Modelling of Interactions Between Pedestrians and Vehicular Traffic to Promote Active Mobility: The Case of San Benedetto Neighbourhood in Cagliari (Italy)

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Abstract. The COVID-19 has significantly led to changes in the mobility needs and in user travel behavior, due to the measures adopted to reduce the spread of the virus. While on the one hand this has resulted in a reduction in the number of trips, on the other this has entailed an increase in the use of the private car, considered as the safest form of transportation in urban contexts. Thus, administrations and policy makers have to promote actions and strategies to encourage soft mobility (i.e. walking and cycling), viewed as solutions to reduce transport emissions and ensure social distancing. This often implies the need for a redesign of urban spaces as pedestrians experience uncomfortable or unsafe situations about the surrounding environment. Within this framework, the paper proposes a methodological framework to evaluate the interactions between pedestrians and vehicular traffic using a microsimulation approach. The analyzed case study concerns a road intersection within the S. Benedetto neighbourhood in Cagliari (Italy). A scenario assessment has been performed through the computation of several performance indicators related both to private transport (i.e. level of service and emissions) and pedestrian users (i.e. density; speed and crossing time). The comparative analysis of results demonstrates that this research approach could represent a flexible and effective tool in guiding administrations through the decision-making process during the planning and development of projects for redevelopment of urban spaces and the promotion of soft mobility. Further research will focus on an extended study area, by modelling the behaviour of different categories of pedestrians and introducing in-field data.

Keywords: VISSIM/VISWALK · Microsimulation · Active mobility · Redesign urban spaces · Level of service · Emissions · Pedestrian evaluation · Smart City

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1 Introduction

Cities represent a key to conduct Europe towards sustainable, climate-friendly and healthy mobility. Nearly 3 out of 4 Europeans live in urban areas and there, road mobility is responsible for 23% of EU greenhouse gas emissions [1]. In Italy it is significant how dependent it is on the car, which accounts for 80% of total passenger traffic [2].

The emergency due to COVID-19 and the measures taken to limit the spread of the virus have represented a concrete possibility to redeem urban spaces dedicated to people, safer roads and less pollution [3–5]. The lockdown imposed to tackle the health crisis has resulted in the consistent spread of previously underdeveloped activities such as smart working, e-commerce and distance learning, significantly changing people's mobility needs. In Italy, 33% of citizens have changed their preferences in terms of frequency and travel times and type of vehicle; private cars and walking are the most used solutions in the post COVID-19 and 51% of citizens have limited their daily trips for personal activities [6–9]. The reduction in the number of trips during the lockdown phase led to a significant reduction in pollutants as reported by the ICOS - Integrated Carbon Observation System - which analyzed the effects of the lockdown for the containment of COVID-19 on CO^2 emissions in seven European cities. This study showed that in the busiest metropolises the blocking of mobility led to CO^2 emissions reduced by up to 75% [10].

Since the transport sector in Europe accounts for about a quarter of greenhouse gas emissions [11], it is essential to adopt strategies and actions with a view to planning sustainable urban mobility. Achieving zero-emission mobility in cities will only be possible through the joint efforts of local policies supported by national and European measures [12, 13]. In line with the *Avoid, Shift, Improve* principles to be implemented to reduce the use of private cars, specific measures must be adopted, including:

- support smart working and proximity services [14, 15];
- expand and differentiate entry times (i.e. in workplaces, schools, public and private services, etc.) to reduce peak hours and make the best use of the spaces and services available [16, 17];
- promote Sharing Mobility (i.e. car sharing, bike sharing, scooter sharing and electric micro mobility) and MaaS services [18–20];
- foster the integration of Intelligent Transport System technologies and the use of big-data [21, 22];
- improve local public transport services, adapt the vehicle fleet towards electrification, implement innovative mobility services, integrating them with other modes of transport [23, 24];
- promote the Limited Traffic Zones and Low Emission Zones [25, 26].

