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Sustainable Urban Mobility Plan for Istanbul: A Critical Review

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ABSTRACT

The concept of a sustainable urban mobility plan (SUMP) for cities was first developed to address the shortcomings of conventional transport planning with its focus on accessibility, social equity, environmental quality, and an integrated development of all transport modes as well as an involvement of stakeholders and citizens through a transparent and participatory approach. Since its development in early 2010s, many European cities have adopted this concept for their mobility planning. The sustainable mobility literature already includes many examples and reviews of SUMPs which have been implemented at various cities across Europe. Having implemented the SUMP concept in 2022, the city of Istanbul, having a population of around 16 million people, offers a novel case in terms of the complexity of urban issues addressed. This paper reviews Istanbul's sustainable urban mobility plan, discussing the benefits as well as shortcomings for achieving a sustainable mobility transition in Istanbul. The review provides many highlights that would be helpful for other cities going through a similar transition.

1. Introduction

With a population of 15.7 million people spread over an area of 5,461 km^2, Istanbul is the most populous city in Europe and the world's thirteenth most densely populated city. It has an average population density of 2,820 people/km^2, while in a number of districts density exceeds 40,000 people/km^2 [1]. Istanbul is the economic centre of Turkey, having 20% of the country's workforce and accounting for 30.4% of Turkey's total GDP [2]. However, major urban mobility issues such as traffic congestion, car-based mobility, and air quality prevents Istanbul from fulfilling its potential in becoming a sustainable and liveable city. A growing population and motorisation, urban sprawl towards the north of the city, and inadequate public transport system exacerbates the urban problems the city of Istanbul faces.

Although transport planning has a long history in Istanbul, previous transport plans, also called 'transportation master plans', have primarily focused on traffic flows and provision of capacity by developing significant road and rail projects. There are major differences between a traditional transport plan and sustainable urban mobility plans (SUMPs). Whereas traditional a transport plan

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focuses on road schemes, infrastructure development, and traffic management with limited input from operators and other local partners within a particular city, SUMPs encourage public transport, walking, and cycling to balance social equity, environmental quality, and economic development with a better integration of practices and policies between policy sectors (land use, social inclusions, etc.) and higher stakeholder engagement [3].

Istanbul's Sustainable Urban Mobility Plan (SUMP) is the first SUMP undertaken in Turkey. The city of Istanbul can also be regarded as the first mega city where a SUMP has been undertaken. One of the key objectives of Istanbul's SUMP is to surpass these conventional transportation master plans, the last of which was prepared in 2011, by providing a new approach for transport planning, with its focus on people, accessibility, and public engagement placed at the centre of its planning process. The SUMP concept emphasises the role of integration across all modes and agencies and provides a systematic monitoring and evaluation framework with well-defined targets. The SUMP implementation process for the city of Istanbul began in 2018, when potential funding was discussed with the UK Government's Global Future Cities Programme during the workshops held among UN Habitat, UK FCDO (Foreign, Commonwealth and Development Office) and the municipalities of Istanbul, Ankara and Bursa. Preparing a SUMP for Istanbul was agreed as a result of these workshops, and the actual preparation began in September 2019 [1]. It then took two years to prepare the final SUMP report.

The SUMP concept was first developed by the EU in 2009–2013, when it became evident that conventional transport planning did not provide effective solutions and tools to address the sustainable mobility needs of cities. The SUMP development process is governed by ELTIS (the EU's urban mobility observatory, funded by the Directorate General for Mobility and Transport), whose 'Guidelines on Developing and Implementing a Sustainable Urban Mobility Plan' was first published in 2013, then revised in 2019 [4]. Although a SUMP is not a mandatory planning document, the guidelines have been widely implemented by many European cities. Cities that are on the path to a sustainable mobility paradigm are recommended to benefit from the SUMP approach and guidelines. Within the abovementioned guidelines, a SUMP is defined as '*a strategic plan designed to satisfy the mobility needs of people and businesses in cities and their surroundings for a better quality of life. It builds on existing planning practices and takes due consideration of integration, participation, and evaluation principles*.' [4]. The SUMPs guidelines have been continuously evolving with developments in themes around urban logistics, electrification, intelligent transport systems (ITS), road security, the harmonisation of approaches between climate and energy policies, and funding mechanisms [5].

This paper reviews Istanbul's sustainable urban mobility plan (SUMP), discussing the benefits as well as shortcomings for achieving a sustainable mobility transition in Istanbul. Section 2 gives an overview of urban mobility in Istanbul focusing on the modal share shifts over the years, and its implication on sustainability. Section 3 gives an overview of the SUMP development and implementation project in Istanbul, focusing on the implementation steps, vision and objectives, themes and projects, performance indicators and scenarios developed as part of the SUMP. Section 4 examines the appraisal methodologies, which is a core part of the SUMP project, with its focus on monitoring key performance metrics. Section 5 discusses the governance aspects of the Istanbul SUMP project. Section 6 compares Istanbul's SUMP with the SUMP examples from other cities, highlighting how Istanbul's SUMP differs from these examples. Finally, Section 7 concludes the paper by highlighting the areas of the Istanbul SUMP project that could have been better addressed, presenting key research areas from the SUMP literature.

