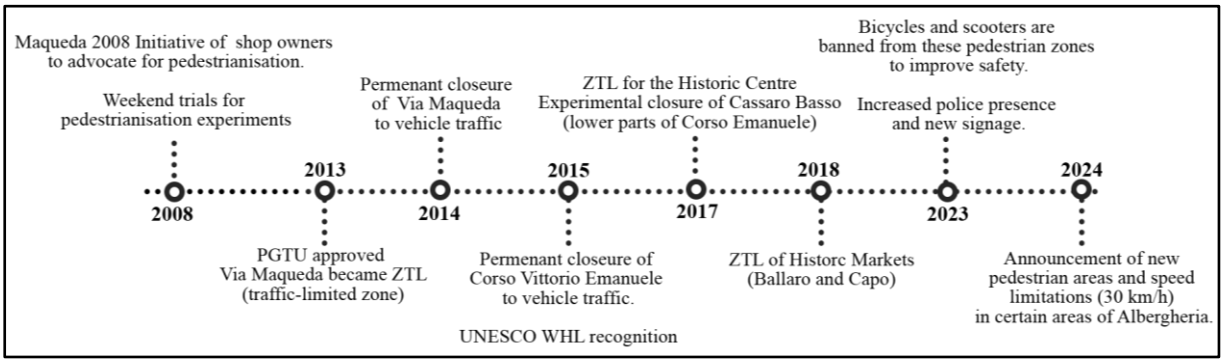


Figure 124. The steps of pedestrianisation of the Old Town.

The first pedestrianisation started from the heart of the Old Town, Via Maqueda, in 2008 by a commercial association for the pedestrianisation (Cavalcante Schussel, 2019). The initial idea started when Via Ruggero Settimo (cont. of Via Maqueda) underwent renovation with new pavements, lighting and urban furniture, which encouraged shop owners of Via Maqueda to form the association (Maqueda 2008) to propose ideas to the municipality, including transforming the area into a pedestrian zone on weekends. From November 2009 to January 2010, Via Maqueda and Via Ruggero Settimo were closed to traffic on weekends as a street experiment.



Figure 125. Police surveillance for the beginning of pedestrian experiments.
Source: Ignazio Vinci, 2018.

Discussions continued until the end of 2013, with public support from residents and shop owners growing for pedestrianisation, seen as integral to improving quality of life and revitalising historic monuments. However, some commerce associations got involved by forcing politicians to restore private vehicle circulation and parking on these streets in favour of commercial activities.

Debates led to experiments expanding to other streets and squares or being halted. In 2013, Palermo's PGTU was approved, and during the holiday season, Via Maqueda and Via Ruggero Settimo became ZTL, closed to unauthorised cars on weekdays with lanes designated for authorities' and residents' vehicles, while pavements were extended for pedestrians and cyclists.

Finally, in January 2014, the strong demand of shopkeepers, residents and associations brought results, and the municipality officially closed the street to vehicles permanently. The bollards were installed in March, and by June 2014, Via Maqueda, from the Politeama Theatre to Quattro Canti, became a heavily pedestrianised limited traffic zone, operating daily from 10:00 to 20:00. Over time, the closure hours extended, restricting private vehicle access to between 7:00 and 10:00 in the morning.

Following the pedestrianisation of Via Maqueda, several other initiatives have been implemented to increase pedestrian areas in the Historic Centre. Both locals and tourists now visit these areas. Notable examples include the pedestrianisation of Via Matteo Bonello along the Arab-Norman historical route and the ongoing revitalisation program for the Albergheria district within the Old Town. This plan includes pedestrianising certain areas and regulating traffic and parking to promote cultural and social activities in that zone.

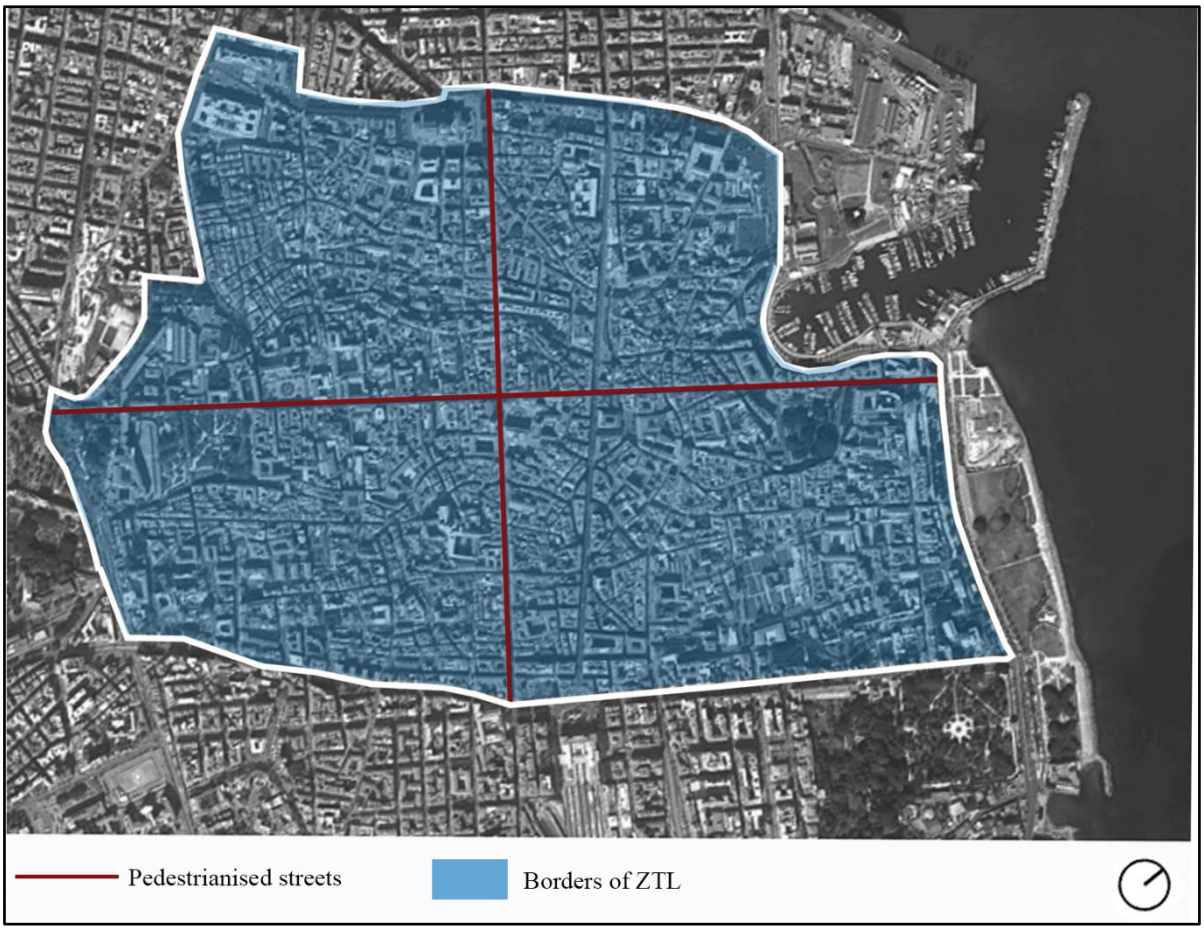


Figure 126. Pedestrian areas and ZTL of the Historic Centre in 2017.

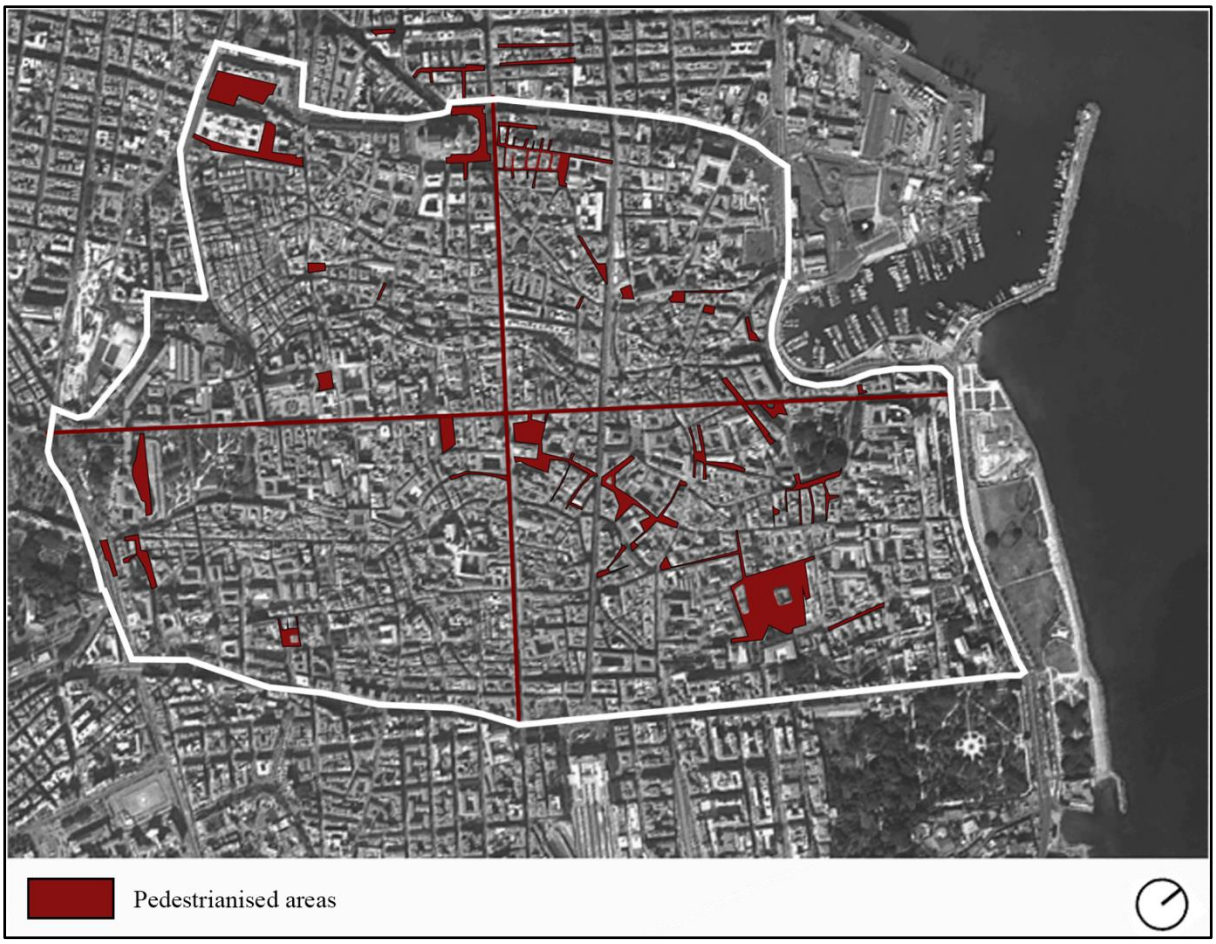
8.1.1 UNESCO and Walkability in the Old Town

In 2009, different proposals for admission at the national level from the municipality were made to UNESCO for the Arab-Norman Itinerary in Palermo. After the formal candidature in 2014, the proposal was recognised by the World Heritage Committee held in Bonn on July 3rd, 2015. A comprehensive management plan has been developed to protect and enhance the site. The management plan for Palermo's UNESCO World Heritage site prioritises pedestrianisation and the removal of car parking, especially around significant landmarks like the Royal Palace and the Quattro Canti. By limiting traffic and creating pedestrian-only zones, the aim is to enhance the aesthetic appeal, improve accessibility, and promote a more pleasant visitor experience.



Figure 127. UNESCO sites and buffer zones in the Old Town of Palermo.
Source: Regione Siciliana.

Additionally, measures to reorganise tourist bus parking help to reduce congestion and improve pedestrian flow. Eventually, the mobility interventions made through PGTU, the pedestrianisation of Via Maqueda and other key places such as Piazza Bellini in Palermo's historic centre, were a significant step for urban revitalisation. The changes have led to the renovation of buildings and the revitalisation of public spaces. While pedestrianisation has brought benefits, challenges such as traffic congestion and the need for careful planning and management remain.



The plan for the Albergheria district focuses on the pedestrianisation of Via San Francesco Saverio, the road between Piazza Napoleone Colajanni and the former Edison Cinema. There are several actions to be implemented according to the project such as regulating traffic and parking to reduce vehicle congestion and illegal parking, creating a pedestrian zone in front of the Church of San Francesco Saverio to protect parish activities, establishing a regulated market area with clear boundaries (Comune di Palermo, 2024b).

The urban regeneration project of Albergheria aims to revitalise the area and make it a more attractive and sustainable place for both citizens and tourists. The project also addresses issues like illegal vending, traffic congestion and the need for more cultural and social activities in the historical area.

Confirmed through experience in pedestrian areas in the Old Town, pedestrian areas have become popular over time, but they often face challenges like overflowing trash, illegally parked scooters, and cluttered pavements. Businesses sometimes invade public space with tables and chairs, and there is a lack of consistent guidelines for outdoor furniture. Additionally, there's limited greenery, with plants often used to mark business territories (Palermo Mobility, 2022). Therefore, planning for these issues in advance, as done with the Albergheria revitalisation project, is vital to prevent future problems.

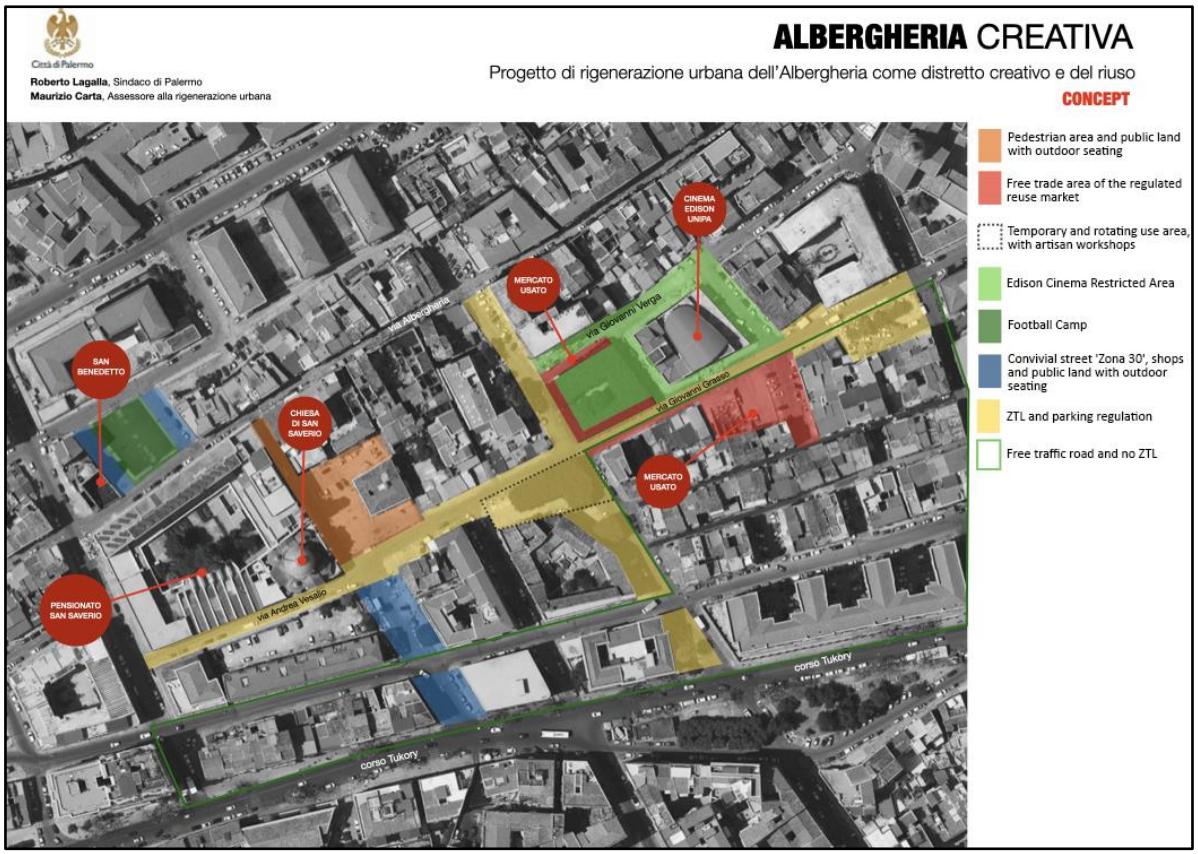


Figure 128. The Albergheria pedestrianisation and revitalisation project by the Comune of Palermo. Source: Comune di Palermo, 2024.

8.2. Walkability Survey of the Old Town

As explored in detail in the theoretical framework, reducing car dependency and promoting walkability require a deeper understanding of the factors that shape travel behaviour. This includes both objective elements, such as urban form, infrastructure, and access to services, as well as subjective influences like personal preferences and the socio-cultural perceptions that shape everyday mobility choices and habits. Cultural norms, often internalised unconsciously, can act as barriers to sustainable mobility by encouraging car use through social expectations, safety concerns, and deeply rooted habits. These factors must be carefully considered when designing strategies to encourage more walkable environments.

To fully understand the complexities of car dependency, this research adopts a twofold analytical approach. The first part focuses on spatial aspects, assessing infrastructure quality and pedestrian accessibility in station areas. In the second part, the focus shifts towards a behavioural perspective, exploring how people experience pedestrian environments and how local attitudes influence mobility choices. Palermo's Old Town, with its relatively high level of walkability compared to other neighbourhoods, serves as a key reference point for this investigation.

By surveying residents, this study aims to uncover both the challenges and opportunities related to walkability in a car-dominated urban context. Analysing the pedestrianisation process in the Old Town provides valuable insights into the cultural and structural barriers that prevent walkability in Palermo. Moreover, understanding residents' travel behaviour and mobility preferences is crucial for initiating a broader shift in mobility culture. In pursuit of these objectives, a survey was conducted as a principal component of this research, offering first-hand perspectives on how walkability can be effectively promoted in the city.

8.2.1 Methodology of the Survey

The development of the survey was a collaborative effort involving esteemed academics. Prof. Vinci and Dr. Igreja from UniPa played a significant role in shaping the survey's structure and focus, while Prof. Bertolini from the University of Amsterdam provided his valuable insights and guidance. This interdisciplinary collaboration ensured a comprehensive and holistic methodology that addresses the complex interplay between mobility behaviour and urban design.

While there is extensive literature exploring qualitative and quantitative strategies to reduce car dependency (e.g., Handy et al., 2005; Zhao, 2011; Storme et al., 2020; Langer et al., 2023), this research adopts a distinct perspective. It aims to uncover the underlying challenges and barriers to walkability by not only analysing spatial conditions but also examining people's preconceived attitudes and perceptions about pedestrian mobility. This combination of behavioural insights and spatial analysis offers a more refined understanding of the cultural and practical obstacles that disrupt or, in some cases, even obstruct walkability, especially in car-dominated urban contexts.

To achieve this, the survey was designed to focus on three key aspects. The first section captures demographic and socio-economic information, providing a profile of the respondents that contextualises their mobility choices and preferences. The second section explores their firsthand experiences as pedestrians in the historical centre, focusing on how they navigate the space, their comfort levels, and any challenges they come across. Finally, the third section gathers opinions on pedestrian areas within the historical centre, exploring their attitudes toward current pedestrianisation efforts and their vision for the future of pedestrian mobility. By structuring the survey in this way, the research seeks to bridge the gap between spatial analysis and the lived experiences of urban residents, offering valuable insights for future planning and policy development.

Table 31. The sections of the walkability survey.

Section	Focus	N. of Questions
Section 1	Characterisation of respondents	9
Section 2	Experiences as pedestrians in the Old Town	11
Section 3	Perceptions and preferences for ped. areas	5

The survey has been distributed through various means, including hard copies and online methods, targeting individuals who visit and reside or work in the historical centre. The initial online version of the survey was created using the 'Typeform'[5] online application, but was later replaced with the more cost-effective Google Forms and MS Forms [6]apps, both of which are open and free resources. There were 677 respondents in 1 month.

8.3 Results of the Survey

First, respondents were grouped according to their residential neighbourhoods in Palermo, as seen from the Figure below. This categorisation helps to understand the results within their specific geographic context and provides a balanced representation of the respondent population. The number of respondents from each zone is provided, along with their percentage of the total respondent population. This information is essential for analysing the data and drawing meaningful conclusions about the relationship between neighbourhood characteristics and survey responses.

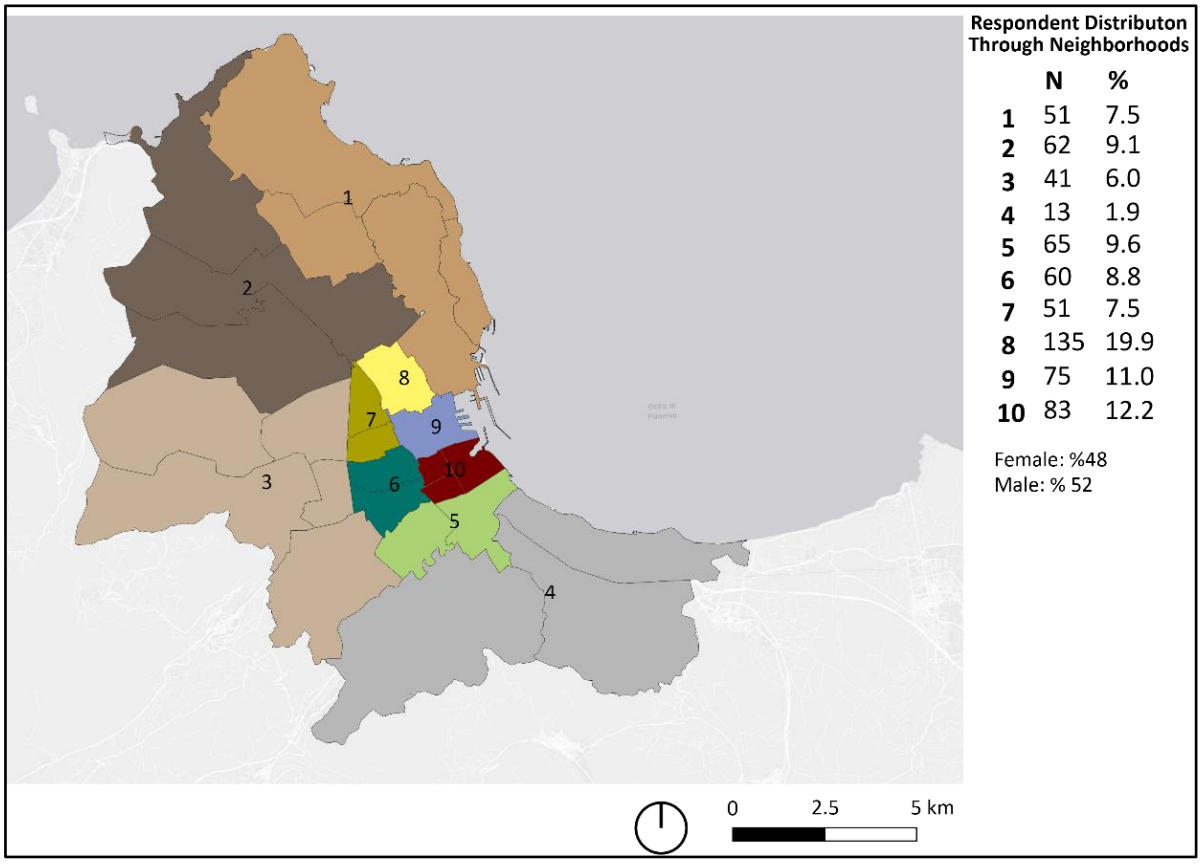


Figure 129. Distribution of respondents according to the neighbourhoods they reside in.

[5] A web-based platform to create surveys to collect data using their API system.
[6] An online survey creator, part of Office 365.

As shown in the figure above, most respondents reside in central neighbourhoods, such as zones 10, 6, 9, 8, and 7 (Liberta, Politeama, and near the central station, which is close to the Old Town). This is significant, considering that these neighbourhoods are more densely populated than the outer zones of Palermo.

Looking at the first section of the survey, respondents showed a balanced gender distribution, with 320 females and 357 males. However, there is a significant dominance of public sector occupations compared to those studying or working in the private sector. The majority of respondents are over 40 years old, particularly between 40-59 years old, with a considerable number also falling within the 21-39 age range. This could be seen as a good distribution considering the average age of the population of the city.

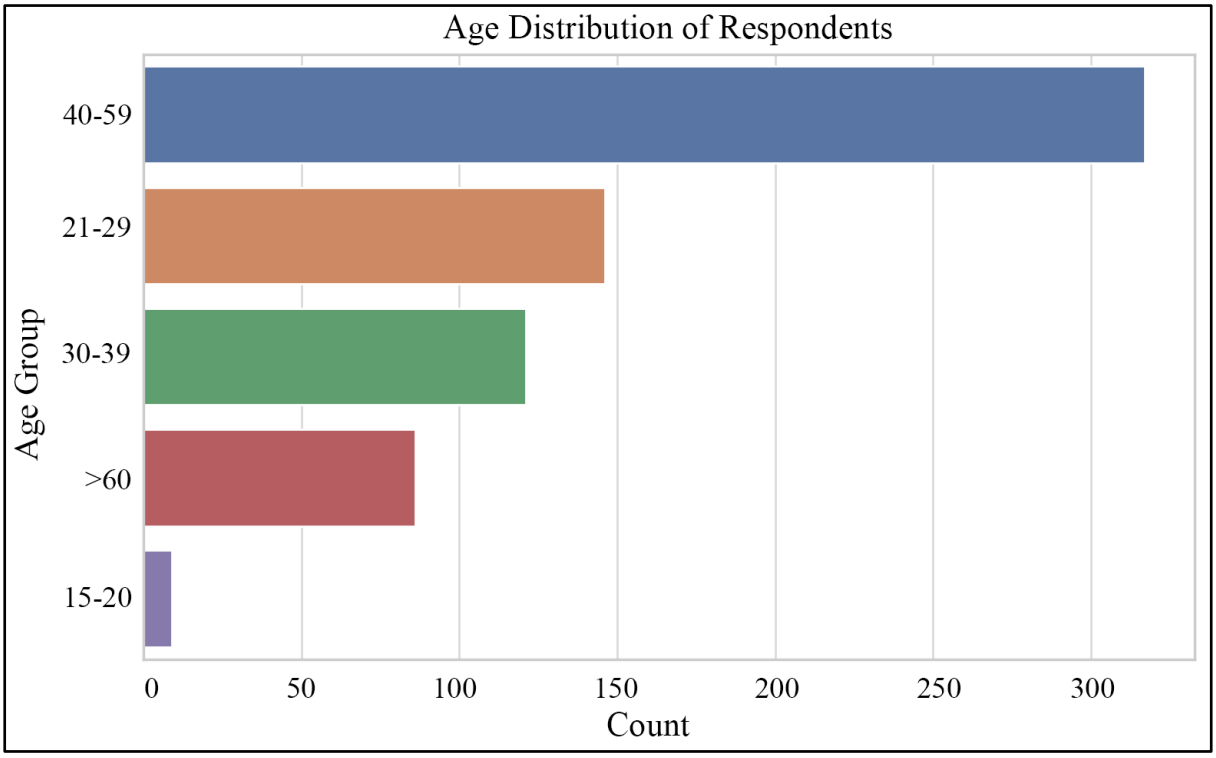


Figure 130. Age distribution of respondents of the survey.

Regarding daily travel habits, the majority indicated a 1-5 km distance between their home and workplace/study location, making daily commutes a central aspect of their routines. Within this context, understanding their preferred travel modes becomes particularly important. Surprisingly, despite the relatively short distance, a significant portion of respondents still prefer using their cars. Approximately one-third of this group prefers driving, another third chooses walking, while the remaining respondents rely on bikes or motorbikes. Particularly, public transport remains the least popular option, with only 13% of respondents selecting it for their daily travel needs.

For residents living in neighbourhoods further from the Old Town, such as Mondello, Aranella, and Boccadifalco, car usage is overwhelmingly dominant. Among this group, 73% of respondents prefer driving, compared to just 21% who rely on public transport, including buses and trains. In contrast, respondents living closer to the Old Town, in neighbourhoods such as Tribunali, Palazzo Reale, Oreto, and Politeama, show a much lower reliance on cars. In these central areas, only 19% choose to drive, while an impressive 76% prefer walking to reach the Old Town, highlighting the impact of proximity on travel behaviour.

Interestingly, while a considerable number of respondents perceive the Old Town as being largely inaccessible by car (71%) and believe that relying on a car while living there would be difficult or even impossible (82%), a huge portion (47%) still prefer to drive to the Old Town. This preference persists despite the challenges associated with driving in the area, such as limited parking, heavy traffic, and congestion.

Given that most respondents are residents in central neighbourhoods with relatively easy access to the Old Town via public transport or active modes like walking and cycling, these findings reveal a persistent reliance on private cars. This tendency suggests that even when alternatives are available, habits, convenience, or perhaps perceptions about public transport and active mobility play a strong role in shaping travel choices. This highlights the cultural and behavioural barriers that must be addressed to encourage a shift towards more sustainable modes of transport.

In section 2, the respondents were asked about their first-hand experiences as pedestrians in the Old Town. To have more meaningful inferences, respondents were asked about their frequency of visiting the Old Town and their use of pedestrian infrastructure. Responses ranged from "never" to "always," and respondents were categorised as "frequent users" or "occasional users" for further analysis.

As shown in the graphic below, frequent users are less satisfied with the quality and the dimensions of the pedestrian areas and infrastructure. They are most likely to be in favour of extension for existing pedestrian areas, too. On the other hand, few respondents think that Old Town is a walkable environment, but also in this case, frequent users are more positive about the walkability in the Old Town with respect to occasional users/visitors. Overall, those who rarely use pedestrian areas exhibit less interest in these spaces and have a less favourable view of pedestrianisation initiatives.

