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Microsimulation analysis of introducing the "shared space" concept in the City of Bitola: A Case Stydy

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Abstract— **during the last half century urbanization has been the dominant demographic trend in the entire world. With the high pace of social and economic development in the Republic of Macedonia and the resulting lack of infrastructure and congested traffic, an environmental degradation became the major issues faced by cities in their sustainable development. Furthermore, local government lack technical instrument to generate a sustainable development. In the first part, this paper emphasize the development of an integrated urban-ecological object oriented microscopic simulation model in order to assist municipal institutions and leaders in deciding the future planning policy for the cities. The second part of the paper shows the application of the SFStreetSIModel, version 2.1 in the procedures for introducing the "shared space" concept in the city centre of Bitola, Macedonia.**

Keywords-"shared space" concept, microscopic simulation tool, urban planning.

I. INTRODUCTION

Urban areas have become more focused on the transportation of vehicles through the public space, as use of cars has increased, than on the ability of people to enjoy the space. This has led to city streets that function poorly in their ability to move traffic. At the city level, local governments have been encouraged to carry out an integrated land-use planning to comprehensively address adverse impacts of urbanization, including environmental problems. Cities and urban settlements seeking funding support for their planning and management strategies should incorporate traffic and environmental issues in their proposals. They should be able to demonstrate why this integration is important in the context of their city, and to suggest how it can be achieved. A new idea has been developed to combat this social disorder, named as "Shared Space" concept.

"Shared space" is a term used to describe an emerging approach to urban design, traffic engineering and road safety in Europe and, increasingly, in North America. It was coined in 2003 following research by the author in 2000 that identified a common thread in the approach of a number of countries on how to reduce the adverse impacts of traffic in towns. The concept has developed further in Denmark, Northern Holland, Sweden and Northern Spain than elsewhere in Europe, although the French programme "*Ville plus sure*" [1], adopts many of the key principles and is evident in countless towns and villages across France. Its adoption in the UK is very recent, and there are, to date, very few examples on the ground of projects that consciously define themselves as "shared space". At the heart of shared space is the concept of integration. This contrasts to the principle of segregation, the idea of separating different functions and different users within the urban landscape. The idea of segregation can be traced back to the urban visions of Le Corbusier in the 1930's, and was formalized into government policy following the "Buchanan Report" – *Traffic in Towns*, published in 1963.

However, shared space could also be seen as the default mode before the separation of vehicles and pedestrians became the accepted approach to designing public spaces. It was the *status quo ante* for most streets and public spaces before the introduction of segregation during the last century. Today shared space is evident in any traditional streetscapes where modern traffic engineering has yet to have an impact. From this perspective, shared space is nothing new. In conventional streets, behaviour is governed by highway infrastructure such as traffic signs, road markings and other street furniture. In streets with shared space much of this infrastructure is removed so it is important that schemes are well designed and can be easily used. The most important is that shared space is often confused with other concepts, such as pedestrian zones, shared surfaces, traffic calming and the like. To date, most schemes are at an early stage of design. Established precedents exist in a few locations, where conventional traffic engineering solutions have been replaced by simpler, more integrated, solutions.

II. URBAN CONTEXT

Since the primary focus of the National Strategy on the Sustainable Development in the Macedonia [2], is placed on systematic and better management of urbanization through sustainable land use policies and tools, the idea to analyze the need and possibilities for introducing the concept by using new simulation tool seems logical and necessary. Thus, the vision of local public authorities, specifically those in the field of traffic and urban planning is highly important for generating sustainable urban development strategies, the main aim of this paper is transfer the scientific knowledge to the local level through the use of 2D simulation of urban streetscape and traffic flow. Namely, the City of Bitola case study illustrates how a city can address a nationwide problem at the local level.