2. Overview of Urban Mobility in Istanbul

As part the SUMP project, an assessment of the current state of urban mobility in Istanbul was carried out as well as an analysis of the future travel demand. Comparisons of modal share of daily trips and daily public transport trips were given as in Figure 1 and Figure 2.

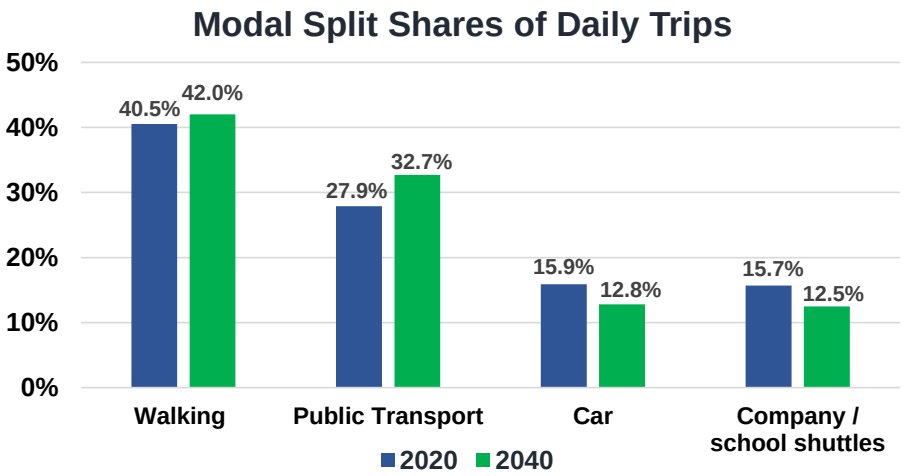

Fig. 1. Modal split share of daily trips (% peak hour) [1]

Figure 1 shows that the modal split shares (%) of walking and public transport are expected to increase from 2020 to 2040, whereas the shares of cars and company / school shuttles are expected to decrease from 2020 to 2040. It should be noted that the effect of interventions such as congestion pricing, bus lanes, and bus parking policies were not included in this analysis. As shown in Figure 2, a significant increase for rail transport share is estimated from 2020 to 2040 as a result of the implementation of the planned railway extensions in Istanbul. On the other hand, public bus and minibus shares are estimated to decrease.

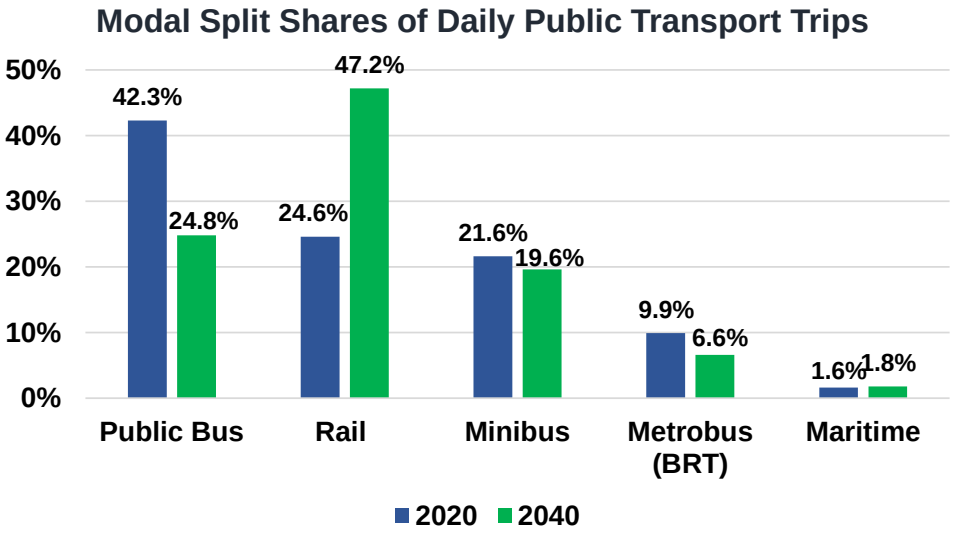

Fig. 2. Modal split share of daily public transport trips (% peak hour) [2]

Given that traffic congestion is one of the most significant urban problems in Istanbul, one of the most critical metrics indicating the sustainability of urban mobility is car ownership rates. According to TurkSTAT, Turkish Statistical Institute, the number of registered motor vehicles and cars has increased rapidly, and as of 2024, 5.4 million motor vehicles are registered in Istanbul, of which 3.6 million were cars [6]. Based on the number of registered cars, average car ownership is 230 cars per 1,000 people in Istanbul. One can argue that increasing investment in the expansion of road space has led to increasing car ownership. The Istanbul SUMP underlines the importance of addressing growing car ownership as well as car usage in daily travel and proposes measures to mitigate this growth. The SUMP estimates that the projects proposed will decrease car-kilometres in peak hours by 10.1% in 2030 and 12.8% in 2040 [1].

The rail network in Istanbul plays a crucial role in Istanbul's public transport. As of 2024, the total rail network length in Istanbul is 380.70 km, of which 241.35 km is metro and tram lines operated by Metro Istanbul [7]. Despite the significant increase in the rail network in recent years, there is still need for greater integration with other public transport modes, particularly with bus services, operated by IETT, the public bus operator as well as private bus operators. Figure 3 shows the railway network in Istanbul.