From the perspective of Sustainable and Smart Cities, the redevelopment of urban spaces is essential to encourage soft mobility (i.e. walking and cycling) and move from a car-oriented to a human-centered vision. Pedestrian networks must be designed to be able to move safely without obstacles and to stop pleasantly within urban areas. With the aim of minimizing the dangers induced by motorized traffic, priority should be given to speed reduction, which contributes considerably to lowering the number of accidents

and risks. [27–30]. Moreover, in accordance with the SUMPs guidelines, developed both at the European and national level [31–33]. The interventions to encourage soft mobility and made it safer could be represented by the limitation of vehicle traffic and the extension of Restricted Traffic Areas (ZTL) with Traffic Calming areas, or the establishment of 30 km/h zones in historical centres [34]. It would be more profitable to adopt predictive analysis tools that allow to measure and quantify the impacts of different scenarios and to provide decision support for administrations.

Within this context, the paper deals with the concepts of sustainable and active mobility and the goal of the work is to present a methodological approach for analyzing the interactions of pedestrians with other traffic components. Specifically, a microscopic modeling has been carried out based on Wiedmann's psycho-social theoretical model. The case study concerns the San Benedetto neighborhood in Cagliari (Italy), presenting the microsimulation of a road intersection at Piazza San Benedetto and focusing on a specific pedestrian crossing. Using a microsimulation software, several alternative design scenarios have been modeled, with variations in terms of both transport supply and mobility demand. Qualitative and quantitative assessments have been carried out based on computed performance indicators related to vehicles and pedestrians.

The paper is structured in five sections: Sect. 2 illustrates the methodological framework based on the use of a microsimulation model to assess the interactions between vehicles and pedestrians; Sect. 3 presents the case study to which the methodology has been applied. The section contains territorial information on the San Benedetto neighbourhood and infrastructural details about the modelled road intersection with related simulated scenarios. Section 4 shows the results of the simulations of various scenarios in terms of levels of service, emissions and pedestrian parameters (i.e. density, speed and crossing time). Moreover, it provides a discussion about the comparison of the results for the different performed scenarios. Finally, Sect. 5 provides conclusions and paves the way for further in-depth research on this work, aimed at analyzing and evaluating strategies and actions to promote sustainable mobility and encourage soft mobility.

2 Methodological Approach

The evaluation of the interactions between pedestrians and vehicular traffic is addressed through a microsimulation model, to simulate the behaviour of the individual units in relation to the configuration of the road geometry and the presence of elements within the urban space.

Figure 1 shows the methodological framework, which is characterized by two phases: the first one is constituted by the model reconstruction, considering both the transport supply and the mobility demand, and the second one is represented by the scenario evaluation through the computation and assessment of several indicators.

The model reconstruction has involved these 3 main steps:

1.1 the identification of the study area, in this specific case coinciding with a road intersection with a focus on the pedestrian crossing and related data acquisition which is the basis of the two subsequent steps;

1.2 the transport supply modelling which provides for the construction of the road network graph, essentially consisting of links (i.e. lanes with relative widths and travel directions) and nodes (i.e. connectors representing the turning manoeuvres), on which the priority rules have been defined. In this regard, two different traffic conditions have been modelled, the first one more consistent with the state of affairs in which pedestrians stop before crossing, giving priority to vehicles; and the second one in favor of pedestrians, who are given priority at the intersection. The priority rules have been modelled through the Vissim software with the Viswalk add-on [35], by placing the conflict areas at the intersections generated between the road and the crossing links. The conflict areas have been set to "Red-Green" for pedestrians in the case of vehicles priority and "Green-Red" to model pedestrians' priority. Moreover, the geometrical infrastructural elements concerning pedestrians (i.e. sidewalks and crossing) have been modelled considering variations in the road geometry;

1.3 the transport demand modelling, with the vehicular and pedestrian flows. Vehicle flows have been simulated based on the Wiedemann 74 model and pedestrian flows in accordance with the social force model. Considering that variations in transport supply (e.g. road geometry) can consequently influence the demand, it has been carried out a sensitivity analysis by varying the values of flows, both pedestrian and vehicular, respectively. This sensitivity analysis serves to determine the robustness of the simulation model by examining which results may be affected by changes in some variables (i.e. in this case the flows) [36]. However, for the correct determination of the mobility demand, the estimates should be validated with in-field surveys.