Bitola (Fig.1) is the economic and industrial centre of south-western Macedonia. The Pelagonia agricultural combine is the largest producer of food in the country. The Strezevo water system is the largest in the Macedonia and has the best technological facilities. The three thermoelectric power stations produce nearly 80% of electricity in the state. Bitola also has significant capacity in the textile and food industries. Bitola is also home to twelve consulates, which gives the city the nickname "the city of consuls." Covering an area of 1,798 km² and with a population of 74.550 (2002), Bitola is an important industrial, agricultural, commercial, educational, and cultural centre. It represents an important junction that connects the Adriatic Sea to the south with the Aegean Sea and Central Europe, as in [3].

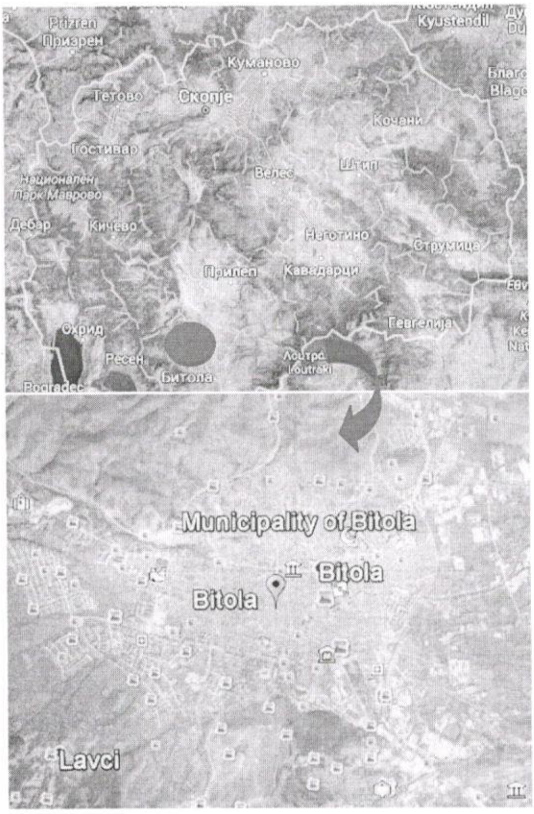

Fig 1. Localization of Bitola, Macedonia

A. City of Bitola and the local mobility

"Local mobility" also known as short-distance mobility of individuals and non-motorized transport as walking and cycling within the Bitola is impaired. City has become more focused on the transportation of vehicles, as use of cars has increased, than on the ability of people to enjoy the space. This has led to city streets that function poorly in their ability to move traffic. Drivers are focused on traffic signals and signage and rarely communicate either visually or verbally with pedestrians along the road. When drivers are not at stoplights, they are often going as fast as the posted limit will allow, which further distances the drivers from pedestrians who are looking to cross the road safely.

For the support of "Local mobility", key elements are the pedestrian and bicycle friendly site and street design and a mixture of land uses combined with parks and green spaces. Having in mind that nearly every trip, for example by public transport or by car, starts and ends with a walking distance, the significance of "Local mobility" is even higher as said yet. And at last but not least, we need to keep in mind that the dependence of children or elderly people on non-motorised traffic, increases the significance of "Local mobility".

B. Methodology for introducing "shared space" concept in the City of Bitola

The idea of shared spaces is beginning to appear in Macedonian cities. But, the advantages and disadvantages of shared spaces are need to be investigated in the Macedonian-specific context to gauge the appropriateness of the concept.