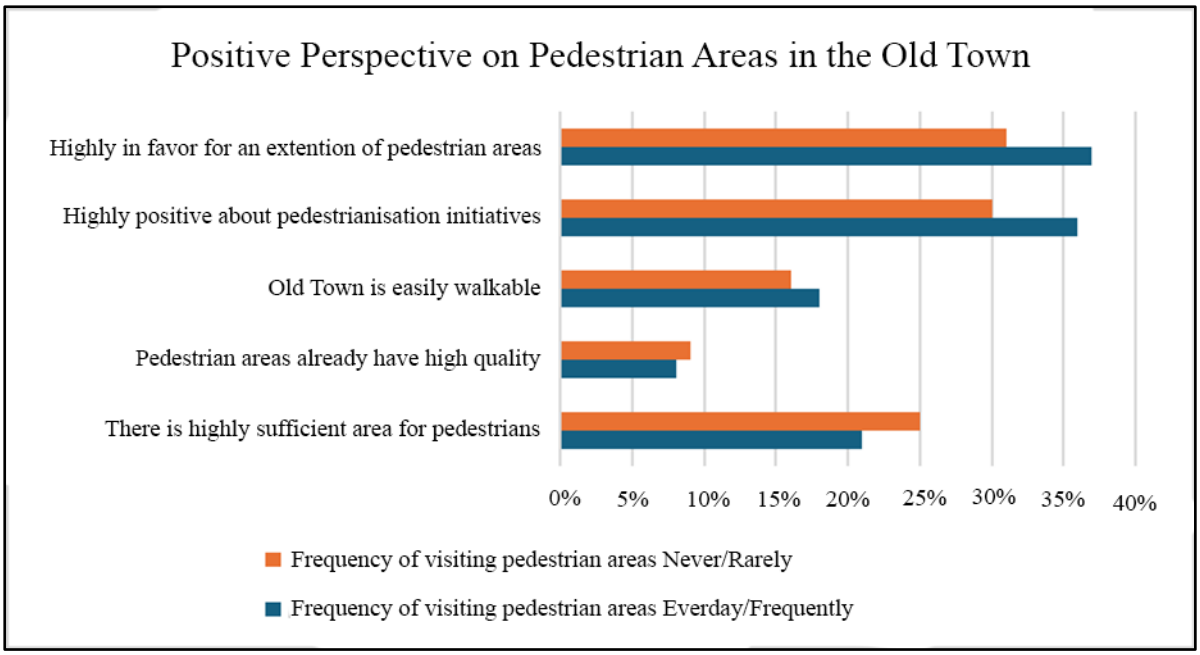


Figure 131. People's perception towards pedestrian areas in the Old Town.

Section 3 looks at people's perceptions and attitudes towards pedestrian areas, which, when combined with earlier analyses of their mobility patterns and pedestrian experiences, provides a fuller understanding of what influences their views on walking and pedestrianisation. This approach helps identify not just the barriers, but also the motivations shaping their behaviour.

The survey data reveals some interesting findings. A notable 33% of respondents believe that pedestrian areas cause traffic congestion, suggesting that many people prioritise smooth vehicle flow over pedestrian accessibility. This reflects the ongoing challenge of reducing car dependency in a city where cars are still seen as central to mobility. Around 10% of respondents felt that pedestrian areas make public spaces overcrowded, making it harder to access essential services. Another 10% conveyed their concerns about the negative impact of pedestrianisation on commercial activities. This perspective contrasts with the generally positive views of shop owners, who tend to benefit from increased foot traffic. This points to a possible disconnect, while businesses thrive on the influx of visitors, some residents may find the increased activity overwhelming. Only 8% of respondents believed pedestrianisation has no negative effects in the Old Town, indicating that concerns about pedestrian areas are relatively common.

When asked about ways to improve walkability in the Old Town, 46% of respondents suggested better connections to public transport as the most important step. This highlights the need to integrate pedestrian networks with wider transport systems to create more convenient mobility options. Another 22% recommended improving the design of pedestrian areas to make them safer and more comfortable. Interestingly, only five respondents felt the current pedestrian areas were adequate and did not need further changes. This small number suggests that most people feel there is still significant room for improvement in how pedestrian spaces are designed and maintained.

The survey also asked, "Do you think that the inhabitants of Palermo will change their mobility habits in the near future, reducing car use and preferring to travel on foot?" The results show a strong sense of scepticism. Only 5% of respondents strongly believe that people in Palermo will embrace active mobility soon. Most respondents rated their optimism in the 1–3 range (from strongly disagree to neutral), reflecting doubts about whether behavioural change is realistic anytime soon. This highlights the deep-rooted car dependency in Palermo, where cars remain the preferred mode of transport despite the challenges of parking, congestion, and the availability of other options.

These responses show how complex it is to encourage pedestrianisation and promote walkability in a city so reliant on cars. They underline the need for strategies that address public concerns, make pedestrian areas more practical and appealing, and offer reliable alternatives to car travel. By tackling both the physical and cultural obstacles to walking, Palermo could take steps towards creating a more walkable and sustainable urban environment that better meets the needs of its residents.

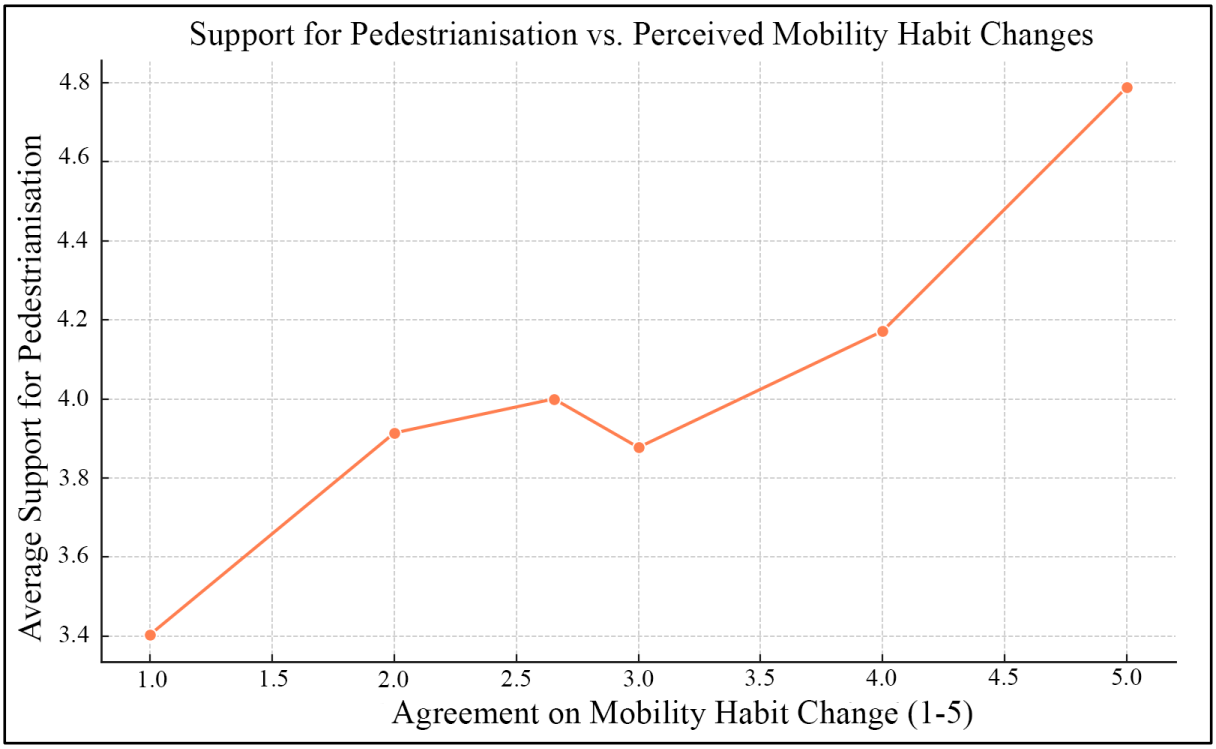


Figure 132. Support for pedestrianisation vs perceived mobility change behaviour for the future.

This result highlights both cultural and infrastructural barriers that limit walking in Palermo. The heavy reliance on private cars seems to influence public attitudes, leading to scepticism about the possibility of reducing car usage. Factors like poor pedestrian infrastructure, narrow or uneven sidewalks, and safety concerns mostly contribute to this perception.

Additionally, the widespread use of private vehicles for convenience, especially in a car-dependent urban setting, further reduces confidence in the likelihood of behavioural change. These factors reflect a deep-rooted reliance on cars that goes beyond practical considerations, showing how cultural habits and infrastructure challenges are closely connected.

8.4 Policy Recommendations

The survey results reveal a largely pessimistic outlook on walkability in Palermo, reflecting the deep influence of car dependency and cultural attitudes. While factors like density, design, and diversity (Frank and Pivo, 1994; Newman and Kenworthy, 1999) can partly explain car dependency, this explanation is less applicable in European cities, where walkability and pedestrian access to services are generally higher than in North America. In Palermo, however, societal norms surrounding car ownership, where cars are seen as status symbols, clearly shape public attitudes toward walkability, as highlighted in the survey findings. This aligns with Savolainen's (2016) study, which explains how socio-cultural barriers are rooted in societal standards and cultural beliefs. Long-standing car use habits, combined with the perception of cars as symbols of success, contribute to negative views of pedestrian areas.

A striking example of this is that only 8% of respondents reported using buses, trains, or trams to reach the Old Town, despite the availability of 15 bus lines, trains running every half hour (with increased frequency during peak hours), and a tram line. While improvements to public transport are always possible, these results indicate that there are already multiple accessible options for reaching the Old Town. This raises an important question: even when public transport offers a practical alternative, why do so many people still choose to rely on cars to access one of the city's most accessible areas?

Another issue that emerged from the survey was complaints about overcrowding in pedestrian areas, which may be partly due to poor maintenance. Factors such as inadequate trash collection, uncomfortable or insufficient street furniture, and the growing number of scooters and bikes obstructing walking routes were highlighted in interviews with shop owners. These issues not only affect the functionality of pedestrian spaces but also reduce their appeal and safety for users.

Based on these findings, tailored policy recommendations for Palermo should address cultural and infrastructural barriers to walkability. Shifting societal norms will be critical, including challenging the perception of cars as status symbols and promoting walking and public transport as appealing, modern alternatives. Improvements to walking infrastructure, such as better maintenance and enhanced safety features, will also be essential. Equally important is fostering community engagement to help residents feel a sense of collective ownership over pedestrian spaces. Through culturally sensitive interventions and infrastructure improvements, Palermo can begin to shift attitudes and reduce its dependency on private vehicles.

Table 32. Policy recommendations and relevant actions.

Policy Recommendation	Actions
Cultural rebranding of walking	Role models for walking Public campaigns and events Educational programs
Community engagement to shift cultural norms	Local consultation and involvement Celebrating pedestrian heritage Promotion of local businesses
Strategic policies to make alternative modes more appealing	Greater visibility to alternative mobility modes Restricted car access Parking policies Incentives programs

8.4.1 Cultural rebranding of walking and public transport

Role models for walking: Bandura's social learning theory (1972, 1977, 1986) highlights the powerful role of observational learning in shaping behaviours and attitudes. People tend to model their actions based on observing individuals they admire or perceive as credible role models. In the context of mobility habits, seeing respected figures such as professionals, community leaders or peers choosing walking over car use can inspire others to follow. By observing role models embracing walking as a sustainable and healthy alternative, societal perceptions of car dependency as a norm can gradually shift. This observational learning process reinforces the idea that walking is not only practical but also aligned with modern, environmentally conscious lifestyles, fostering a collective move toward more sustainable mobility habits.

Public campaigns and events: Another approach could be launching awareness campaigns that rebrand walking as a symbol of modern urban lifestyle, environmental responsibility, and healthy living. By highlighting walking as a contemporary, eco-friendly choice, campaigns can challenge societal norms that associate cars with status and convenience. Events such as car-free days, walking festivals, and health-oriented initiatives can engage the public, highlighting the personal and collective benefits of walking. Collaborating with local influencers, community leaders, and businesses can further amplify this message, positioning walking as not only practical and sustainable but also a desirable and forward-thinking lifestyle choice.

Educational programs: Including walking and sustainable mobility themes into the education system is another way to rebrand walking. To promote sustainable mobility habits with a focus on walking, schools can integrate walking-related concepts into curricula through modules on carbon footprints, active mobility benefits, and the role of walking in reducing emissions and improving health. Project-based learning can encourage students to analyse their school's walkability and propose improvements such as safer pedestrian routes and 'walk to school' zones.

Experiential learning opportunities, such as car-free school days, walking challenges, and urban planning workshops, allow students to experience the benefits of walkable environments firsthand. Technology can be used to support walking-focused education through gamified apps that track steps, virtual simulations displaying walkable cities, and STEM projects on pedestrian-friendly design. Initiatives targeting community and families, such as 'Leave the Car at Home' campaigns and role model programs featuring local leaders who prioritise walking, can further encourage a cultural shift. Incentive-based strategies, like step-tracking competitions, rewards for walking to school, and eco-certifications, motivate students to adopt walking as a daily routine. Finally, teacher training programs can equip educators with the tools to emphasise the importance of walking as a sustainable, healthy, and accessible form of mobility.

8.4.2 Community engagement to shift cultural norms

Local consultation and involvement: Local consultation and involvement are essential for creating a sense of ownership and ensuring the success of urban planning initiatives. To ensure meaningful local consultation and involvement, several concrete actions can be taken. The first one is organising regular community workshops, focus groups, and public forums to gather input from citizens, shop owners, and stakeholders on urban planning projects. The second step could be digital tools, such as interactive online surveys, mapping platforms, and feedback apps, that can broaden participation and help to receive diverse perspectives. Another one is establishing dedicated advisory committees with representatives from local businesses, residents, and advocacy groups to ensure ongoing collaboration throughout the planning and implementation phases. Additionally, conducting walkability audits or 'urban walks', which have become increasingly popular in the last years, with community members to identify specific challenges and opportunities firsthand. Finally, co-creating solutions by implementing pilot projects, such as temporary pedestrian zones or pop-up infrastructure improvements, and gathering feedback to refine long-term plans, ensuring they meet the community's needs while developing collective ownership of urban spaces.

Promotion of Local Businesses: Targeted actions can be taken to promote local businesses and demonstrate the economic advantages of increased foot traffic by highlighting pedestrian-friendly commerce. Launching marketing campaigns that emphasise the Old Town as a vibrant, walkable commercial hub, featuring its unique shops, cafes, and cultural attractions are important step to start. Events such as street markets, festivals, and 'walk and shop' days can draw attention to local businesses and encourage pedestrian activity.

Collaborating with business owners to offer incentives, like discounts or loyalty programs, for customers who walk or use active mobility to visit their stores may encourage people to choose walking over car use. In addition to this, it is vital to develop clear wayfinding signage and maps highlighting key commercial areas and pedestrian routes, which make it easier for visitors to explore commercial areas and Old Town on foot. Lastly, sharing success stories and data on the positive impact of increased foot traffic on local businesses can help overcome the misconception that pedestrianisation is bad for commercial vitality, while developing broader community support for walkability initiatives and highlighting the link between walking and economic vitality.

Celebrating Pedestrians: To celebrate Palermo's pedestrian heritage, actions can include organising cultural events and guided walking tours that highlight the city's rich historical and architectural landmarks, creating a sense of pride in pedestrian spaces. Walking is deeply embedded in Italian culture, with *'la passeggiata'*—the traditional evening stroll—being a beloved social activity that reflects Italy's appreciation for pedestrian-friendly environments. Italian cities, with their compact design, vibrant piazzas, and historic centres, are inherently walkable and encourage exploration on foot. Palermo, like many Italian cities, has historical and cultural treasures best experienced through walking. Collaborating with historians, artists, and cultural organisations, the city can host events such as 'Heritage Walk Days,' themed tours, and nighttime walks displaying illuminated landmarks. By promoting walking as a way to engage with the city's history, culture, and vibrant urban life, these initiatives can attract tourism, strengthen community pride, and highlight the value of preserving and enhancing pedestrian-friendly spaces.

8.4.3 Strategic policies to make alternative modes more appealing

Restricted Car Access: To make walking more appealing to citizens, it can be effective to discourage car use by implementing restrictions at appropriate times and locations. To effectively restrict car access to pedestrian zones, gradual and strategic actions can be implemented to ensure a smooth transition while maintaining accessibility. Introducing car-free times or days, such as weekends or specific hours, can help residents and visitors to adopt the concept of pedestrian-only areas. These initiatives should be supported by enhanced public transport availability, such as increased bus, tram, or shuttle services to and from key pedestrian zones, ensuring convenience and connectivity. Clear communication through signage, awareness campaigns, and digital tools can inform the public about restricted access schedules and alternative transport options.

Parking Policies: Reducing parking availability in the Old Town by limiting on-street parking spaces or converting them into alternative areas such as parklets and shared spaces can make car use less convenient. Simultaneously, increasing parking fees for the remaining spaces, especially during peak hours, can discourage unnecessary car trips while prioritising short-term parking for essential visits.

Public support is crucial for implementing parking policies in the car-dependent urban context; therefore, clear and effective communication strategies such as awareness campaigns and personalised engagement should be employed to highlight the benefits of these policies and address public concerns. Additionally, parking revenue can be redirected to fund improvements in walkability, including better sidewalks, pedestrian-friendly infrastructure, and enhancements to public transport services to show people that the city gives priority to improving public and shared spaces. This integrated approach not only discourages car use but also reinvests in creating a more accessible, sustainable, and pedestrian-oriented Old Town.

Restricting parking in the Old Town and central zones may lead to parking problems and increased traffic congestion. To address these issues, park-and-ride facilities should be developed on the outskirts of the Old Town, allowing drivers to park their cars and continue with public transport, shuttle services, or bike rentals. Also, limited parking spaces within the Old Town primarily should be reserved for essential users, such as residents, delivery vehicles, disabled individuals, and emergency services, ensuring accessibility while maintaining the area's walkability and functionality.

Incentive programs: To encourage people to walk instead of using their cars, simple and engaging incentives can make a real difference. Organising car-free days, walking festivals, or fun challenges like ‘walk to work’ or ‘walk to shop’ can inspire people to leave their cars behind and enjoy their city on foot. These events can be made even more rewarding by partnering with local businesses to offer discounts or small benefits to those who walk, such as loyalty points, vouchers, or special deals. Step-tracking competitions with prizes, like free coffee, store discounts, or small gifts, can also add an element of fun and motivation. By making walking more enjoyable, rewarding, and connected to the local community, these efforts can help to shift societal behaviours and habits gradually, showing people that walking is not simply good for the environment and health, but also a great way to explore and connect with their city

PART III

Conclusion

“Restore human legs as a means of travel. Pedestrians rely on food for fuel and need no special parking facilities.”

Lewis Mumford, writer, 1895–1990

CHAPTER 9

Lessons learned from the Palermo experience

9. Lessons learned from the Palermo experience

The Palermo case study serves as a compelling and insightful perspective through which to examine the challenges and opportunities of enhancing walkability in a highly car-dependent city. With typical characteristics of Southern European cities, Palermo combines a compact urban form, a dense historic centre with cultural heritage, and vibrant urban life. However, these same features also give rise to significant complexities, such as touristification, resource exploitation, parking shortages, and congestion. The city's reliance on private vehicles and the lack of efficient public transport increase these challenges, making the case for transformative urban mobility strategies even more critical.

Despite these barriers, Palermo's urban and socio-cultural fabric also presents unique opportunities. The proximity of essential services, the presence of public spaces enabling social interaction, and strong community ties provide a foundation for promoting pedestrian-friendly environments. The diversity of urban contexts within the city, exemplified by the historic and multifunctional Orleans station area and the modern, residential Lazio station area, underscores the importance of tailored strategies. These contrasting areas demonstrate the need to address both spatial and socio-cultural barriers, highlighting the potential to apply lessons learned in Palermo to similar car-dependent cities across Southern Europe and beyond.

9.1 Key lessons and insights

This chapter aims to extract the key lessons learned from the spatial and socio-cultural analyses conducted in the catchment areas and the Old Town. These insights not only reveal the challenges of integrating the 15-minute city and TOD concepts into a Southern European context but also highlight the opportunities for creating a more pedestrian-friendly and sustainable urban environment by considering complex socio-cultural barriers in traditional societies.

Palermo's distinct characteristics, such as its dense historic core, socio-economic disparities, and car-dependent culture, presented a layered and multifaceted setting for analysis. The Old Town, rich in cultural heritage and architectural landmarks, embodies both the potential and challenges of reducing car dependency while preserving its identity. Meanwhile, the residential neighbourhoods surrounding Lazio station provided a contrasting environment, outstanding with spatial flexibility but limited infrastructure and amenities. Together, these areas illustrate the diverse urban dynamics that need to be addressed in achieving a walkable city.

On the other hand, the survey and socio-cultural aspect of the research helped to highlight the other side of the coin. As Jeff Speck mentioned in his book, *"The pedestrian is an extremely fragile species, the canary in the coal mine of urban liveability"* (Speck, 2012). Therefore, considering the emotions and preferences of pedestrians and pedestrian-to-be is important as providing a convenient built environment for walkability.

This chapter captures the practical lessons learned from these two analyses, exploring how theoretical frameworks translate into actionable strategies on the streets. It focuses on what worked, what did not, and why, while identifying transferable lessons for cities with similar challenges. By focusing on both the spatial and socio-cultural dimensions of mobility, the findings underline the importance of a comprehensive approach that prioritises not just physical changes but also behavioural and community-driven interventions.

9.1.1 Context-specific design solutions

One of the most significant takeaways from the spatial analysis is the importance of tailoring interventions to the unique characteristics of each area. In Orleans, the historic and multifunctional nature of the catchment area required solutions like shared streets and pedestrian-priority zones. Narrow streets, high-density land use, and landmarks such as the Royal Palace create both limitations and opportunities. Shared street designs emerge to respect the area's cultural heritage while enhancing pedestrian safety and accessibility. Functions like the University that create high pedestrian volume require attention to safety and comfort alongside the practicality of the infrastructure and street design.

In contrast, Lazio's residential character and modern urban layout allow for greater flexibility. Strategies such as woonerf-style streets, neighbourhood plazas, and integration of cycling and pedestrian networks are more feasible here. The area's wider streets provide the space needed for interventions like dedicated bike lanes, expanded sidewalks, and green public spaces, creating a sense of community while improving overall mobility.

There are numerous approaches to address physical barriers to walkability across diverse urban contexts, as discussed in the previous sections (see Section 6). The key to success is selecting the most appropriate and convenient solution for each specific challenge, especially tailored to the unique characteristics of the streetscape. A "one-size-fits-all" approach, however, is often a mistake for placemaking and could undermine efforts to enhance walkability. On the other hand, studies like this one aim to provide valuable guidelines for those seeking to improve walkability in their cities or neighbourhoods. These recommendations serve as a foundation, offering practical insights to help initiate this transformative journey.

9.1.2 Challenges in historic areas

Historic areas like Palermo's Old Town and Orleans catchment area exemplify the complexities of implementing walkability strategies within dense, culturally significant environments. These spaces are often constrained by narrow streets, high pedestrian traffic, and a need to preserve architectural and cultural heritage, which limits the variety for urban interventions. For instance, streets in the Old Town are frequently only 2–5 meters wide, leaving minimal room for the addition of separate pedestrian paths, bike lanes, or even basic green infrastructure.

This spatial limitation that makes walkability "uncomfortable" is getting even more complex by socio-cultural perceptions that reinforce car dependency. Informal interviews with locals often reveal a belief that there is not enough space to accommodate both pedestrians and vehicles. This perception not only affects public opinion on the appeal of walkability but also impacts governance, as policymakers face resistance when attempting to allocate more space to pedestrian infrastructure. Addressing these challenges requires innovative, context-sensitive designs, such as shared streets where pedestrians, cyclists, and vehicles coexist on the same surface. These designs rely on speed-limiting measures and shared-use principles to enhance safety without requiring extensive physical alterations that might compromise cultural heritage, as seen in the UNESCO area in the Old Town of Palermo.

High pedestrian traffic, driven by tourism and cultural landmarks like the Royal Palace, complicates matters further. Tourists and residents generate demand for accessible and safe pedestrian routes, yet the infrastructure is often inadequate to meet these demands. This creates a dynamic where the vibrancy of the area becomes a barrier to walkability, as overcrowding and safety concerns discourage pedestrian activity. Additionally, space invasion by parked cars, street vendors, and café seating worsens the issue, reducing the usability and accessibility of these spaces.

One of the key lessons from these historic areas is the importance of prioritising pedestrian safety and comfort. Vulnerable groups such as children, the elderly, and tourists navigating unfamiliar streets must feel secure and welcome. By introducing shared streets, raised crossings, improved signage, and tactile paving, cities can enhance accessibility while respecting the unique spatial and cultural character of historic districts. The role of government and enforcement is equally important to ensure these changes are maintained over time and with proper regulations. Otherwise, these efforts can be undermined by informal uses and a lack of public support. This approach is seen in many European cities, as explained in Chapter 4.

Moreover, walkability improvements in historic areas must strike a balance between preservation and modernisation. For instance, enhancing connectivity between landmarks and public transport nodes can reduce the need for car use, while integrating public art, greenery, and culturally relevant street furniture can enhance the sense of place. These interventions not only improve functionality but also reinforce the identity and vibrancy of historic areas, creating spaces that are both accessible and culturally enriching.

9.1.3 Importance of connectivity

The spatial analyses emphasised the importance of connectivity in improving walkability within urban areas. Establishing seamless links between key destinations, such as train stations, cultural landmarks, schools, and residential zones, emerged as a crucial strategy for creating a pedestrian-friendly urban environment. Connectivity not only makes movement easier but also encourages sustainable travel habits by reducing dependence on private vehicles.

In the Orleans catchment area, the focus is on improving connections between the train station and nearby pedestrianised streets, as well as city-level functions like the University. This involves identifying pathways that could better integrate the station with the historic centre and surrounding amenities. To achieve this, enhancements such as clearer signage, better lighting, and improved landscaping were identified as essential for making these routes both safe and appealing for pedestrians. These interventions are particularly important in a context characterised by narrow streets and high-density land use, where walkability is often challenged by spatial constraints.

On the other hand, in the Lazio catchment area, connectivity is approached differently, reflecting the residential nature of the area and its wider streetscape. Here, the priority is on linking residential neighbourhoods with transit nodes, schools, and local amenities through well-designed, walkable corridors, including small plazas that prioritise pedestrian safety. The strategy included introducing wayfinding systems, integrating cycling infrastructure, and creating safe crossings to support active travel modes. By focusing on these elements, the aim is to build a cohesive network that encourages multimodal mobility while fostering a sense of community and accessibility.

9.1.4 Addressing the "why": socio-cultural barriers

The Palermo case study highlights the critical need to address socio-cultural barriers to walkability alongside physical interventions and redesigning streets. While spatial changes like pedestrianised streets and improved infrastructure create the "how," they are only effective when accompanied by efforts to change mindsets and behaviours. Palermo's challenges in tackling deeply rooted car dependency, particularly the "self-fulfilling cycle of mobility", offer a valuable lesson for cities worldwide; infrastructure alone cannot succeed without public trust and behavioural change.

Cultural perceptions

A strong car-centric culture emerged, where walking was often considered secondary or even tertiary to driving. Also, most of the respondents demonstrated that public transport and other mobility options are 'not seen' by locals or are seen as 'inefficient' even though they are underutilised. These results must be examined attentively with the right sociological approach to make a shift in people's perspective on private cars and services provided by the authorities. Besides, actions should be taken to enhance the visibility of new interventions, making them more noticeable and encouraging greater public engagement.

Barriers to walking

Most respondents indicated a lack of connectivity between pedestrian infrastructure and public transport services, making walking an unattractive option. Additionally, they criticised the overall quality of existing infrastructure, highlighting that recent changes implemented over the past decade have not been sufficient to shift public perceptions on walkability. This suggests that significant improvements are still needed in how mobility is approached.

A key question that arises is: Why have these interventions fallen short? As emphasised repeatedly in this research, public engagement in the preliminary stages of planning is crucial, not only to ensure that projects align with local needs but also to gain public support. This is particularly important in cities like Palermo, where efforts like full pedestrianisation often face resistance from residents who are mostly reluctant to give up car usage. The current opinion among Palermo's residents is that pedestrian infrastructure remains poorly integrated with public transport, creating a major obstacle not only to the functionality of these spaces but also to the broader goal of encouraging a shift in travel behaviour.

Opportunities for Change

Opportunities for change lie in using effective communication and targeted interventions to bridge the gap between perception and reality. Although the Old Town benefits from a well-served bus and tram network and hosts many of the city's pedestrian areas due to its cultural significance, survey responses indicate that many residents still perceive these spaces as inaccessible and uncomfortable. There were many respondents, even those living in central neighbourhoods, who continued to prefer using their cars to access the Old Town. At the same time, widespread complaints about traffic congestion and parking shortages continue, with some individuals, despite acknowledging these issues, viewing pedestrian areas as a cause of vehicle congestion, as discussed in Chapter 8.

These contradictions suggest multiple underlying causes. Some residents may simply be unaware of existing pedestrian infrastructure and public transport options, while others may retain a strong cultural attachment to cars, seeing them as status symbols or prioritising their convenience despite the disadvantages. Additionally, the lack of sufficient interventions and policies to ensure a seamless and comfortable walking experience further reinforces car dependency.

This challenge presents a unique opportunity. By implementing visible, tangible improvements, while simultaneously launching public awareness campaigns to highlight these upgrades, policymakers can reshape public perceptions of walkability. Addressing the psychological attachment to cars requires redefining urban spaces and shifting cultural norms around transportation. Expanding car-free zones, enhancing pedestrian environments, and fostering a sense of social pride in active mobility while demonstrating that the cars are not the owners of public spaces can gradually decrease the prestige associated with car ownership.

9.1.5 Bringing spatial and socio-cultural lessons together

The Palermo case study highlights the close connection between spatial design and socio-cultural factors in improving walkability. Physical changes, such as pedestrian-only streets, shared streets, and enhanced streets, provide the infrastructure needed to support walking and active mobility. However, these interventions can only succeed when combined with strategies that address the social and cultural barriers to changing behaviours. Palermo illustrates the need for a dual approach: transforming both the built environment and the habits, perceptions, and attitudes of its users.

For example, the redesign of streets in Orleans and Lazio is suggested to be accompanied by initiatives to encourage a culture of walking. Public awareness campaigns, cultural events, and incentive programs enhance the impact of physical improvements by fostering a positive perception of walking, making it a more attractive and culturally valued mode of transport, especially for younger generations that are more open to change.

In Orleans, shared streets are introduced as policy recommendations, not just to improve the space but also to challenge the car-focused mindset. By showing that pedestrians and vehicles can share the space harmoniously, these interventions can help to build trust and acceptance for walkability initiatives. Similarly, in Lazio, the creation of neighbourhood plazas and green corridors can be supported by community engagement activities, promoting walking as both a practical and enjoyable mode of transport.

Another key takeaway from Palermo is the importance of prioritising vulnerable users, such as children, older people, and those with disabilities, in both spatial design and cultural strategies. Designing streets to be safe, accessible, and welcoming for these groups creates environments that encourage walking for everyone. For instance, features like tactile paving, audible signals, and clear wayfinding systems address physical barriers, while educational campaigns and community events promote a sense of inclusivity and belonging.

