Integrated Public Transport Planning for Urban Sustainable Development in Potenza Town

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Abstract. Public transport represents a critical area of intervention for urban development. Assuming UN – HABITAT New Urban Agenda as a reference framework, the experimentation proposed in this work promotes an integrated approach for urban development policies. The main purpose it to implement measures, based on territorial specialization and to design place-based development strategies structured on sustainable mobility:

Main objects of the proposed approach are: the infrastructures of new interchange areas; phasing out the obsolete TPL buses to be replaced by Euro6 and electric vehicles for the reduction of polluting emissions; development of an ICT info-mobility project related to further and more incisive actions on mobility technological systems. The synthetical representation is based on land suitability approach delivered according with GEODESIGN methodological framework.

Keywords: Sustainable transport, sustainable urban development · Urban agenda

1 NUA and Urban Sustainable Mobility in the Framework of EU New Cohesion Policy

A city model looking at advanced criteria of sustainability, inclusiveness and equity [1–3] has to put in the agenda concrete efforts in facing both urban inequities of citizens and climate change issues. Public transport represents a critical area of intervention that we assumed as a stimulating background to perform a critical study for the sample context (the city of Potenza in Basilicata – Italy) assuming, in the design phase, UN – HABITAT New Urban Agenda [3] as a reference framework. According to the UN-HABITAT guidelines [4], it is possible to distinguish different levels of urban and territorial planning. At city and municipal level, both city development strategies and integrated development plans has to consider interactions between distant urban areas, looking for an optimal land use assets based on an effective organization of open urban spaces. On the other hand, at the neighborhood level, development projects for road

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and public space has the role to improve the urban quality, both social cohesion and inclusion and the protection of local resources. The urban and territorial planning will essentially promote more compact cities, through suitable road and interconnection schemes, which could reduce the urban mobility needs, as well as the costs of the services distribution. Therefore, the New Urban Agenda 2030, adopted during the United Nations Conference on urban and sustainable development (Habitat III held in Quito, Ecuador, from 17 to 20 October 2016), is clear and useful reference to improve the current planning system both at normative and methodological level.

Additionally, adopting the Agenda for Sustainable Development [5], all countries committed themselves to achieving the 17 Sustainable Development Goals (SDGs), through constant monitoring and regularly evaluating their progress [6, 7], in order to improve the performance of urban and territorial governance. In particular, the theme of urban mobility is addressed in the eleventh objective: "*sustainable cities and communities*". In fact, the goal for 2030 will be to provide access to safe, sustainable and affordable transportation systems for everyone, to improve road safety, in particular by expanding public transportation, with particular attention to women, children, people with disabilities and the elderly needs.

Improving the Local Public Transport (LPT) in terms of efficacy and efficiency means to removing some critical problems which are still present in the actual organization models of urban mobility. If we focus on the case study area, the main critical factors affecting Potenza urban mobility result from a lack of effective and integrated spatial planning policy, able to systematically deal with the dynamics of mobility at urban scale.

Potenza Municipality has adopted the Urban Mobility Plan (PUM) in 2008. This program proposes a multimodal and multi-action approaches to face the problems of urban mobility with the aim of ensuring a sustainable system on environmental, technical and economical point of view.

The experimentation proposed in this work is also based on OP FESR Basilicata 2014–2020 which promotes an integrated approach for urban development policies. The main purpose it to implement measures, based on territorial specialization and to design place-based development strategies [8–11]. Such integrated approach is realized through the Integrated Territorial Investment (ITI) [12] which is a programming instrument including negotiated development strategies on a specific area. In particular, integrated actions are initiated with the ITI of Potenza Municipality coherently with the thematic objectives defined in Regulation (EU) n. 1303/2013 [13]. The ITI program structured the sustainable mobility strategy of the city pointing out specific actions concerning:

- the infrastructures of new interchange areas for the transhipment from extra-urban buses to urban buses, with a view to reducing the overall traffic of buses in the city, and for promoting the use of automated systems;
- phasing out the most obsolete TPL buses to be replaced by Euro6 and electric vehicles for the reduction of polluting emissions;

- development of an ICT info-mobility project related to further and more incisive actions on mobility technological systems, providing innovative services through technological tools for the public transportation and the traffic management and urban mobility networks.