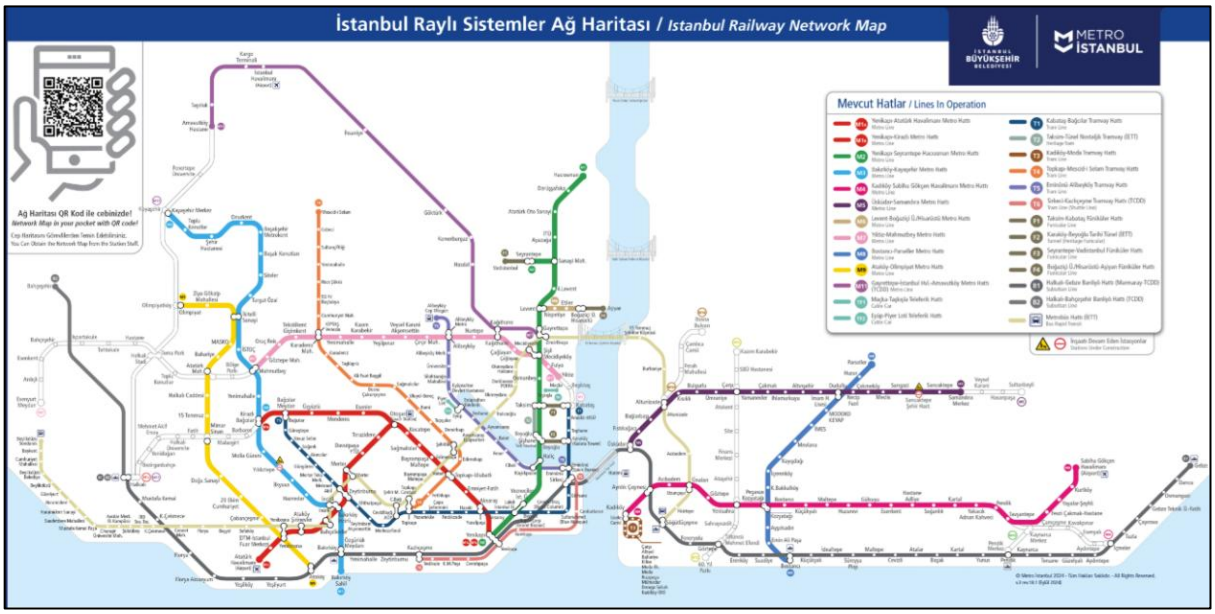

Fig. 3. Istanbul railway network map (*https://www.metro.istanbul/yolcuhizmetleri/agharitalari*)

It is widely accepted that active modes of transport (walking and cycling) play an important role in reducing the environmental impact of transport and contribute to a healthy way of life. Maltese et al. [8] point out the role of active travel including walking and cycling within SUMPs, showing that infrastructural active travel projects are more prevalent in SUMP-induced projects and recommend that a more comprehensive policy package with citizen engagement, land-use planning, gamification, and data collection for promoting active travel is still lacking in many SUMP implementation projects\. Having a consistent approach with regards to the definition and implementation of the sustainable urban mobility is key for the success of SUMP projects.

The healthy streets approach in the Istanbul SUMP aims to plan and design streets to support and encourage walking and cycling [1]. Although there are many barriers on the way to a transport system conducive to cycling in Istanbul [9], increasing investment in cycle lanes and paths is only the first

step to encourage cycling in Istanbul. Cycling is still seen mainly as a sports and leisure activity rather than a mode of transport. Istanbul SUMP considers that cycling can play an important role in providing a first/last-kilometre solution with cycle feeder routes connecting major public transport hubs and transfer centres with key destinations. There are also barriers to actively using walking as a key mode of transport. Despite some enabling factors for walking such as short streets along with dense and mixed land use, there are many streets and footways which are unsafe and poorly designed. This is being exacerbated with poorly situated street furniture, signs, and lamp posts as well as illegally parked cars blocking pavements. Although Istanbul has quite a high share of walking within daily trips, as shown in Figure 1, walkability in the city is low and there is a need for a holistic policy which considers walking as a key part of sustainability mobility.

Istanbul aims to become a carbon neutral and resilient city by 2050, by reducing carbon emissions gradually. The Istanbul Climate Change Action Plan sets out the milestones in achieving this goal [10]: 73% reduction in carbon emissions from transportation sources by 2030, 94% reduction by 2040, and 100% reduction by 2050. In addition to transportation and logistics, this plan covers ten areas including energy production and distribution, industry, land use, buildings, waste management, and water resources. People with lower incomes, mostly residing in the outskirts of the city, are particularly vulnerable to health problems caused by air pollution. Therefore, it is critical to adopt measures to reduce car dependency and road space occupied by cars in those areas and decarbonise the transport system and increase its resilience.

3. The Istanbul Sustainable Urban Mobility Plan (SUMP): A General Overview

There were four key steps for the Istanbul SUMP, including 1) preparation and analysis, 2) strategy development, 3) measure planning, 4) implementation, monitoring, and evaluation [1]. As part of the first phase, an assessment of institutional resources and the local planning context was carried out. In the second phase; scenarios, visions, and objectives were developed in collaboration with the Istanbul Metropolitan Municipality (IMM) SUMP team as well as other stakeholders. A set of metrics were defined to measure the progress of SUMP goals. As part of the third phase; a list of measures including social inclusion and gender equality were identified, and all policies were classified into measure packages. The projects for these policies were prioritised based on a combination of quantitative and qualitative appraisals. Finally, the last step involved the development of a systematic monitoring and evaluation framework to track the progress of the SUMP projects. A number of surveys, workshops, and focus group meetings were conducted with various stakeholders to ensure the citizen participation. Stages as well as milestones of the SUMP project can be found in detail on the Istanbul SUMP report, pg.26-28 [1]. In addition to typical phases defined in the SUMP guidance, a governance structure was established to identify the main principles and a framework for the planning and implementation of the Istanbul SUMP along with a capacity building and training programme for IMM.