Connectivity stands out as a central theme across both the physical and social dimensions. In terms of design, it involves creating well-connected pedestrian networks that link key destinations, such as transit hubs, schools, and cultural landmarks. From a social perspective, it means building narratives and experiences that help people connect with their surroundings, creating a sense of pride and ownership in pedestrian spaces. By aligning these two aspects, Palermo can show how walkability can become a foundation of urban life, reducing car dependency, and improving overall liveability.

Consequently, the Palermo case demonstrates that walkability is not just a design challenge but a complex effort requiring collaboration across different disciplines, sectors, and communities. By integrating lessons from both spatial design and socio-cultural approaches, cities can create pedestrian-friendly environments that are not only functional but also vibrant, inclusive, and reflective of their unique identities.

CHAPTER 10

Final Considerations: Back to Theory from Practice

10. Final Considerations: Back to Theory from Practice

This final chapter serves as the culmination of the research, bringing together the spatial and socio-cultural analyses, theoretical frameworks, and empirical insights explored throughout the thesis. While the previous chapter focused on the case-specific dynamics of Palermo, offering targeted recommendations to improve pedestrian accessibility and reduce car dependency, this concluding section adopts a broader lens. It synthesises the key findings to address the overarching research questions and positions them within the wider discourse on sustainable urban mobility. By consolidating both theoretical and practical dimensions, the chapter aims to translate the study's insights into a coherent set of reflections and policy considerations that extend beyond the local context, offering value for similarly challenged urban environments.

The chapter is structured into five parts to systematically guide the reader through the broader implications of the study:

The first section explores the socio-cultural and psychological determinants of travel behaviour, investigating why individuals choose to walk or to rely on private vehicles. By uncovering these underlying dynamics, it becomes possible to identify strategic policy interventions capable of addressing deeper cultural and social barriers to walkability.

The second section discusses spatial and infrastructural strategies, focusing on how urban design improvements and pedestrian-oriented interventions can create cities that are not only more walkable but also more attractive, equitable, and functional. This section broadens the scope of the analysis beyond the Palermo case study to suggest generalizable planning approaches.

The third section critically reflects on the application of the 15-minute city and TOD concepts, with a particular emphasis on the 15-minute city. Given its novelty and the relatively limited number of real-world applications to date, this critique highlights the complexities and challenges of adapting these frameworks to Southern European contexts characterised by entrenched car dependency and historic urban morphologies.

The fourth section synthesises the key findings of the research, explicitly answering the research questions and situating the results within the broader academic discourse on sustainable urban mobility and walkability.

Finally, the fifth section discusses the study's limitations and outlines future research directions, emphasising the areas where further investigation is necessary to refine and expand upon the insights generated by this work.

Through this structure, the conclusion aims to offer a coherent and comprehensive reflection on the study's contribution, originality, practical implications, and avenues for further development.

10.1 Exploring the social and cultural barriers to walkability in a car-dependent urban context

This research examines the socio-cultural dimensions of mobility by addressing two central questions: "What are the cultural barriers and drivers of walkability?" and "How can these barriers be overcome to enable a mobility transition?" To explore these questions, a comprehensive review of behavioural change theories was conducted, based particularly on the work of Davis et al. (2015). This foundational study identifies and categorises leading theories in behavioural change, highlighting their relevance to public health interventions such as physical activity.

Among the theories, the Transtheoretical Model of Change is the most cited (33% of reviewed articles), followed by the Theory of Planned Behaviour (13%), Social Cognitive Theory (11%), and the Information-Motivation-Behavioural Skills Model (7%). These theories provide a structured framework for understanding the mechanisms influencing individual and collective behaviour, offering valuable insights into designing strategies to address socio-cultural barriers to walkability.

For this research, specific attention has been given to the Theory of Planned Behaviour (Ajzen, 1991, 2002), Theory of Unreasoned Behaviours (Triandis, 1980), Environmental Psychology (Stokols, 1977), Social Practice Theory (Bourdieu, 1977), and Social Learning and Cognitive Theory (Bandura, 1972; 1977; 1986). These theories provide a strong framework for understanding and addressing the socio-cultural factors influencing mobility choices.

Among these theories, the Theory of Planned Behaviours (TPB) has been studied as the first one in this research, assuming that people make their choices mostly consciously. TPB suggests that individuals' intentions to perform a specific behaviour are influenced by several key factors:

- Attitude: An individual's positive or negative evaluation of the behaviour.
- Subjective Norms: The perceived social pressure to perform or not perform the behaviour.
- Social Norms: The customary codes of behaviour in a group or people or a larger cultural context. Social norms are the accepted or typical behaviours within a particular group of people.
- Behavioural Intention: The motivational factors that influence a given behaviour, where the stronger the intention to perform the behaviour, the more likely the behaviour will be performed.
- Perceived Behavioural Control: An individual's belief in their ability to perform the behaviour.

Regarding the key factors of TPB given above, cultural barriers and drivers of walkability could come from the social and subjective norms related to car use and ownership. Owning/using a car could be seen as a social status in many societies. Social norms significantly influence an individual's decision to travel by car by shaping their understanding of what is considered acceptable or expected behaviour within their society or group. The stronger the belief that owning and using a car is normal, the higher the possibility of an individual choosing to travel by car.

Additionally, social pressure from someone's social circle can strengthen these norms, making car travel appear more desirable or necessary compared to active modes such as walking (Soza-Parra & Oded Cats, 2023). In the same study, the 5 most prevalent subjective factors influencing car choice were given as instrumental motives and autonomy (82%) related to personal freedom and convenience, affective dimension (38%) related to emotional factors such as excitement and pleasure, status symbol (59%) regarding the social status and prestige, social norms (30%) considering the influence of social expectations and cultural norms, environmental concerns (41%) reflecting car purchase decision concerning emissions.

Social norms, both what is commonly done (descriptive) and what is socially approved or disapproved (injunctive), significantly influence people's car-related choices. These norms reflect societal beliefs and expectations (Keizer & Schultz, 2018). Overall, the more individuals believe that car ownership and use are normative, the higher the chance of them engaging in these behaviours. (Barker, 2014; Belgiawan et al., 2017; Donald et al., 2014; Heinonen et al., 2021; Paijmans & Pojani, 2021; Steg, 2005; Steg et al., 2001).

In their study, Soza-Parra & Oded Cats (2023) mention many different statements regarding varied factors affecting the mobility choices. Social norm-related statements mostly are “my family/friends think I should commute by car,” “getting your car is part of growing up,” and “cars are a part of modern life.” Some studies also have mentioned statements related to status symbol dimension, such as “my colleagues would think it is peculiar not to commute by car.”

In some cases, preferring not to own a car/living without a car is considered enough to be an outsider (Heinonen et al., 2021). Because most of the time, those living a car-free lifestyle are associated with not having the money to afford it and deprivation (Heinonen et al., 2021; Paijmans & Pojani, 2021). Besides, Steg (2005) suggests that ideas such as “a car provides status and prestige”, “my car shows who and what I am”, and “you can know a person by looking at his or her car” create motivations for car use. Also, Thøgersen et al. (2021) emphasise that positive attitudes towards car use, including instrumental motives, emotional attachment, and symbolic value, reinforce the influence of social norms. This interplay between social norms and positive attitudes strengthens the appeal of car ownership and usage.

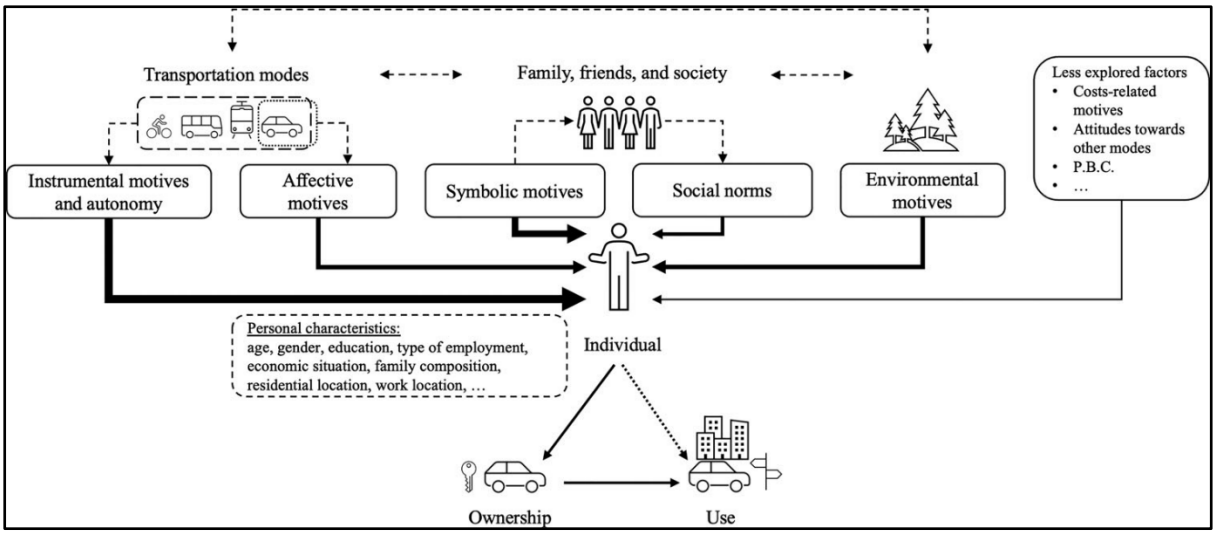


Figure 133. Factors/motives affecting car use.
Source: Soza-Parra & Oded Cats, 2023.

Eventually, the statements and motives regarding car use mentioned above could be the cultural barriers towards walkability in car-dependent societies because walking and using active modes are not seen as acceptable as using cars in car-dependent societies. According to informal interviews with people from Palermo during this research shows that suggesting walking or using public transport instead of private cars is met with opposition, and these reactions are supported by assumptions and social norms. Those assumptions, such as "Palermo is not a walkable city," "having a car instead of walking is always more comfortable and flexible in Palermo", are common ideas shared by locals.

Moreover, social norms can create pressure on individuals' mobility choices. This influence can be both positive and negative. For instance, if someone's social circle prioritises environmental sustainability, it can encourage pro-environmental behaviours (Thøgersen et al., 2021), such as preferring environment-friendly cars and even choosing walking, cycling over car use. On the other hand, a social circle that values car ownership and use can create pressure to prioritise car-based mobility. For instance, informal interviews with Palermo residents revealed an interesting paradox: while they often choose cars for short trips, especially at night, they are more likely to walk similar distances in other cities like Turin, known for its walkability. This suggests that social norms and cultural expectations play a significant role in shaping mobility choices. Turin, as a student-friendly city, fosters a culture of walking and public transport use, particularly among young people who may be more environmentally conscious and less likely to own cars. This highlights how societal norms can influence individual behaviour, even for individuals who may have similar preferences in different contexts.

Interestingly, survey results from this research revealed another contradiction. While some respondents in Palermo expressed support for pedestrian areas and their extension, they also acknowledged the potential inconvenience to vehicular traffic. This highlights the complex interplay between individual preferences and societal norms in shaping urban mobility choices.

Regarding the second research question related to behavioural change, perceived behavioural control, among other factors affecting the planned behaviour, is a crucial concept that comes from Bandura's self-efficacy theory (Bandura, 1977). He distinguishes between two diverse types of goal-related expectations: self-efficacy and outcome expectancy. Self-efficacy means that a person believes that he or she has the capacity and competence to perform a behaviour. Outcome expectancy here means a person's estimation that a given behaviour will lead to a certain outcome or will create a change. In this theory, self-efficacy theory is put as the most important precondition for behavioural change because it is the key to the initiation of coping behaviour.

With respect to this research, TPB suggests that behavioural change in mobility can be effectively promoted by the following two key factors:

- If a person believes that he/she can successfully perform a given behaviour (in this case, it is preferring active mobility types such as walking instead of car use at appropriate times and distances).
- If a person thinks that a given behaviour will lead to a certain outcome (in this case, it could be a multitude of benefits, such as improved health, reduced environmental impact, economic advantages, and traffic congestion mitigation).

Another theory used to figure out what the cultural barrier to walkability could be is Bourdieu's Social Practice approach from Theory of Practice (1977). Practice Theory is a group of social science approaches that emphasise people's actions and behaviours, rather than their internal thoughts and mental processes. In his book, Pierre Bourdieu offers a framework for understanding how cultural contexts shape and reproduce themselves, as well as how this process influences individuals within a specific 'habitus.'

The concepts of habitus, doxa, and field are explored in depth in the second chapter of this research. At its core, habitus, as explained by Bourdieu, refers to the ingrained tendencies that shape how individuals act, perceive, and think in specific ways. These tendencies are not innate but are instead formed through an individual's lived experiences and cultural engagement within society (Gutiérrez, 2005, p. 68). As a social product, habitus reflects the influence of one's surroundings, including family, peers, and broader cultural norms. It operates on both individual and societal levels, influencing behaviours, values, and worldviews. This concept encapsulates the social position we occupy, the norms and expectations tied to that position. Furthermore, habitus comprises tacit, unconscious knowledge that emerges collectively within societies sharing similar conditions of existence (Bourdieu, 2011; Rodríguez Holguín & Lozano, 2023).

The Social Practice approach builds on this understanding, suggesting that individuals internalise an unspoken sense of what is culturally acceptable and unacceptable. This sociocultural knowledge is deeply embedded in everyday life and often operates beneath conscious awareness. When applied to the scope of this research, Bourdieu's concept of habitus provides a lens to identify and analyse cultural barriers to walkability in car-dependent urban environments.

One prominent barrier is the common belief in cities like Palermo that car ownership is essential for mobility. This shared cultural understanding, deeply rooted in societal norms and shaped by generations of experiences, remains widespread despite recent improvements in urban infrastructure and pedestrian accessibility. Beyond its practical utility, car ownership in Palermo is also tied to social status. Cars are often viewed as symbols of success and independence, further reinforcing car dependency. This association of vehicles with prestige perpetuates a cultural environment where reliance on private cars remains dominant and alternatives like walking or public transport are undervalued.

Another significant cultural barrier is the perception of Palermo as an inconvenient city for walking. This belief, grounded in past experiences of inadequate pedestrian infrastructure and urban design, has become part of the collective unconscious. Even in areas where pedestrian infrastructure has been significantly improved, such as the Old Town, this perception persists and may prevent residents from fully embracing active mobility. The findings discussed in the previous chapter support this point, showing that individuals who regularly use pedestrian areas in the Old Town tend to have a more positive perception of walkability compared to those who rarely visit these areas. This contrast suggests a lack of awareness or familiarity among occasional users, further highlighting the importance of addressing these cultural norms.

These deeply embedded cultural norms, which are parts of habitus, act as significant barriers to transitioning toward a more pedestrian-friendly urban culture. Therefore, challenging these norms is essential to encourage a shift in attitudes and behaviours, fostering a culture that prioritises active mobility and sustainable alternatives.

To address the second research question, the integration of social practice theory, social mobilisation, social learning, and cognitive theories offers a comprehensive framework for overcoming these cultural barriers. Since negative attitudes toward walkability and pedestrianisation are closely tied to entrenched car-dependent behaviours, achieving behavioural change is a critical step in promoting walkability and increasing the visibility and importance of pedestrian spaces.

Social learning theory and social cognitive theory (Bandura, 1972; 1977; 1986) provide valuable insights into this process. According to these theories, behaviour is influenced by a combination of external and internal factors. In the context of mobility, individuals are more likely to adopt walking as a mode of transport if they observe positive role models engaging in this behaviour (observational learning), have the necessary skills and knowledge to incorporate walking into their routines (behavioural capacity), and feel confident in their ability to walk (self-efficacy). These factors highlight the importance of visible role models, public awareness campaigns, and the dissemination of practical knowledge about the benefits of walking.

To effectively promote this behavioural change and encourage a modal shift in mobility, local administrators and planners must consider both the physical and social environments that influence travel behaviour. Infrastructure improvements, such as creating safe and comfortable pedestrian spaces, must be complemented by strategies that address cultural and psychological barriers. Engaging communities in the planning process, fostering a sense of collective ownership over public spaces, and challenging ingrained perceptions of cars as status symbols are all critical steps toward achieving a more walkable and sustainable urban future.

To summarise the initial steps for a behavioural shift in mobility, as suggested by these theories, three key elements must be considered in any social and cultural context.

- Knowledge: Individuals must understand what behaviours need to change, why those changes are important, and how to implement them.
- Enabling Environment: Individuals need access to the necessary resources, tools, and infrastructure to support their desired behavioural changes.
- Motivation: Individuals must be motivated to change their behaviour. This can be influenced by personal beliefs, social norms, and external incentives.



Figure 134. Elements of behavioural change according to social mobilisation.

Source: International Federation of Red Cross and Red Crescent Societies, 2024.

10.2 Creating walkable urban environments

Walking, a simple yet powerful activity, has been overlooked in modern society with the increasing pace of life and the convenience of modern technology that brings people together faster. The devastating results of decreased walkability and increased car-dependency in cities (Banister, 2008) have already been discussed in the previous chapters. As a result of these consequences, in the last decades, numerous studies have explored strategies to enhance walkability and reduce car dependency in urban environments (see Chapter 2).

These strategies have gained significant public support, as increasing numbers of people prioritise environmental concerns and sustainable transportation. A 2004 European Commission report found that a significant portion of European citizens believe that improving public transport and creating more pedestrian areas are the most effective ways to address traffic-related environmental problems. This shift in public opinion reflects a growing awareness of the negative impacts of car-centric urban planning on both the environment and quality of life.

Necessary interventions for a transition to sustainable mobility in every city require tailored solutions. While some cities with adequate space can prioritise pedestrians, cyclists, and public transport without significantly affecting car traffic, others, especially those with congested roads, must find ways to reallocate road space and reduce road capacity for vehicle traffic.

However, implementing such changes requires bold decisions and effective public engagement to address concerns about potential traffic disruptions and economic impacts. As explained in detail in Chapter 4, cities like Copenhagen, Ghent and many others demonstrate that prioritising sustainable transportation can lead to significant benefits for urban environments. Based on worldwide examples, this section will explore the possible spatial strategies and solutions to increase walkability and decrease car dependency in cities.

Reflecting on decades of research and experience in pedestrian-oriented planning (e.g., Jacobs, 1961; Gehl, 2010; Speck, 2013; Matan and Newman, 2016; Moreno et al., 2021), several key principles consistently emerge as essential for creating walkable environments regardless of context. These principles can be grouped as safety, accessibility, comfort, land use and connectivity. These principles serve as a guiding framework for all actions and policies to be implemented, adapting to various contexts while remaining central to the success of their application.

To provide these factors, there are distinctive design guidelines for different pedestrian-friendly urban spaces. To create safe and pleasant walking environments, the differences among urban streets must be considered during the design and decision-making phases. Based on literature studies and analysis, the streets are grouped in 3 classes based on their spatial enhancement for pedestrian accessibility and walkability in this research.

The classification constitutes pedestrian-only streets, pedestrian-prioritised streets, and enhanced streets.

- Pedestrian-only streets are fully pedestrianised, like Via Maqueda in Palermo, where vehicle traffic is restricted. These streets are designed to provide comfort and safety to pedestrians with an enhanced experience, and in some examples, may host other active mobility users such as cyclists.

- Pedestrian-prioritised streets are streets that have extremely low traffic volumes and speed limits in residential areas. These streets accommodate different users but still prioritise the experience of pedestrians by securing their safety among other users. Woonerfs originated in the Netherlands, and living streets could be an example of this type of street (van Veen & Steinberg, 2021).
- Lastly, enhanced streets are conventional streets with moderate to high traffic volumes, where pedestrians share the space with vehicles, but still, the design interventions, such as traffic calming measures, are utilised to improve the pedestrian experience. The streets such as 'Corso Re Ruggero and 'Viale Lazio' within catchment areas could be examples for enhanced streets.

The following sections outline the proposed design guidelines and corresponding actions for these three street categories, based on universal examples of pedestrian areas, established design principles, and key insights from literature on pedestrian streets.

10.2.1 Pedestrian-only streets

Pedestrian-only streets are designed to create lively and welcoming spaces for people to walk and enjoy. These streets are often found in areas with high foot traffic and commercial activity, such as historic city centres or shopping districts. By removing vehicles, they encourage walking, cycling, and other non-motorised forms of transport. A well-planned pedestrian-only street offers a range of experiences, from shopping and dining to strolling or simply watching the environment. These streets can revitalise urban areas, support local businesses, and improve quality of life. Their design prioritises comfort, accessibility, and inclusivity for pedestrians and, in some cases, other active travellers.

The success of pedestrian-only streets depends on several factors, including their connectivity, practicality, comfort, safety, accessibility, aesthetics, and how well they fit within the local context. If these elements are ignored, these streets risk becoming unused or disconnected spaces, often seen as failed urban projects.

The first step in creating a pedestrian-only street is choosing the right location. This requires careful consideration of the area's context, activity levels, and existing urban patterns. Streets with low pedestrian activity are typically unsuitable, as they may feel unsafe or uninviting once cars are removed. Instead, pedestrian-only streets work best in high-density, mixed-use areas that naturally attract people, such as busy shopping streets, transit hubs, or city centres.

For instance, streets close to major transit hubs can improve the experience of public transport users by providing seamless connections between walking and other modes of travel. In residential neighbourhoods, pedestrianisation can transform streets into lively, community-focused spaces, encouraging social interaction and leisure activities. These areas prioritise the well-being of residents while offering opportunities for community events and placemaking projects.

In commercial or cultural districts, pedestrianisation can significantly enhance walkability, benefiting local businesses and improving air quality while creating more enjoyable public spaces. A notable example is Via Maqueda in Palermo's Old Town, where pedestrianisation has transformed the street into a vibrant, accessible area that highlights the district's cultural and historical charm.

Another key factor in the success of pedestrian-only streets is how well they connect to the surrounding urban environment. These streets should be linked to public transport, cycling infrastructure, and pedestrian networks to make them easy to access and use. Good connections to public transport are especially important, as they allow people travelling longer distances to easily reach these walkable areas. This integration encourages sustainable travel, making walking and cycling more appealing options.

It is also important to connect pedestrian-only streets to nearby shops, cafes, cultural landmarks, and community facilities. These connections make the street a destination rather than just a route, encouraging people to linger, socialise, and interact with their surroundings. Without these links, pedestrian-only streets risk feeling empty or isolated, which can lead to safety concerns.

Integrating pedestrian streets with other walkable areas, plazas, and green spaces creates a sense of flow and cohesion within the city. This can be achieved through multiple access points, ensuring easy navigation and preventing the feeling of isolation. Such permeability is important for functional reasons, such as access for delivery vehicles and emergency services, but also for ensuring inclusivity and welcoming design for all users.

In terms of overall planning, pedestrian-only streets should be designed to fit within the city's broader layout, linking to key routes and forming uninterrupted walking paths. When properly connected, these streets contribute to a city's overall flow, supporting walkability and creating lively, dynamic spaces.

Safety and functionality are essential in making pedestrian-only streets work for everyone. These spaces should always feel safe, with clear, well-maintained paths and crossings that are easy to use. Uneven surfaces, obstacles, or disconnected pavements can discourage walking and cause challenges for vulnerable groups, such as wheelchair users, the elderly, or children. Good lighting is also important for visibility and security, while accessible ramps and slopes make the space more inclusive.

Beyond safety, pedestrian streets should serve multiple purposes to remain vibrant and successful over time. Multipurpose spaces meet a variety of needs, helping create lively and attractive areas. Thoughtful design can also foster a sense of place, with features like benches and seating areas encouraging people to rest and connect with others (Deakin, Mitchell, Vreeker, & Nijkamp, 2007, p. 365; Yücel, 2013). These features make pedestrian areas more welcoming, especially for families, older adults, and other vulnerable groups.

Street furniture should be carefully placed and designed so it enhances the space rather than creating obstacles. Shaded seating, as well as good lighting, can make the area more comfortable and usable at all times of the day. Together, these elements transform pedestrian streets from simple pathways into lively urban spaces that attract foot traffic, encourage community connections, and support a variety of activities. By focusing on both safety and usability, pedestrian streets can become thriving, inclusive parts of the city.

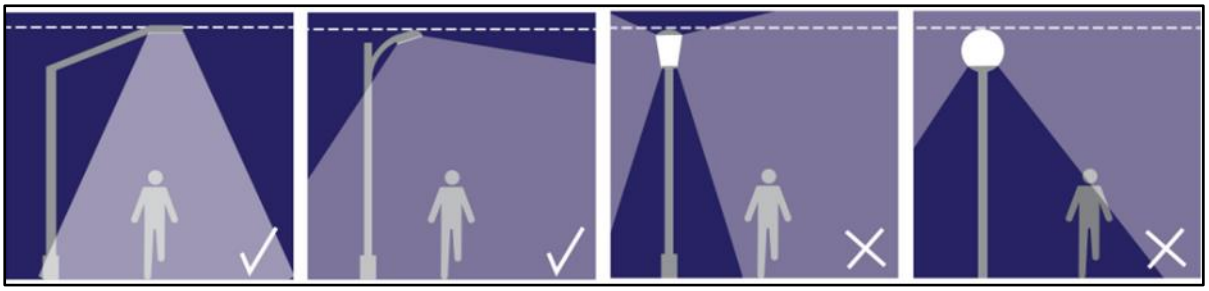


Figure 135. Street lighting fixtures for better lighting.
Source: Global Street Design Guide Initiatives, 2022.

Regarding street furniture, benches and other seating elements should be designed for comfort and usability, with features like armrests and back support to assist users, especially the elderly. Moveable chairs offer flexibility in arrangement, while benches should be strategically placed near amenities and allow space for wheelchair access to accommodate all users. Waste bins should be identifiable to encourage proper waste disposal and minimise littering. Signage elements, as another example, play a crucial role in providing information, directions, and safety by increasing site navigation. They should be visible with an appropriate and readable design.



Figure 136. Different street seating furniture for diverse urban contexts.
Source: Broxap Street Furniture, n.d.



Figure 137. Pedestrian-only Street, Milan (IT).
Source: The Wonder of Wandering - Simcha, 2024.

Lastly, to create truly engaging and enjoyable pedestrian experiences, the design of building facades and street edges must prioritise visual interest, human scale, and aesthetic appeal. This involves not only the architectural articulation of façades but also the integration of a rich variety of elements, such as varied building heights, elaborated architectural details, active frontages, thoughtfully curated signage, and strategically placed greenery or street furniture. Such interventions help animate the street and create layers of visual complexity that break uniformity and foster a more intimate urban experience. These strategies significantly reduce the monotony in urban streetscapes, creating a dynamic and stimulating atmosphere that appeals to people. As a result, walking distances are perceived as shorter and less boring, transforming pedestrian movement into a pleasurable activity that invites lingering, exploration, and deeper engagement with the urban fabric.

Table 33. Design Principles for pedestrian-only streets.

Street-level design principles	
Connectivity and Integration	To ensure their success, pedestrian-only areas must be thoughtfully integrated into the broader urban fabric. Direct links with pedestrian networks: Pedestrian-only streets should be part of a comprehensive network with links to plazas, parks, and other pedestrianised areas. These connections invite more people to use the space and encourage exploration. A well-organised mobility plan should guide these links, focusing on pedestrian flow and accessibility to make the network easy and logical to navigate. Integration with cycling: While pedestrian-only areas focus on walking, their proximity to cycling networks enhances multimodal travel options. Cycling routes intersecting pedestrian-only areas should include bike parking zones and pathways to ensure smooth transitions between walking and cycling. Integration with transit hubs and key destinations: Proximity to transit hubs, such as train stations or bus stops, increases the functionality of pedestrian-only streets by improving access for users coming from longer distances. These streets should serve as welcoming pathways to key destinations like cultural landmarks, schools, and commercial centres, encouraging foot traffic and reducing car dependency. Continuous pathways: A fragmented pedestrian network can reduce walkability. Pedestrian-only streets should fill critical gaps, bridging disconnected pathways and enhancing network cohesion. Special attention should be given to overcoming physical barriers such as wide roadways or underutilised spaces. Where necessary, pedestrian bridges or underpasses can provide safe and accessible crossings, especially in areas with high traffic volumes.
Limiting vehicle-access	Emergency vehicle access: Clear and unobstructed paths must be preserved to ensure emergency vehicles can use the area when needed. Design considerations should include wider entry points and strategically placed removable barriers that allow emergency access without compromising pedestrian safety. Parking and traffic restrictions: Vehicular traffic should be limited within pedestrian-only zones, with comprehensive enforcement to prevent unauthorised vehicles. Parking should be entirely prohibited to maintain an uninterrupted pedestrian flow, creating a safer and more inviting environment for users.

	Loading and service access: To accommodate essential activities like deliveries and waste collection, access for service vehicles should be limited to designated hours, typically early mornings or late evenings, when pedestrian traffic is minimal. Marked loading zones and time-restricted access points can help control these operations without disrupting the pedestrian experience.
Clear paths	Eliminating invasions of space: The invasion of public space by cafes, bars, and shops through outdoor seating, displays, or advertising boards must be managed carefully to avoid disrupting pedestrian flow. While outdoor seating and vibrant commercial activities contribute to the street's atmosphere, these elements should be allocated to designated zones that do not interfere with the primary walking path. A balance between active frontage and pedestrian mobility can be achieved by setting clear spatial guidelines and enforcement mechanisms for businesses. Removing obstacles: Pedestrian-only streets should be free of random or poorly placed obstacles, such as bins, recycling containers, or utility poles, which can decrease movement and create accessibility challenges for users with disabilities. Waste bins should be positioned in specified areas, designed for easy use while maintaining the street's aesthetic and functionality. Regular maintenance is necessary to prevent disorganisation and ensure these elements do not sprawl into the walking space. Designated clear pathways: A clear and uninterrupted pedestrian path should be designed through the street, marked by paving patterns or other design elements to separate it from seating, greenery, or other features. While curved paths can add visual appeal, they should still be easy to navigate and accessible for everyone, including people using mobility aids.
Street Lighting	In pedestrian-only streets, lighting plays a crucial role in creating a safe, welcoming, and practical environment for users, particularly during the evening and nighttime. Since these streets are often located in areas with high pedestrian activity, such as commercial districts or historic centres, lighting must focus on three key aspects: visibility, safety, and aesthetic appeal. Pedestrian-scale lighting, typically installed at heights ranging from 3 to 4.5 metres, provides targeted illumination for foot traffic while minimising glare and reducing light pollution. Well-lit pathways and plazas significantly enhance the sense of security, particularly in high-traffic areas like marketplaces or near transit hubs. For narrow streets, a single row of lighting may suffice, whereas wider spaces require multiple rows to ensure even coverage (Global Street Design Guide Initiatives, 2022). Accent lighting can add an extra layer of visual interest to pedestrian-only streets. For instance, façade lighting on heritage buildings or ambient light spilling from shop windows can enhance the area’s aesthetic appeal.