2 Case Study Area: Potenza Town

The City of Potenza is the capital of the Basilicata Region and with its 67168 inhabitants (ISTAT source) is the largest town of the region. The residents are distributed over an area of 175.42 km^2, with a density of 382.6 inh/km^2. Its area has mountainous characteristics, with a maximum altitude above sea level equal to 1345 m and a minimum of 605 m; the maximum altitude of the urban area is 819 m. The city is characterized by the presence of several services of local and regional interest (hospital, university, administrative offices of the Region and of the Province) and for this reason is therefore considered a functional pole for the whole regional community, namely a destination city for most of the journeys.

Hence the need for an urban mobility system able to respond to the increasing citizen's needs. The city has a very particular urban structure that places the historic center on the top of an hill and the remaining districts are settled at a lower altitudes. It is also known as the "City of the hundred stairs", due to its system of stairs, ancient and modern, which connect the various parts of the urban center.

The definition of an efficient and sustainable configuration of the urban mobility system for Potenza suffers from the morphological character of the city. We identified areas with a strong and concentration of activities and services compared with other neighborhoods developed as a result of a weak urban planning [14] and, consequently, a strong fragmentation of the settlement density [15–17]. Such urban configuration favored over decades exclusively the use of private vehicles of urban mobility.

Furthermore, from the analysis of transportation and mobility plan drawn up over the last few decades, we can highlight the substantially unchanged strategy. In fact not radical actions are promoted in order to shift from private cars mobility based system towards a more sustainable one.

Another weakness of the urban mobility management in Potenza town is connected with the usefulness undermined time scheduling of envisaged actions. Due to the excessive time span between the phase of planning/design and the operational implementation of actions, soft and hard measures, organizational schemes. Such delay makes ineffective the interventions due to the changes the settlement and functional context. Italy is one of the European countries with the highest motorization rate; in particular, Potenza ranks second among the regional capital cities, registering an increase in the motorization index of 3.4% from 2015 to 2017 (Fig. 1). At the same time, there was a decrease in LPT demand in the Municipality of Potenza at around 67% (Fig. 2).

The graph in Fig. 3 shows the modal imbalance deriving from the increasing use of individual transportation, which represents the main concern that persists in the urban mobility system.