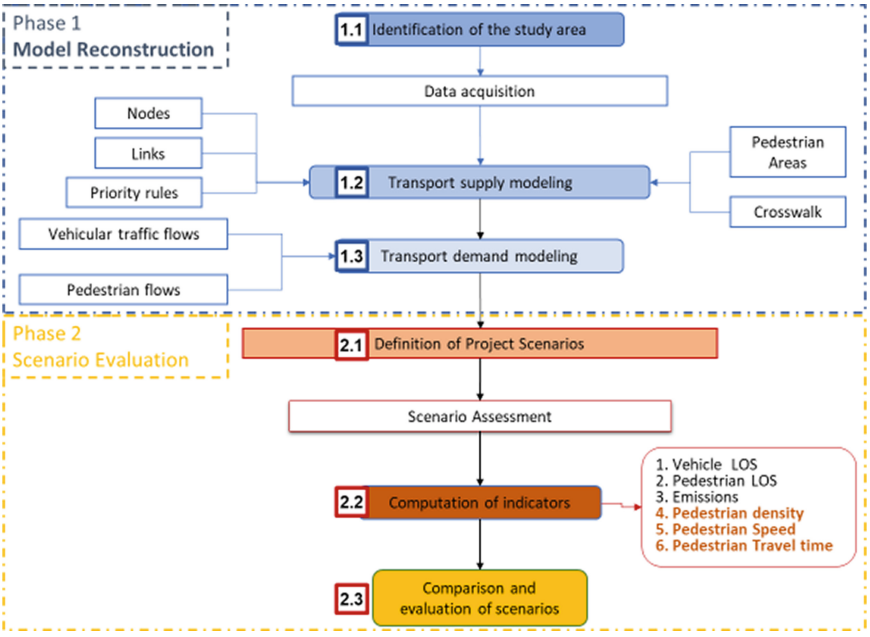

Fig. 1. Methodological framework. Source: authors elaboration.

After this first phase, it has been necessary to identify the node at which to perform node evaluations. This second phase envisages the following steps:

2.1 the definition of various alternative scenarios, with variations both in terms of transport supply and demand;
2.2 the identification and choice of certain nodes at which to calculate several evaluation parameters for the scenario assessment in accordance with [37, 38]; specifically, it concerned the calculation of levels of service (LOS) which represents a measurement of the quality of vehicular and pedestrian traffic; in addition the estimation of emissions (i.e. CO, NOx, VOC), relating to vehicular traffic, and a pedestrian assessment in terms of density, speed and crossing time.
2.3 the analysis and comparison of the indicators relating to the various hypothesized scenarios.

3 Case Study

The methodological approach has been applied to the study area located within the San Benedetto neighbourhood in Cagliari (Sardinia), in the southern part of the region. San Benedetto is a central district of the Sardinian municipality with a high population rate (i.e. more than 5,000 inhabitants per square kilometer). It is characterized by commercial services, public and private activities (e.g. schools, bus stops, shops, churches, post offices and banks). This work focuses on the area corresponding to *San Benedetto Square.* It consists of a roundabout where the main streets of the district converge. Dante Alighieri *Road* represents the main road that crosses the neighbourhood along the north-south direction (Fig. 2a).

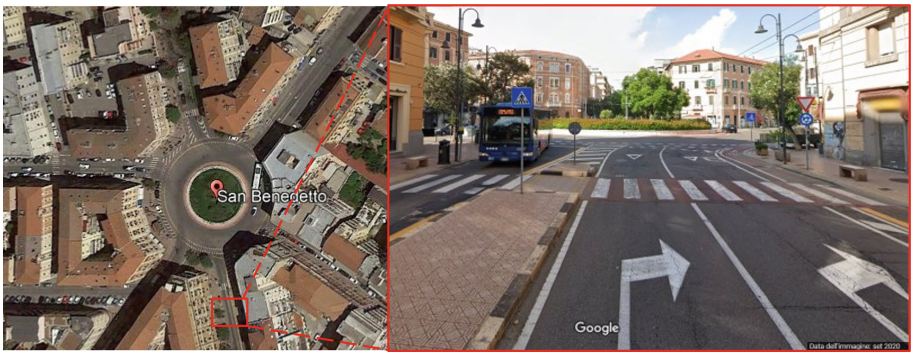

Fig. 2. (a) Delimitation of the neighbourhood boundaries of San Benedetto; (b) street-view of the pedestrian crossing. Source: Author elaboration from Google Earth.

What emerges from the analysis of this area is that the concept of public space, and in the case of a square (i.e. San Benedetto Square), is completely distorted. In fact, the square is not used as a meeting place, but it constitutes a road infrastructure that is a roundabout, in which roads are characterized by high vehicular flows.