	In-ground LED lighting or illuminated paving at key intersections and crossings can improve navigation, subtly guiding pedestrians while maintaining the openness and unobstructed feel of the space. Seasonal or decorative lighting is another valuable addition, as it can create a lively atmosphere during festivals or special events, making these streets more engaging and versatile. Innovative technologies, such as kinetic energy-powered lighting, offer an exciting opportunity to merge functionality with sustainability. Pressure-sensitive tiles embedded in sidewalks can generate energy from pedestrians' steps, which can then be stored to power nearby lighting. This not only encourages walking but also raises awareness of renewable energy and promotes environmentally conscious behaviours among users.
Street Furniture	Seating for Rest and Social Interaction: Providing fixed or modular benches at regular intervals, such as every 50–100 metres, can offer convenient resting points for pedestrians. Placing seating near shaded areas, greenery, or public art installations may encourage people to linger and engage in social interactions, creating a more welcoming and comfortable environment. Tables for Outdoor Activities: Adding public tables for activities like outdoor dining, chess games, or small gatherings can help foster a sense of community and provide opportunities for leisure and social interaction. Trash Bins: Positioning waste and recycling bins near seating areas and at the entrances and exits of pedestrian streets can support cleanliness and sustainability. Regular maintenance to ensure the bins are accessible and emptied frequently can further enhance the user experience. Drinking Fountains: Installing drinking fountains at key locations, such as playgrounds, plazas, or high-traffic areas, could be a practical addition. Including lower spouts for children and wheelchair users would make the fountains more inclusive and accessible for all. Customised Street Furniture: Using furniture designs that reflect the area's cultural identity or history, such as incorporating local motifs or materials like stone or wrought iron, can contribute to the unique character of the street and enhance its visual appeal. Bike Racks: Providing secure bike parking facilities at the entrances or in nearby areas could encourage cycling while preserving the car-free nature of the pedestrian street. Canopies and Umbrellas: Incorporating fixed or movable shading structures, such as canopies or umbrellas, over seating or gathering areas may offer weather protection, increasing the usability of these spaces throughout the year.

Multifunctionality	Creating vibrant and engaging pedestrian-only streets often depends on a well-balanced mix of businesses and activities. Retail shops, cafes, restaurants, and cultural venues can contribute to a dynamic atmosphere, ensuring steady pedestrian activity throughout the day. By integrating commercial and cultural elements, these streets become attractive to a wide variety of users, enhancing their overall appeal. Event Spaces and Pop-Up Markets: Flexible zones designed for community events, farmers' markets, or seasonal fairs can add a sense of vibrancy and adaptability to the street. These spaces might be temporary, marked out with movable partitions, or permanent, equipped with practical features such as power outlets and water supply to accommodate vendors and organisers. Outdoor Dining Areas: Sections of the street could be dedicated to outdoor dining, where cafes and restaurants provide *'al fresco'* options. A consistent use of furniture and shading structures could help create a cohesive and visually organised space, adding to the street's charm while supporting local businesses. Art Installations and Performances: Designated areas or platforms for street performers and temporary art installations could encourage cultural expression and bring unique, engaging experiences to residents and visitors alike. These elements would not only make the street livelier but also celebrate local creativity. Recreational Features: Incorporating recreational elements, such as small play structures or interactive water features, could make the street more family-friendly. Seating placed nearby would provide comfortable spots for caregivers, enhancing the usability of these areas for families. Plazas and Community Spaces: Central plazas or gathering spaces featuring benches, trees, and drinking fountains could serve as welcoming hubs for social interaction and relaxation. These areas would provide people with opportunities to rest, meet others, or simply enjoy the atmosphere of the street. Based on the flexibility of design, these places could be used by different social groups for diverse activities. Seasonal Decorations and Themes: Introducing decorative features, such as lighting, banners, or thematic elements, could transform the street during festivals or holidays. These seasonal touches would ensure the space remains vibrant and appealing throughout the year.
Green Infrastructure and Greenery	Green Infrastructure Actions Linear Green Corridors: Tree-lined walkways along the length of pedestrian streets can provide shade and improve air quality, making the environment more comfortable and healthier for users. Selecting native tree species with deep root systems is particularly beneficial, as these species are well-adapted to the local environment and less likely to cause pavement damage over time, which creates a serious inconvenience for any kind of mobility.

	Rain Gardens and Bioswales: Adding bioswales to the edges of streets can help to manage stormwater by improving drainage and reducing the risk of flooding. These features also bring greenery into the space, making it look more attractive. At the same time, they can act as natural buffers between pedestrian areas and other zones, like bike lanes or roads, creating a safer and more pleasant environment. Green Roofs on Street Furniture: Integrating greenery into street furniture, like kiosks and bus shelters, is another way to add green spaces in urban areas where space is limited. Using green roofs can make the street feel more vibrant while also helping to clean the air and reduce heat. The effectiveness and cost-efficiency of green roofs and similar interventions depend on the specific context and the requirements of the area. Permeable Pavements: Replacing traditional pavement materials with permeable options can allow rainwater to filter through the surface, reducing urban flooding while supporting natural water cycles. These pavements contribute to healthier urban ecosystems and complement other green infrastructure efforts. Greenery Actions Pocket Gardens: Transforming underutilised spaces into small gardens can create opportunities for rest and social interaction. These pocket gardens with a mix of plant species can add charm and biodiversity to pedestrian streets while offering inviting spots to pause and relax. Seasonal Planting: Introducing planters with seasonal flowers and shrubs can bring colour and vibrancy to the streetscape throughout the year. Climbing Plants and Vertical Gardens: Installing green walls on nearby building facades can soften the hard edges of urban environments. Climbing plants like ivy or other suitable species can reduce heat absorption, improve air quality, and create a more inviting atmosphere for pedestrians. Public Art with Green Features: Combining greenery with public art can create unique focal points that draw attention and add cultural value to pedestrian streets. Examples include moss graffiti or sculptures integrated with vegetation, blending nature and creativity to enhance the overall experience of the space.

10.2.2 Pedestrian-prioritised streets

Pedestrian-prioritised streets are designed to put pedestrians' safety and comfort first, making vehicles a secondary consideration. These streets are shared spaces, usually with low traffic levels and speed limits, and often lack formal traffic controls or marked lanes and signs. Key features of pedestrian-prioritised streets include shared spaces where pedestrians and vehicles coexist without much physical separation, slow traffic to reduce the risk of accidents, clear wayfinding elements such as guidance paving and navigation aids, and street furniture like seating and other amenities that create inviting and inclusive environments for pedestrians.

Often called Woonerfs, living streets, or neighbourhood streets, pedestrian-prioritised streets can vary in design depending on their context, such as residential or commercial areas. However, they all share the fundamental principle of prioritising pedestrians and other active mobility users over vehicles. These streets are typically characterised by low traffic volumes and designs that prioritise pedestrian safety and comfort while still accommodating other forms of movement.

In residential neighbourhoods, particularly those with families, children, and elderly residents, these streets provide safer spaces for walking and encourage social interaction among neighbours. In commercial areas with a lot of foot traffic, pedestrian-prioritised streets are often used to create a balance between accessibility and safety, while keeping vehicle traffic to a minimum.



Figure 138. An example design for residential shared streets.
Source: National Association of City Transportation Officials, 2013.



Figure 139. An example of design for commercial shared streets.
Source: National Association of City Transportation Officials, 2013.

Beyond safety and comfort, these streets emphasise placemaking and a sense of community, transforming everyday pathways into vibrant, welcoming environments that encourage social cohesion and enhance the quality of urban life.



Figure 140. A typical Dutch Woonerf.
Source: McBeath, C. (2009). Home Zones: Shared Streets in Halifax (master's thesis). Dalhousie University.

Based on the features mentioned above, there are design principles that are commonly found in pedestrian-prioritised streets. At their core, these streets use a shared-space concept, where pedestrians, cyclists, and vehicles share the same area without rigid separations. The absence of kerbs or physical barriers allows smooth movement and encourages users to interact with greater awareness and respect. Instead of traditional traffic controls like stop signs or signals, these streets use design elements such as textured paving and narrower road widths to guide behaviour. Materials like cobblestones, bricks, or patterned surfaces emphasise the shared nature of the space, reminding drivers to slow down and prioritise pedestrian safety.

A defining feature of these streets is low-speed limits, typically set at 20–30 km/h or less, to create a safe and comfortable environment where children can play or move around freely. Speed-reducing measures, such as speed bumps, raised intersections, and chicanes, are commonly used but can sometimes create challenges for other users. Alternatives like narrowing entry points or using distinct paving textures for pedestrian areas are often better suited to shared streets. Temporary solutions, such as traffic-calming measures or tactical urbanism projects, can help guide behaviour until users become used to the shared-space concept.

To make these streets vibrant and welcoming, elements such as benches, planters, and bike racks can be included. When placed near shaded areas, playgrounds, or small plazas, these features encourage people to pause, interact, and enjoy the space. Green elements like trees, vertical gardens, and planters not only improve the aesthetic but also provide shade and comfort, particularly during hot or rainy weather.

Accessibility is another critical factor in pedestrian-prioritised streets. As with pedestrian-only streets, accessibility here means ensuring the space is inclusive, functional, and welcoming for everyone, regardless of age or physical ability. These spaces are designed with universal accessibility in mind, making movement and interaction easier while prioritising the needs of vulnerable users such as children, older adults, and people with disabilities. One key principle is creating a barrier-free environment. Instead of separate pavements and roadways, the entire surface is often designed as a single, continuous plane, allowing safe and seamless transitions between pedestrian and vehicular areas. Obstacles such as parked cars, poorly positioned furniture, or uneven surfaces should be removed to ensure accessibility.

In neighbourhood settings, shared streets can serve multiple purposes beyond transportation. Depending on the available space, these streets can host markets, community events, or social activities, fostering a sense of belonging and community. Small public spaces or "micro-plazas" can be integrated into the design to support these functions. The flexibility of these spaces allows them to adapt to the community’s changing needs over time.

Finally, pedestrian-prioritised streets should be well-connected to the wider urban network, including pedestrian-only streets, cycling routes, and transit hubs. These connections improve accessibility and encourage sustainable, multimodal travel. For example, shared streets near schools or parks can enhance safety for children, while those in residential areas can strengthen community ties and social interactions. Integrated design ensures these streets contribute to a cohesive urban environment, supporting broader efforts to improve walkability and reduce car dependency.

By combining safety, comfort, and flexibility, pedestrian-prioritised streets not only put pedestrians first but also create spaces that enhance urban life. They encourage stronger communities, support social interaction, and make neighbourhoods more dynamic and engaging.

Table 34. Design Principles for pedestrian-prioritised streets.

Street-level design principles	
Shared-Space Design	Continuous surface design: To create shared spaces that are accessible and easy to navigate for everyone, materials such as concrete, asphalt, or compact paving can be used. These materials ensure smooth transitions across different areas, allowing people, including wheelchair users, to move comfortably and safely. A well-designed continuous surface eliminates barriers and promotes universal accessibility while maintaining the functional flow of the space. Textured paving for visual differentiation: Using textured or tactile paving in pedestrian-priority zones can help guide user behaviour while signalling that vehicles need to slow down and give attention to pedestrians. These distinctive materials not only improve safety but also make it easier for all users, including visually impaired individuals, to navigate shared spaces. It is also essential to select materials that are durable, weather-resistant, and comfortable for active mobility users like cyclists or people on scooters, ensuring the design remains practical and functional throughout the year. Visual cues for pedestrian priority: Subtle visual elements, such as patterns, design interventions, or symbols like pedestrian icons, can be integrated into paving at key points, such as intersections, to reinforce the principles of shared spaces. These cues visually indicate pedestrian priority and encourage respectful behaviour from drivers while blending seamlessly into the overall streetscape. By incorporating aesthetically pleasing details, these features can also enhance the visual appeal of the area, making the space more inviting for all users.
Low-Speed Environment	Traffic calming and speed limit: To maintain safety, speed limits are typically set at 20-30 km/h or lower. Traffic calming measures such as speed bumps, raised intersections, and chicanes (slight curves) discourage speeding but create barriers for pedestrians and people with wheelchairs. Therefore, entry points can be narrowed, and different surface textures can be used to signal pedestrian priority and slow vehicle flow.

	Vehicle lanes: Regarding the transit infrastructure, vehicle lanes that are more than 3 meters encourage cars to drive faster and increase the distance pedestrians must cross the street. Based on the streetscape, vehicle lanes in pedestrian-prioritised streets can be limited with 'road diets' done by other elements like bike lanes, bike parking, and street furniture.
Street Furniture	Integrated Seating and Planters: Seating combined with planters offers a multifunctional solution for pedestrian-priority zones. These elements can help define the space while maintaining flexibility in the design. Movable benches can further enhance adaptability, allowing the street to accommodate various uses and activities as needed. Tactile Wayfinding Elements: Tactile paving or guiding features integrated with seating or bollards can provide essential navigation aids for visually impaired users. These elements can ensure a clear and accessible path through the space without creating barriers or disrupting the shared environment. Movable Furniture: Lightweight and stackable chairs or tables can be used to make the space more adaptable to different activities. Whether for pop-up markets, outdoor dining, or temporary events, these movable furnishings allow the street to respond to changing needs while fostering a sense of community and interaction. Play Elements for Children: Small play elements, such as interactive sculptures or climbing structures, can create opportunities for children to engage with the space in a fun and creative way. These additions can make the area more family-friendly, encouraging parents and caregivers to spend more time there. Compact Trash Bins: Discreet, compact trash bins can be integrated into the overall design to maintain cleanliness without disrupting the flow of the shared space. Placing them thoughtfully, away from main walkways, can help avoid obstructions while ensuring convenience. Bike Parking and Maintenance Stations: Compact bike racks and small maintenance points equipped with pumps and basic tools can support cyclists while maintaining the shared character of the space. These features not only promote cycling but also ensure that the area remains inclusive and functional for all users.

Green Infrastructure and Greenery	**Green Infrastructure Actions** Green Buffer Zones: Narrow green buffers with shrubs or small plants can help define the boundary between pedestrian areas and vehicular zones in a subtle, natural way. These buffers provide a clear separation without relying on rigid barriers, creating a more inviting and visually appealing streetscape. Tree Canopies with Adaptive Planting: Planting medium-sized trees with wide canopies along the street can provide shade and improve comfort of pedestrians. Selecting drought-tolerant or low-maintenance species that can live in compacted urban soils ensures that the trees remain healthy and sustainable in challenging environments. Planter-Integrated Street Furniture: Street furniture, such as benches or bollards, can be designed to include planters. This approach saves space while introducing greenery into the streetscape, ensuring that the additions do not obstruct pedestrians or vehicles. Rainwater Harvesting Systems: Rainwater collection systems can be incorporated into the street design to support green infrastructure. These systems could direct water to bioswales or underground storage tanks, providing an irrigation source for street vegetation and reducing the need for municipal water supplies. **Greenery Actions** Movable Planters: Large movable planters can add flexibility to the space, allowing for temporary uses such as community events or seasonal markets. These planters can also function as informal traffic calming features, helping to create safer and more adaptable pedestrian zones. Shared Gardens or Edible Landscaping: Small community garden spaces or edible landscaping, such as herb beds or fruit-bearing plants, can encourage community involvement and interaction. These features can transform pedestrian streets into more engaging and inclusive spaces while adding a practical and educational element. Shading Devices with Green Elements: Shading structures, such as pergolas, can be enhanced with climbing plants to create shaded walkways or seating areas. This combination of greenery and functionality can make public spaces more comfortable and visually appealing. Green Intersections: Small planting areas or trees placed at intersections can help to calm traffic while improving safety for pedestrians. At the same time, these additions enhance the aesthetic of the area, making intersections feel more welcoming and less dominated by vehicles, as is aimed in pedestrian-prioritised streets.

Multifunctionality	Creating multi-purpose micro-plazas: Micro-plazas can be introduced into shared streets depending on the available space and surrounding context. These small plazas are particularly effective at intersections, corners, or wider sections of streets, where they can provide space for both individual and group activities. Flexible seating arrangements, such as modular or movable furniture, can be included to adapt to different needs. Adding elements like trees, canopies, or umbrellas can provide shade and make these spaces usable throughout the year, creating comfortable environments regardless of the season. Pop-up elements: Temporary features, such as pop-up parklets, outdoor dining zones, art installations, or small play areas for children, can bring life and activity to the street. These elements are easy to install and remove, allowing the space to adapt to different uses and events. They also encourage people to spend more time in the area, making it more vibrant and engaging. Integration of play and recreation spaces: In residential settings, adding play elements for children and recreational features can foster a stronger sense of community while also making the street feel more dynamic and safer. Depending on the space available, features like outdoor chess tables, ping-pong tables, or fitness equipment can attract people of all ages, turning the street into a lively, multi-use environment. Increasing vibrancy through mixed uses: Encouraging active frontage, where cafes, small businesses, and community-oriented shops open directly onto the street, can enhance the energy and vitality of the area. This mix of uses not only makes the street more inviting during the day but also helps improve safety and activity levels during the evening hours by ensuring the space remains lively and well-used.
Connectivity to Urban Networks	Smooth integration with pedestrian networks: Pedestrian streets, plazas, and public spaces should be connected in a clear and straightforward way, allowing shared streets to naturally fit into the wider pedestrian network. This can only be achieved through a well-designed mobility plan that focuses on improving connections and creating a cohesive urban layout. Connection to cycling infrastructure: In shared streets, cyclists share the same space with vehicles and pedestrians, without a need for dedicated bike lanes or physical buffers. The core design philosophy of shared streets focuses on promoting careful and respectful interaction among all users. Instead of rigid separations, these streets rely on design elements, such as narrowed entry points, textured pavements, and visual indicators, to guide user behaviour and ensure safety.

	While the recommended width for shared cycling paths in low-traffic areas is typically 2.5–3 meters for two-way traffic and 1.5–2 meters for one-way traffic, shared streets function differently. By design, they prioritise an integrated space where all users coexist on the same level. Without barriers or buffers, the emphasis is placed on traffic-calming measures and design strategies that promote low speeds and shared use, rather than on separating users. In examples where pedestrian-prioritised streets intersect with main cycling corridors or networks, well-thought-out transitions are crucial to maintaining a better flow. Features like clear wayfinding signage, ramps, or level crossings ensure that cyclists can navigate these intersections smoothly without disturbing pedestrian movement. At vehicle access points, additional traffic-calming measures, such as raised entryways or narrowed lanes, support low-speed environments, prioritising the safety and comfort of both cyclists and pedestrians. Links to transit hubs and key destinations: Connecting pedestrian-prioritised streets to transit hubs, such as bus stops or train stations, is essential for improving accessibility and encouraging the use of public transportation. These connections should be designed with clear pathways and direct links that make transitioning between walking and public transport well-integrated for all users. Integrating shared streets with key destinations like schools, parks, and local businesses ensures that these spaces are not just passages but vital parts of a broader, multimodal urban network. Continuous pathways and network cohesion: A disconnected and sparse pedestrian and cycling network can discourage walking and biking. Shared streets should bridge gaps in existing networks by acting as connectors between fragmented paths. This requires evaluating the spatial configuration of the area and addressing interruptions caused by roadways and physical barriers. Pedestrian bridges or underpasses, where necessary, can provide safe and accessible connections in high-traffic areas.
Lighting	The lighting design for pedestrian-prioritised streets, such as shared streets or woonerfs, aims to create a balanced environment where pedestrians, cyclists, and vehicles can coexist safely and comfortably. Given that these streets are intended for low-speed vehicle traffic, low-level and evenly spaced lighting plays a key role in ensuring visibility for all users, whether they are walking, cycling, or driving. Integrated lighting systems, like bollard lights or fixtures built into planters, provide targeted illumination while maintaining the openness of the shared space and avoiding visual clutter. These solutions contribute to both functionality and aesthetics, enhancing the overall experience of the street. At key points such as intersections or crossings, differentiated lighting, such as brighter or more focused lights, can highlight areas where pedestrians have priority. This makes these spaces more noticeable to drivers and other users, reinforcing safety and shared-space principles.

	In quieter residential areas, motion-sensor lighting can offer an effective solution for improving safety and energy efficiency. These systems can black-out when the area is inactive and light up when movement is detected, reducing unnecessary energy use while ensuring adequate visibility when needed. In neighbourhood contexts, soft, warm-toned lighting (typically around 2,700–3,000 Kelvin) can help create a comfortable and inviting atmosphere. This type of lighting is particularly suitable for streets used by families, children, and older adults, making the environment feel safer and more welcoming during evening hours.

10.2.3 Enhanced streets (complete streets)

Enhanced streets are designed to balance the needs of pedestrians, cyclists, and drivers while placing a strong emphasis on pedestrian safety and comfort. Unlike fully pedestrianised or pedestrian-prioritised streets, these roads typically experience medium to high levels of traffic and serve as key urban connectors. They include features such as pedestrian pathways, cycling lanes, and public transport infrastructure, creating more integrated mobility networks. Streets like Corso Re Ruggero and Viale Lazio in Palermo are prime examples of enhanced streets, where mobility must be managed effectively to maintain vehicle flow while ensuring a safe and pleasant environment for those walking or cycling. Despite variations in traffic levels and street width, the primary goal remains the same: improving accessibility and liveability without compromising urban mobility.

A key aspect of enhanced streets is the successful integration of different modes of transport in shared spaces. Cycling infrastructure plays a major role in this, with dedicated bike lanes often separated from vehicular traffic by planters, kerbs, or barriers to enhance safety. In some cases, unprotected cycling lanes may be introduced, but this depends on the context. High-traffic areas or streets with faster-moving vehicles benefit from physical separation, whereas quieter streets can accommodate shared-use lanes. In cities with strong car cultures, such as Palermo, where cycling infrastructure remains limited, protected lanes are generally more effective in encouraging bike use.

When it comes to walkability, pedestrian pathways must be carefully designed to ensure safety and comfort, particularly in areas with heavy traffic. Widening pavements and separating them from vehicle lanes using elements like trees, benches, and planters can significantly improve the pedestrian experience. On streets with lower traffic volumes, shared spaces may work better, allowing pedestrians and vehicles to coexist with reduced speed limits and traffic-calming measures. However, on busier roads, clear separation between pedestrian areas and vehicle lanes is essential to avoid unsafe conditions.

Pavement width is another critical factor in enhancing pedestrian accessibility. According to the Global Street Design Guide (2016), sidewalks in low-density areas should be at least 1.8 metres wide to accommodate two people walking side by side comfortably. In busier urban streets, pavements should be expanded to 3–4 metres or more to support higher pedestrian volumes. Wider sidewalks are especially important in transit hubs and commercial areas, where crowding is more common. Additional pedestrian-friendly features, such as raised crossings, refuge islands, and kerb extensions, make crossing streets easier and safer. Ensuring continuous and obstacle-free sidewalks is equally important, particularly for people with disabilities. Features like tactile paving, as highlighted by Chong, Lam, and Chan (2010), play a key role in making streets more accessible for visually impaired users.

Public transport infrastructure is another fundamental component of enhanced streets. Well-designed bus stops and transit hubs should be seamlessly connected to pedestrian pathways, allowing for safe and efficient access. Dedicated bus lanes can also improve public transport efficiency, particularly when combined with supporting features like bus bulbs, shelters, and priority traffic signals (National Association of City Transportation Officials, 2013). However, for these measures to remain effective, proper enforcement is required to prevent vehicles from parking in or obstructing bus lanes.

Traffic analysis is essential in identifying opportunities for repurposing underused road space. If traffic conditions allow, certain lanes can be reallocated for alternative uses such as wider pavements, bike lanes, or bus corridors. In some cases, parking spaces can be transformed into pedestrian plazas or parklets, creating more engaging and active street environments.

Beyond functionality, the success of enhanced streets also depends on their ability to create inviting and aesthetically appealing spaces. Unlike fully pedestrianised streets, where designing for walkability is more straightforward, enhanced streets present additional challenges due to higher traffic levels, noise pollution, and dense urban infrastructure. However, these streets are often located around key city amenities and frequently used destinations, making improvements in pedestrian accessibility particularly impactful. Enhancing walkability in these environments can catalyse shifting mobility habits in car-dependent cities, gradually encouraging more sustainable modes of transport.

To make enhanced streets feel more engaging and vibrant, their design should go beyond basic functionality. Research has shown that well-designed shopfronts and varied street uses increase pedestrian activity by encouraging interaction with the surrounding environment (Kesici & Erkan, 2023; Mu, Mu, & Zhang, 2024). Ensuring clear sightlines into shop interiors and maintaining a strong visual connection between buildings and the street can further enhance the pedestrian experience.

Aesthetic improvements also play a crucial role in shaping how people perceive and interact with enhanced streets. Thoughtfully designed paving patterns and textured surfaces can give a street a distinct character, while public art installations, such as sculptures, murals, or interactive displays, can bring additional vibrancy to the urban landscape. Lighting is another essential factor, ensuring streets remain safe and welcoming in the evening while enhancing their overall appeal.

Green infrastructure is particularly beneficial for improving both the aesthetic and environmental quality of enhanced streets. Unlike fully pedestrianised streets, these roads often have more space available for introducing greenery. Trees, vertical gardens, landscaped medians, and planters can help soften the urban environment, making it more visually appealing and pedestrian-friendly. Green features not only provide shade and improve air quality but also serve as natural barriers, protecting pedestrians from vehicle traffic. Incorporating seasonal plants, flowers, and pocket gardens can add variety and keep streets lively throughout the year.

To encourage social interaction, enhanced streets should be designed to accommodate a variety of activities. Strategically placed benches, tables, and bike racks near bus stops, retail areas, or small plazas provide opportunities for people to rest, gather, and engage with their surroundings. These elements should not only serve practical purposes but also reflect the local character, using materials and designs that align with the neighbourhood's identity. Introducing flexible spaces, such as pop-up seating areas, temporary art installations, or outdoor dining zones, can bring diversity to the street environment while allowing for seasonal or community-driven adaptations.

Enhanced streets occupy a unique position within the broader street classification system, serving as transitional spaces between fully pedestrianised zones and more car-oriented streets. Their design requires a delicate balance between maintaining urban mobility and fostering a pedestrian-friendly environment. When implemented effectively, these streets can support active mobility, enhance public transport efficiency, and contribute to a more walkable and inclusive urban landscape. Especially in cities where car-centred urban design has been utilised for many decades, enhanced streets are convenient ways to transform both the built environment and travel habits.

Table 35. Design Principles for Enhanced Streets.

Street-level design principles	
Connectivity and Integration	Safety and connectivity: Ensuring well-connected and continuous pedestrian pathways is especially important on enhanced streets, where high volumes of vehicle traffic make safety a primary concern. Strategically placed crossings near key transit points, such as bus stops and train stations, can significantly improve pedestrian comfort and safety. Raised crosswalks, for example, can make pedestrian movement more visible to drivers while also helping to slow vehicle speeds in these busy areas. On wider streets, pedestrian refuge islands at mid-block crossings or wide intersections provide a safe resting point for people crossing multi-lane roads. By breaking up long crossing distances, these islands reduce risks for pedestrians and make navigating these areas less daunting. To ensure inclusivity, these islands should feature proper paving and adequate lighting, making them accessible for disabled users. Additional measures, such as kerb extensions at intersections, can improve pedestrian safety by narrowing the roadway, shortening crossing distances, and increasing visibility. Crossings can also be equipped with traffic signals that include countdown timers, giving clear information on crossing times. Audible signals can further enhance accessibility for visually impaired pedestrians, ensuring that shared spaces are welcoming to all. To emphasise pedestrian priority, visual indicators such as contrasting paving materials, painted markings, or other subtle design features can make crossing areas more noticeable to both drivers and pedestrians. These elements help reinforce the message that pedestrians take precedence in these spaces. Integrating cycling: Integrating cycling infrastructure into enhanced streets requires thoughtful planning to ensure that cyclists can travel safely and efficiently while coexisting with other modes of transport. Updated guidelines from the CROW Design Manual for Bicycle Traffic (Talens, 2023) recommend that bike lanes be at least 2 metres wide for one-way traffic and 3.5 to 4 metres wide for two-way traffic on high-traffic streets. These dimensions allow cyclists to turn comfortably, reducing the risk of conflicts with vehicles. In areas with medium to high motorised traffic, physical barriers such as planter boxes, bollards, or raised kerbs can be used to separate bike lanes from vehicle lanes. These features provide an added layer of safety for cyclists by clearly delineating their space. At intersections, advanced stop lines or bike boxes can improve cyclist safety by positioning them ahead of vehicles at traffic signals. This increases their visibility and ensures their movements are prioritised. Where space permits, dedicated cycling crossings with distinct markings or raised designs can further enhance safety by making these areas more noticeable and user-friendly.

	To encourage cycling as a practical mode of transport, secure and easily accessible bike parking is essential. Key locations such as transit hubs, shopping districts, and public spaces can be equipped with covered bike racks or lockers to offer protection from weather and theft. In densely populated areas, integrating bike-sharing stations with public transit systems can create seamless connections, enabling commuters to switch easily between cycling and other transport modes.
Green Infrastructure and Greenery	**Green Infrastructure Actions** Tree-Lined Medians: Tree-lined medians can separate traffic going in opposite directions, while also providing shade and reducing heat in urban areas. Hardy tree species that can handle urban conditions, such as pollution and compacted soil, are ideal for these spaces to ensure they last and stay healthy. Vegetated Strips Adjacent to Sidewalks: Planting strips between sidewalks and roads can add greenery and improve the environment. These strips can also include features like bioswales or trenches to help manage stormwater, reducing runoff and improving drainage. Vertical Green Infrastructure: Green walls or vertical gardens on nearby buildings are a good way to bring greenery into busy areas without using up ground space. These additions can improve air quality, reduce noise, and make the area look more appealing, especially in dense urban streets. Landscaped Roundabouts and Traffic Islands: Roundabouts and traffic islands can be turned into green spaces by adding trees, flowers, and shrubs. This kind of landscaping can improve the look of vehicle-heavy areas and bring a natural touch to the space. **Greenery Actions** Seasonal Green Features: Using hanging flower baskets, planter boxes, or seasonal decorations can add colour and freshness to the street throughout the year. These features do not require much space but can make a big difference in how the area looks and feels. Shaded Transit Stops: Planting small groups of trees or adding pergolas near bus stops or transit hubs can create shaded areas for people waiting. This not only makes the space more comfortable but also adds greenery to the area. Multi-Layered Vegetation: Combining different types of plants—like low-growing flowers, shrubs, and tall trees—can create a layered look along sidewalks or public spaces. This design makes the area feel more natural and visually interesting for people passing by. Dynamic Green Spaces: Creating flexible green spaces that change with the seasons or events can make urban areas more dynamic. For example, temporary green zones for festivals or combining greenery with lights can add excitement to the area while keeping it functional and attractive.