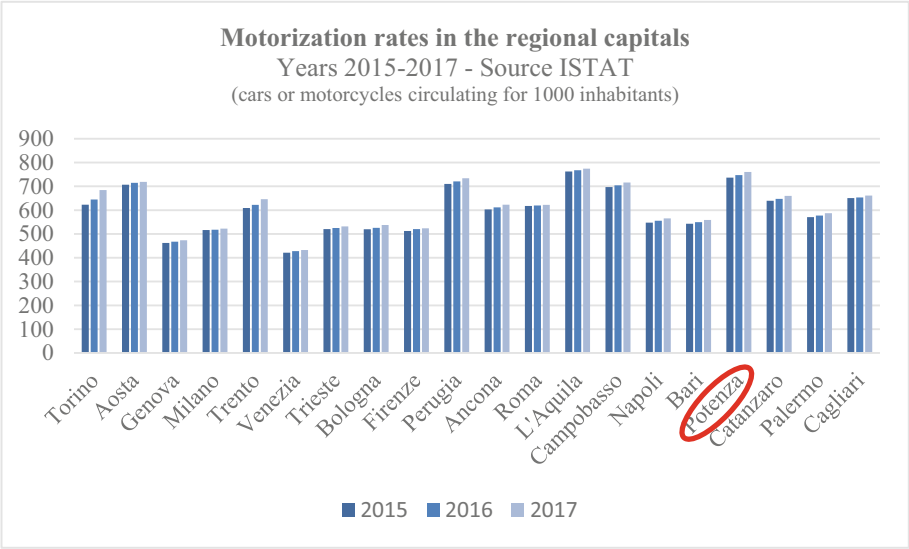


Fig. 1. Motorization rate in the regional capitals

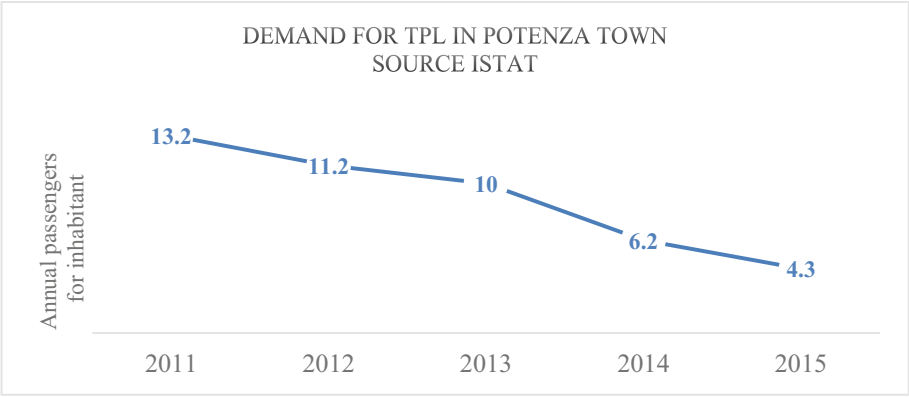


Fig. 2. TPL demand in the municipality of Potenza - Years 2011–2015

The few indicators discussed represent critical factors and, at the same time, unavoidable design constraints for any policy that pursues sustainability objectives. Therefore, it is necessary to structure integrated policies for the sustainable dimensioning of urban public transportation. However, the concept of 'mobility' must be regarded as inclusive as much as possible and it should meets the needs of every individual and citizen analyzed in a participatory way (cfr. [18–23] participation experiences in Potenza).

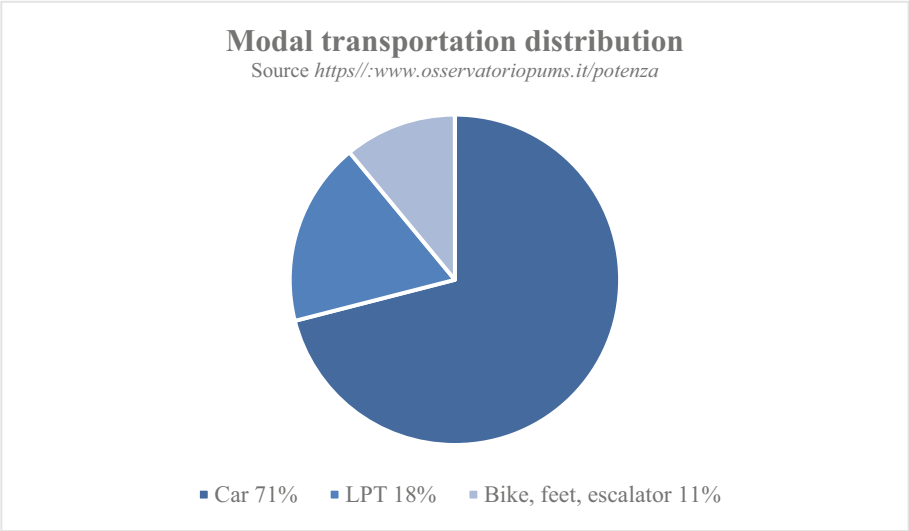


Fig. 3. Modal transportation distribution

The case study experimentation was carried out according with the Logical Framework Approach [24–26], which is a robust methodological framework based on the analysis of logical links between the activities included in a strategy or in a project and its objectives systems organized in a synthetic program structure. This methodology provides a structured and logical approach, which will establish priorities and determine the expected results. It includes the elaboration of four main outputs: SWOT Analysis, Problem Tree, Object Tree and Logical Framework Matrix.

A useful instrument to support the context analysis is the SWOT Analysis, from which an integrated view of the territorial context could be obtained. In the SWOT we summed up the salient aspects analyzed in internal Strengths and Weaknesses points, external Opportunities and Threats. In this way, it is possible to clearly and synthetically highlight the variables that can facilitate or hinder the project.

The analysis phase continues through the problems identification and the analysis of the objectives: the first one is realized with the development of the Problems' Tree, which lead to the identification of the cause-effect relationships existing between the negative issues. The second one is realized with the Objectives' Tree, which describes the future scenarios. Finally, in the synthesis phase the project idea is organized in operational parameters with the elaboration of the Logical Framework Matrix. It is a synthetic document that outlines how the project/strategy will guarantee the achievement of the selected objectives. Furthermore, it allows both the management and the evaluation of the efficiency and effectiveness of territorial transformation activities in terms of priorities and costs, through the use of indicators (Fig. 4).