The analysis presented in this paper consisted of the microsimulation of a pedestrian crossing located in Dante Alighieri Road near the intersection with San Benedetto square (Fig. 2b). The choice to model this crossing is motivated by the fact that it is characterized by a high pedestrian transit and at the same time by an intense interaction with other traffic components (i.e. private vehicles, public transport and bicycles).

Using simulation software, it has been possible to carry out an accurate analysis of the road intersection. In the PTV Vissim/Viswalk software, the pedestrian crossing has been first modelled by entering all the information relating to the transport supply. For this purpose, to model the state of affairs referred to March 2022, an online survey has been carried out using the Google Street View tool, to detect the number and width of road lanes, the travel directions, the dimensions of the pedestrian crossing and adjacent sidewalks. Subsequently, the transport demand has been modelled. In the absence of in-field traffic measurements, therefore, variable pedestrian and vehicular flows have been simulated to perform sensitivity analysis when these input data vary. Furthermore, two different traffic regulation conditions have been identified (in accordance with Table 1). The first condition attributes the priority rule to vehicles penalizing pedestrians, in which cars do not respect the right of way of pedestrians at the crossing. The second condition, on the other hand, attributes the priority rule to pedestrians, in which the cars strictly comply with this rule. For each of these conditions, the percentage of pedestrian flow has been varied (see Table 1) to evaluate the impact on the simulation results.

The outputs that have been taken into consideration for the research study are: the pedestrian density, the pedestrian speed and travel time of the crossing, the level of service relating to both the pedestrian and vehicular traffic. In addition, emissions associated with private traffic and public transport have been estimated. In our case, they have been calculated with the COPERT model which allows to estimate the emission values of these pollutant CO, NOx and VOC.

Table 1 summarizes the seven scenarios that have been performed in the microsimulation model, derived from the combination of variations in both the transport demand and supply. In the four scenarios (i.e. from 1.1 to 1.4) the priority rules (alternatively for vehicles and pedestrians) and the pedestrian hourly flow (between 200 ped/h and 400 ped/h in each crossing direction) have been varied. Subsequently, for the scenario 2.1 and 2.2 a variation of the road geometry with narrowing of the pedestrian crossing has

Table 1. Scenarios description with supply and demand combinations

Scenario	N. Tpr lanes	Crosswalk length	Vehic/h	Ped/h	Priority rules
1.1	2	18 m	675	200	Vehicles
1.2	2	18 m	675	400	Vehicles
1.3	2	18 m	675	200	Pedestrian
1.4	2	18 m	675	400	Pedestrian
2.1	1	13 m	675	200	Pedestrian
2.2	1	13 m	675	400	Pedestrian
2.3	1	13 m	450	400	Pedestrian

been assumed. Finally, in the last scenario 2.3, a modal shift from private transport in favour of pedestrian mobility has been hypothesized.

4 Results and Discussion

4.1 Scenarios 1.1 and 1.2: Priority to Vehicles

A first step of the analysis has been to model the current state of the pedestrian crossing, simulating that pedestrians give priority to vehicles before entering the crosswalk. This occurs due to various factors, e.g. the lack of adequate lateral visibility. The following Fig. 3 shows how, during the simulation, pedestrians stop on the sidewalk threshold waiting for no more vehicles to be able to cross later.



Fig. 3. 3D simulation showing pedestrians waiting at the sidewalk of the crosswalk

With the priority rule to vehicles, two scenarios have been modelled: the scenario 1.1 with a pedestrian flow of 200 pedestrians per hour and the scenario 1.2 with 400 pedestrians per hour in each crossing direction. Specifically, Table 2 reports the obtained results from the performed simulations, both in terms of vehicular indicators and pedestrian ones. The Highway capacity manual (HCM) defines 6 values of level of service, from the best A to the worst F, depending on the generated delay. As it emerges from the analysis, by increasing the pedestrian demand it is registered an increase in the pedestrian density and in the travel time of the crosswalk. From the comparison of Table 2 by increasing the pedestrian flow there is an increase in density equal to 89% and a decrease of 3% in speed. Furthermore, even by increasing the number of pedestrians, this has no impact in terms of level of service, i.e. always maintaining a service level equal to A for vehicles. In terms of emissions, there is also no significant increase since vehicles are not subject to stop and go phenomena because they have the priority. In fact, the sum of the total emissions for scenario 1.1 is equal to 161.82 g and for scenario 1.2 it is 162.18 g. This information is also provided in accordance with ANPA's "Local Air Emission Inventory Guidelines" and forms the basis for the calculation of pollutant concentrations in the macro-sector of transport, and to analyze which threshold values are exceeded.