Multifunctionality	Enhanced streets should be designed to support a variety of uses, creating spaces that are functional, vibrant, and adaptable while maintaining efficient traffic flow. Small plazas/pocket spaces: In areas near transit hubs or commercial zones, small plazas or pocket spaces with outdoor seating can create welcoming places for people to gather, rest, or socialise. These spaces can be further enhanced with features such as shaded seating, planters, and water elements, encouraging people to linger and enjoy the environment. In locations where space allows, pop-up parklets can also be introduced, offering temporary yet flexible uses. These features not only add to the street's vibrancy but also help regulate vehicle flow by reclaiming areas for pedestrian use. Mixed-use: Encouraging active frontages, like cafes, shops, and local businesses, can support a wide range of activities and meet the needs of different users. Mixed-use streets are especially lively in the evening, with well-lit shopfronts and extended business hours creating a safer, more dynamic atmosphere. Apart from main streets or commercial areas, ground floor mixed-use in residential areas also enhances the street's vibrancy by ensuring activity throughout the day and night. Positioning amenities like small grocery stores, local markets, and cultural venues along the street creates destinations that attract pedestrians and encourage community engagement. This combination of residential, commercial, and recreational uses makes the street more functional and enjoyable, while also fostering an inclusive environment. By supporting diverse lifestyles and promoting walkability, these streets can become dynamic spaces that meet the needs of the whole community.
Street Furniture	Seating Zones with Noise Barriers: Seating areas can be made more comfortable by using low walls, planters, or acoustic barriers to reduce traffic noise. These features create a more pleasant environment for pedestrians, offering spaces to rest while being shielded from the chaos of the street. Transit-Supportive Furniture: Comfortable, weather-resistant bus shelters equipped with seating, real-time transit information displays, and integrated greenery, such as green roofs or walls, can enhance the experience for public transport users. These features not only provide practical benefits but also improve the aesthetic of transit hubs. Wayfinding and Information Kiosks: Digital or static kiosks placed near key intersections or transit hubs can provide useful information, such as maps, schedules, and tourist guides. Ensuring that these kiosks are well-lit, accessible, and user-friendly makes them more effective for a wide range of users. Landscaped Median Rest Points: For wider streets, small seating areas can be introduced on landscaped medians, providing pedestrians with safe and relaxing rest points. Access to these areas can be ensured through raised crossings or pedestrian refuge islands, improving safety and usability.

	Lighting-Integrated Benches: Benches with built-in lighting can enhance visibility at night while also contributing to a welcoming and safe atmosphere. These multifunctional elements make public spaces more inviting and practical during evening hours. High-Capacity Trash and Recycling Bins: Durable, high-capacity bins placed near transit hubs and busy pedestrian areas can help manage waste more effectively in high-traffic zones. Ensuring their placement is convenient for users while maintaining cleanliness supports a well-maintained urban environment. Bike Storage and Charging Stations: Secure bike lockers or charging stations for e-bikes can be installed near transit hubs or commercial areas, encouraging people to combine cycling with other modes of transport. These facilities promote multimodal travel and make cycling a more practical option. Kerbside Dining Furniture: Dedicating kerbside zones for outdoor dining with durable, weather-resistant tables and chairs can create lively social spaces. Furniture that is easy to store or rearrange ensures the area can adapt to changing street uses or events. Urban Charging Points: Public charging stations for phones and other electronic devices can be added near seating areas, offering convenience and connectivity for pedestrians. These features enhance the usability of public spaces while catering to modern needs.
Traffic Calming Measures	Kerb Extensions and Bulb-Outs: Kerb extensions, often referred to as bulb-outs, can be placed at intersections and mid-block crossings to reduce crossing distances for pedestrians. By visually narrowing the roadway, these extensions encourage drivers to slow down, enhancing safety for those on foot. In addition, they provide extra space for amenities such as street furniture, planters, or bike racks, improving the pedestrian environment without compromising the functionality of traffic flow. Raised Crosswalks and Intersections: Raised crosswalks and intersections prioritise pedestrian movement by slowing vehicles at key crossing points. These features also improve visibility for pedestrians and are especially beneficial for wheelchair users, as they eliminate kerbs and create a smooth, continuous walking surface. Lane Narrowing and Road Diets: Wide traffic lanes often encourage higher vehicle speeds, which can create risks to pedestrians. Reducing lane widths or reallocating road space for features such as bike lanes, wider pavements, or green buffers can naturally moderate traffic speed. On enhanced streets, lane widths for main vehicle lanes can be reduced to between 3 and 3.5 metres, while bus or bike lanes can be clearly marked to improve safety and usability.

	Median Islands and Refuge Areas: Central medians or pedestrian refuge islands can provide safe resting points for people crossing multi-lane streets. These features visually divide long parts of the road, encouraging drivers to slow down. When landscaped with greenery or small trees, they also contribute to the overall aesthetic of the street. Textured Pavements and Visual Cues: Textured surfaces, such as cobblestones, brick pavements, or stamped asphalt, can be used in key areas like crossings, intersections, or parking zones. These materials not only visually signal drivers to reduce their speed but also act as a reminder to be cautious. At the same time, they add an element of visual appeal, enhancing the character of the streetscape. Speed Cushions and Raised Speed Tables: Speed cushions or raised speed tables are slightly elevated sections of road designed to slow vehicles while allowing emergency vehicles to pass more easily compared to traditional speed bumps. These features are particularly useful on streets with moderate to high traffic volumes, where maintaining emergency response times is crucial. Dynamic Traffic Calming with Smart Technology: Smart traffic-calming measures, such as speed feedback signs, motion-activated lighting, or adaptive traffic signals, can adjust to real-time conditions to regulate vehicle speeds. These systems are especially effective on high-traffic enhanced streets, where pedestrian and cyclist activity may vary throughout the day.
Lighting	Enhanced streets, which are often characterised by medium to high volumes of vehicle traffic, require carefully designed lighting strategies to support multimodal mobility while ensuring the safety of pedestrians and cyclists. A layered lighting approach is particularly important, combining pedestrian-scale lighting along pavements and crossings with higher streetlights to illuminate areas used by vehicles. At key crossing points, features such as overhead lights or in-ground LED systems can improve visibility for both pedestrians and drivers. Raised crossings with integrated lighting add an extra layer of safety by slowing vehicles and marking pedestrian-priority zones. To improve both the aesthetics and environmental sustainability of enhanced streets, green lighting solutions can be integrated into the design. Solar-powered light poles, for instance, provide a sustainable option while fixtures combined with greenery, such as planter boxes, can contribute to a more visually cohesive and inviting streetscape. Colour-adaptive lighting is another useful feature, as it can visually distinguish different areas, such as pedestrian crossings or bus stops, making the street easier to navigate for all users. In commercial corridors, accent lighting for shopfronts or cultural landmarks can help enhance the area's visual appeal while encouraging activity during the evening. These features not only make the street more attractive but also support its use as a vibrant, dynamic public space throughout the day and night.

The proposed street classification, dividing streets into pedestrian-only, pedestrian-prioritised, and enhanced streets, provides a structured approach to improving walkability in car-dependent cities. By acknowledging the different mobility needs, spatial characteristics, and functional roles of streets, this framework allows for targeted interventions that prioritise pedestrian accessibility, safety, and comfort. Each category serves a specific function within the urban landscape, creating a network that encourages walking while accommodating different levels of vehicular movement.

Pedestrian-only streets, which are entirely car-free, represent the most direct and transformative approach to enhancing walkability. By removing vehicles altogether, these streets create uninterrupted pathways that promote safer, more pleasant, and socially vibrant spaces. Their design encourages lingering and interaction, making them natural gathering places for residents and visitors alike. Features such as street trees, seating areas, and public art make the environment more inviting, while the integration of permanent functions like markets, outdoor cafés, and cultural activities fosters a sense of place and community. As seen in many successful pedestrianisation projects, these streets not only improve mobility but also contribute to economic vitality by increasing foot traffic and supporting local businesses.

Pedestrian-prioritised streets aim to strike a balance between allowing limited vehicle access and ensuring pedestrian safety. Unlike pedestrian-only streets, they are designed to accommodate cars but in a way that gives clear priority to people walking, cycling, and socialising. Shared space principles play a crucial role here, where different users coexist at low speeds, often without traditional traffic segregation. Elements such as textured paving, raised crossings, and curb extensions naturally slow down vehicles, creating a safer and more pedestrian-friendly environment. These streets often feature adaptable spaces that can be used for seasonal events, outdoor seating, or temporary market stalls, offering flexibility in how public space is utilised. Additionally, incorporating functional greenery, such as tree-lined walkways and planted buffers, enhances both the aesthetic and environmental quality of these streets, making them more comfortable and inclusive for all users, including families, older people, and those with mobility challenges.

Enhanced streets, which accommodate medium to high levels of vehicle traffic, present a different set of challenges but also opportunities to integrate walkability into busy urban corridors. While full pedestrianisation is not feasible on these streets, strategic interventions can significantly improve pedestrian comfort and accessibility. Widened pavements provide safer walking routes, while marked crossings, pedestrian refuge islands, and traffic-calming measures help reduce conflicts between vehicles and pedestrians.

Cycling infrastructure, where possible, is carefully integrated to encourage active mobility while maintaining efficient traffic flow. Green infrastructure plays a key role in mitigating the dominance of cars on these streets—tree-lined medians, landscaped buffers, and vertical greenery help improve air quality, reduce heat, and create a more inviting streetscape. Additionally, enhanced streets often function as key public transport corridors, making transit-friendly features, such as accessible and well-designed bus stops, shelters, and multimodal connections, essential for ensuring that walking remains a seamless part of urban mobility.

This classification system places walkability at the core of urban street design, recognising that diverse types of streets require tailored solutions. By prioritising pedestrian accessibility and comfort in all three categories, the approach goes beyond basic infrastructure improvements, aiming to reshape the way people move through and interact with their cities. Rather than applying a one-size-fits-all pedestrianisation model, this framework allows cities to make strategic interventions based on the specific spatial and functional characteristics of each street. The result is a flexible, adaptable strategy that not only reduces car dependency but also makes walking a more practical, enjoyable, and sustainable mode of transport.

10.3 15-minute city and TOD in Walkability Planning: From Barriers to Opportunities

The interventions proposed in this research are not conceived as isolated or ad hoc urban strategies but are firmly rooted in the theoretical perspectives of both the 15-minute city and TOD paradigms. As outlined in the introduction, this study does not aim to operationalise the full spectrum of principles embedded within the 15-minute city model, such as digitalisation, proximity to a comprehensive set of essential services, or the complete reconfiguration of neighbourhood-level functions. Rather, it deliberately narrows its focus to the core elements of walkability and the reduction of car dependency, which are central to both frameworks and particularly relevant to Palermo's current mobility challenges. This methodological decision reflects a pragmatic research scope; a full implementation assessment of the 15-minute city model would require a more extensive, dedicated study. Instead, this research prioritises pedestrian accessibility to high-capacity public transport nodes, train stations, as a means to foster sustainable mobility behaviours and tackle the rooted dependence on private vehicles, a critical barrier to urban sustainability in cities with similar socio-spatial and infrastructural profiles.

Both models share the common goal of creating sustainable, walkable, and accessible urban spaces, but approach this goal from slightly different perspectives. The 15-minute city focuses on decentralising services so that residents can access essential amenities within a 15-minute walk or bike ride, while TOD centres on concentrating development around transit hubs to encourage multimodal connectivity and reduce car dependency.

This research integrates the principles of these two frameworks into its spatial and socio-cultural recommendations, recognising the unique challenges of car-dependent cities like Palermo. By tailoring interventions such as pedestrianisation, introducing greenery, implementing traffic calming, and enhancing multimodal connectivity, the study shows how the 15-minute city and TOD frameworks can complement one another in reshaping urban environments. For instance, the categorisation of pedestrian-only streets, pedestrian-prioritised streets, and enhanced streets addresses different aspects of walkability, accessibility, and urban vibrancy, all while aligning with the broader goals of these models.

The analysis in this section examines how the proposed actions align with the principles of both the 15-minute city and TOD. It explores the compatibility between creating pedestrian-friendly streets, encouraging multimodal travel, and ensuring equitable access to urban services. This is followed by a critical discussion of the practical challenges and limitations of applying these frameworks in urban contexts like Palermo, with a specific focus on the 15-minute city. Spatial constraints, socio-cultural factors, and governance issues often present significant obstacles in these contexts, requiring thoughtful adaptation of the models to local conditions.

Table 36. Key actions of this research and their correlation with 15-minute city and TOD concepts.

Action Area	Key Actions	Link to 15-minute city	Link to TOD
Prioritising Pedestrian Space	• Expand pavements, create shared streets, and pedestrian-only zones. • Eliminate on-street parking to reclaim public space.	• Encourages walkability, enabling residents to safely reach essential services within a 15-minute radius. • Reclaims streets for pedestrians.	• Enhances first- and last-mile connectivity, ensuring seamless access to transit hubs. • Creates walkable station areas.
Enhancing Safety	• Implement traffic calming measures, 20–30 km/h speed zones, and safe crossings.	• Improves quality of life and supports human-scale design through safer streets. • Enables safe and comfortable movement for vulnerable groups.	• Ensures pedestrian safety around transit stations, increasing accessibility. • Reduces conflicts between modes near transit hubs.
Improving the Walking Environment	• Add greenery, street furniture, lighting, and weather protection.	• Enhances the quality of public spaces, making walking enjoyable and convenient. • Supports year-round active mobility by providing comfort.	• Creates welcoming transit areas that encourage multimodal transfers. • Increases pedestrian appeal within transit catchments.
Activating Public Spaces	• Develop placemaking initiatives, pop-up plazas, and parklets.	• Promotes social cohesion by creating vibrant spaces for interaction.	• Fosters active and engaging public spaces near transit stations, making them attractive hubs.

		• Encourages community life and reduces dependency on long commutes.	• Increases TOD zone vibrancy.
Optimising Connectivity	• Establish direct pedestrian pathways and clear wayfinding systems. • Integrate routes with public transport stops.	• Enhances multi-modal accessibility and neighbourhood efficiency. • Improves seamless pedestrian access to daily needs.	• Connects transit hubs to surrounding areas through clear pedestrian routes. • Encourages walkable, integrated TOD precincts.
Reducing Vehicle Dominance	• Implement Limited Traffic Zones (ZTLs) and car-free streets. • Create peripheral parking hubs and promote park-and-ride systems.	• Reduces vehicular dominance, creating safer and quieter streets for active travel. • Encourages walking and cycling over car use.	• Reduces car dependency within TOD catchment areas. • Supports park-and-ride systems that enhance transit accessibility.
Encouraging Mixed Modal Use	• Integrate bike lanes, pedestrian paths, and public transport facilities.	• Expands low-carbon mobility options within neighbourhoods. • Promotes active travel modes aligned with 15-minute city goals.	• Facilitates multimodal access to transit hubs. • Encourages cycling and walking as key modes for last-mile transit connections.
Improving Street Aesthetics	• Use uniform materials, decorative elements and reduce visual clutter.	• Creates an appealing pedestrian environment that encourages walkability. • Aligns with human-centred urban design principles.	• Enhances the aesthetic appeal of station areas, making them desirable destinations. • Reinforces TOD principles of liveability.
Monitoring and Adaption	• Use smart infrastructure, pilot programs, and community feedback.	• Ensures flexibility to meet local needs. • Aligns with the 15-minute city's focus on creating adaptive, people-centred neighbourhoods.	• Supports real-time improvements in transit and active mobility systems. • Enhances data-driven decision-making for TOD success.

10.3.1 Critics on the applicability of the 15-minute city in Palermo

The concept of the 15-minute city has gained significant attention in urban planning as a framework for creating walkable, mixed-use neighbourhoods where residents can access most daily needs within a short walk or bike ride. While the idea has been widely celebrated for its potential to improve urban living and quality of life, it is also criticised by scholars for its various aspects. Several scholars have raised questions about its originality, practical application, and socio-economic implications, particularly in the context of car-dependent cities like Palermo.

One of the most often cited critiques of the concept is its lack of originality. As highlighted in the theoretical framework of this research, similar ideas have existed throughout the history of urban planning. Concepts such as the neighbourhood unit, New Urbanism (Duany et al., 2001), Cities for People (Gehl, 2013), and Compact, Walkable, Diverse (CWD) neighbourhoods (Talen & Koschinsky, 2014) all share common principles, including walkability, mixed land use, and human-centred design. Mouratidis (2024) notes that while these earlier models vary in focus, they all advocate for a sufficient level of density, connectivity, and accessibility, which are also central to the 15-minute city.

What makes the 15-minute city different, however, is its emphasis on decentralisation and polycentricity. Unlike many earlier theories, which suggest that neighbourhoods should meet only some of their residents' needs, the 15-minute city advocates for a model where nearly all essential services can be reached within a 15-minute walk or bike ride. This focus on self-sufficient neighbourhoods has been acclaimed for its ambition but also criticised for its idealism and potential impracticality, particularly in contexts with complex socio-spatial dynamics.

One of the most significant critiques of the 15-minute city is its potential to increase socio-economic segregation. Pozoukidou and Chatziyiannaki (2021), along with others (Casarin, MacLeavy, & Manley, 2023; Glaeser, 2024; Elldér, 2025), argue that while the model aims to bring urban services closer to residents, argue that while the model aims to make services more accessible, it could trap disadvantaged communities in under-served areas." In cities like Palermo, where spatial inequalities already exist between the well-developed neighbourhoods and under-resourced suburban areas, models like the 15-minute city could unintentionally deepen the segregation.

Suburban areas in Palermo often suffer from underinvestment, lacking the infrastructure and amenities available in the central districts. Without targeted efforts to ensure equitable investment in these disadvantaged areas, the 15-minute city risks creating isolated enclaves where only specific (mostly central) neighbourhoods benefit from improved services. For this reason, it is crucial to adopt context-based planning that prioritises balanced development and avoids reinforcing existing spatial inequalities.

Another socio-economic risk is the potential for gentrification. As Pozoukidou and Chatziyiannaki (2021) highlight, improving amenities and infrastructure in line with 15-minute city principles can lead to rising property values, pricing out lower-income residents. In cities like Palermo, where socio-economic disparities are already reflected in the spatial organisation (Igreja, Sezer & Vinci, 2024), this issue requires careful planning. Provisions for affordable housing must be integrated into any redevelopment strategy to prevent displacement and ensure inclusivity.

Adapting the principles of the 15-minute city to historic cities like Palermo presents unique challenges. The compact urban cores, narrow streets, and complex layouts characteristic of cities with historic centres often leave little room for the wide pavements, cycling infrastructure, and large public spaces envisioned by the model. Gehl's (2010) approach of implementing small-scale, human-centred interventions, like shared streets and pedestrian-prioritised zones, may offer a more realistic solution in such contexts, rather than imposing extensive changes that conflict with the historic streetscape.

Additionally, the balance between historic preservation and modernisation can create tensions. While the proximity of services in these areas aligns with 15-minute city principles, fragmented pedestrian routes and poor public transport integration limit their practicality. Incremental improvements that respect the historic character of the area while enhancing accessibility for all users may be the most viable approach.

Cultural barriers also present significant challenges, particularly in car-dependent cities like Palermo. Cars are deeply ingrained in the local culture, often symbolising independence and status, especially in suburban areas. Proposals to redesign urban spaces to reduce car dependency often face public opposition. Residents who are used to car-centric lifestyles may resist changes that they perceive as limiting their mobility or convenience. For instance, the implementation of congestion pricing in New York City faced significant public opposition, with nearly two-thirds of residents opposing the plan initially. The introduction of the 15-minute city model has, in some cases, been met with conspiracy theories and public backlash. Certain groups have misinterpreted the concept as an attempt to impose restrictions on personal freedoms, leading to protests. However, experiences from cities like London and Stockholm demonstrate that public support can grow after witnessing the benefits of reduced traffic and improved public transportation (Fayyad, 2025). This reliance on cars creates a cycle where public transport and pedestrian infrastructure remain underused, leading to underinvestment, which further reinforces car dependency. The self-fulfilling cycle of mobility in heavily car-dependent cultures is.

People assume it does not work →

They avoid using it →

The system lacks users, investment, and trust →

The narrative remains: "See? It doesn't work."

Breaking this cycle to promote active mobility in these environments requires more than just infrastructure changes; it also demands a shift in public attitudes and behaviours. Promoting public awareness campaigns, incentives for active travel, and visible role models advocating walking and cycling are equally important in shifting public attitudes.

While the 15-minute city offers a visionary framework for creating sustainable, walkable cities, its success depends on how well it is adapted to local conditions. In cities like Palermo, addressing socio-economic inequalities, historic preservation challenges, and cultural resistance is essential. By integrating spatial and socio-cultural strategies and prioritising equity across all areas, cities can go beyond the limitations of the 15-minute city to create inclusive, vibrant urban environments that truly meet the needs of their residents.

10.4 Final Statement

This research set out to investigate the factors influencing walkability and pedestrian accessibility in car-dependent contexts, using Palermo as a case study. In addressing the research questions, the findings emphasise the centrality of walkability as both a spatial and socio-cultural phenomenon, rather than focusing exclusively on proximity and built environment.

Regarding how urban planning strategies can promote walkability within cities, the study reveals that there are many different ways to approach pedestrian accessibility depending on the context, as it was seen from the examples in Chapter 4. Every decision in urban planning is political, especially because all those decisions affect our daily lives directly or indirectly. To repeat, as Jan Gehl quoted[7] *"If you invite more cars, you get more cars. If you make more streets better for cars, you get more traffic. If you invite people to walk more and use public spaces more, you get more life in the city. You get what you invite."* Therefore, primarily, it is about what we want to achieve through our policies and actions.

Urban planning strategies can effectively promote walkability by addressing the multi-dimensional nature of pedestrian accessibility, which encompasses physical, functional, and perceptual dimensions. Walkability is not merely a function of spatial proximity but arises from a combination of factors that determine how inviting, safe, and convenient walking is as a mode of everyday mobility.

Firstly, spatial design interventions are fundamental. Urban planners must prioritise the development of continuous, legible, and well-connected street networks that facilitate direct and logical pedestrian movements. This includes the creation of permeable urban fabrics with frequent intersections, short blocks, and a fine-grained street layout, which support ease of access and encourage active mobility. Furthermore, the quality of public spaces, such as sidewalks, squares, and pedestrian crossings, needs to meet high standards in terms of width, surface conditions, lighting, shading, and urban furniture, enhancing both the safety and comfort of walking.

[7] Climate One. (2019). Jan Gehl: Designing Cities for People, Not Cars. Retrieved from https://www.youtube.com/watch?v=tRZMpGyQBZ0

Secondly, functional diversity and land-use integration are essential to sustaining walkability. Urban environments where a mix of residential, commercial, cultural, and institutional uses coexist generate continuous pedestrian flows and reduce the need for long journeys. Ensuring that daily necessities are within a walkable range is crucial, but it must be accompanied by vibrant street-level activity that fosters perceived safety and social engagement. A vibrant and active ground floor is not always present; however, in such cases, it is essential to ensure that public spaces and streets remain safe, adaptable, and welcoming at all times of the day to encourage continuous pedestrian use and a sense of security.

Thirdly, policy measures that prioritise pedestrians over motorised traffic play a pivotal role. These include the establishment of traffic-calming measures, car-free zones, low-speed streets, and pedestrian-priority areas. Limiting car accessibility in central and sensitive urban areas (such as historic centres) not only reallocates space to pedestrians but also shifts the symbolic hierarchy of urban mobility, where walking is no longer a secondary mode. Successful examples demonstrate that physical interventions must be combined with regulatory frameworks, such as traffic-limited zones, dynamic pricing for car access, and urban logistics strategies that respect pedestrian spaces.

Moreover, urban form and micro-scale elements are critical in shaping walkability perceptions. Research highlights the importance of urban design qualities such as enclosure, transparency, human scale, complexity, and imageability (Ewing and Handy, 2009) in creating environments that pedestrians find attractive and safe. Good urban design promotes visual interest, offers frequent opportunities for social interaction, and provides protection from climatic discomfort through shaded streets and accessible resting areas.

Finally, urban planning must integrate participatory processes that involve residents in the design and management of public spaces. Engaging the community in the co-creation of pedestrian environments not only ensures that interventions meet actual needs but also fosters a stronger sense of ownership and stewardship over urban spaces, encouraging long-term behavioural shifts toward walking.

The Palermo case study reinforces these findings: while infrastructural improvements (e.g., expansion of pedestrian areas, creation of limited traffic zones) have been made, the persistence of cultural barriers, such as the symbolic value attributed to car ownership, highlights the necessity of planning strategies that address both physical and socio-cultural dimensions simultaneously. Urban planning strategies that holistically promote walkability must therefore align infrastructural, regulatory, and cultural measures into a coherent vision that makes walking the most attractive, convenient, and preferred mode of daily mobility.

With respect to the second research question, the analysis identifies key barriers to walkability in both spatial and socio-cultural domains. The spatial barriers are explored within the answer to the first question above. On the other hand, the findings of this research highlight that walkability is influenced not only by the physical configuration of the urban environment but also by deeply embedded socio-cultural barriers that shape individuals' mobility choices and perceptions of public space. In car-dependent contexts like Palermo, these barriers manifest through several interconnected dynamics.

First, cultural attachment to the private car represents a significant obstacle. As it is supported by the theories in previous chapters, the car is often perceived not merely as a practical tool but as a symbol of status, autonomy, and social prestige. This cultural valuation of car ownership persists even when alternative mobility options, such as public transport or improved pedestrian networks, are available. Thus, car use becomes embedded in everyday mobility habits and social norms, reinforcing resistance to walking even in areas with suitable infrastructure.

Social practices and habits also emerged as barriers. As shown by the survey conducted in the historic centre of Palermo, many citizens are unaware of existing sustainable mobility initiatives or undervalue walkability improvements because these are not integrated into their daily mobility culture. This reveals a gap between the provision of infrastructure and its actual use and acceptance by the public.

To address these barriers, urban planning strategies must move beyond spatial interventions alone. As it is explained at the beginning of this chapter (10.1), strategies targeting a socio-cultural shift should be utilised along with spatial interventions. Prioritising pedestrians in daily urban life and designing our cities according to this approach is a first step to foster this shift. In sum, overcoming barriers to walkability requires a combined socio-spatial strategy that simultaneously transforms the built environment and the cultural frameworks within which mobility choices are made.

Concerning the implementation of models like the 15-minute city and TOD the findings suggest that while these models offer valuable guidance, their application in cities like Palermo must be adapted to the socio-spatial realities on the ground. Rather than attempting an immediate and full realisation of the 15-minute city model, the thesis proposes an incremental focus on enhancing walkability around transit nodes and densifying mixed-use functions. TOD principles, emphasising the walkability of catchment areas, provide a more operational starting point. Ultimately, both models can support the shift toward sustainable mobility if they are rooted in a deep understanding of local travel behaviour and urban form.

Finally, the study underscores the importance of travel behaviour data in designing walkability strategies. The survey conducted in Palermo's historic centre demonstrates that understanding public perceptions, preferences, and barriers reveals critical insights into how walkability is experienced and where interventions are most needed. Behavioural data also illuminate the gap between the existence of alternative mobility options and their actual use, pointing to underlying cultural resistances that must be addressed. In this sense, behavioural insights become indispensable for shaping both the spatial and cultural dimensions of walkability policies.

In conclusion, this research shows that promoting walkability in car-dependent cities requires an integrated approach that combines spatial reconfiguration with social and behavioural transformation. Addressing both the built environment and the socio-cultural barriers is essential for creating cities that are not only more accessible and sustainable but also more inclusive, liveable, and resilient in the long term.

10.5 Future direction of the research

This research explored the socio-cultural and spatial barriers to walkability in car-dependent urban contexts, using Palermo as a case study. It combined spatial analysis, integration of 15-minute city and TOD principles, and survey-based assessments to reveal how urban planning, mobility infrastructure, and social attitudes interplay to shape pedestrian accessibility.

The study confirms that while improvements in urban design and public transport infrastructure are necessary, they alone are not sufficient to shift mobility patterns. Deeply ingrained cultural attachments to the private car, perceptions of safety and convenience, and gaps in pedestrian-friendly environments continue to discourage walking even where conditions are favourable. These findings align with existing literature on sustainable mobility but extend it by offering a deeper socio-cultural interpretation in a Southern European, car-dependent context, an area that remains underexplored.

The originality of the research lies in its combined socio-spatial approach, integrating walkability indicators from the 15-minute city and TOD models while emphasising behavioural and cultural dimensions. By doing so, the study contributes to more comprehensive frameworks for promoting pedestrianisation in cities where car dominance is not only infrastructural but also cultural.

From a practical standpoint, the research offers valuable insights for urban planners, policymakers, and local authorities. Recommendations based on the Palermo case can inform mobility strategies in other Mediterranean cities facing similar challenges, focusing on pedestrian infrastructure, integrating first/last-mile accessibility, and actively reshaping mobility culture.

Limitations

Despite its contributions, the study faces several limitations. First, the spatial analysis focuses primarily on two railway catchment areas and the historic centre, providing important but geographically partial insights. A broader coverage, including suburban and peri-urban areas, would offer a more complete picture. Besides, examining the entire catchment area of the railway link is necessary to make a definite judgement on the essential policy recommendations.

Second, although the survey provided rich information on perceptions of walkability and pedestrianisation, the sample size was limited to Old Town users. A larger and more diverse sampling across different city districts would strengthen the generalisability of the findings.

Third, the study did not conduct a full-scale quantitative evaluation of proximity in the 15-minute city framework, as such an analysis would require extensive land-use, service, and micro-mobility datasets beyond the scope of this project. Thus, while the study addresses walkability and accessibility, it cannot claim to have fully operationalised the 15-minute city model for Palermo.

Moreover, behavioural factors such as personal security concerns, gender-specific perceptions of walkability, or socio-economic disparities influencing mobility choices could be explored in greater depth with additional qualitative research methods such as interviews or focus groups.

Future Research Directions

Future research could build upon the foundations of this study in several critical ways. One promising direction involves expanding the spatial analysis of walkability and pedestrian accessibility through a more comprehensive and multi-scalar assessment. While this research adopted a largely sufficientarian approach, assuming that the presence of adequate infrastructure within station catchment areas enables individuals to walk and to access public transport, the reality of mobility is far more complex. To design truly meaningful interventions that support walking and public transport use, future studies should integrate frameworks such as the Capability Approach. This perspective shifts the focus from merely providing infrastructure to understanding whether individuals have the real freedom and opportunity to make use of it. It acknowledges that personal, social, and environmental factors, such as age, physical ability, cultural expectations, or perceived safety, can significantly influence one's ability to benefit from available services. Moving beyond assumptions of equal usability, research must explore how to transform access into effective opportunities, enabling individuals to fully participate in urban life and achieve mobility in a way that is both equitable and empowering.