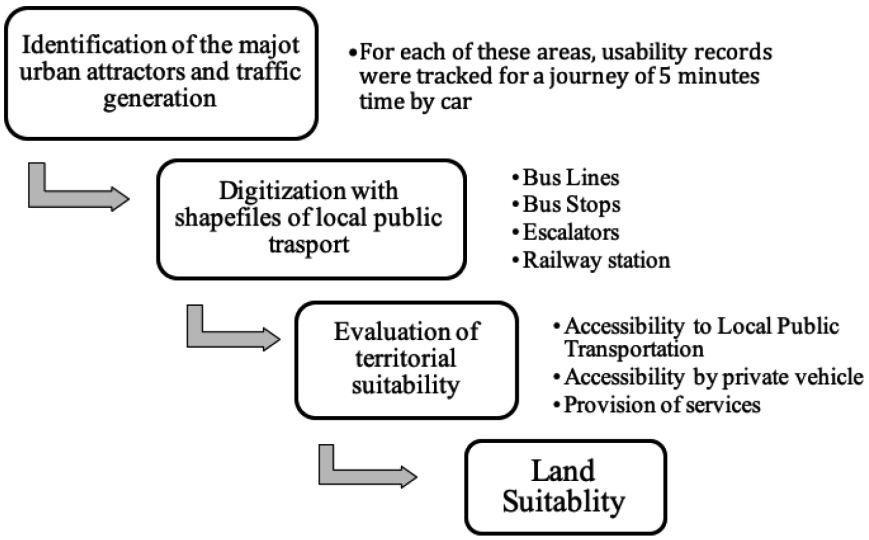


Fig. 4. Methodological flowchart

3 Methodology and Place Based Assessment

The analysis of the current situation were conducted using the open source software Q-GIS, through the identification of the major urban attractors and traffic generators (see Fig. 5):

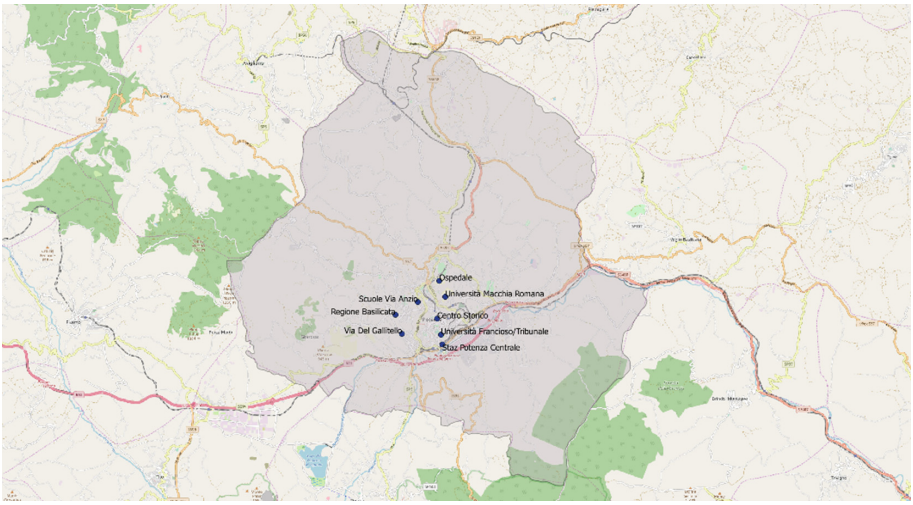


Fig. 5. Urban attractors and traffic generators

- the Historical Center which over time has gradually lost its function as a service center and is laboriously recovering the residential one and strengthening that of a center of quality trade and culture and leisure;
- the Francioso district with the presence of the historic headquarters of the University, the Court and the railway stations RFI and FAL;
- the Macchia Romana district, in continuous growth from the residential point of view and where the two largest territories of local services are concentrated: the Hospital and the University;
- the district of Poggio Tre Galli, characterized by a high residential load, several schools for upper-secondary education and the offices of the Basilicata Region;
- the Gallitello district where most of the commercial and working activities are concentrated.

For each of these areas, usability records were tracked for a journey of 5 min time by car, to evaluate the accessibility by private vehicle depending on their geographical location.

Regarding the structure of Local Public Transport service (Fig. 6), the system is served by 17 Urban Busses Lines and 10 School Busses Lines. The urban connection is integrated with the FAL rail service, which acts as an urban subway, connecting opposite parts of the city in a short time and at a reduced cost. As mentioned above, the city is famous for its escalators system that is divided into 4 different structures: Via Tammone - Santa Lucia (Ponte Attrezzato), Rione Mancusi - Via Due Torri, Viale Marconi - Centro Storico, Potenza Inferiore.