Table 2. Simulation results of scenarios 1.1 and 1.2 with private vehicles priority rules

Scenario 1.1. - 200 ped/h and vehicles priority					
Type lane	*LOS (vehic)*	*LOS (ped)*	*CO [g]*	*NOx [g]*	*VOC [g]*
Tpr 1	LOS A	LOS A	80,195	15,603	18,586
Tpr 2	LOS A	LOS A	31,894	6,205	7,392
Tpb	LOS A	LOS A	1,1366	0,266	7,392
Bike	LOS A	LOS A	–	–	–
Total	**LOS A**	**LOS A**	**113,454**	**22,074**	**26,294**
Pedestrian evaluation			*Density [ped/m^2]*	*Speed [km/h]*	*Travel time [s]*
			0,0162	2,94	24,85
Scenario 1.2. - 400 ped/h and vehicles priority					
Type lane	*LOS (vehic)*	*LOS (ped)*	*CO [g]*	*NOx [g]*	*VOC [g]*
Tpr 1	LOS A	LOS A	80,266	15,617	18,602
Tpr 2	LOS A	LOS A	32,001	6,226	7,417
Tpb	LOS A	LOS A	1,445	0,281	0,335
Bike	LOS A	LOS A	–	–	–
Total	**LOS A**	**LOS A**	**113,712**	**22,124**	**26,354**
Pedestrian evaluation			*Density [ped/m^2]*	*Speed [km/h]*	*Travel time [s]*
			0,0307	2,85	25,90

4.2 Scenarios 1.3 and 1.4: Priority to Pedestrians

The second modelled condition requires vehicles to give priority to pedestrians during the crossing (Fig. 4). In practice, this is achieved by trying to make this pedestrian crossing more visible, e.g. making a two-color marking, increasing the vertical and horizontal signs near the crossing, or transforming it into a raised crosswalk. With these design measures, drivers will be encouraged to give priority to pedestrians, increasing road safety and ensuring that pedestrians do not feel like "guests" in the surrounding urban spaces.

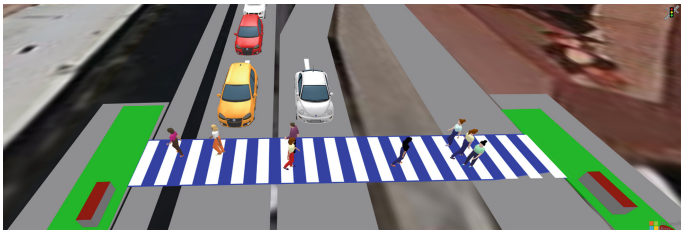

Fig. 4. 3D simulation showing vehicles waiting for pedestrians to cross.

Tables 3 shows the results of the simulations carried out respectively with 200 and 400 pedestrians per hour and per crossing direction. It should be noted that following the continuity of the pedestrian path, the crossing time decreases. On the other hand, there is a worsening in terms of vehicular emissions due to continuous stop and go phenomena. Furthermore, it is found that the vehicular level of service remains equal to A with 200 pedestrians per hour even if they have the priority at crossing; while there is a downturn (i.e. level of service equal to C) when the pedestrian demand is increased to 400 pedestrians per hour. By comparing Table 3, by doubling the pedestrian flow, the total emission levels increase from 241.81 g for scenario 1.3 to 530.75 g for scenario 1.4. Looking at the level of service for the lanes of private transport, as previously highlighted it is reduced, by passing from LOS A to LOS B and LOS C on the two lanes.