Another possible improvement is that while this study focused on selected areas within the urban core, extending the analysis to encompass Palermo's entire urban fabric, including peripheral and suburban neighbourhoods, would allow for a more nuanced understanding of accessibility disparities and spatial injustices. Such a broader scope could uncover hidden barriers and inform more inclusive and geographically balanced urban policies.

Additionally, a dedicated investigation into the operationalisation of the 15-minute city concept would be beneficial. While this thesis addressed the model's core principles, such as walkability and car dependency, a systematic evaluation of proximity to essential services like schools, healthcare, shops, and public spaces, based on strict 15-minute thresholds, would offer a clearer picture of the concept's applicability in Palermo. This focused analysis could also help identify critical gaps and inform more targeted urban interventions.

Understanding the deeper social and psychological dimensions of mobility behaviour represents another essential research avenue. Employing mixed-methods approaches, such as ethnographic fieldwork, in-depth interviews, or participatory observation, could reveal latent cultural norms, symbolic associations, or emotional ties to car use that remain inaccessible through standard surveys. This would significantly enrich the interpretation of mobility patterns and better inform policies aimed at behavioural change.

Moreover, conducting longitudinal studies would provide valuable insights into the long-term effectiveness of sustainable mobility interventions. Monitoring changes over time, particularly following the implementation of large-scale infrastructure projects like the expansion of the tram network, could help assess the real impact of such measures on travel behaviour, modal shifts, and reductions in car dependency. Longitudinal data would also allow for iterative policy adjustments and a more adaptive planning approach.

Finally, comparative research with other Southern European cities facing similar structural and cultural constraints would help place Palermo's experience within a broader context. By analysing parallel cases, future studies could extract transferable lessons and better understand the contextual factors that enable or hinder the success of pedestrianisation strategies and sustainable mobility policies. Such comparisons could enhance the transferability of the findings and contribute to a shared body of knowledge on equitable urban transformation in car-dependent regions.

In sum, while the research provides important insights into walkability and mobility culture in car-dependent cities, it also highlights the need for ongoing, interdisciplinary investigation to fully realise the shift toward more sustainable, pedestrian-friendly urban environments.

BIBLIOGRAPHY

A Better City. (2016). *A guide for placemaking for mobility*. Boston, USA: A Better City.

Abdelfattah, L., Deponte, D., & Fossa, G. (2022). The 15-minute city: Interpreting the model to bring out urban resiliencies. *Transportation Research Procedia, 60*, 330–337.

Abbiasov, T., Heine, C., Sabouri, S., Salazar-Miranda, A., Santi, P., Glaeser, E., & Ratti, C. (2024). The 15-minute city quantified using human mobility data. *Nature Human Behaviour, 8*, 1–11.

Adelfio, M., & Hamiduddin, I. (2014). Transit-oriented mixed communities: Social sustainability lessons from case studies of Germany and Spain. *Proceedings of the ITRN2014,* Limerick, Ireland.

Ahmadipour, F., Mamdoohi, A. R., & Wulf-Holger, A. (2021). Impact of built environment on walking in the case of Tehran, Iran. *Journal of Transport & Health, 22*, 101083.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179–211.

Anokye, N. K., Trueman, P., Green, C., Pavey, T. G., & Taylor, R. S. (2012). Physical activity and health-related quality of life. *BMC Public Health, 12*(1).

Appleyard, D., Gerson, M. S., & Lintell, M. (1981). *Livable streets.* Berkeley: University of California Press.

Arroyo, R., Ruiz, T., Mars, L., Rasouli, S., & Timmermans, H. (2020). Influence of values, attitudes towards transport modes and companions on travel behaviour. *Transportation Research Part F: Traffic Psychology and Behaviour, 71*, 8–22.

Axhausen, K. W. (2005). Social networks and travel: Some hypotheses. In Donaghy, K., Poppelreuter, S., & Rudinger, G. (Eds.), *Social Dimensions of Sustainable Transport: Transatlantic Perspectives* (pp. 90-108). Aldershot: Ashgate.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84(2)*, 191–215.

Banister, D., & Hickman, R. (2006). How to design a more sustainable and fairer built environment: Transport and communications. *IEE Proceedings - Intelligent Transport Systems, 153(4)*, 276.

Banister, D. (2008). The sustainable mobility paradigm. *Transport Policy, 15(2)*, 73–80.

Banister, D., & Anable, J. (2009). Transport policies and climate change. *Planning for Climate Change: Strategies for Mitigation and Adaptation for Spatial Planners*, 249-262.

Barker, J. (2014). Aspirations for automobility: Family geographies and the production of young people's aspirations for cars. *Families, Relationships and Societies, 3(2),* 167–183.

Behren, S. von, Minster, C., Esch, J., Hunecke, M., Vortisch, P., & Chlond, B. (2018). Assessing car dependence: Development of a comprehensive survey approach based on the concept of a travel skeleton. *Transportation Research Procedia, 32,* 607–616.

Belgiawan, P. F., Schmöcker, J. D., Abou-Zeid, M., Walker, J., & Fujii, S. (2017). Modelling social norms: Case study of students' car purchase intentions. *Travel Behaviour and Society, 7,* 12–25.

Bento, A., Cropper, M., Mobarak, A., & Vinha, K. (2005). The effects of urban spatial structure on travel demand in the United States. *The Review of Economics and Statistics, 87(3),* 466-478.

Bertolini, L. (1999). Spatial development patterns and public transport: The application of an analytical model in the Netherlands. *Planning Practice and Research, 14(2),* 199–210.

Bertolini, L. (2000). Planning in the borderless city: A conceptualization and an application to the case of station area redevelopment. *Town Planning Review, 71(4),* 455–475.

Bertolini, L., le Clercq, F., & Kapoen, L. (2005). Sustainable accessibility: A conceptual framework to integrate transport and land use plan-making. Two test-applications in the Netherlands and a reflection on the way forward. *Transport Policy, 12(3),* 207–220.

Bertolini, L. (2010). Transit-oriented development. *Sage, Thousand Oaks, CA.*

Boarnet, M. G., & Crane, R. (2001). *Travel by design.* Oxford University Press.

Boarnet, M. (2011). Longer view: A broader context for land use and travel behaviour, and a research agenda. *Journal of the American Planning Association, 77(3),* 197–213.

Borgers, A. W. J., Hofman, F., & Timmermans, H. J. P. (1997). Activity-based modelling: Prospects. In Ettema, D. F., & Timmermans, H. J. P. (Eds.), *Activity-Based Approaches to Travel Analysis* (pp. 339-352). Oxford: Elsevier.

Bourdieu, P. (1977). *Outline of a theory of practice* (R. Nice, Trans.). Cambridge: Cambridge University Press.

Braess, D. (1969). Über ein Paradoxon aus der Verkehrsplanung. *Unternehmensforschung, 12,* 258–268.

Brindle, R. (2003). Kicking the habit: Some musings over the meaning of "car dependence." *Road and Transport Research, 12(3), 61-73.*

Brown, A. L., Khattak, A. J., & Rodriguez, D. A. (2008). Neighbourhood types, travel, and body mass: A study of new urbanist and suburban neighbourhoods in the US. *Urban Studies, 45(4),* 963 – 988.

Brown, J., Morris, E., & Taylor, B. (2009). Planning for cars in cities: Planners, engineers, and freeways in the 20th century. *Journal of the American Planning Association, 75(2),* 161-177.

Browne, D. H., Herrin, R. H., & Khattak, A. (2009). The role of neighbourhood attributes in promoting walking for physical activity. *Preventive Medicine, 49(2),* 139-145.

Bruegmann, R. (2005). *Sprawl: A compact history.* University of Chicago Press.

Brunet, R. (2011). Geographical space production: Systems and laws. In *Sustainable Geography* (pp. 6–13). ISTE.

Calthorpe, P. (1993). *The next American metropolis: Ecology, community, and the American dream.* Princeton Architectural Press.

Cervero, R., & Kockelman, K. (1997). Travel demand and the 3Ds: Density, diversity, and design. *Transportation Research Part D: Transport and Environment, 2(3),* 199–219

Cervero, R. (2001). Walk-and-ride: factors influencing pedestrian access to transit. *Journal of Public Transportation, 3(4),* 1–23.

Cervero, R., Murphy, S., Ferrel, C., Goguts, N., Tsai, Y.-H., Arrington, G. B., … Witenstein, N. (2004). *TCRP Report 102 Transit-Oriented Development in the United States: Experiences, Challenges, and Prospects.* Washington D.C.: The Federal Transit Administration in Cooperation with the Transit Development Corporation.

Cervero, R. (2012). Transit-Oriented Development and Land Use. In Meyers, R.A. (Ed.), *Encyclopedia of Sustainability Science and Technology*. Springer, New York, NY.

Chen, C. F., & Chao, W. H. (2011). Habitual or reasoned? Using the theory of planned behaviour, technology acceptance model, and habit to examine switching intentions toward public transit. *Transportation Research Part F: Traffic Psychology and Behaviour, 14(2),* 128–137.

Chorus, C., & Timmermans, H. (2009). Empirical study into influence of travel behaviour on stated and revealed mental maps. *Proceedings of the Transportation Research Board 88th Annual Meeting,* Washington D.C.

Cilliers, E. J., & Timmermans, W. (2014). The importance of creative participatory planning in the public place-making process. *Environment and Planning B: Planning and Design, 41(3),* 413–429.

Città di Palermo Assessorato all'urbanistica e alla Rigenerazione Urbana. (2023). *Direttive Generali per la formazione del Piano Urbanistico Generale (PUG) del Comune di Palermo.*

Cohen, N., Rubinchik, A., & Shami, L. (2020). Towards a cashless economy: Economic and socio-political implications. *European Journal of Political Economy, 61,* 101820.

Collantes, G. O., & Mokhtarian, P. L. (2007). Subjective assessments of personal mobility: What makes the difference between a little and a lot? *Transport Policy, 14*, 181-192.

Comune di Milano, Bloomberg Associates, & Global Designing Cities. (2022). *PIAZZE APERTE: A Public Space Program for Milan.* Comune di Milano.

Chong, S., Lam, W., & Chan, C. (2010). Pedestrian level of service for sidewalk design in high-density urban areas. *Transportation Research Record: Journal of the Transportation Research Board, 2198(1)*, 28-37.

Cooley, C. H. (1909). *Social Organization: A Study of the Larger Mind.* New York: Charles Scribner's Sons.

Curtis, C. (2012). Delivering the "D" in transit-oriented development: Examining the town planning challenge. Journal of Transport and Land Use, 5(3).

Çörek Öztaş, Ç., & Akı, M. (2014). *İstanbul Tarihi Yarimada Yayalaştirma Projesi Mevcut Durum Değerlendirmesi.* Istanbul: EMBARQ Türkiye.

Dahir, J. (1947). Background of the Neighbourhood Unit Plan. In *The Neighbourhood Unit Plan, Its Spread and Acceptance: A Selected Bibliography with Interpretative Comments* (pp. 16–23). New York, USA: Russel Sage Foundation.

Dargay, J. M., & Hanly, M. (2003). The impact of land use patterns on travel behaviour. Presented at the *European Transport Conference, Strasbourg, France.*

David, Q., Janiak, A., & Wasmer, E. (2010). Local social capital and geographical mobility. *Journal of Urban Economics, 68(2)*, 191–204.

Davis, R., Campbell, R., Hildon, Z., Hobbs, L., & Michie, S. (2015). Theories of behaviour and behaviour change across the social and behavioural sciences: A scoping review. *Health Psychology Review, 9(3)*, 323–344.

Davoudi, S., Peter Hall, S., & Power, A. (2008). Key issues for planning futures and the way forward. *Twenty-First Century Society, 3(3)*, 229–247.

Day, K. (2003). New urbanism and the challenges of designing for diversity. *Journal of Planning Education and Research, 23(1)*, 83–95.

Deakin, M., Mitchell, G., Vreeker, R., & Nijkamp, P. (Eds.). (2007). *Sustainable Urban Development: The Environmental Assessment Methods* (Vol. 2, p. 365). Routledge.

Deboosere, R., El-Geneidy, A. M., & Levinson, D. (2018). Accessibility-oriented development. *Journal of Transport Geography, 70*, 11–20.

De Bourdeaudhuij, I. D., Sallis, J. F., & Saelens, B. E. (2003). Environmental correlates of physical activity in a sample of Belgian adults. *American Journal of Health Promotion, 18(1),* 83–92.

Dembski, F., Wössner, U., Letzgus, M., Ruddat, M., & Yamu, C. (2020). Urban Digital Twins for smart cities and citizens: The case study of herrenberg, Germany. *Sustainability, 12*(6), 2307.

Dennis, K., & Urry, J. (2009). *After the car*. Cambridge, England: Polity Press.

De Spuches G, Guarrasi V, Picone M (2002) *La città incompleta.* Palumbo, Palermo

Di Dio, S., Lo Casto, B., Micari, F., Rizzo, G., Vinci, I. (2015). Mobility, data and behaviour: the TrafficO2 case study. In: Vesco A, Ferrero F (eds) *Handbook of research on social, economic, and environmental sustainability in the development of smart cities*. IGI Global, Hershey.

Dieleman, F., & Wegener, M. (2004). Compact City and Urban Sprawl. *Built Environment, 30*(4), 308–323.

Di Leo P, Esposito G. (1991) *Palermo: Pianificazione urbana e Metropolitana. Due studi*. In: Atti del Seminario dell'INU, Palermo, 28–29.

Di Leo P (1997) *Area metropolitana di Palermo. Città e Territorio*, Bollettino del Dipartimento della Città e Territorio dell'Università di Palermo 3, 72–79.

Dolce, A., Barbera, P., Rosone, R. M., & Patti, A. (2020). *Città Metropolitana di Palermo Identità e Fabbisogni nel Contesto Nazionale e Interno Dossier Metropolitano* (pp. 1–96). Palermo: Città Metropolitana di Palermo.

Donald, I. J., Cooper, S. R., & Conchie, S. M. (2014). An extended theory of planned behaviour model of the psychological factors affecting commuters' transport mode use. *Journal of Environmental Psychology,* 40, 39–48.

D'Onofrio, R., & Trusiani, E. (2022). The Future of the City in the Name of Proximity: A New Perspective for the Urban Regeneration of Council Housing Suburbs in Italy after the Pandemic. *Sustainability,* 14(3), 1252.

Donovan, T. M., Buchan, B., Ayeva, L., Prestemon, D. H., & Scheibla, M. E. (2011). City green spaces and local temperature regulation effects. *Landscape Ecology*, 26(6), 155-165.

Duany, A., & Plater-Zyberk, E. (1991). *Towns and town making principles*. New York, NY: Rizzoli.

Duany, A., Plater-Zyberk, E., & Speck, J. (2001). *Suburban nation: The rise of sprawl and the decline of the American dream.* New York: North Park Press.

Duffhues, J., & Bertolini, L. (2015). From integrated aims to fragmented outcomes: urban intensification and transportation planning in the Netherlands. *Journal of Transport and Land Use, 9*(3).

El-Geneidy, A. and Levinson, D. (2011). Place rank: Valuing spatial interactions. *Networks and Spatial Economics*, 11(4), 643–659.

Elldér, E., Larsson, A., Solá, A. G., & Vilhelmson, B. (2017). Proximity changes to what and for whom? Investigating sustainable accessibility changes in the Gothenburg city region 1990–2014. *International Journal of Sustainable Transportation*, 12(4), 271–285.

Elldér, E. (2025). Exploring socio-economic inequalities in access to the 15-minute city across 200 Swedish built-up areas. *Journal of Transport Geography, 122*, 104060.

Ellis, C. (2002). The New Urbanism: Critiques and rebuttals, *Journal of Urban Design*, *7*(3), pp. 261–291.

European Commission: Directorate-General for Environment. (2004). *Reclaiming city streets for people : chaos or quality of life ?*. Publications Office.

European Union. (2007). *Leipzig Charter on Sustainable European Cities*. Leipzig, 24-25 May 2007. Information on Spatial Development, 2010(4), 315-319.

Ewing, R., Pendall, R., & Chen, D. (2002). *Measuring sprawl and its impacts*. Smart Growth America.

Ewing, R., & Cervero, R. (2010). Travel and the Built Environment. *Journal of the American Planning Association*, 76(3), 265–294.

Ewing, R. H., Bartholomew, K., Burden, D., Cloyton, H. J., Brown, L., & Ebrary, I. (2013). *Pedestrian- and transit-oriented design*. Washington, DC: Urban Land Institute.

Ewing, R., Hamidi, S., Grace, J. & Wei, D. (2016). Does sprawl hold down upward mobility? *Landscape and Urban Planning*, 148, 80 – 88.

Ewing, R., & Cervero, R. (2017). "Does Compact Development Make People Drive Less?" The Answer Is Yes. *Journal of the American Planning Association*, 83(1), 19–25.

Fayyaz, M., González-González, E., & Nogués, S. (2022). Autonomous mobility: A potential opportunity to reclaim public spaces for people. *Sustainability*, *14*(3), 1568.

Federal Highway Administration (2022, April). *Pedestrian Lighting Primer*. FHWA-SA-21-087. Washington, D.C.

Ferreira, A., & Batey, P. (2007). Re-thinking accessibility planning: A multi-layer conceptual framework and its policy implications. *Town Planning Review*, *78*(4), 429–458.

Ferrer-Ortiz, C., Marquet, O., Mojica, L., & Vich, G. (2022). Barcelona under the 15-minute city Lens: Mapping the Accessibility and Proximity Potential Based on Pedestrian Travel Times. *Smart Cities*, *5*(1), 146–161.

Forsyth, A. (2015). What is a walkable place? The walkability debate in urban design. *Urban Design International*, *20*(4), 274–292.

Frank, L.D., Pivo, G., 1994. Impacts of mixed use and density on utilization of three modes of travel: single occupant vehicles, transit, and walking. *Transportation Research Record* 1466, 44–52.

Fransen, K., Deruyter, G., & De Maeyer, P. (2018). The impact of driver's license ownership on unemployed job seekers' access to job openings: Assessing the driver's license at School project in Flanders. *Case Studies on Transport Policy*, *6*(4), 695–705.

Fransen, K., & Farber, S. (2019). Using person-based accessibility measures to assess the equity of transport systems. In *Measuring transport equity* (pp. 57–72). Amsterdam: Elsevier.

Fraser, S. D. S., & Lock, K. (2010). Cycling for Transport and Public Health: A systematic review of the effect of the environment on Cycling. *European Journal of Public Health*, *21*(6), 738–743.

Fulton, W. (1996). *The New Urbanism: Hype or hope for American communities*? Cambridge, MA: Lincoln Institute of Land Policy.

Galster, G. et al. (2001). Wrestling sprawl to the ground: Defining and measuring an elusive concept, *Housing Policy Debate*, *12*(4), 681-718.

García, J., Mars, L., Arroyo, R., Casquero, D., di Ciommo, F., & Ruiz, T. (2019). Personal values, attitudes and travel intentions towards cycling and walking, and actual behaviour. *Sustainability* (Switzerland), *11*(13), 1–20.

Garde, A. (2006). Designing and developing New Urbanist projects in the United States: Insights and implications. *Journal of Urban Design*, *11*(1), 33–54.

Garde, A. (2019). The future of urbanism. In E. Talen (Ed.), *A research agenda for New Urbanism* (pp. 153–165). Northampton, MA: Edward Elgar.

Garde, A. (2020). New urbanism: Past, present, and future. Urban Planning, 5(4), 453–463. Giles-Corti, B., Kelty, S. F., Zubrick, S. R., & Villanueva, K. P. (2009). Encouraging Walking for Transport and Physical Activity in Children and Adolescents. *Sports Medicine*, *39*(12), 995–1009.

Gemzøe, L. (2013). Cities for People – Copenhagen studies in urban life. In J. C. Dextre, M. Hughes, & L. Bech (Eds.), *Cyclists & Cycling Around the World Lars Gemzøed – Creating Liveable and Bikeable Cities*. Peru: Fondo Editorial, Pontificia Universidad Católica del Perú.

Geurs, K., & van Eck, J. (2001). Accessibility measures: review and applications. Evaluation of accessibility impacts of land-use transportation scenarios, and related social and economic impact.

Geurs, K., & van Wee, B. (2004). Accessibility research: State of the art and future directions. *Journal of Transport Geography*, 12(2), 141-151.

Gehl, J. (2010). *Cities for people*. Washington, Dc: Island Press.

Giampino A, Picone M, Todaro, V. (2014) Postmetropoli in contesti al margine. *Planum*, *2*(29), 1308–1316

Giddens, A. (2006). *Sociology* (5th ed.). Cambridge: Polity Press.

Gifford, R., & Nilsson, A. (2014). Personal and Social Factors That Influence pro-environmental Concern and behaviour: a Review. *International Journal of Psychology*, *49*(3), 141–157.

Gil Solá, A., & Vilhelmson, B. (2018). Negotiating proximity in sustainable urban planning: A Swedish case. *Sustainability*, 11(1), 31.

Giles-Corti, B., Kelty, S. F., Zubrick, S. R., & Villanueva, K. P. (2009). Encouraging Walking for Transport and Physical Activity in Children and Adolescents. *Sports Medicine*, *39*(12), 995–1009.

Grasso A. (1994) *Le Aree metropolitane siciliane. Funzioni, vincoli, strategie*. Pàtron, Bologna.

Golledge, R.G. and Stimson, R.J. (1997) *Spatial Behaviour: A Geographic Perspective*. New York: The Guildford Press.

Golledge, R.G. and Zanaras, G. (1973) Cognitive approaches to the analysis of human spatial behaviour, in: Ittelson, W.H. (Ed.) *Environment and Cognition*, pp. 59-94 New York: Seminar Press.

Goodwin, Phil, 1995. Car Dependence, *Transport Policy*, *2*(3), pages 151-152,

Gordon, P., 1997. Densities, urban form, and travel behaviour. *Town and Country Planning*, *66* (9), 239–241

Gordon, P., Richardson, H.W., 1997. Are compact cities a desirable planning goal? *Journal of the American Planning Association*, 63 (1), 95–106.

Gorham, R. (2002). Car Dependence as a Social Problem: A critical essay on the existing literature and future needs. In: Black, W. & Nijkamp, P., *Social change, and sustainable transport.* Bloomington: Indiana University Press (6) 107-115.

Götz, K., Deffner, J., (2009). Eine neue Mobilitätskultur in der Stadt – praktische Schritte zur Veränderung. In: Bundesministerium für Verkehr, Bau u. Stadtentwicklung (Eds.), *Urbane Mobilität. Verkehrsforschung des Bundes für die kommunale* Praxis. NW-Verlag, Bremerhaven, 39–52.

Gutiérrez, A. (2005). *Las prácticas sociales: una introducción a Pierre Bourdieu.* Ferreyra Editor.

Hamer, M.; Stamatakis, E.; Steptoe, A. (2009). Dose-Response Relationship between Physical Activity and Mental Health: The Scottish Health Survey. Br. J. *Sports Med., 43*, 1111–1114.

Hamidi, S., & Ewing, R. (2015). Is sprawl affordable for Americans? Exploring the association between housing and transportation afford-ability and urban sprawl. Transportation Research Record: *Journal of the Transportation Research Board*, 2500, 75 – 79.

Handy, S. L. (1992). Regional versus local accessibility: Neo-traditional development and its implications for non-work travel. *Built Environment, 18*(4), 253–267.

Handy, S. (1993). A Cycle of Dependence: Automobiles, Accessibility, and the Evolution of the Transportation and Retail Hierarchies. *Berkeley Journal, 8*, 21-43.

Handy, S., van Wee, B., & Kroesen, M. (2014). Promoting cycling for transport: Research needs and challenges. *Transport Reviews, 34*(1), 4–24.

Handy, S., Weston, L., & Mokhtarian, P. L. (2005). Driving by choice or necessity? *Transportation Research Part A: Policy and Practice, 39*(2-3), 183–203.

Handy, S. (2020). Is accessibility an idea whose time has finally come? *Transportation Research Part D: Transport and Environment, 83*, Article 102319.

Hansen, K. B., & Nielsen, T. A. (2014). Exploring characteristics and motives of long-distance commuter cyclists. *Transport Policy, 35*, 57–63.

Hansen, T. (2014). Substitution or Overlap? The Relations between Geographical and Non-spatial Proximity Dimensions in Collabourative Innovation Projects. Regional Studies, 49(10), 1672–1684.

Hanson S. (2004) The context of urban travel: Concepts and recent trends. In: Hanson S, Giuliano G (eds) The geography of urban transportation. Guilford Press, New York.

Harms, L. (2008). Overwegend onderweg. De leefsituatie en de mobiliteit van Nederlanders. Den Haag: Sociaal Cultured Planbureau .

Haugen, K. (2011). The Advantage of "Near": Which Accessibilities Matter to Whom. *European Journal of Transport and Infrastructure Research, 11*(4).

Heffernan, E., Heffernan, T., & Pan, W. (2013). The relationship between the quality of active frontages and public perceptions of public spaces. *URBAN DESIGN International, 19*(1), 92–102.

Heinen, E., van Wee, B., & Maat, K. (2010). Commuting by bicycle: An overview of the literature. *Transport Reviews, 30*(1), 59–96.

Heinonen, J., Czepkiewicz, M., Árnadóttir, Á, & Ottelin, J. (2021). Drivers of car ownership in a car-oriented city: A mixed-method study. *Sustainability, 13*(2), 619–626.

Hillnhütter, H. (2016). *Pedestrian Access to Public Transport*. University of Stavanger.

Holden, E., Gilpin, G., & Banister, D. (2019). Sustainable Mobility at Thirty. *Sustainability*, 11(7), 1965.

Hu, S., & Meyerhoff, J. (2017). Pedestrian crossing behaviour at marked mid-block crosswalks with countdown pedestrian signals. *Accident Analysis & Prevention*, 108, 125-133.

Hunt, J.D., Abraham, J.E. (2007) Influences on bicycle use. *Transportation 34*, 453–470.

Ibraeva, A., de, H., Silva, C., & António Pais Antunes. (2022). Impacts of transit-oriented development on car use over a 10-year period in Porto, Portugal: From macro- to micro-analysis. *International Journal of Sustainable Transportation*, *17*(11), 1195–1206.

Igreja, J., Sezer, E., Vinci, I. (2024). Exploring transport inequalities in Palermo and Naples. The role of spatial accessibility to the rail system. In A. Gospodini (a cura di), *Proceedings of the International Conference on Changing Cities VI: Spatial, Design, Landscape, Heritage & Socio-economic Dimensions* (pp. 1403-1412). Volos : University of Thessaly, Department of Planning and Regional Development, Research Unit of Urban Morphology and Design.

Il Dipartimento della Programmazione della Regione Siciliana. (2024). *PR FESR 2021/2027 – Territorial Strategy of the Functional Urban Area of Palermo*. Regione Siciliana.

Istanbul Site Management Directorate (2011). *Istanbul Historic Peninsula Management Plan*.

ISTAT. (2011). Indicatorid Comunali 2011 per Area di Censimento. Rome: Istituto Nazionale di Statistica.

Jacobs, J. (1961). *The Death and Life of Great American Cities.* New York: Random House.

Jaskiewicz, F. (2001). *Pedestrian level of service based on trip quality*. Transportation Research Board Circular E-C019: Urban Street Symp., Transportation Research Board, Washington, D.C.

Jeekel, H. (2013). *The Car-dependent Society*. Farnham: Ashgate Publishing Group.

Jeong, J., Lee, J., & Gim, T. T. (2022). Travel mode choice as a representation of travel utility: A multilevel approach reflecting the hierarchical structure of trip, individual, and neighbourhood characteristics. *Papers in Regional Science*, *101*(3), 745–765.

Jones, P. (2011), Conceptualising car 'Dependence.' In K. Lucas, E. Blumenberg & R. Weinberger (Eds.), *Auto motives. Understanding car use behaviours* (39-62). Bingley, UK: Emerald.

Jones, P.M., Sloman, L., (2003). Encouraging behavioural change through marketing and management: what can be achieved? Paper presented at the 10th International Conference on *Travel Behaviour Research*, Lucerne, Switzerland.

Kakderi, C., Komninos, N., Panori, A., & Oikonomaki, E. (2021). Next City: Learning from Cities during COVID-19 to Tackle Climate Change. *Sustainability, 13*(6), 3158.

Kamruzzaman, L. (2022). Typologies of 20-minute neighbourhoods, active transport use, and spatial spillovers, *Findings*.

Kaufmann, V., Bergman, M. M., & Joye, D. (2004). Motility: mobility as capital. International *Journal of Urban and Regional Research, 28*(4), 745–756.

Keizer, K., & Schultz, P. W. (2018). Social norms and pro-environmental behaviour. *Environmental Psychology: An Introduction*, 179–188.

Kenworthy, J. R., & Laube, F. B. (1999). Patterns of automobile dependence in cities: an international overview of key physical and economic dimensions with some implications for urban policy. *Transportation Research Part A: Policy and Practice, 33*(7-8), 691–723.

Kesici, N., & Erkan, N. Ç. (2023). The effect of public facade characteristics on changing pedestrian behaviors. *Journal of Architecture and Urbanism, 47*(1), 68–76.

Khavarian-Garmsir, A. R., Sharifi, A., Hajian Hossein Abadi, M., & Moradi, Z. (2023). From Garden City to 15-minute city: A Historical Perspective and Critical Assessment. *Land, 12*(2), 512.

Kim, J., & Kaplan, R. (2004). Physical and psychological factors in sense of community: New Urbanist Kentlands and nearby Orchard Village. *Environment and Behaviour,* 36 (3), 313 – 340.

Kim, S. H., & Seock, Y. K. (2019). The roles of values and social norm on personal norms and pro-environmentally friendly apparel product purchasing behaviour: The mediating role of personal norms. *Journal of Retailing and Consumer Services*, 51, 83–90.

Klinger, T., Kenworthy, J. R., & Lanzendorf, M. (2013). Dimensions of urban mobility cultures – a comparison of German cities. *Journal of Transport Geography, 31*, 18–29.

Klöckner, C. A., & Friedrichsmeier, T. (2011). A multi-level approach to travel mode choice—How person characteristics and situation specific aspects determine car use in a student sample. *Transportation Research Part F: Traffic Psychology and Behaviour, 14*(4), 261–277.