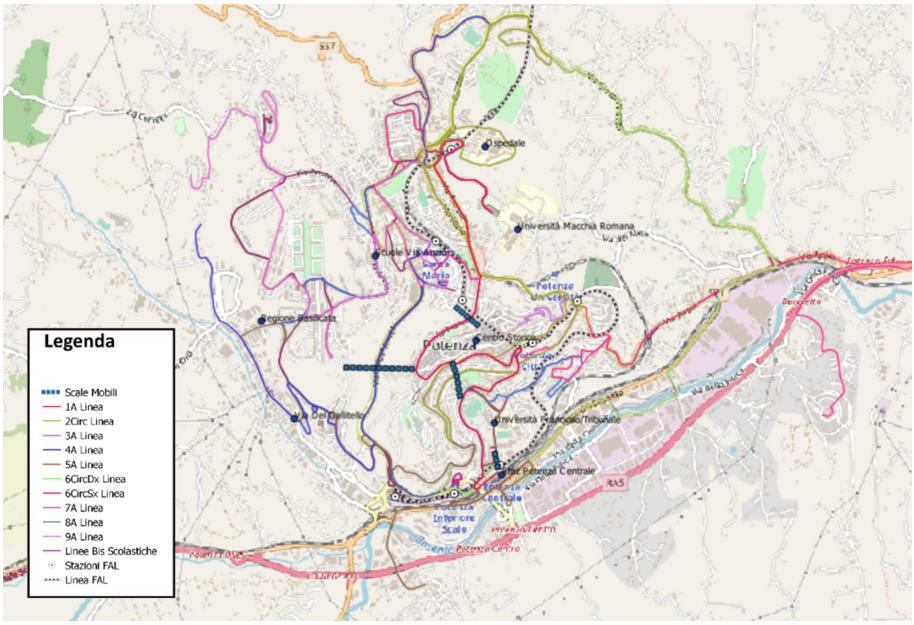


Fig. 6. Local Public Transport Service of the Municipality of Potenza

The system had been digitalized and data allowed to analyze and represent the actual situation. In particular, the study focused on the accessibility to main public services settled in the city through the Local Public Transport service. Although significant investments in the field of urban mobility (shelter renewal interventions as per *"Three-year Program of Public Works 2017/2019")*, the TPL sector continues to rest in inefficient conditions, severely affecting the users. Emblematic is the case of the *"ITS Infomobility Project - Intelligent Transportation Systems"*. Yet with the funds of the previous 2007–2013 programming cycle, a first project was carried out, which consisted in supplying of n. 80 poles with electronic information panel installed near the bus stops. This system, which was supposed to facilitate public buses tracking in real time, is currently not working. A further disadvantage of the urban mobility system is represented by the current abandonment and degradation state of mechanized facilities (Fig. 7); in addition to being poorly used and oversized compared with current demand for transportation, they lack of ordinary and extraordinary maintenance. Moreover, the service does not operate during night and some facilities are poorly integrated with road transportation due to the lack of parking areas.

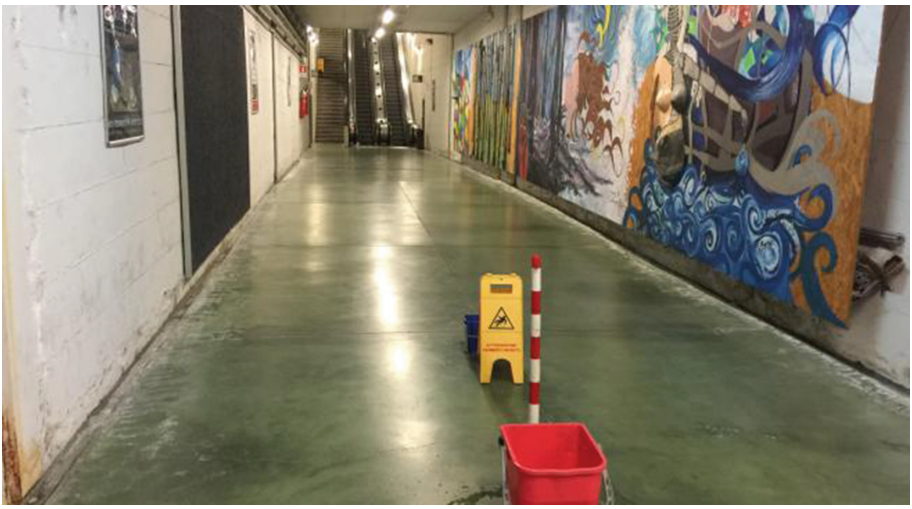


Fig. 7. Abandonment and degradation of mechanized plants

In this view, it is clear that collective transportation has increasingly lost attractiveness and competitiveness compared with private cars. It appears to be neither adequate nor timely with the dynamics of land use and with the increasingly complex requirements of users mobility needs. To reverse this trend, the LPT system has to be radically improved in terms of performances and services supply considering more flexibility in urban mobility organization.