Table 3. Simulation results of scenarios 1.3 and 1.4 with pedestrians' priority rules

Scenario 1.3. - 200 ped/h					
Type lane	*LOS (vehic)*	*LOS (ped)*	*CO [g]*	*NOx [g]*	*VOC [g]*
Tpr 1	LOS A	LOS A	120,205	23,388	27,859
Tpr 2	LOS A	LOS A	45,607	8,873	10,570
Tpb	LOS A	LOS A	3,727	0,725	0,864
Bike	LOS A	LOS A	–	–	–
Total	**LOS A**	**LOS A**	**169,539**	**32,986**	**39,292**
Pedestrian evaluation			*Density [ped/m^2]*	*Speed [km/h]*	*Travel time [s]*
			0,0136	3,58	19,78
Scenario 1.4. - 400 ped/h					
Type lane	*LOS (vehic)*	*LOS (ped)*	*CO [g]*	*NOx [g]*	*VOC [g]*
Tpr 1	LOS C	LOS A	295,694	57,531	68,530
Tpr 2	LOS B	LOS A	72,352	14,077	16,768
Tpb	LOS A	LOS A	4,066	0,791	0,942
Bike	LOS A	LOS A	–	–	–
Total	**LOS C**	**LOS A**	**372,112**	**72,399**	**86,241**
Pedestrian evaluation			*Density [ped/m^2]*	*Speed [km/h]*	*Travel time [s]*
			0,0243	3,46	20,43

4.3 Scenarios 2.1 and 2.2: Crossing Narrowing and Priority to Pedestrians

The second step of the analysis focused on the effects that would occur assuming to narrow the pedestrian crossing and widening the sidewalk, suppressing one of the two vehicle lanes and diverting the traffic flow only to ones. As can be seen from Table 4,

having reduced the length of the pedestrian path, the crossing travel time is reduced. Moreover, the pedestrian density decreases as the sidewalk has been widened. From the comparison of scenarios 2.1 and 2.2, with the new geometric road configuration, doubling the number of pedestrians, the level of service drastically worsens, passing from A to F. Total emissions also undergo a sharp increase, from 266, 86 g in scenario 2.1 against 1372.08 g in scenario 2.2. From the point of view of pedestrian evaluations, comparing the two scenarios, there is a 74% increase in pedestrian density and a 7% decrease in pedestrian speed.

Table 4. Simulation results of scenarios 2.1 and 2.2 with narrowing crossing and pedestrians' priority rules

Scenario 2.1. - 200 ped/h					
Type lane	*LOS (vehic)*	*LOS (ped)*	*CO [g]*	*NOx [g]*	*VOC [g]*
Tpr 1	LOS A	LOS A	184,185	35,836	42,687
Tpb	LOS A	LOS A	2,912	0,567	0,675
Bike	LOS A	LOS A	–	–	–
Total	**LOS A**	**LOS A**	**187,097**	**36,402**	**43,361**
Pedestrian evaluation			*Density [ped/m^2]*	*Speed [km/h]*	*Travel time [s]*
			0,0105	3,53	15,82
Scenario 2.2. - 400 ped/h					
Type lane	*LOS (vehic)*	*LOS (ped)*	*CO [g]*	*NOx [g]*	*VOC [g]*
Tpr 1	LOS F	LOS A	956,270	186,055	221,625
Tpb	LOS A	LOS A	5,704	1,110	1,322
Bike	LOS A	LOS A	–	–	–
Total	**LOS F**	**LOS A**	**961,975**	**187,165**	**222,947**
Pedestrian evaluation			*Density [ped/m^2]*	*Speed [km/h]*	*Travel time [s]*
			0,0184	3,29	17,21

4.4 Scenario 2.3: Modal Shift, Crossing Narrowing and Priority to Pedestrians

Evaluating the results of scenario 2.2, in which pedestrian flows have been increased, as road safety conditions have also been improved thanks to the restriction of pedestrian crossing, it is reasonable to hypothesize a modal shift from private motorized mobility. In fact, following the elimination of one of the two private traffic lanes, drivers may no longer be inclined to travel along this road section. Therefore, they could first choose another route or secondly, opt for another transport mode (e.g. public transport, cycling, walking).

In this view, a final new scenario has been defined and modelled (i.e. scenario 2.3), in which the vehicular flow decreases by approximately 25%.

From Table 5, it emerges that a decrease in vehicular flow corresponds to an improvement in the level of service, which passes from F in scenario 2.2 to C in scenario 2.3. In addition, there is also a clear improvement in the reduction of emissions, with a total of 404.57 g.