The new SUMP concept shifted the emphasis on technical expert knowledge, which was the dominant paradigm in previous transport plans, to a culture of participation whereby a range of stakeholders as well as under-represented groups (e.g. women, the elderly, children/youth, low-income groups/unemployed populations, individuals with disabilities, ethnic minorities, refugees, tourists, etc.) were involved throughout the SUMP development. One of the key objectives of the Istanbul SUMP was to mitigate transport inequalities through greater participation, gender equality and social inclusion. ‘Workshops, focus groups, and expert meetings were some examples of means of ensuring public participation and engagement. In terms of public participation and citizen

engagement, the Istanbul SUMP is expected to set a new standard for sustainable mobility planning for other major cities in Turkey such as Ankara and Izmir.

Kiba-Janiak and Witkowski [11] showed that cities having an integrated mobility plan like a SUMP collaborate with different stakeholders and implement the greatest number of measures for sustainable urban mobility, achieving better outcomes with regards to safety and emission reductions. The key objective of Istanbul's SUMP is to increase the role of citizens in planning processes and encourage the use of sustainable mobility modes, principally public transport, walking, and cycling while reducing car dependency. Istanbul's SUMP also aims to address the negative impacts of carbon emissions, air and noise pollution as well as accidents. The vision statement of the SUMP for Istanbul is thus stated as the following: "*an inclusive and innovative transport system, focusing on people and the environment, providing the right mix of safe, integrated, accessible and affordable mobility alternatives, compatible with the unique geography and historical values of Istanbul for a sustainable and resilient future*.

The Istanbul SUMP offers a comprehensive overview of factors impacting mobility in Istanbul. These factors include economy, governance, climate change, pandemic, earthquake, technology, and population-demography. In this respect, the SUMP is the first among transport plans undertaken for Istanbul's mobility that provides a holistic perspective taking into account the socio-economic factors as well. Among these factors, predicting the economic situation in Turkey in foreseeable future is considered the most challenging. Both low economic prosperity associated with unbalanced regional economic development with significant gap between rich and poor as well as high economic prosperity scenarios are likely. The SUMP also concedes that the evolution of governance structure in Turkey is quite unpredictable. A more centralised governance structure with greater top-down approach as well as a decentralised governance structure are likely. These changes affect the current power of local authorities in city's decision-making processes. The SUMP addresses these uncertainties by turning these likely outcomes into different scenarios as in Figure 4 and sets out different strategies for each of these scenarios.

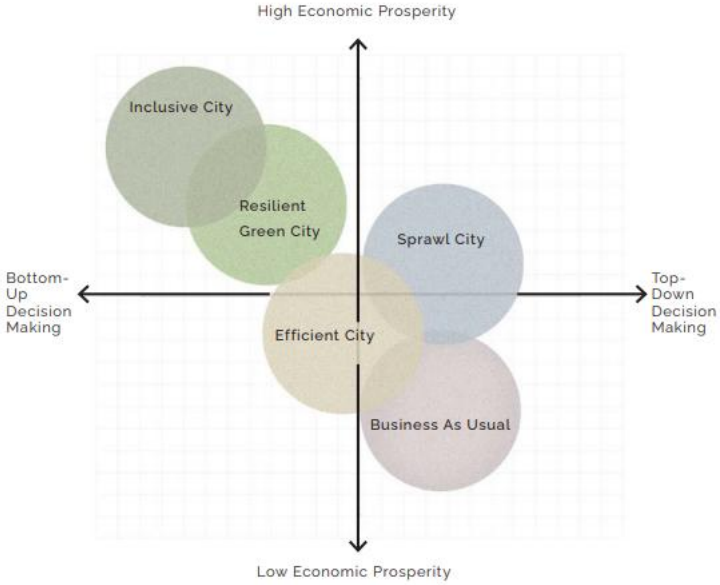

Fig. 4. Future scenarios for Istanbul's urban mobility [1]

The SUMP develops various scenarios for the future of Istanbul's urban mobility, identified based on the level of economic prosperity (low vs. high) and decision-making structure (bottom-up vs. top-

down). An illustration of these scenarios, where 'business as usual' represents today's mobility situation, is given in Figure 4. For example, 'spawl city' refers to a scenario where increased economic prosperity is coupled with a top-down decision-making structure. Other scenarios, namely 'efficient city', 'resilient-green city' and 'inclusive city', anticipate improvements in efficiency, resilience and inclusiveness. The SUMP strongly advocates for the bottom-up decision-making whereby the local government's decision power is not curtailed by the dominant power of the central government. This is particularly critical in the Turkish political context where the decision-making power, local and national, tends to be strongly centralised at the central/national government at the expense of local governments.