The SWOT analysis is the starting point of the entire design process, as it outlines all the features of the analyzed territorial area, which takes into account, through a

Table 1. SWOT analysis

Points of strength	Points of weakness
Widespread development of mechanized collective transport systems (elevators/escalators) that collocate the city in second place in the world Presence of the FAL line with the characteristics of a "light rail" with 7 city stops PICK ME APP ": service that allows you to book trips to Potenza on minibuses or cars at a reduced cost, with certain times of coverage and prices even for disabled users, tracked by a GPS detector to find out the position and arrival of a family member Arrangement of new shelters (In accordance with the three-year program of public works 2017/2019 with the intervention "stops and paths without barriers" - source of funding: FSC 2007/2013)	Poor quality levels of urban roads No info-mobility Overlap of urban and extra-urban vehicles Difficulty finding tickets for urban lines and mechanized systems Low frequencies of urban lines (40 min) and average travel time 1 h The urban service and the mechanized systems do not serve a night band (9.00 pm/10.00 pm) Elimination of single ticket for the urban service: 5-pass ticket € 5 Elimination of the single journey ticket for mechanized systems: 20 pass ticket € 5 State of abandonment of mechanized plants Overcrowding of the parking lots in the historic center
Opportunities	**Threats**
SMILE initiative Integrated territorial investment (ITI) for the urban development of the city of Potenza funded with resources from the OP FESR BASILICATA 2014/2020 operational plan Promote the development of an online app for urban mobility as experienced by the De Estudios Superiores De Monterrey Technological Institute (Moovit)	The citizen's tendency to want to prefer private transport to alternative means Disinterest of the citizen towards sustainable mobility

brainstorming, the opinions and points of view of all the involved subjects, who can endure the program or influence it in a more or less significantly way (Table 1).

Starting from Weakness and Strength identified with the SWOT analysis, we have selected issues related to an existing negative condition, leading to the Problems' Tree. By contrast, the objectives analysis consists in the definition of the consequent positively projection of the negative situation (Figs. 8 and 9).

The Land Suitability approach is a method of land classification which allows to evaluate the suitability of a territorial portion for a specific use considering the current situation and its possible improvement. Therefore, each area, obtained from the intersection of the accessibility isochrones, has been characterized on the basis of three criteria:

- Accessibility to Local Public Transportation
- Accessibility by private vehicle
- Services Endowment.