Table 5. Simulation results of scenario 2.3 with modal shift, mobility demand of 400 pedestrians per hour and pedestrians' priority rules

Scenario 2.3. - 400 ped/h Shift modale					
Type lane	*LOS (vehic)*	*LOS (ped)*	*CO [g]*	*NOx [g]*	*VOC [g]*
Tpr 1	LOS C	LOS A	276,060	53,711	63,980
Tpb	LOS A	LOS A	7,562	1,471	1,753
Bike	LOS A	LOS A	–	–	–
Total	**LOS C**	**LOS A**	**283,622**	**55,183**	**65,732**
Pedestrian evaluation			*Density [ped/m^2]*	*Speed [km/h]*	*Travel time [s]*
			0,0185	3,28	17,33

4.5 Scenario Comparison Results

This section presents a comparative analysis of the obtained results for all simulated scenarios: 1.1 and 1.2 with the schematization of the intersection according to the state of affairs and with priority to vehicles; 1.3 and 1.4 with priority to the pedestrians; 2.1 and 2.2 with a geometric variation characterized by the reduction of the crossing width and the elimination of a transit lane; 2.3 similar to 2.2 but with a reduction of vehicles from 500 veic/h to 400 veic/h. Attention has been paid to the effects deriving from changes in terms of transport demand (i.e. increase in pedestrian flow and modal shift) and transport supply (i.e. road geometric variations).

The graph relating to the level of service represented in Fig. 5 shows that in scenarios where pedestrians stop to give way to vehicles, decreases in the vehicle level of service are not recorded, despite the increase in pedestrian flow. The situation is different in the scenarios where vehicles stop to give way to pedestrians. In fact, by increasing the pedestrian flow, the level of service is lowered to level C. The worst result is obtained when the carriageway is narrowed by eliminating a private traffic lane, when the level of service assumes the value F. Therefore, to balance the simulated improvements in favour of pedestrians and return to service level C it is essential to hypothesize a modal shift, by reducing vehicular flows.

By observing the graph of the total emissions (Fig. 6), it presents approximately the same trend as the graph of the level of service, since, in correspondence with a low pedestrian flow, a low level of emissions is estimated. Similarly, when priority is given to pedestrians, there is an increase in emissions. With the same demand flows, the increase in emissions appears to be more significant in the scenario with the narrowing crossing and a single private vehicular lane.

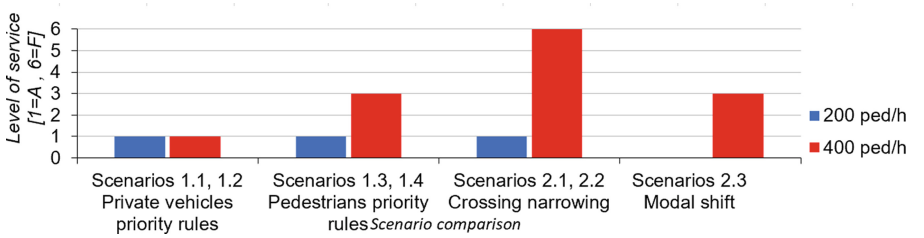

Fig. 5. Scenario comparison results - Level of service

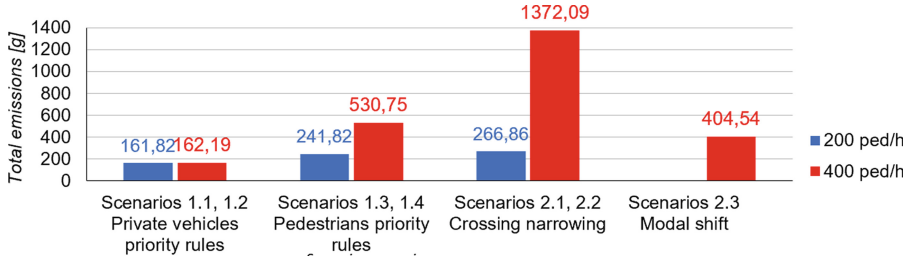

Fig. 6. Scenario comparison results - Total emissions [g]

From the analysis of the pedestrian density (Fig. 7) graph, it emerges that with moderate pedestrian flows, the consequent density is at low values and vice versa. With a pedestrian flow of 200 pedestrians per hour, it is observed a linear decrease in density deriving from the fact that by giving priority to pedestrians they move faster, thus creating less crowding; furthermore, by widening the sidewalk, the surface on which pedestrians can walk becomes more extended. A similar trend has been also found in the scenarios characterized by 400 pedestrians per hour.