Kockelman, K., Siethoff, B., Walton, M., & Mahmassani, H. (2002). *Research on relationships between transportation infrastructure & increase in vehicle miles travelled: The effects of highway capacity expansion on land development.* Final technical report for the U.S. Environmental Protection Agency. Austin: Centre for Transportation Research. University of Texas.

Krzepota J, Sadowska D, Biernat E. (2018). Relationships between Physical Activity and Quality of Life in Pregnant Women in the Second and Third Trimester. *International Journal of Environmental Research and Public Health, 15*(12), 2745.

Kukkonen, J., Kangas, L., Kauhaniemi, M., Sofiev, M., Aarnio, M., Jaakkola, J. J. K., … Karppinen, A. (2018). Modelling of the urban concentrations of PM2.5 on a high resolution for a period of 35 years, for the assessment of lifetime exposure and health effects. *Atmospheric Chemistry and Physics, 18*(11), 8041–8064.

Kyoto Club - CNR-IIA. (2023). *Mobilità 2030: Aria Pulita, Decarbonizzazione e Spazi Sicuri nelle Grandi Città Italiane* (Pp. 142–147).

Landman, K. (2020). Inclusive public space: rethinking practices of mitigation, adaptation and transformation. *URBAN DESIGN International*, 25, 211–214.

Langer, M., Duran-Rodas, D., & Pajares, E. (2023). Exploring a quantitative assessment approach for car dependence: a case study in Munich. *Journal of Transport and Land Use, 16*(1), 87-104.

Lanzendorf, M. (2002). Mobility Styles and Travel Behavior: Application of a Lifestyle Approach to Leisure Travel. Transportation Research Record: Journal of the *Transportation Research Board, 1807*(1), 163–173. https://doi.org/10.3141/1807-20

Leonardi, R. 2005. *Cohesion Policy in the European Union.* Basingstoke: Palgrave Macmillan.

Levine, J. (2020). A century of evolution of the accessibility concept. *Transportation Research Part D,* 83.

Leyden, K. M. (2003). Social capital and the built environment: The importance of walkable neighbourhoods. *American Journal of Public Health*, *93* (9), 1546 – 1551.

Lo Piccolo, F. (1996). Urban Renewal in the Historic Centre of Palermo. *Planning Practice & Research, 11*(2), 217 - 226.

Lo Piccolo F (2009) Territori agricoli a latitudini meridiane: residui marginali o risorse identitarie? In: Lo Piccolo F (ed) *Progettare le identità del territorio*. Alinea, Florence, 11 – 42.

Lo Piccolo F, Picone M, Schilleci F (2013) Forme di territori post-metropolitani siciliani: un contest al margine. *Planum 27*(2), 46–51.

Lotta F (2015) Palermo. In: De Luca G, Moccia D (eds) *Immagini di territori metropolitani*. INU Edizioni, Rome, pp 114 –119.

Lotta, F., Picone, M., Schilleci, F. (2017). Palermo : an incomplete post-metropolitan area. *In A. Balducci, V. Fedeli, Curci F (a cura di), Post-Metropolitan Territories. Looking for a New Urbanity* (pp. 161-182). Abingdon: Routledge.

Louiza, H., Zéroual, A., & Djamel, H. (2015). Impact of the Transport on the Urban Heat Island. *International Journal for Traffic and Transport Engineering*, *5*(3), 252–263.

Lyu, G., Bertolini, L., & Pfeffer, K. (2020). How does transit-oriented development contribute to station area accessibility? A study in Beijing. *International Journal of Sustainable Transportation*, *14*(7), 533 - 543.

Macharia, P. M., Ray, N., Giorgi, E., Okiro, E. A., & Snow, R. W. (2021). Defining service catchment areas in low-resource settings. *BMJ Global Health, 6*(7), e006381.

Mackett, R. L. (2002). Increasing car dependency of children: Should we be worried? Municipal Engineer, 151(1), 29 – 38.

Magnaghi, A. (2013). Riterritorializzare il mondo. *Scienze del Territorio 1*, 31 – 42.

Majed, L., Ibrahim, R., Merilyn Jean Lock, & Jabbour, G. (2024). Walking around the preferred speed: examination of metabolic, perceptual, spatiotemporal and stability parameters. *Frontiers in Physiology*, *15*.

Majid Mofidi, S., & Kashani Jou, K. (2010). Emergence of pedestrianisation in Tehran: obstacles and opportunities. *International Journal of Urban Sustainable Development*, 2(1-2), 121 – 134.

Marchigiani, E. and Bonfantini, B. (2022) "Urban transition and the return of Neighbourhood Planning. questioning the proximity syndrome and the 15-minute city," *Sustainability*, *14*(9), p. 5468.

Marquet, O. and Miralles-Guasch, C. (2014). Walking short distances. the socioeconomic drivers for the use of proximity in everyday mobility in Barcelona, *Transportation Research Part A: Policy and Practice*, 70, pp. 210 –222.

Marsh, P., Collett, P. (1986). *Driving passion: the psychology of the car*. Cape, London.

Marshall, W. E., & Garrick, N. W. (2010). Street network types and road safety: A study of 24 California cities. *Urban Design International, 15* (3), 133 – 147.

Matan, A., & Newman, P. (2016). *People cities : the life and legacy of Jan Gehl*. Washington, Dc: Island Press.

Mattar, S. D., Jafry, T., Schröder, P., & Ahmad, Z. (2021). Climate justice: priorities for equitable recovery from the pandemic. *Climate Policy*, *21*(10), 1–11.

Mattioli, G., Anable, J., Vrotsou, K. (2016). Car dependent practices. Findings from a sequence pattern mining study of UK time use data. *Transportation Research Part A: Policy and Practice* 89, 56 – 72.

Mattioli, G., Roberts, C., Steinberger, J. K., & Brown, A. (2020). The political economy of car dependence: A systems of provision approach. *Energy Research & Social Science*, *66*, 10148.

McKenzie, R. D., (1923). *The Neighbourhood: A Study of Local Life in the City of Columbus*, Ohio. Chicago: University of Chicago Press.

McMillan, T., (2005). Urban form and a child's trip to school: The current literature and framework for future research. *Journal of Planning Literature 19*, 440 - 456.

McPhearson, T., Grabowski, Z., Herreros-Cantis, P., Mustafa, A., Ortiz, L., Kennedy, C., … Vantu, A. (2020). Pandemic Injustice: Spatial and Social Distributions of COVID-19 in the US Epicentre. *Journal of Extreme Events, 7*(04).

Mitra, R. (2013). Independent mobility and mode choice for School Transportation: A review and framework for Future Research. *Transport Reviews, 33*(1), 21 – 43.

Mokhtarian, P.L., Salomon, I. (2001). How derived is the demand for travel. Some conceptual and measurement considerations. *Transportation Research A 35*, 695 – 719.

Mokhtarian, P.L. and Cao, X.Y. (2008) Examining the impacts of residential self-selection on travel behaviour: A focus on methodologies, *Transportation Research B, 42*, 204 - 228.

Moore, S. M. (2013). What's wrong with best practice? Questioning the typification of New Urbanism. *Urban Studies, 50*(11), 2371–2387.

Moreno, C., Allam, Z., Chabaud, D., Gall, C., & Pratlong, F. (2021). Introducing the "15-minute city": Sustainability, Resilience and Place Identity in Future Post-Pandemic Cities. *Smart Cities, 4*(1), 93 – 111.

Moudon, A. V., Lee, C., Cheadle, A. D., Garvin, C., Johnson, D., Schmid, T. L., … Lin, L. (2006). Operational Definitions of Walkable Neighborhood: Theoretical and Empirical Insights. *Journal of Physical Activity and Health, 3*(s1), S99–S117.

Mouratidis, K. and Yiannakou, A. (2022). COVID-19 and Urban Planning: Built Environment, health, and well-being in Greek cities before and during the pandemic, *Cities, 121*, 103491.

Mouratidis, K. (2024). Time to challenge the 15-minute city: Seven pitfalls for sustainability, equity, livability, and spatial analysis. *Cities, 153*, 105274–105274.

Muñoz, B., Monzon, A., & Daziano, R. A. (2016). The increasing role of latent variables in modelling bicycle mode choice. *Transport Reviews, 36*(6), 737–771.

Mu, X., Mu, L., & Zhang, J. (2024). The Impact of Street Elements on Pedestrian Stopping Behavior in Commercial Pedestrian Streets from the Perspective of Commercial Vitality. *Sustainability, 16*(17), 7727–7727.

Næss, P., Næss, T., & Strand, A. (2009). *The challenge of sustainable mobility in urban planning and development in Oslo Metropolitan Area*. The Institute of Transport Economics.

National Association of City Transportation Officials. (2013). *Urban street design guide*. Washington: Island Press.

Nettleton, S., & Green, J. (2014). Thinking about changing mobility practices: how a social practice approach can help. *Sociology of health & illness*, *36*(2), 239–251.

Newman, M. (1991). Focus: Sacramento, Calif.; A Transit-Oriented Approach to Suburbia. The New York Times, November 10, 1991.

Newman, P., Kenworthy, J. (1999). *Sustainability and Cities: Overcoming Automobile Dependence*. Island Press, Washington, DC

Newman, P. & Kenworthy, J. (2006). Urban Design to Reduce Automobile Dependence. Opolis: An International *Journal of Suburban and Metropolitan Studies, 2*, (1), Article 3.

Nogueira, M., Dias, F., & Santos, V. (2023). Sustainable mobility choices: Exploring the impact of consumers' values, attitudes, perceived behavioural control and subjective norms on the likelihood to choose sustainable mobility options. *Journal of Consumer Behaviour*, *22*(2), 511–528.

Noland, R. B., Weiner, M. D., DiPetrillo, S., & Kay, A. I. (2017). Attitudes towards transit-oriented development: Resident experiences and professional perspectives. *Journal of Transport Geography, 60*, 130–140.

Oslo Kommune. (2019). *The Car-free Liveability Programme 2019*. Oslo, Norway: Oslo Kommune.

Pajares, E. et al. (2021). Accessibility by proximity: Addressing the lack of interactive accessibility instruments for active mobility, *Journal of Transport Geography, 93*, 103080.

Paijmans, H., & Pojani, D. (2021). Living car-free by choice in a sprawling city: Desirable and … possible? *Case Studies on Transport Policy*, *9*(2), 823–829.

Pakzad J. (2005). Design guideline of urban spaces in Iran. Tehran: Ministry of Housing and Urban Development, *Payam Sima Design & Publish*, 271.

Papagiannakis, A., Vitopoulou, A., & Yiannakou, A. (2020). Transit-Oriented Development in the Southern European city of Thessaloniki introducing urban railway: typology and implementation issues. *European Planning Studies*, *29*(1), 1–25.

Parkany, E., Gallagher, R. and Viveiros, P. (2004). *Are attitudes important in travel choice?* Transportation Research Record, 1984, 127-139.

Passell, A. (2013). *Building the New Urbanism: Places, professions, and profits in the American metropolitan landscape*. New York, NY: Routledge.

Perry, C. (1921). *Ten Years of the Community Centre Movement*. New York: Russell Sage Foundation.

Perry, C. A. (1929). *The neighbourhood unit (*Monograph I, Neighborhood and Community Planning, of the Regional Survey of New York and Its Environs, Vol. 7). In Committee on Regional Plan of New York and Its Environs. New York.

Peterson, M., & Simkins, T. (2019). Consumers' processing of mindful commercial car sharing. *Business Strategy and the Environment, 28*(3), 457– 465.

Picone M (2006) Il ciclo di vita urbano in Sicilia. Rivista *Geografica Italiana 113*, 129 – 146.

Picone, M., Lo Piccolo, F., & Schilleci, F. (2021). From the Metropolitan Areas to the Post-metropolitan Dimension. In F. Lo Piccolo, M. Picone, & V. Todaro (Eds.), *Urban Regionalisation Processes Governance of Post-Urban Phenomena in Sicily* (pp. 21–63). Switzerland: Springer.

Pinzello I (ed) (2003) *Il ruolo delle aree metropolitane costiere del Mediterraneo*. Alinea, Florence.

Piraino A (1988) *Il sistema metropolitano di Palermo.* Quale fisionomia. Celup, Palermo.

Pishue, B. (2023). *2022 INRIX Global Traffic Scorecard* (pp. 13–19). Washington, United States of America: INRIX.

Podobnik, B. (2011). Assessing the social and environmental achievements of New Urbanism: Evidence from Portland, Oregon. *Journal of Urbanism, 4* (2), 105 – 126.

Pozoukidou, G. (2020). Designing a green infrastructure network for metropolitan areas: A spatial planning approach. Euro-Mediterranean *Journal for Environmental Integration, 5*(2).

Pozoukidou, G., & Chatziyiannaki, Z. (2021). 15-minute city: Decomposing the New Urban Planning Eutopia. *Sustainability*, *13*(2), 928.

Pozoukidou, G. and Angelidou, M. (2022). Urban Planning in the 15-minute city: Revisited under sustainable and Smart City Developments until 2030, *Smart Cities, 5*(4), 1356–1375.

Renne, J. L., Curtis, C., Bertolini, L., Hesse, M., & Knowles, R. (2016*). Transit Oriented Development making it happen*. Taylor and Francis.

Renne, J. L. (2017). Make rail (and transit-oriented development) great again. *Housing Policy Debate, 27*(3), 472–475.

Robbins, E. (1998). The New Urbanism and the fallacy of singularity. *Urban Design International, 3*(1), 1–10.

Rodríguez Holguín, E., & Lozano, M. F. D. (2023). Social Mobility: Contemporary Theoretical Considerations and the Constructivist Structuralism of Pierre Bourdieu. *New Zealand Sociology, 38*(2), 90–95.

Rogers, S. H., Halstead, J. M., Gardner, K. H., & Carlson, C. H. (2011). Examining walkability and social capital as indicators of quality of life at the municipal and neighbourhood scales. *Applied Research in Quality of Life, 6* (2), 201 – 213.

Ronis, D.L., Yates, J.F. and Kirscht, J.P. (1989) Attitudes, decisions, and habits as determinants of repeated behaviour, in: Pratkanis, A.R., Breckler, S.J. and Greenwald, A.G. (Eds.) *Attitude Structure and Function*, pp. 213-239 (Hillsdale: Lawrence Erlbaum Associates).

Rossi Doria B (2003) La Sicilia: da Regione del Mezzogiorno a periferia dell'Europa forte. In: Lo Piccolo F, Schilleci F (eds) *A sud di Brobdingnag. L'identità dei luoghi: per uno sviluppo locale autosostenibile nella Sicilia Occidentale*. Franco Angeli, Milan, 11–41.

Rossi Doria B, Lo Piccolo F, Schilleci F, Vinci I (2005) Riconoscimento e rappresentazione di fenomeni territoriali inediti in Sicilia. In: *Proceedings of the 9th SIU conference 'Terre d'Europa e fronti mediterranei'*, Palermo, 3–4 March 2005, vol 1. Zangara Editore, Bagheria, 263–273.

Roth, M. A., Millett, C. J., & Mindell, J. S. (2012). The contribution of active travel (walking and cycling) in children to overall physical activity levels: a national cross-sectional study. *Preventive Medicine, 54*(2), 134–139.

Sachs, W. (1983). Are energy-intensive life-images fading. The cultural meaning of the automobile in transition. Journal of Economic *Psychology 3*, 347–365.

Saeidizand, Fransen, K., & Boussauw, K. (2022). Revisiting car dependency: A worldwide analysis of car travel in global metropolitan areas. *Cities*, 120.

Sartori, E. (2012). *Milano: I limiti dell'abitare - Bisogno abitativo, mobilitazioni sociali e ripresa del pubblico* (Master's thesis, pp. 17–23). Politecnico di Milano, Scuola di Architettura e Società.

Savolainen, R. (2016). Approaches to socio-cultural barriers to information seeking. *Library & Information Science Research, 38*(1), 52–59.

Scheurenbrand, K., Parsons, E., Cappellini, B., & Patterson, A. (2018). Cycling into headwinds: Analyzing practices that inhibit sustainability. *Journal of Public Policy and Marketing, 37*(2), 227–244.

Schilleci F (2005) Il contesto normativo in Sicilia. Una difficile pianificazione tra ritardi e resistenze. In: Savino M (ed) *Pianificazione alla prova nel mezzogiorno*. FrancoAngeli, Milan, 189–208.

Schilleci F (2008a) *La dimensione metropolitana in Sicilia: un'occasione mancata?* Archivio di Studi Urbani e Regionali 91, 147–161.

Schilleci F (2008b) *Visioni metropolitane. Uno studio comparato tra l'Area Metropolitana di Palermo e la Comunidad de Madrid.* Alinea, Florence.

Schlossberg, M., & Brown, N. (2004). Comparing transit-oriented development sites by walkability indicators. Transportation Research Record: *Journal of the Transportation Research Board, 1887*(1), 34–42.

Schuch, F. B., Vancampfort, D., Firth, J., Rosenbaum, S., Ward, P. B., Silva, E. S., Hallgren, M., Ponce De Leon, A., Dunn, A. L., Deslandes, A. C., Fleck, M. P., Carvalho, A. F., & Stubbs, B. (2018). Physical activity and incident depression: A meta-analysis of prospective cohort studies. *American Journal of Psychiatry*, *175*(7), 631–648.

Scott, A., J. (2008) *Social economy of the metropolis: cognitive-cultural capitalism and the global resurgence of cities.* Oxford University Press, Oxford

Sezer, E., Igreja, J., Vinci, I. (2024). Integrating the TOD and 15-minute city concepts in the analysis of rail station areas: a methodological approach for a case study in Palermo (Italy). In M. Tira, M. Tiboni, M. Pezzagno, G. Maternini (a cura di), *New Challenges for Sustainable Urban Mobility: Volume One. Proceedings of the XXVI International Conference on Living and Walking in Cities, 2023*. Cham : Springer.

Sezer, E., Igreja, J. & Vinci, I. (2024). Capturing city-transport interactions. An analysis on the urban rail network of Palermo (Italy). *TeMA - Journal of Land Use, Mobility and Environment*, (3), 197-214.

Sharifi, A. and Khavarian-Garmsir, A.R. (2020). The COVID-19 pandemic: Impacts on cities and major lessons for urban planning, design, and Management, *Science of the Total Environment, 749*, p. 142391.

Shatu, F. and Kamruzzaman, M. (2021). Determining optimum design density for 20-minute neighbourhoods, *Findings*.

Shove, E., Pantzar, M., & Watson, M. (2012). *The dynamics of social practice: Everyday life and how it changes.* Thousand Oaks, CA: SAGE.

Silva, C. (2020). Accessibility at the local scale: How it constrains our ability to 'live locally. *In C. Curtis (Ed.), Handbook of sustainable transport*. Edward Elgar Publishing.

Silva, C., Büttner, B., Seisenberger, S., & Rauli, A. (2023). Proximity-centred accessibility—A conceptual debate involving experts and planning practitioners. *Journal of Urban Mobility*, *4*, 100060.

Sirard, J. R., & Slater, M. E. (2008). Walking and Bicycling to School: A Review. *American Journal of Lifestyle Medicine*, *2*(5), 372–396.

Snellen, D. (2001). *Urban Form and Activity-Travel Patterns: An Activity-Based Approach to Travel in a Spatial Context*. Techn. Univ. Fac. Bouwkunde, Eindhoven, Eindhoven.

Speck, J. (2013). *Walkable city: How downtown can save America, one step at a time*. New York: North Point Press.

Southworth, M. (1997). Walkable suburbs? An evaluation of neotraditional communities at the urban edge. *Journal of the American Planning Association, 63*(1), 28 – 44.

Southworth, M. (2005). Designing the Walkable City. *Journal of Urban Planning and Development, 131*(4), 246–257.

Soja EW. (2000). *Postmetropolis: critical studies of cities and regions*. Blackwell, Malden, MA

Soja EW. (2011). Regional urbanisation and the end of the metropolis era. *In: Bridge G, Watson S (eds) New companion to the city*. Wiley-Blackwell, Chichester, pp 679 – 689.

Soza-Parra, J., & Oded Cats. (2023). The role of personal motives in determining car ownership and use: a literature review. *Transport Reviews, 44*(3), 1–21.

Stead, D. (2001). Relationships between land use, socioeconomic factors, and travel patterns in Britain. *Environment and Planning B 28* (4), 499–529.

Steer Davis Gleave (2005). *Overcoming Car Dependence*. London: Transport for London.

Steg, L., & Vlek, C. (1997). The role of problem awareness in willingness-to-change car use and in evaluating relevant policy measures. *In J. A. Rothengatter & E. Carbonell Vaya (Eds.), Traffic and transport psychology. Theory and application* (pp. 465-475). Elmsford, NY: Pergamon.

Steg, L., Vlek, C., & Slotegraaf, G. (2001). Instrumental-reasoned and symbolic-affective motives for using a motor car. *Transportation Research Part, 4*(4), 151–169.

Steg, L. (2005). Car use: lust and must. Instrumental, symbolic, and affective motives for car use. *Transportation Research Part A: Policy and Practice, 39*(2–3), 147–162.

Steg, L., & Gifford, R. (2005). Sustainable transportation and quality of life. *Journal of Transport Geography, 13*(1), 59–69.

Steinbach, R., Green, J., Datta, J. and Edwards, P. (2011) Cycling and the city: a case study of how gendered, ethnic and class identities can shape healthy transport choices, *Social Science & Medicine,72*, 7, 1123–30.

Steinbach R., Green J., and Edwards P., (2012) Look who's walking: Social and environmental correlates of children's walking in London, *Health & Place, 18*, 4, 917-927.

Stinder, A. K., Schelte, N., & Severengiz, S. (2022). Application of Mixed Methods in Transdisciplinary Research Projects on Sustainable Mobility. *Sustainability, 14*(11), 6867.

Stokols, D. (1977) Origins and directions of environment-behavioural research, in: Stokols, D. (Ed.) *Perspectives on Environment and Behaviour. Theory, Research and Applications*, pp. 5-36 (New York: Plenum Press).

Stokols, D. (1996). Translating Social Ecological Theory into Guidelines for Community Health Promotion. *American Journal of Health Promotion, 10*(4), 282–298.

Storme, T., De Vos, J., De Paepe, L., & Witlox, F. (2020). Limitations to the car-substitution effect of MaaS. Findings from a Belgian pilot study. *Transportation Research Part A: Policy and Practice, 131*, 196–205.

Stradling, S. (2007). Determinants of car dependence. In T. Gärling & L. Steg (Eds.), *Threats to the quality of urban life from car traffic: Problems, causes and solutions*. Oxford: Elsevier.

Stradling, S. G. (2011). Travel Mode Choice. Elsevier eBooks, 485–502.

Talen, E. (1999). Sense of community and neighbourhood form? An assessment of the social doctrine of New Urbanism. *Urban Studies, 36*(8), 1361–1379.

Talen, E. (2005). *New Urbanism and American planning: The conflict of cultures*. London: Routledge.

Talen, E., & Koschinsky, J. (2014). Compact, Walkable, Diverse Neighborhoods: Assessing Effects on Residents. *Housing Policy Debate, 24*(4), 717–750.

Tertoolen, G., van Kreveld, D., & Verstraten, B. (1998). Psychological resistance against attempts to reduce private car use. *Transportation Research Part A, 32*(3), 171-181.

The Chartered Institution of Highways & Transportation. (2018). *Creating better streets: Inclusive and accessible places - Reviewing shared space.* London UK: Chartered Institution of Highways & Transportation.

Thomas, R., & Bertolini, L. (2020). Introduction to transit-oriented development. In *Transit-oriented development* (pp. 1–20).

Thøgersen, J., Vatn, A., Aasen, M., Dunlap, R. E., Fisher, D. R., Hellevik, O., & Stern, P. (2021). Why do people continue driving conventional cars despite climate change? Social-psychological and institutional insights from a survey of Norwegian commuters. *Energy Research & Social Science, 79*, 102168.

Triandis, H. C. (1977). *Interpersonal behaviour.* Brooks/Cole Publishing Company.

Triandis, H.C. (1980) Values, attitudes and interpersonal behaviour, in: Howe, H.E. Jr. And Page, M.M. (Eds.) *Nebraska Symposium on Motivation*, pp. 195-260 (Lincoln: University of Nebraska Press).

Trudeau, D. (2016). Tracing New Urbanism's suburban intervention in Minneapolis-St. Paul. *Journal of Planning and Education Research, 38*(1), 25–38.

Urry, J. (2004). The "System" of Automobility. *Theory, Culture and Society. 21*(4/5), 25-40.

Vale, D. S., Viana, C. M., & Pereira, M. (2018). The extended node-place model at the local scale: Evaluating the integration of land use and transport for Lisbon's subway network. *Journal of Transport Geography, 69*, 282–293.

Van Acker, V., Van Wee, B. & Witlox, F. (2010). When Transport Geography Meets Social Psychology: Toward a Conceptual Model of Travel Behaviour. *Transport Reviews 30*(2), 219-24.

Van den Berg L, Drewett R, Klaassen LH. (1982) *Urban Europe: a study of growth and decline.* Pergamon, Oxford.

Van de Velde, K., & Holemans, D. (2020). *Cities as places of hope: Ghent*. Green European Foundation.

Van Eenoo, E., Boussauw, K., & Fransen, K. (2022). Car dependency beyond land use: Can a standardized built environment indicator predict car use? *Journal of Transport and Land Use, 15*(1), 117–136.

Van Hoose, K., de Gante, A. R., Bertolini, L., Kinigadner, J., & Büttner, B. (2022). From temporary arrangements to permanent change: Assessing the transitional capacity of city street experiments. *Journal of Urban Mobility, 2,* 100015.

Van Wee, B. & Handy, S. (2014). Key research themes on urban space, scale, and sustainable urban mobility. *International Journal of Sustainable Transportation: Identifying Key Research Themes for Sustainable Urban Mobility, 10(*1), 18–24.

Van Wee, B. (2002). Land use and transport: research and policy challenges. *Journal of Transport Geography, 10(*4), 259–271.

Vatavali, F. et al. (2020). Impact of COVID-19 on urban everyday life in Greece. perceptions, experiences and practices of the active population, *Sustainability, 12*(22), 9410.

Vinci, I., & Di Dio, S. (2014). Designing Mobility in a City in Transition. Challenges from the Case of Palermo. *TeMA – Journal of Land Use, Mobility and Environment*, 977 – 988.

Vinci, I., & Di Dio, S. (2016). Reshaping the urban environment through mobility projects and practices: Lessons from the case of Palermo. In R. Papa & R. Fistola (Eds.), *Smart energy in the smart city Urban Planning for a Sustainable Future* (pp. 291-305). Springer.

Vinci, I. (2017). Understanding urban policy through the lens of twenty years of cohesion policy: The case of Palermo. In *Proceedings of the EURA Conference 2017: Cities locked in networks* Warsaw, Poland, 21–24 June.

Vinci, I. (2019). How the EU regional policy can shape urban change in Southern Europe: learning from different planning processes in Palermo. *Urban Research & Practice, 14*(4), 1–26.

Vinci, I. (2023). The Reshaping of the City-Port Inter- face in Palermo: A Case of Successful Urban Governance? *IGLUS Quarterly, 8*(4), 40–46.

Wang, Y., Chau, C. K., Ng, W. Y., & Leung, T. M. (2016). A review on the effects of physical built environment attributes on enhancing walking and cycling activity levels within residential neighbourhoods. *Cities*, *50*, 1–15.

Wang, X., Shao, C., Yin, C., Zhuge, C., & Li, W. (2018). Application of Bayesian multilevel models using small and medium size city in China: the case of Changchun. *Sustainability*, *10*(2), 484.

Watson, M. (2012). How theories of practice can inform transition to a decarbonized transport system. *Journal of Transport Geography*, *24*, 488–496.

Wee, B. van, & Maat, K. (2003). Land-Use and Transport: a Review and Discussion of Dutch Research. *European Journal of Transport and Infrastructure Research*, *3*(2).

Wegener, M., & Fürst, F. (2004). *Land-use transport interaction: State of the art* (SSRN scholarly paper ID 1434678). Social Science Research Network.

White, R. L., Babic, M. J., Parker, P. D., Lubans, D. R., Astell-Burt, T., & Lonsdale, C. (2017). Domain-specific physical activity and Mental Health: A meta-analysis. *American Journal of Preventive Medicine, 52*(5), 653–666.

Whitelaw, S., Teuton, J., Swift, J., & Scobie, G. (2010). The physical activity – mental wellbeing association in young people: A case study in dealing with a complex public health topic using a 'realistic evaluation' framework. *Mental Health and Physical Activity, 3*(2), 61–66.

Wiersma, J., Bertolini, L., & Straatemeier, T. (2015). How does the spatial context shape conditions for car dependency? An analysis of the differences between and within regions in the Netherlands. *The Journal of Transport and Land Use, 9*(3), 33–55.

Wiersma J. K., Bertolini, L., & Straatemeier, T. (2017). Adapting spatial conditions to reduce car dependency in mid-sized "post growth" European city regions: The case of South Limburg, Netherlands. *Transport Policy*, *55*(C), 62–69.

Wiersma, J. K. (2020). Commuting patterns and car dependency in urban regions. *Journal of Transport Geography, 84*, 102700.

Wiersma, J. (2021). *Spatial conditions for car dependency in urban areas* [Thesis, fully internal, Universiteit van Amsterdam].

Wiersma J. K., Bertolini, L. & Harms, L. (2021) Spatial conditions for car dependency in mid-sized European city regions, *European Planning Studies*, *29*(7), 1314-1330.

Wungo, G. L., Mussadun, M., & Novianto, A. (2023). Important factors for inclusive pedestrian ways development in Pecinan Semarang City. *IOP Conference Series: Earth and Environmental Science, 1184*(1), 012021.

Yücel, G. F. (2013). Street Furniture and Amenities: Designing the User-Oriented Urban Landscape . In M. Ozyavuz (Ed.), *Advances in Landscape Architecture* (pp. 623–644). IntechOpen.

Zhang, X., Shao, C., Wang, B., Huang, S., & Xiong, Y. (2022). Car purchase intention modelling in the context of COVID-19: an integrated analysis of impact range and impact asymmetry. *Journal of Advanced Transportation*, 1-15.

Zhao, J. (2011). Subjective Measure of Car Dependence. Transportation Research Record: *Journal of the Transportation Research Board, 2231*(1), 44–52.