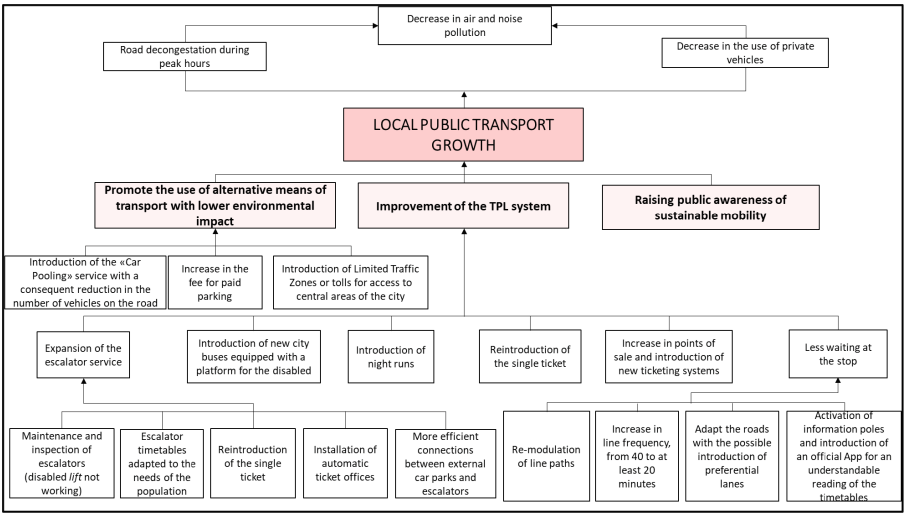


Fig. 8. Problems' Tree

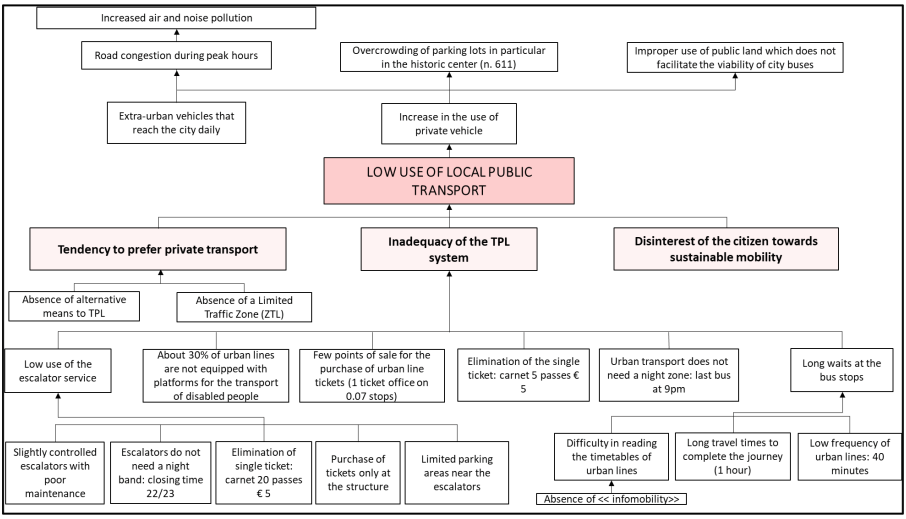


Fig. 9. Objectives' Tree

We select such criteria according with the overall objective to improve transportation modes, with the aim of balancing supply and demand, as well as integrating the services and transport infrastructures. The attributes included in the analysis represent requirements and characteristics that are easily observable, recognizable and

measurable: the number of public busses lines that serves each area and, those equipped with platforms allowing the use of public transport vehicles by the disabled, the number of buss-stops, the number of public busses school lines, the functionality of transport information poles, the proximity to one or more escalators, the presence of parking lots and parking areas, the presence of services such as ticket offices, health points, schools and offices, commercial activities.

Each attribute has been weighted according to the importance it holds in our interpretation model. In order to pursue sustainable transportation mobility, as well as ensuring improved accessibility in urban area, we assigned higher weight to the attribute "accessibility to LPT". In the following Table 2 we present the list of attributes and corresponding weight for land suitability classification.

Table 2. Land Suitability criteria

Criteria	Attributes		Weights
Inhabitants	n. Inhabitants		10
TPL Accessibility	n. lines that serve the area		10
	n. lines with platform for the disabled for n. lines		10
	n. stops present		10
	n. of school lines Information posts at working stops	Presence (1) Absence (0)	10
	Frequency of lines		10
	Presence of escalators at 200mt	Presence (1) Absence (0)	7
	n. city subway stops		5
Car Accessibility	n. poles reachable in 5 min by car		7
	n. parking lots		5
	Parking areas	Presence (1) Absence (0)	7
Services	Ticket offices		10
	Education & Business		7
	Post offices		3
	Health		7
	Business		3
	Parks		5

In the following map the obtained land suitability is represented accompanied by the detailed definition of each classes according with Geodesign method [27–30] (Fig. 10, Table 3).