1) Traffic flow and speed in the context of sharing the street space

Sharing is also a function of reduced traffic flow and speed. In general, shared space schemes achieve their maximum benefits when pedestrians use the space in the street that would be dedicated primarily to vehicular use in a conventional setting, as in [4]. For pedestrians to fully share the space, relatively low traffic flows and speeds are usually necessary. Vehicle speed has a significant influence on pedestrians and bicyclists' willingness to share the space and drivers' willingness to give way to pedestrians and others. As vehicle speeds decrease, the proportion of drivers giving way increases, so the street becomes more shared. This is where the design speed becomes important. The design speed is a target speed that designers intend most vehicles not to exceed and is dictated primarily by the geometry within the street. Level of Service (LOS) is a qualitative measure used to relate the quality of traffic facilities from 1 or LOS-A as the best quality to the 6 or LOS-F as worst quality. The purpose of computing one or more traffic performance measures of effectiveness- MOEs is to quantify the achievement of a project's traffic operations objectives. This study identified eight measures of effectiveness as travel time, speed, density, queue, safety pressure, CO and NO_x Emissions and congestion, which are the building blocks of most existing and potential future systems for evaluating the traffic operations performance of street facilities. Namely, the goal of this study was to develop information and guidance on which MOEs should be produced, how they should be interpreted, and how they are be defined and calculated in traffic analysis tools.

2) Application of SFStreetSIModel, version 2.1: case study

Recently developed, fourth improved version of microscopic simulation model Side Friction Street Simulation Model - SFStreetSIModel, version 2.1, simulates movement of heterogeneous flow of passenger cars, light duty vehicles, buses and pedestrians on two lane two way city street, as in [5].

SFStreetSIModel, version 2.1, is objective-oriented model, written in the program language Action Script 3, implemented in Adobe Flash and Adobe Flex technology. Here will be described in details, the application of the model and the results received with ten-hour simulation of traffic movement on the streets of six locations which belongs to the study area (Fig.2), in the city of Bitola, Macedonia.

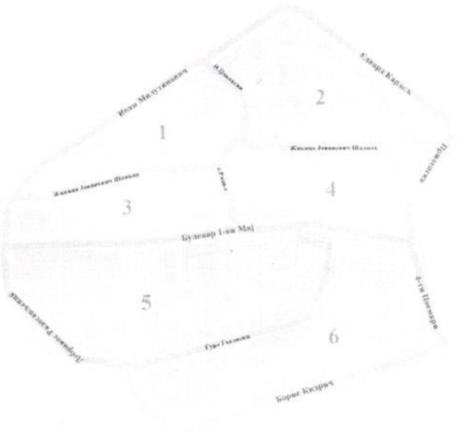

Fig 2. Localization of the study area

3) Simulation and visualization of the traffic and the environment on the analyzed locations in SFStreetSIModel, version 2.1

Since changing the way a street operates to bring about an increase in the level of sharing requires an understanding of how people currently use the space, we collect a certain amount of baseline data (Table 1), as in [6].

TABLE I.

Useful baseline data	Method used for data asquising
Traffic speed	GPS device in the vehicles (GARMIN nuvi 1390t)
Classified vehicle counts	Manually - filling forms ready before hand
Pedestrian flows along the street	Manually - filling forms ready before hand
Assessment of land use and frontage activity	Manually - filling Open-space forms
Records of existing street furniture	Manually - filling Open – space forms
Observation of how people use the space	Manually - filling Open – space forms
Traffic accidents	so called "Safety method"

Collected and analysed data were used within the simulation model as it is shown in the dialogue window (Input), (Fig. 3).

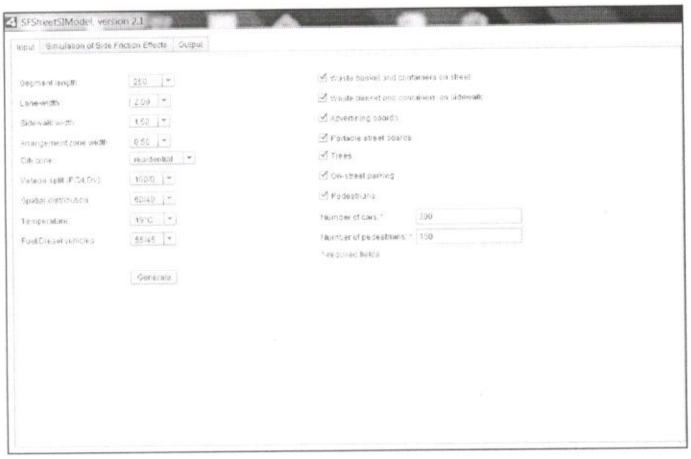

Fig. 3. Geometrical, Functional and Design Characteristics of the locations under study, as input parameters into the SFStreetSIModel, version 2.13

SFStreetSIModel, version 2.1, output parameters (Fig. 4 to Fig. 7), enable analysis of effectiveness, safety and environmental conditions at the studied locations.