To achieve the vision of Istanbul's SUMP as provided above, the SUMP also sets out the following nine objectives:

- Having an accessible, affordable, integrated, and inclusive transport system
- Having an environmentally sustainable transport system
- Having an economically sustainable and resilient transport system
- Improving the safety and security of transport
- Reducing traffic volumes, congestion, and car dependency
- Encouraging the modal shift to public transport
- Stimulating the modal shift to active modes (cycling and walking)
- Having a transport system that encourages compact and polycentric urban development
- Having an efficient city logistics system with minimal negative impact

A set of indicators along with baseline values and targets were developed for each objective to monitor the progress in this area. For example, performance indicators for the first objective above ('*having an accessible, affordable, integrated, and inclusive transport system'*) is listed as below:

Table 1
Performance indicators for the objective 'having an accessible, affordable, integrated, and inclusive transport system' in Istanbul SUMP [1]

Performance Indicators	Baseline Data	Targets (2040)
% of the poorest quintile (lowest 20%) of the population's household budget spent on transportation	8.3%	5% (poorest quintile)
% of jobs accessible within 30 min of PT travel time	Average 7.8%	30%
% of population within 15 min travel time by public transport or 10 min travel time by active modes to rail transit and BRT stations	67% (Istanbul average, based on BRT stations and 15 min PT travel time)	30% increase
% of rail transit and BRT stations with step-free access	Rail systems 100% - 2020 BRT 75% (2020)	100% compliance
% of buses that are wheelchair accessible, and have provision for the visual and hearing impaired	%100 (2020, for wheelchair accessibility only)	100% compliance
% of bus stops that are wheelchair accessible, including streets within 250 m radius of bus stops	Data not available	50%-100% compliance

Average travel time to and from work or an educational establishment, using any mode of transport	Work trips: 41.9 min School trips: 23.3 min	Work trips: 30 min. School trips: 15 min

A comprehensive plan of actions was developed to achieve the SUMP targets, objectives, and vision. This resulted in 26 core projects based around three themes, as shown in Figure 5. Moreover, four cross-cutting themes, in relation to all core projects were also identified, including gender equality and social inclusion, safety, resilience, and innovation.

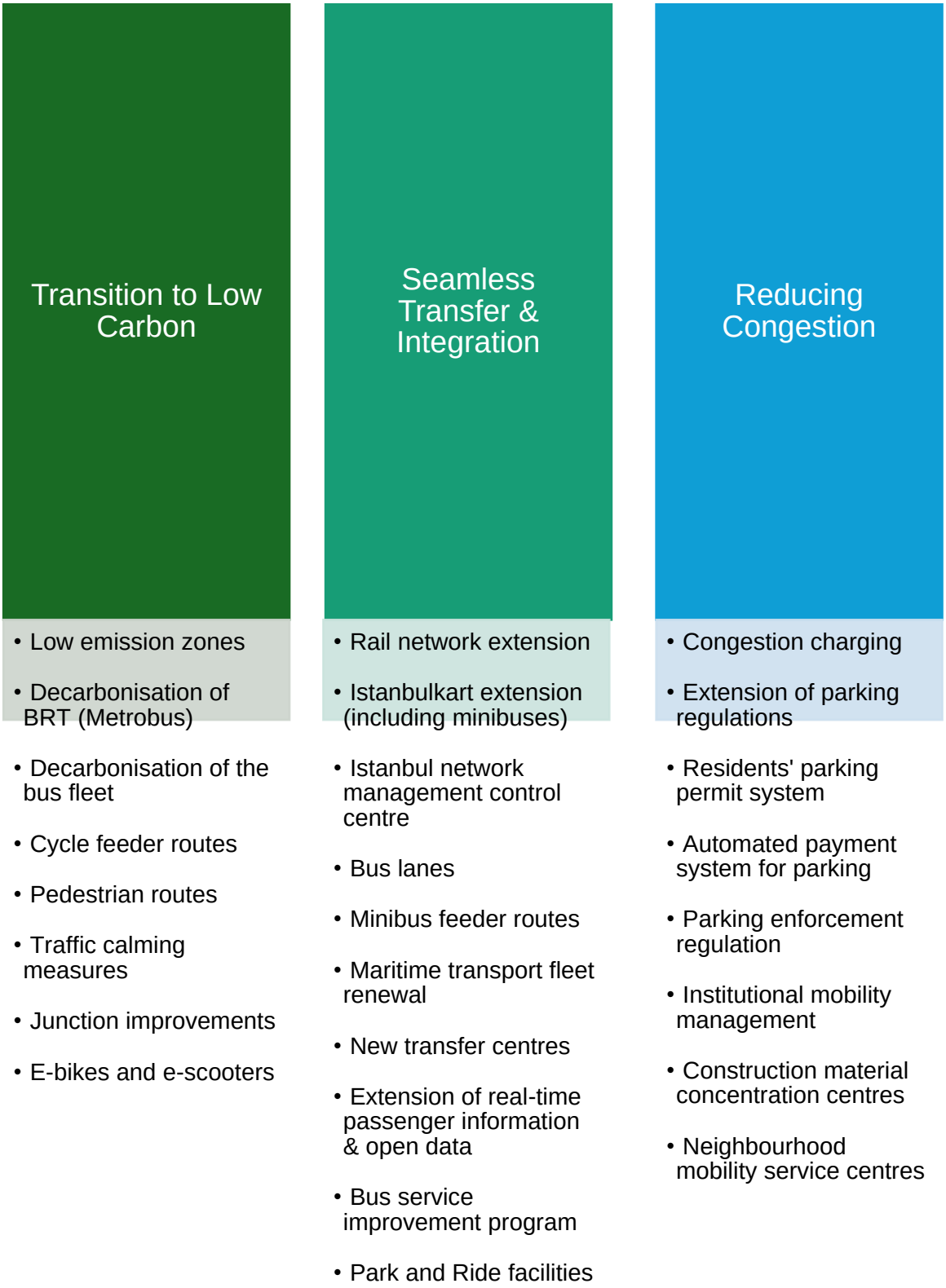

Fig. 5. Themes and Projects for the SUMP [1]