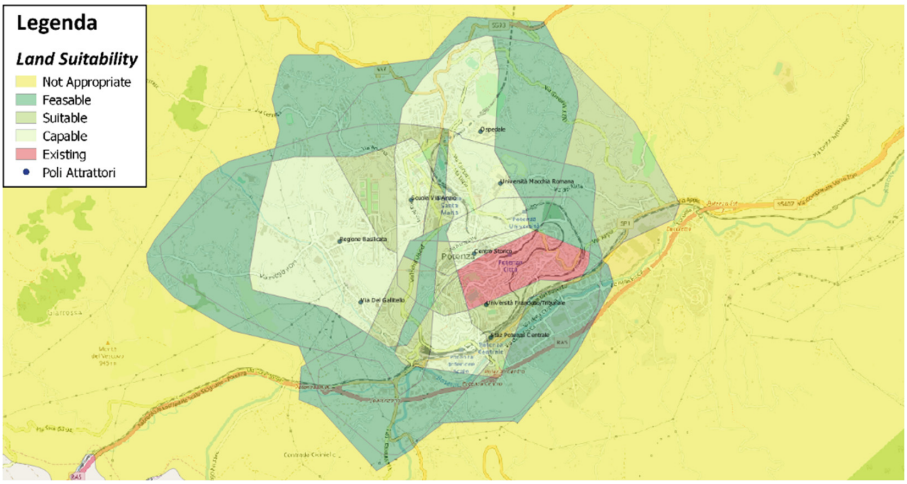


Fig. 10. Land suitability elaboration

Table 3. Land suitability classes

Description of the Evaluation map: Promote the increase of a sustainable mobility for the progressive reduction of the private car. The classification was made based on the uniformity and accessibility of the TPL, the supply of goods and services and the reachability by private means of the poles under study.

Feasible	Suitable	Capable	Not Appropriate	Existing
Areas where there is a non-existence or a strong lack of the TPL service (absence of stops and urban lines serving the area) and integrated transport services.	Areas served on average suitable for modest re-modulation of the lines and adjustment of services.	Area that has a good supply of TPL service, goods and services and reachability by private vehicle.	All the rest of the study area.	Areas with high accessibility to the TPL service and with a satisfactory endowment of services.

4 Strategic Vision

The choice of transport means to be used in a city defines a discriminating trait of the "mobility style" for the citizens and, at the same time, it determines the impact of the external costs that the community will have to shoulder (congestion costs, pollution, accidents, liveability of the public space). In the city of Potenza, the modal imbalance deriving from the increasing use of individual transport represents the main source of

the problems. Therefore, this project aims to increase sustainable mobility in the city for the progressive reduction of the private car. The development of sustainable mobility requires the implementation of supply integration policies together with awareness-raising activities encouraging the use of alternatives to individual car. The proposed sustainable mobility strategy for Potenza town was directed towards specific interventions:

- re-modulation of lines and frequencies
- introduction of new ticketing systems
- increase in ticket sales points
- introduction of night lines
- extension of the urban lines timetable
- extension of the opening times of the escalators
- info-mobility system
- purchase of buses equipped with a platform for people with disabilities
- purchase of new urban buses with low polluting emissions
- introduction of the car-pooling service
- dissemination activities with initiatives such as "Mobility Days" and "downtown without cars".

These interventions categories can be realized by the financial means available in the OP-ERDF Basilicata 2014-2020. Therefore we refers to Axis IV (*"Energy and urban mobility"*) and Axis III (*"Competitiveness"*).

The Urban Mobility Plan proposes the development of ICT technologies for traffic monitoring and users' information, parking addressing, control and management of the LPT bus fleet and info-mobility. The total cost of the operation and financial coverage plan is € 1,000,000.00.

Axis III is instead addressed to the competitiveness of companies through the improvement of small and medium sized businesses (SME). The share of public funds for that is about € 2,500,000 in the framework of the call named "CreOpportunità", approved by D.G.R. n. 1223 of 26/10/2016.

5 Conclusions

Policies for promoting sustainable urban mobility require a deep integration between urban planning instruments, as well initiatives and programs aimed at the realization and adaptation of mobility infrastructures. Fundamental importance has to be payed to the capacity to promote an innovative mobility management of the overall urban mobility system that proposes a better use of existing infrastructures, favors the integration between the different modes of transport, guides the demand expressed by the users based on their direct involvement. It is necessary to stimulate the citizens to use the different public transport modes, which are already available in the city but currently under-utilized, in the perspective to overcome the chronic problem of Potenza town ranked in national statistics as one of the city with lowest use of public transport [31]. The correct project proposal is oriented to enhance quality factors for the supply system, namely:

- the density of the offer in terms of frequency and capillarity;
- average speed, punctuality and reliability;
- the cost to users;
- quality factors such as: accessibility, comfort and cleanliness, integrated travel information, easy interchange, easy to use and integrated ticketing.

Effective means/actions to reach such ambition are:

- to improve and expand the range of collective and semi-collective transport services, alternative to private cars (carpooling, call transport);
- to promote modes of transport with a lower energy and environmental impact by spreading electric or hybrid cars;
- to take the advantages deriving from the use of Intelligent Transportation System (ITS) technologies which with very limited investments can be used for different purposes: from information to users, to optimize their movements, to maximizing the existing urban network;
- to implement integrated actions and policies that attract and push users towards LPT and alternative methods to private cars;
- to promote awareness-raising activities towards sustainable mobility.

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