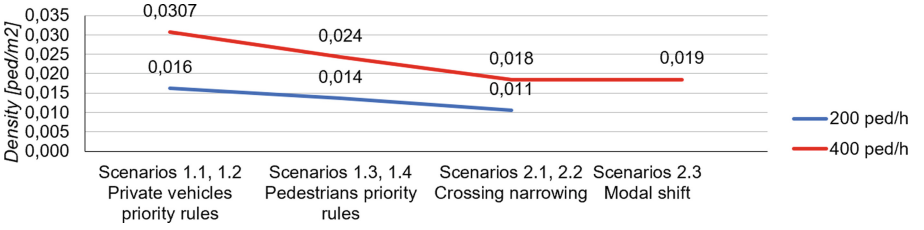

Fig. 7. Scenario comparison results - Pedestrian density [ped/m^2]

The trend of the speed graph represented in Fig. 8 is similar in both pedestrian demand configurations. Specifically, there are slightly higher speed values in scenarios with 200 pedestrians per hour. It is observed that in the case in which priority is given to vehicles, a low-speed value is found. Then, by making the improvements in terms of road geometry, it is noted that the pedestrian speed values during the crossing slightly

decrease. This is due to the reduction to only one lane and therefore to a worsening of the conditions of private traffic which consequently also affect pedestrian transit.

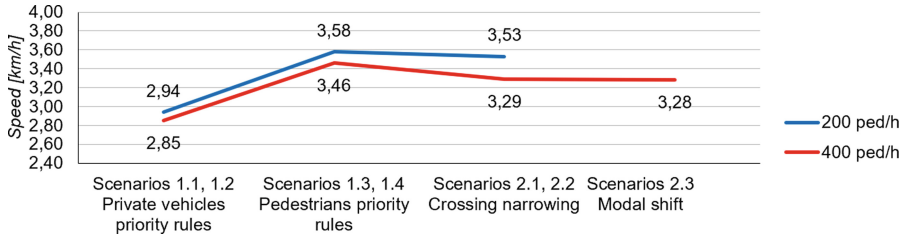

Fig. 8. Scenario comparison results - Pedestrian speed [km/h]

5 Conclusions and Future Research

The impact of COVID-19 on mobility has been and will continue to be particularly significant, both due to the severe measures adopted to reduce the risk of spreading the virus and the changing in mobility needs. In accordance with this, users are seeking solutions that can ensure social distancing, and this often leads to a preference for the use of private vehicles and the increase in walking and cycling for short distances.

This paper has proposed a methodology for evaluating the interaction between pedestrians and vehicular traffic through the implementation of a microsimulation model. Using the simulation software, it has been possible to create an accurate modelling of the road intersection within the neighbourhood of San Benedetto. By inserting detailed input data (i.e. number and width of lanes, flows and pedestrian and vehicular itineraries), it has been possible to simulate the behaviour of road users (i.e. pedestrians and drivers) in different alternative design scenarios, varying both the transport supply and the mobility demand. Moreover, quantitative assessments have been performed through the calculation and analysis of indicators (i.e. level of service, emissions, pedestrian density and speed, crossing time).

The research approach has significant implications both from a methodological and practical points of view. First, with the microsimulation it is possible to carry out controlled experiments varying different parameters to perform sensitivity analysis. In addition, the possibility of performing both qualitative (i.e. 2D and 3D visualizations) and quantitative (i.e. computation of performance indicators) scenario assessment, represent a valid decision support tool for administrations and planners in evaluating different strategies and actions for the redevelopment of urban spaces and the promotion of soft mobility.

The limitation of this simulation approach is the need of in-field measurements related to the transport demand to obtained results for operational scenario assessments. Moreover, through the calibration of the parameters related to the pedestrian simulation it would be possible to reproduce their real behavior which can be influenced by the context area. In-depth analysis of the research work moves in this direction, which will foresee the extension of the study area and the modelling of the behaviour of different

categories of pedestrians (i.e. men, women, elderly people and children). Furthermore, the possibility of carrying out field surveys will allow to characterize the mobility demand that is more in keeping with reality, thus achieving simulation results that can be used in the context of operational plans and programs.

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