The main objective of the projects classified under the 'transition to low carbon' theme is to reduce transport-related carbon emissions with a number of measures that aim to change travel behaviour by restricting car use, decarbonising the existing bus fleet, and promoting active mobility.

The projects classified under the 'seamless transfer and integration' theme aim to encourage public transport use by providing an accessible, integrated, inclusive, safe and comfortable transport system. Lastly, the projects classified under the 'reducing congestion' theme aim to discourage the use of private vehicles through various push or pull interventions and regulating the parking system.

For each project, the following list of information is provided: problem description, relations with other projects, preparatory tasks, follow-up tasks, beneficiaries, owner of the project (who is responsible), and third parties involved, project process: preparation, pilot, and implementation, estimated budget and financing source, contribution to SUMP objectives, and index value of appraisals.

There are many other urban sectoral plans referred to in the SUMP that would support the implementation of the Istanbul SUMP, as given below:

- Istanbul Parking Master Plan [12]
- Istanbul Logistics Master Plan [13]
- Istanbul Climate Change Action Plan [10]
- Istanbul Cycling Master Plan [14]
- Istanbul Local Equality Action Plan 2021-2024 [15]
- Road Traffic Safety Action Plan [16]
- Marmara Region Spatial Development Strategic Framework Document [17]
- Istanbul Pedestrian Master Plan [18]
- Istanbul Vision 2050 Strategy Document [19]
- National Transport and Logistics Master Plan by 2053 [20]

4. Istanbul SUMP: Appraisal Methodologies

The Istanbul SUMP puts forward an appraisal methodology, quantitative and qualitative, for these projects for their capacity to achieve the SUMP objectives. Whereas the cost-benefit ratio (CBR) is used for quantitative appraisal, the multi-criteria analysis is used for qualitative appraisal. The methodology combines the scores of different appraisal methods to calculate a weighted score for each project. The projects were then listed according to the weighted scores whereby the highest score was given as 1.0. For example, the project for 'parking enforcement regulation' was given the lowest score of 0.47 while the project for 'rail network extension' was given the highest score of 1.0. Overall, out of 26 projects, 23 projects had a score above 0.5, which led the SUMP team to conclude that none of the projects received a significantly low score, and the results were balanced across different mobility modes and environmental impacts. The projects for which quantitative assessment is to be carried out include rail network extensions, low emission zones, decarbonisation of the public bus fleet, decarbonisation of BRT, extension of parking regulations, bus lanes, cycle feeder routes, and bus service improvement programme. On the other hand, the projects for which qualitative assessment is required include congestion charging, Istanbulkart extension (including minibuses), residents' parking management system, automated payment system for parking, reorganisation of parking regulation enforcement, minibus feeder routes, and extension of transfer centres. The Istanbul SUMP projects were also classified into short-term (2022-2024), medium-term (2025-2032), and long-term (2033-2040), and the scale of investment costs for each project was classified under three groups: low-cost (0-10 million TL), medium-cost (10-100 million TL), and high-cost (above 100 million TL).

A significant part of the Istanbul SUMP document is about project appraisal methodologies and measurement of total benefits in quantitative (i.e. monetary) benefits as well as ranking projects based on these benefits. For the quantitatively appraised projects, indicators associated with congestion (measured by delays in road traffic during peak hours as compared to off-peak hours), environmental sustainability (measured by GHG emissions based on emission characteristics for relevant vehicle types), and road safety (measured by fatal accidents and accidents with severe injuries). To turn these into monetary value of a benefit, the SUMP uses certain assumptions such as the value of travel time lost in congestion, the external costs of GHG emissions, health benefits or road accidents, using the Handbook on the External Costs of Transport (European Commission) [21]. Based on these monetary values, the most benefits are obtained through the rail network extension project, followed by the extension of parking regulation and bus lanes projects. Time saving benefits are the most significant benefit to be obtained as a result of rail network extension projects. Benefits for the environment are mostly generated by the decarbonisation projects.

On the other hand, projects subject to qualitative appraisal are scored, on a 5-point-Likert-scale, by the project team and IMM SUMP team in terms of a project's anticipated contribution to nine SUMP objectives and related indicators. The highest scores obtained as a result of the qualitative appraisal belong to these five projects: the extension of transfer centre, maritime transport fleet renewal, Istanbul network management control centre, extension of real-time passenger information & open data, minibus feeder routes. These five projects comprise 63% of the overall anticipated SUMP impact of qualitative projects.