ONLINE BIBLIOGRAPHY

- Abbasi Design Studio. (2021). 11 *Parklets You Wish Your City Had*. Retrieved from: https://www.abbasi-design.com/11-parklets-you-wish-your-city-had/ (Accessed December 3, 2024).
- Ares, E. (2013). *Visualizing a Walkable City*. Retrieved from: https://www.thepolisblog.org/2013/02/metrominuto-walking-map.html (Accessed August 8, 2024).
- Autorità di Sistema Portuale del Mare di Sicilia Occidentale. (2018). *Storia del Porto di Palermo | Autorità Portuale di Palermo*-AdSP mare di Sicilia Occidentale. Retrieved from: https://www.adsppalermo.it/palermo-storia-del-porto . (Accessed September 22, 2024).
- Bailly, A. (2018). *What are other cities doing around the world?* Retrieved from: https://www.centreforcities.org/reader/can-uk-cities-clean-air-breathe-2/cities-around-world/ (Accessed February 6, 2025).
- Barra, D. (n.d.). *Isec | Meridionali e non solo. Sguardi sulla condizione migrante a Milano nel secondo dopo guerra.* Retrieved from: https://fondazioneisec.it/newsletter/giugno-2023/meridionali-e-non-solo (Accessed September 11, 2024).
- Bsummers. (2017). *The movement.* CNU. Retrieved from: https://www.cnu.org/who-we-are/movement. (Accessed December 21, 2022).
- Büttner, B., Seisenberger, S., Baquero Larriva, M. T., Rivas De Gante, A. G., Haxhija, S., Ramirez, A., & McCormick, B. (2022). *Urban mobility next 9 ±15-minute city: Human-centred planning in action mobility for more liveable urban spaces.* EIT. Retrieved from: https://www.eiturbanmobility.eu/wp-content/uploads/2022/11/EIT-UrbanMobilityNext9_15-min-City_144dpi.pdf (Accessed October 12, 2023).
- Büttner, B., Seisenberger, S., Silva, C., Teixeira, J. F., McCormick, B., Papa, E., & Cao, M. (2024). *Mapping of 15-minute city practices: Overview on strategies, policies, and implementation in Europe and beyond.* DUT Partnership. Driving Urban Transitions. Retrieved from: https://dutpartnership.eu/news/new-publication-mapping-of-15-minute-city-practices/ (Accessed May 23, 2024).
- C40 Cities. (2020). *How to Build Back Better with a 15-minute city.* Retrieved from: https://www.c40knowledgehub.org/s/article/How-to-build-back-better-with-a-15-minute-city?language=en_US. (Accessed April 20, 2022).
- C40 Cities Climate Leadership Group. (2021). *15-minute cities: How to develop people-centred streets and mobility.* C40 Knowledge Hub. Retrieved from: https://www.c40knowledgehub.org/s/article/15-minute-cities-How-to-develop-people-centred-streets-and-mobility?language=en_US (Accessed March 30, 2022).

- Carmanah. (2018). What Is Traffic Calming? | Traffic Calming Devices and Signs | Carmanah. Retrieved from: https://carmanah.com/resources/traffic-calming/ (Accessed December 3, 2024).
- Centre for Transit-Oriented Development (CTOD). (2019). *Frequently asked questions "What is Transit Oriented Development."* Retrieved from: http://ctod.org/faqs.php. (Accessed November 29, 2022).
- City of Helsinki. (2022). *New pedestrian areas in the centre.* Retrieved from: https://www.hel.fi/en/urban-environment-and-traffic/urban-planning-and-construction/search-plans-and-projects/new-pedestrian-areas-in-the-centre#:~:text=Promotion%20of%20walking%2C%20and%20Helsinki (Accessed August 25, 2024)
- City of Vancouver. (2018). *Housing Vancouver strategy*. Vancouver, BC: City of Vancouver. Retrieved from: https://vancouver.ca/people-programs/housing-vancouver-strategy.aspx. (Accessed October 17, 2022).
- Chollet , O. (2024). *Congestion-Free City Centres.* Retrieved from: https://www.nordicpolicycentre.org.au/congestion_free_city_centres#:~:text=Oslo (Accessed August 31, 2024).
- Comune di Milano. (2020). *Quartieri. Con "Strade aperte" nuove aree pedonali, ciclabili, zone 30 e spazi pubblici.* Retrieved from: https://www.comune.milano.it/-/quartieri.-con-strade-aperte-nuove-aree-pedonali-ciclabili-zone-30-e-spazi-pubblici (Accessed September 9, 2024).
- Comune di Palermo. (2021a). *Consulta l'archivio biografico.* Retrieved from: https://www.comune.palermo.it/archivio-biografico-consultazione.php?id=381 (Accessed September 3, 2024).
- Comune di Palermo. (2021b). *Sito Istituzionale - Comune di Palermo.* Retrieved from: https://www.comune.palermo.it/grandi-opere-tram (Accessed October 7, 2024).
- Comune di Palermo. (2024a, April). *Costruzione partecipata dello Scenario di Piano - SUMP* - Comune di Palermo. Retrieved from: https://www.comune.palermo.it/SUMP/scenari-sostenibili.php (Accessed October 17, 2024).
- Comune di Palermo. (2024a, July 27). *Nota su delibera relativa alla pedonalizzazione dell'Albergheria.* Retrieved from: https://www.comune.palermo.it/palermo-informa-dettaglio.php?id=41342&tipo=1 (Accessed October 17, 2024).
- Copenhagen Portal. (2012*). Strøget - The world's longest Pedestrian Street - Copenhagen - Copenhagen Visitors*<. Retrieved from: https://www.copenhagenet.dk/cph-map/CPH-Pedestrian.asp (Accessed August 31, 2024).

- Crook, L. (2021, October 26). *15-minute city concept by Carlos Moreno wins Obel Award 2021*. Retrieved from: https://www.dezeen.com/2021/10/26/15-minute-city-carlos-moreno-obel-award/. (Accessed January 9, 2022).
- Dunnell, T. (2019). *La Ciclovía de Bogotá.* Retrieved from: https://www.atlasobscura.com/places/la-ciclovia-de-bogota (Accessed aUGUST 9, 2024).
- EIT. (2022). *Proximity for all: Implementing inclusive ±15-minute city concepts.* Marketplace EIT. Retrieved from: https://marketplace.eiturbanmobility.eu/insights/proximity-for-all-implementing-inclusive-15-minute-city-concepts. (Accessed December 12, 2022).
- EIT. (2024, July 9*). Riga's path to promote active transport for the first and last mile.* Retrieved from: https://marketplace.eiturbanmobility.eu/best-practices/rigas-path-to-promote-active-transport-for-the-first-and-last-mile (Accessed December 19, 2024).
- ESPON. (2020). *Population and living conditions ESPON 2020 Atlas*.
- Retrieved from: https://gis-portal.espon.eu/arcgis/apps/storymaps/collections/bf9da58bf04b4c77b867984f4e44ae6d?item=1 (Accessed September 2, 2024).
- EU Urban Mobility Observatory. (2021*). Valencia using smart city solutions to deliver on its SUMP*. Retrieved from: https://urban-mobility-observatory.transport.ec.europa.eu/resources/case-studies/valencia-using-smart-city-solutions-deliver-its-sump_en?utm_source=chatgpt.com (Accessed February 6, 2025).
- EU Urban Mobility Observatory. (2022). *Istanbul's new Sustainable Urban Mobility Plan* - European Commission. urban-mobility-observatory.transport.ec.europa.eu Retrieved from: https://urban-mobility-observatory.transport.ec.europa.eu/resources/case-studies/istanbuls-new-sustainable-urban-mobility-plan_en. (Accessed July 31, 2024).
- Fry, R. (2020). *Millennials overtake baby boomers as America's largest generation.* Pew Research Centre. Retrieved from: https://www.pewresearch.org/facttank/2020/04/28/millennials-overtake-babyboomers-as-americas-largest-generation (Accessed December 15, 2022).
- Fulton, W. (2017). *The 'New Urbanism' movement might be dead*. Governing. Retrieved from: https://www.governing.com/columns/urban-notebook/govnew-urbanism.html (Accessed July 23, 2023).
- García Iglesias, J. B. (2016). *Pontevedra, bonne ville.* Retrieved from: https://pontevedraviva.com/opinion/2045/pontevedra-bonne-ville/?lang=es (Accessed August 6, 2024).

- Global designing cities initiative. (n.d.). *Pedestrian only streets: Case study | Stroget, Copenhagen.* Retrieved from: https://globaldesigningcities.org/publication/global-street-design-guide/streets/pedestrian-priority-spaces/pedestrian-only-streets/pedestrian-streets-case-study-stroget-copenhagen/ (Accessed August 30, 2024).
- GES.AP SpA. (2024). *Press realeses - 68,4 milioni di euro di investimenti tra 2024 e 2027 Consegnati i lavori del primo lotto: nuove sale e finger, impianti all'avanguardia*. Retrieved from: https://www.aeroportodipalermo.it/news-eventi/684-milioni-di-euro-di-investimenti-tra-2024-e-2027-consegnati-i-lavori-del-primo-lotto-nuove-sale-e-finger-impianti-allavanguardia/ (Accessed September 22, 2024).
- Glaeser , E. (2024, April 17). *Forward Thinking - What's the future for cities in the post pandemic world?* (J. Bush, Interviewer). Retrieved from: https://www.mckinsey.com/mgi/forward-thinking/whats-the-future-for-cities-in-the-postpandemic-world (Accessed January 25, 2025).
- Global Designing Cities Initiative. (2016*). Community Led Processes Create Better Streets in Bogotá* - Global Designing Cities Initiative. Retrieved from: https://globaldesigningcities.org/update/storing-cars-celebrating-people-community-lead-processes-help-creating-better-streets-bogota/ (Accessed August 8, 2024).
- Global Street Design Guide Initiatives. (2022, October 25). *Lighting Design Guidance* - Global Designing Cities Initiative. Retrieved from: https://gdci.wpengine.com/publication/global-street-design-guide/utilities-and-infrastructure/lighting-and-technology/lighting-design-guidance/ (Accessed November 4, 2024).
- Harris, A. (2024*). Creating the cultural shift behind Ghent's mobility revolution* - Eurocities. Retrieved from: https://eurocities.eu/latest/creating-the-cultural-shift-behind-ghents-mobility-revolution/ (Accessed September 8, 2024).
- Herbert, J. (2021, August). *Transformation or Gentrification? The Hazy Politics of the 15-minute city*. Retrieved from: https://degrowth.info/en/blog/transformation-or-gentrification-the-hazy-politics-of-the-15-minute-city (Accessed January 25, 2025).
- Hernández-Morales, A. (2022). *The city that pioneered Europe's car-free future.* POLITICO Retrieved from: https://www.politico.eu/article/pontevedra-city-pioneer-europe-car-free-future/ (Accessed August 6, 2024).
- International Federation of Red Cross and Red Crescent Societies. (2024, August). *Social mobilization and behaviour change* | Epidemic Control Toolkit. Retrieved from: https://epidemics.ifrc.org/volunteer/action/43-social-mobilization-and-behaviour-change (Accessed October 29, 2024).
- ISTAT. (2023). *Bilancio demografico mensile.* Retrieved from: https://demo.istat.it/app/?a=2023&i=D7B. (Accessed March 25, 2024).

- Kayak . (2024). *Oslo Travel Guide*. Retrieved from: https://www.kayak.co.in/Oslo.29309.guide (Accessed August 31, 2024).
- Local Governments for Sustainability. (2022*). ICLEI Europe - Ghent*. Retrieved from: https://iclei-europe.org/member-in-the-spotlight/ghent#:~:text=Ghent%20is%20a%20port%20city (Accessed September 6, 2024).
- Locatelli, A. (2024). *The ultimate guide to Ghent, Belgium*. Retrieved from: https://www.nationalgeographic.com/travel/article/guide-to-ghent-belgium (Accessed September 6, 2024).
- Macrotrends. (2024). *Bogota, Colombia Metro Area Population 1950-2024*. Retrieved from: https://www.macrotrends.net/global-metrics/cities/20837/bogota/population (Accessed August 8, 2024).
- Maley, D.W., Weinberger, R.R. (2011). *Food shopping in the urban environment: parking supply, destination choice, and mode choice.* In: Proceedings of the 90th Annual Transportation Research Board. Washington, DC. Retrieved from: https://www.streetsblog.org/wpcontent/uploads/2012/02/MaleyWeinberger2011.pdf
- Marina Convention Centre. (2022). *IL MOLO TRAPEZOIDALE* – Marina Convention Centre. Retrieved from: https://www.marinaconventioncentre.com/il-molo-trapezoidale/ (Accessed September 22, 2024).
- McAskie, L. (2021a). *Pontevedra: The Little Utopian City That Drove Out Cars - and How They Made It Happen*. Retrieved from: https://citychangers.org/pontevedra-the-little-utopian-citythat-drove-out-cars/ (Accessed August 6, 2024).
- McAskie, L. (2021b). *The Streets Are Alive In Ghent: It's More Than Just Removing Traffic, It's Bringing People Together.* Retrieved from: https://citychangers.org/the-streets-are-alive-in-ghent/ (Accessed September 8, 2024).
- McKinsey & Company (2018). *Smart City Solutions: What Drives Citizen Adoption around the Globe?* Retrieved from: https://www.mckinsey.com/industries/public-sector/our-insights/smart-city-solutions-what-drives-citizen-adoption-around-the-globe. (Accessed March 16, 2022).
- Mobilita Palermo. (2022, December 21). *Tram | Progetto definitivo approvato, la giunta manda in gara le nuove linee* - Mobilita Palermo. Retrieved from: https://palermo.mobilita.org/2022/12/21/tram-progetto-definitivo-approvato-la-giunta-manda-in-gara-le-nuove-linee/ (February 6, 2025).
- Mobilita Palermo. (2024a, February 20). *Passante ferroviario: fermata Lazio, procede lo spostamento dei sottoservizi* - Mobilita Palermo. Retrieved from: https://palermo.mobilita.org/2024/02/20/passante-ferroviario-fermata-lazio-procede-lo-spostamento-dei-sottoservizi/ (Accessed October 9, 2024).

- Mobilita Palermo. (2024b, March 19). *Nuovamente deserta la gara per il completamento delle fermate Lolli e Papireto e degli impianti di sicurezza della galleria Orleans-Notarbartolo* - Mobilita Palermo. Retrieved from: https://palermo.mobilita.org/2024/03/19/nuovamente-deserta-la-gara-per-il-completamento-delle-fermate-lolli-e-papireto-e-degli-impianti-di-sicurezza-della-galleria-orleans-notarbartolo/ (Accessed October 9, 2024).
- Mobilita Palermo. (2024c, June 20). *Passante Ferroviario | Dal 1 luglio apre la fermata "De Gasperi"* - Mobilita Palermo. Retrieved from: https://palermo.mobilita.org/2024/06/20/passante-ferroviario-dal-1-luglio-apre-la-fermata-de-gasperi/ (Accessed October 9, 2024).
- Mouzon, S. (2012). "*Walk Appeal Measurables,"* Original Green. Retrieved from: https://originalgreen.org/blog/2012/walk-appeal-measurables.html, (Accessed April 9, 2022).
- Municipality of Palermo. (2023). *Statistical Repertoire* - Sito Istituzionale del Comune di Palermo. Retrieved from: https://www.comune.palermo.it/palermo-statistica.php?sez=187&sel=7&per=2022&cap=5 (Accessed April 3, 2024).
- Project Drawdown. (2020). *Walkable Cities* . Project Drawdown: https://drawdown.org/solutions/walkable-cities (Accessed July 31, 2024).
- Palermo Mobility. (2022, June 16). *Il "gioco" di Via Maqueda: da area pedonale a zona franca.* Retrieved from: https://palermo.mobilita.org/2022/06/16/via-maqueda-da-area-pedonale-a-zona-franca/ (Accessed June 4, 2024).
- Pandey, N. (2016, August 30). Smart cities could result in social inequality, say experts. *The Hindu Business Line*. Retrieved from https://www.thehindubusinessline.com/economy/smart-cities-could-result-in-social-inequality-say-experts/article9111629.ece (Accessed November 29, 2021).
- PRIN Postmetropoli. (2015). *Atlante web dei territori postmetropolitani* [web atlas]. Retrieved from http://www.postmetropoli.it/atlante (Accessed July 17, 2024).
- Project for Public Spaces. (2005). *Great Public Spaces - Strøget District.* Retrieved from: www.pps.org website: https://www.pps.org/places/strooget-district (Accessed August 30, 2024).
- Ramírez, M. F., & Calderón, P. (2022). *Bogotá's Approach to Safe, Sustainable, and Accessible Transport.* Retrieved from: https://itdp.org/wp-content/uploads/2022/12/Bogota-STA_ST-Magazine-34.pdf (Accessed August 8, 2024).
- Redazione - PalermoVia. (2016). *Aereoporto di Palermo* – Falcone Borsellino www.palermoviva.it. Retrieved from: https://www.palermoviva.it/aereoporto-di-palermo-falcone-e-borsellino/ (Accessed September 22, 2024).

- Rigitano, E. (2019, February 23). *Come la Ciclovìa ha cambiato le abitudini di Bogotà e del mondo*. Retrieved from: https://www.lifegate.it/come-la-ciclovia-ha-cambiato-le-abitudini-di-bogota-e-del-mondo#:~:text=BY%2DSA%202.0- (Accessed August 9, 2024).
- Rutter, T. (2016, November 28*). Car-free Belgium: why can't Brussels match Ghent's pedestrianised vision?* Retrieved from: https://www.theguardian.com/cities/2016/nov/28/car-free-belgium-why-cant-brussels-match-ghents-pedestrianised-vision (Accessed September 8, 2024).
- Obordo, R. (2020, January 20). "The streets are more alive": Ghent readers on a car-free city centre. *The Guardian.* Retrieved from https://www.theguardian.com/environment/2020/jan/20/the-streets-are-more-alive-ghent-readers-on-a-car-free-city-centre (Accessed September 8, 2024).
- OECD (2018), *Rethinking Urban Sprawl: Moving Towards Sustainable Cities*, OECD Publishing, Paris, Retrieved from: https://doi-org.proxy.uba.uva.nl/10.1787/9789264189881-en.
- OECD (2020), *Decarbonising Urban Mobility with Land Use and Transport Policies: The Case of Auckland*, OECD Publishing, Paris. Retrieved from: https://doi.org/10.1787/095848a3-en
- O'Sullivan, F. (2020) Paris mayor pledges a greener '15-minute city' *Bloomberg*. Retrieved from: https://www.bloomberg.com/news/articles/2020-02-18/paris-mayor-pledges-a-greener-15-minute-city (Accessed March 4, 2022).
- Sanderson, R. (2024, April 10). Peeling back Sicily's tourist facade: Revealing the Mafia's economic grip *(BizNews, Ed.).* Retrieved from: https://www.biznews.com/global-citizen/2024/04/10/sicilys-tourist-facade-mafias-economic-grip (Accessed July 25, 2024).
- Serna, I. (2023). *Plug and Play*. Retrieved from: https://www.plugandplaytechcentre.com/insights/urban-planning-milan-sustainable-city (Accessed September 11, 2024).
- Setti, S. (2024, July 8). *The Art of Passeggiata: Italy's Most Beloved Tradition*. Retrieved from: https://blog.rosettastone.com/passeggiata/ (Accessed September 1, 2024).
- Stagni, G. (n.d.). *La tranvia Palermo-Monreale* Stagniweb. Retrieved from: https://www.stagniweb.it/foto6.asp?File=monreale&InizioI=1&RigheI=100&Col=5 (Accessed October 6, 2024).
- Steuteville, R. (2021). Guiding principles of the 15-minute city. *CNU*. Retrieved from: https://www.cnu.org/publicsquare/2021/02/16/guiding-principles-15-minute-city (Accessed January 28, 2025).
- Steuteville, R., & Duany, A. (2021). Defining the 15-minute city. *CNU*. Retrieved from: https://www.cnu.org/publicsquare/2021/02/08/defining-15-minute-city. (Accessed October 17, 2022).

- Superblock (superilla) Barcelona – *A city redefined*. Public Realm. CitiesForum.org. (2021). Retrieved from https://www.citiesforum.org/news/superblock-superilla-barcelona-a-city-redefined/ (Accessed April 13, 2022).
- Surrer, T. (2021). Gent - The car-free city. *SIMagazin*. Retrieved from https://www.simagazin.com/en/si-urban-en/topics-urban/urban/gent-the-car-free-city/ (Accessed September 6, 2024).
- Talens, H. (2023). CROW updates bike lane width recommendations. *Dutch Cycling*. Retrieved from https://dutchcycling.nl/knowledge/blogs-by-experts/crow-updates-bike-lane-width-recommendations/ (Accessed January 23, 2025).
- Tekir, A. (2013). *Pedestrianisation of Istanbul's Historic Peninsula*. Retrieved from: https://slideplayer.com/slide/3851320/ (Accessed August 6, 2024).
- The Academy of Urbanism. (2015). Oslo, Norway - Assessment for European City of the Year Award 2012. *The Academy of Urbanism*. Retrieved from https://www.theaou.org/resources/oslo-norway (Accessed August 31, 2024).
- The City of Edinburgh Council. (2021). *City Plan 2030. Proposed plan.* Retrieved from https://www.edinburgh.gov.uk/downloads/file/29776/the-city-mobility-implementation-plan (Accessed October 17, 2022).
- The Ottawa Citizen. (2008). *The Strøget Solution*. Retrieved from https://web.archive.org/web/20151109111044/http://www.canada.com/ottawacitizen/story.html?id=d47ee45e-4f47-4b2b-b947-ab95578e2e8a&k=30759&p=1 (Accessed August 30, 2024).
- Transformative Urban Mobility Initiative. (2021). *The 15-minute city*. TUMI Management: Bonn, Germany. Retrieved from https://www.transformative-mobility.org/assets/publications/TUMI_The-15-Minute-City_2021-07.pdf (Accessed March 30, 2022).
- TUMI Management. (2021). *Strategic Outlook: the 15-minute city.* Retrieved from https://www.transformative-mobility.org/assets/publications/TUMI_The-15-Minute-City_2021-07.pdf (Accessed November 3, 2022).
- TomTom International BV. (2024). *Traffic index ranking* | TomTom traffic index. Retrieved from https://www.tomtom.com/traffic-index/ranking/ (Accessed March 26, 2024).
- Turismo de Galicia. (2024). *Ría de Pontevedra – GALICIA*. Retrieved from https://www.turismo.gal/que-visitar/rias-e-praias/ria-de-pontevedra?langId=en_US (Accessed August 6, 2024).
- UNESCO World Heritage Centre. (2015). *Arab-Norman Palermo and the Cathedral Churches of Cefalú and Monreale*. Retrieved from https://whc.unesco.org/en/list/1487/ (Accessed September 24, 2024).

- United Nations. (2024). *World Population Prospects.* Retrieved from https://population.un.org/wpp/ (Accessed August 30, 2024).
- Urban Sustainability Exchange. (n.d.). *Walkable Helsinki*. Retrieved from https://use.metropolis.org/case-studies/walkable-helsinki (Accessed August 25, 2024).
- van Veen, D., & Steinberg, L. (2021, October 4). *Designing a Livable Neighbourhood: The Woonerf Concept* | Urban Mobility Courses. Retrieved from https://urbanmobilitycourses.eu/courses/designing-a-livable-neighbourhood-the-woonerf-concept/ (Accessed May 15, 2022).
- Ville de Paris. (November 2021*). 250 premiers projets pour entretenir et rénover Paris*. Retrieved from https://www.paris.fr/pages/250-premiers-projets-pour-entretenir-et-renover-paris-19762 (Accessed March 30, 2022).
- Ville de Paris. (November 2021). Paris ville du quart d'heure, ou le pari de la proximité. Retrieved from https://www.paris.fr/dossiers/paris-ville-du-quart-d-heure-ou-le-pari-de-la-proximite-37 (Accessed March 30, 2022).
- Virga, F. (2023, December 14). C'è l'ordinanza: stop a biciclette e monopattini in via Maqueda e corso Vittorio Emanuele. *Palermo Today*. Retrieved from https://www.palermotoday.it/cronaca/divieto-monopattini-biciclette-via-maqueda-corso-vittorio-emanuele.html (Accessed October 18, 2024).
- World Population Review. (2024). *Milan, Italy Population 2024*. Retrieved from: https://worldpopulationreview.com/cities/italy/milan (Accessed September 10, 2024).
- World Population Review (2024). *Oslo, Norway Population 2024*. Retrieved from: https://worldpopulationreview.com/cities/norway/oslo (Accessed August 31, 2024).

APPENDICES

Appendix A – The Indicators of Street Quality Analysis

The evaluation of street quality in this research is **mostly** grounded in the framework proposed by M. Southworth in *Designing the Walkable City* (Journal of Urban Planning and Development, vol. 131, no. 4, pp. 246–257, 2005). The analysis focuses on micro-scale urban design features that influence pedestrian safety and comfort. These indicators were selected to complement the broader land-use and socio-economic components of the methodological framework.

Six indicators were developed and operationali**s**ed in GIS to assess the quality of the pedestrian environment:

1. Pedestrian–Road Width Ratio

This indicator evaluates the proportion of street space allocated to pedestrian infrastructure relative to the total street width. The following scale was applied:

0.00–0.20 → 0

0.21–0.40 → 0.25

0.41–0.60 → 0.50

0.61–0.80 → 0.75

0.81–1.00 → 1.00

Streets exclusively dedicated to pedestrian use were assigned a maximum value of 1.0. The lower threshold (0.2) corresponds to approximately 1.5 meters in width, which aligns with universally accepted minimum standards for pedestrian paths. This classification enables comparative analysis across the entire street network.

2. Vegetation

Vegetation was assessed based on its contribution to the pedestrian experience and urban microclimate. The scoring system is as follows:

Presence of a piazza → 1.00

Continuous vegetation and street division planting → 0.75

Continuous trees on one side → 0.50

Sparse vegetation → 0.25

No vegetation → 0.00

3. Lighting

This binary indicator considers the presence of street lighting. If lighting infrastructure is present along the street segment, a score of 1.0 is assigned; otherwise, the value is 0. The analysis does not evaluate lighting quality or design.

4. Slope

Slope conditions were evaluated using Digital Elevation Model (DEM) data within QGIS. The city center of Palermo presents generally flat topography, with no significant gradient issues identified. Slope values were normalized on a 0–1 scale, where 0 indicates steep segments and 1 indicates flat or near-flat conditions conducive to pedestrian movement.

5. Speed Limit

To reflect pedestrian safety, this indicator considers the official speed limits. Streets with speed limits of 30 km/h or less were assigned a value of 1, while those exceeding this threshold were assigned 0.

6. Traffic Restrictions

Traffic regulation was incorporated by considering the presence of ZTL (Zona a Traffico Limitato) areas. Streets falling within ZTL zones were assigned a value of 1, representing restricted motor vehicle access, which generally enhances pedestrian comfort and safety. Streets outside these zones were scored 0.

Appendix B – "Pedestrianisation of the Old Town" Survey Questions

Section – 1

1. Age

15-20

21-29

30-39

40-59

>60

2. Sex

Female

Male

I prefer not to answer.

3. Occupation

Student

Public sector

Private sector

Autonomous

Unemployed

Retired

Other

4. Which neighbourhood you live in?

Tribunali-Castellammare

Palazzo Reale-Monte di Pietà

Oreto-Stazione

Montegrappa-Santa Rosalia

Cuba-Calatafimi

Zisa

Noce

Malaspina-Palagonia

Libertà

Politeama

Settecannoli
Brancaccio-Ciaculli
Villagrazia-Falsomiele
Mezzomonreale-Villatasca
Altarello
Boccadifalco
Uditore-Passo di Rigano
Borgo Nuovo
Cruillas-San Giovanni Apostolo
Resuttana-San Lorenzo
Tommaso Natale-Sferracavallo
Partanna-Mondello
Pallavicino
Montepellegrino
Arenella-Vergine Maria
Altro

5. How far is the place where you work or study from your home?
0-1 km
1-5 km
5-10 km
> 10 km

6. How do you usually get to your place of work/study? (you can choose from more than one answer)
By train
By tram
By bus
By car
By motorbike
By bike
On foot
Taxi
Others (Scooter, car sharing, etc)

7. How long does it take you on average to get to where you work or study?
0-15 minutes

15-30 minutes

30-60 minutes

> 60 minutes

8. What amenities can you access by walking (no more than 15 minutes) in your neighbourhood? (you can choose from more than one answer)

Shops/Businesses

Middle and High Schools

Health services (clinics, pharmacies, etc.)

Leisure activities (Cinema/theatre and similar)

Bar/Pub/Restaurants

Financial services (banks and similar) or postal services

None of the above

Section – 2

9. How often do you travel to the historic centre of Palermo?

Every day

On certain days of the week

Only on weekends

Rarely

Never

10. For what reason, in general, do you go to the historic centre? (you can choose from more than one answer)

For socialization/leisure activities

For work/study

For public services or offices

To reach family members

Other

11. How do you usually get to the Old Town? (you can choose from more than one answer)

By train

By tram

By bus

By car

By motorbike

By bike

On foot

Taxi

Others (Scooter, car sharing etc)

I never go to the Old Town

12. How long does it take on average to get to the historic centre from your residence?

0-15 minutes

15-30 minutes

30-60 minutes

> 60 minutes

13. When you reach the historic centre by car, how do you rate this experience?

Not easy

Almost easy

Easy

Exceptionally easy

I never use the car to get to the historic centre.

14. How often do you use the pedestrian spaces in the historic centre?

Never

Rarely

Often

Every day

15. Do you find the area of the historic centre reserved for pedestrians sufficient?

Insufficient – Sufficient (Rating type question)

16. How do you find the pedestrian areas of the historic centre in terms of quality? (flooring, furniture, etc.)

Low Quality - High Quality (Rating type question)

17. Beyond the areas reserved for pedestrians, do you think the historic centre is an easily walkable neighbourhood?

Not very viable - Very viable (Rating type question)

18. Do you think that the residence in the historic centre is compatible with the use of the car?

Absolutely NO - Absolutely YES (Rating type question)

Section – 3

19. How do you judge the pedestrianisation initiatives in the historic centre?

Very Negative - Very Positively (Rating type question)

20. Would you be in favour of an extension of the pedestrian areas in the historic centre?

Not at all favourable - Very favourable (Rating type question)

21. While you are in favour of pedestrianisation, what negative effects do you think they could have? (you can choose from more than one answer)

They negatively affect commercial activities.

They create congestion for vehicular traffic around pedestrian areas.

They stimulate an excess of visitors in some public spaces.

They make some essential services inaccessible.

I do not see any negative effects in pedestrianisation.

22. From your point of view, what should be done to encourage walking in the historic centre? (you can choose from more than one answer)

Increase the spaces reserved for pedestrians.

Improving the design of pedestrian spaces

Improving their connection with public transport networks

Increasing safety for pedestrians

I am satisfied with the pedestrian infrastructure.

23. Do you think that the inhabitants of Palermo in the near future will change their mobility habits, reducing the use of the car and preferring to walk?

Absolutely NO - Absolutely YES (Rating type question)