The Istanbul SUMP has a particular focus on gender equality and social inclusion (GESI), measuring the impact of each project on this issue. A GESI-index is developed based on parameters associated with accessibility, safety, empowerment of underrepresented groups, environment public health as well as economic impacts such as affordability, travel time, and local economic impacts. Among all proposed projects, the rail network extension project obtained the highest GESI score, followed by extension of transfer centres, maritime transport fleet renewal, bus service improvement programme, and bus lanes. The Istanbul SUMP is different from previous transport plans in that it takes social issues at the forefront of the planning process. The SUMP puts forward a social inclusion approach whereby increasing gentrification and segregation leading to the creation of areas whereby poorer groups cannot reside aims to be prevented. A significant emphasis is put on the close link between land use and transport policies. The Istanbul SUMP represents a paradigm change in the transport planning regime not just in Istanbul, but also in Turkey, in recognising the transport-based inequalities as well as proposing policies and developing measures to address it.

5. Istanbul SUMP: Governance Structures

The governance structure for the management of urban mobility has a major impact on land use and sustainable transport. Recent decades have seen a significant increase in the power of the central government in Turkey in all decision-making mechanisms, including what would be seen as the purview of the local government. The SUMP proposes setting up independent auditing processes to keep track of the progress of the projects set out in the plan. Therefore, the uncertainty around the governance structure in the future is selected as one of the main external factors influencing future scenarios, with the other one being economic prosperity. The SUMP aims to provide an inclusive governance framework with the collaboration of central government, local councils, citizens, non-governmental organisations such as cycling associations, associations for the disabled.

Although the Istanbul SUMP sets out transport policies at an urban level, it has also various impacts on regional and national development objectives, in environmental, social, and economic aspects. Various other policies such as land use, environment, energy, public health, urban development, etc., that are governed at local, regional, and national levels have intersections with the transport policies set out in the SUMP document. The governance framework for the Istanbul SUMP, therefore, is crucial to ensure a multi-dimensional engagement between all relevant agencies. The participatory and inclusive approach of the Istanbul SUMP is essential for its implementation. NGOs, businesses, public and private sector stakeholders, transport operators, educational institutions, and citizens all have a stake in the development and implementation of the Istanbul SUMP. The dynamic and flexible nature of the SUMP provides an ongoing process, which is based on data reflecting the mobility patterns of Istanbul citizens. The governance framework addresses the data collection and management issues by ensuring a reliable and consistent data processing.

The governance structure of the Istanbul SUMP puts forward a coordinating body, the SUMP governing body, by which the IMM Transportation Planning Department is responsible for undertaking and managing the activities for the SUMP planning and implementation as well as coordinating between different stakeholders involved. The SUMP recognises the need for establishing a dedicated transport authority to govern the transport planning processes within the urban area of Istanbul, including all modes of transport, and coordinating all transport operators. Various studies have been undertaken to examine the conditions for establishing a transport authority for Istanbul [22], as well as identifying the legal, political, and technical barriers for such an authority. Another key role of this authority would be introducing regulations for open data sharing among the stakeholders partnering with the authority, including transport operators.

The existence of a national legal framework and role of national government to support local SUMPs have been pointed out by many studies in the SUMP literature [23, 24]. It is crucial that national legal frameworks enable the coordination between local transport authorities and transport operators by recognising the autonomy of transport authorities, by actively encouraging cooperation and transparency. This is particularly problematic in a political environment whereby partisan politics trump other administrative and technical efficiency considerations. Although the SUMP does not put it directly, the fact that the local government and national government are run by different political parties, there is a lack of bipartisan political framework that would ensure the implementation and continuity of long-term plans like the SUMP. The most significant predicament of the Istanbul SUMP is its dependence on a planning culture whereby its measures and policies cannot be dramatically influenced by political changes in local or central government. However, this is what makes the success of Istanbul's SUMP tenuous.

The Istanbul SUMP acknowledges the future unpredictability of various factors that would influence the future implementation of SUMP projects. Economic and political changes, internal and external migration, earthquakes, major urban transformation projects, urban sprawl, and increased density of the built environment are major factors that create significant unpredictability for the future sustainability of the Istanbul SUMP. The SUMP seeks to address these challenges by setting out various scenarios around the future of economic development and governance structure. By linking these scenarios with the proposed projects, the SUMP develops a flexible approach to tackle these uncertainties.

6. Comparison of Istanbul's SUMP with Other SUMP Examples

This section presents three case study examples taken from the academic literature so as to provide a comparison with Istanbul's SUMP. Since the SUMP concept emerged from a practice-oriented approach, having an overview of the other case study examples as well as key takeaways from these SUMP examples is helpful to compare their key themes with Istanbul's SUMP. The three SUMP examples presented in this section is not intended to be exhaustive. These examples are provided with a view to having a general understanding of key themes tackled in case study examples as well as highlighting areas that differentiate Istanbul's SUMP from these examples.

Table 2 provides three SUMP examples from the academic literature showing the key themes they address and cities/countries where they are from:

Table 2
SUMP Examples from Other Cities

Case Study - Paper	Cities / Countries	Key Themes
Sampaio et al. [25]	Águeda, Portugal	Economic & Environmental Performance Measurement
Okraszewska et al. [26]	Gdynia, Poland	Multi-Level Perspective
Vujadinović et al. [27]	Podgorica, Montenegro	Data Collection

Sampaio et al. [25] provides a methodology as well as a case study to examine the economic and environmental impacts of the measures proposed by the SUMP in Águeda, a small-sized city in Portugal with a population of 15,000 people. The paper estimates the emissions and external costs along with an economic analysis using indicators such as Net Present Value (NPV) and Internal Rate of Return (IRR). The paper also calculates and evaluates the profitability of the SUMP project, concluding that the project is profitable after 6,5 years. By quantifying the CO_2 emission savings into monetary units, the paper provides a good example of developing and measuring performance indicators for the effectiveness and profitability of SUMP measures. Although this methodology is similar to the appraisal methodology used in Istanbul's SUMP, there is a lack of NPV and IRR analysis for the measures put forward in Istanbul's SUMP, and this analysis could provide a more accurate analysis of the costs involved in each measure.

Okraszewska et al. [26] proposes a method to integrate a multilevel model of transport systems with the SUMP process, by providing the case of SUMP implementation in Gdynia, Poland between 2012 and 2016. The paper recommends using this multilevel model to improve the effectiveness of SUMP. This model can help understand the improvements in a particular city development scenario and integrating mobility with land use. The model can also be used at various stages of the SUMP process, allowing analyses at different planning levels including strategic, tactical, and operational levels. A key feature of the model is that it can be used for public engagement, particularly for contentious mobility measures. Istanbul's SUMP lacks such as a multilevel perspective that differentiates strategic, tactical, and operational planning levels.

Data collection is a key part of SUMP, and an effective SUMP depends on availability of accurate, complete, and reliable data along with robust modelling methods. There are various data collection methods used in SUMP initiatives including origin/destination surveys, journey time surveys, traffic counts, ridership counts for various modes of transport, crowdsourced data through mobility apps, etc. A key challenge in data collection is that data can often be found in different organisations, that are often unwilling to share. Therefore, stakeholder engagement in data collection and processing is

also key. Although Istanbul's SUMP presents various data and graphs throughout the report, accuracy and reliability of data do not seem to be accounted for. Vujadinović et al. [27] offer a practical approach for collecting data for the SUMP for Podgorica, the capital of Montenegro. The methodology presented in their study provides a cost-effective way for local governments to collect and update the mobility data on an annual basis, which is a key part of monitoring and evaluating the progress of SUMP. Istanbul's SUMP might provide an analysis of the reliability of data collection methods as well as the accuracy of the data being utilized.

7. Conclusions and Recommendations

Although stakeholders can share the same definition of sustainable urban mobility, they can have different approaches with regards to how to achieve it [28]. There is still a wide gap between the theory of sustainable urban mobility, as promulgated in SUMP documents, and its implementation in practice. It is important to identify these gaps that represent barriers to sustainable urban mobility transition in cities. Although Istanbul's SUMP document represents a quite important milestone in the evolution of urban mobility planning in Istanbul, there are still major gaps and barriers that need to be identified to better guide the transition to sustainable urban mobility in Istanbul.

Smart urban mobility innovations include intelligent transportation systems, electric vehicles, autonomous vehicles, demand-responsive transportation, shared transportation, and mobility-as-a-service [29]. One of the drawbacks of the Istanbul SUMP is its limited focus on these smart urban mobility innovations and their future impact and potential implementation for Istanbul's urban mobility. The study of Butler et al. [29] provides recommendations as to how to turn these smart urban mobility innovations into policy recommendations as part of the SUMP implementation. These recommendations include investing in smart infrastructure, focusing on shared mobility, encouraging reduced travel, ensuring accessibility to employment locations, and integrating mobility services.

Although the Istanbul SUMP document addresses the uncertainties around government / governance structures and economic development with regards to their influence on sustainable urban mobility development in Istanbul, there is a lack of research in analysing the potential urban mobility pathways Istanbul might take in the near future considering the developments in areas such as electric vehicles, autonomous vehicles, shared mobility, etc. The SUMP could provide a better understanding of what major trends shape Istanbul's urban mobility in the foreseeable future, laying out possible future scenarios within these parameters as well as asking questions around the adoption of new trends and technological innovations [30]. Taking into account changes in trip-making behaviour and possibilities in lifestyle changes such as remote working would contribute a wider perspective. Three key considerations as set out by Ceder [31]; namely, imagination, perceived and justified feasibility, and lessons gained from the past are helpful in setting out and capturing the possibilities and travel modes of Istanbul's future urban mobility.

The performance of public transport in Istanbul is an area not much explored within the Istanbul SUMP, although accessibility of the public transport has been covered by some of the themes and projects such as rail network extension, bus service improvement programmes, new transfer centres, etc. However, the performance of transport providers, in particular IETT, private bus operators, private ferry operators, etc. with metrics addressing financial performance, network efficiency, and service quality is a key area to improve the efficiency and effectiveness of public transport services [32].

Although the Istanbul SUMP sets out and recommends measures to implement sustainable urban mobility projects, there is a lack of transition governance approach critical in shaping the major transition involved in the SUMP concept. Exploring the social, cultural, institutional, and technological change and how they are interrelated to one another is needed to achieve a just and sustainable mobility future [33]. By addressing the drawbacks and gaps highlighted in this section, the Istanbul SUMP can better address an effective sustainability transition in Istanbul. The SUMP document's flexibility and being open to further improvements allow taking into account these considerations.

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Conflicts of Interest
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