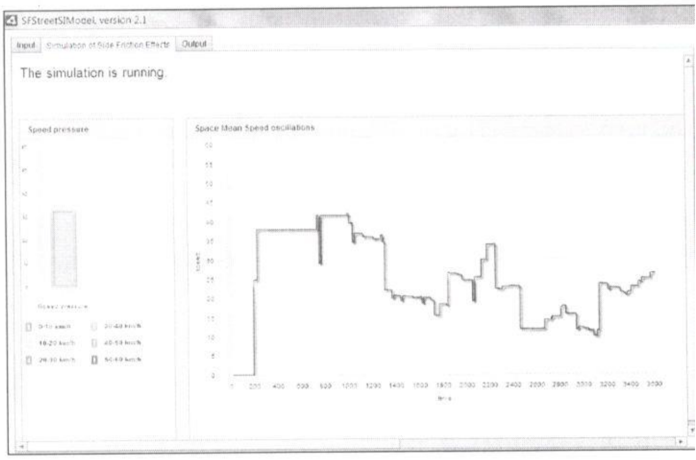

Fig. 4: An example of simulated Space Mean Speed Oscillations in every moment (t=1, 3600s) and the magnitude of drivers Speed Pressure

Fig. 5: An example of simulated MOEs

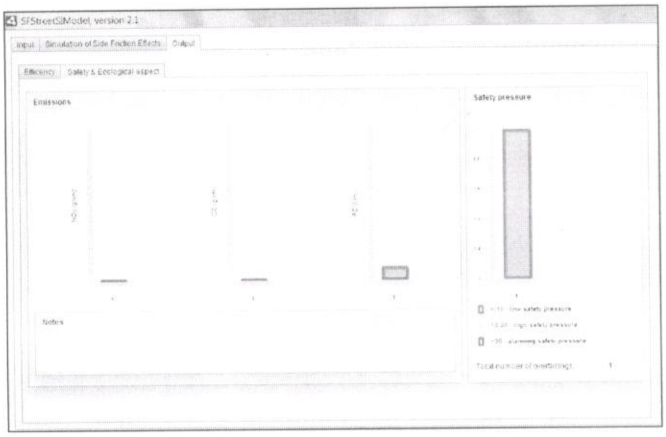

Fig. 6: An example of simulated Safety and Ecological Measures

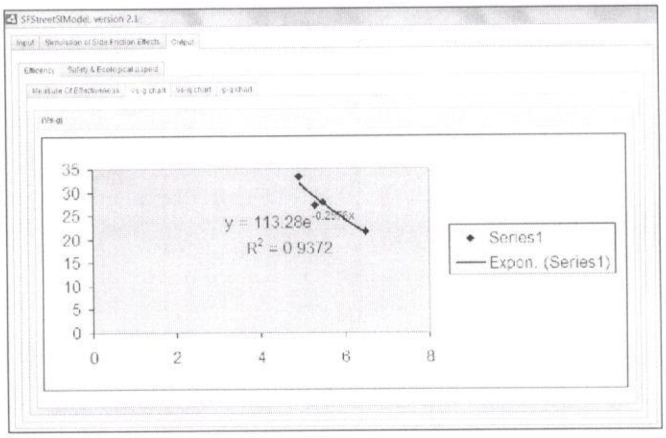

Fig. 7: An example of calculated and visually presented Traffic Flow Diagram "Speed-Density"

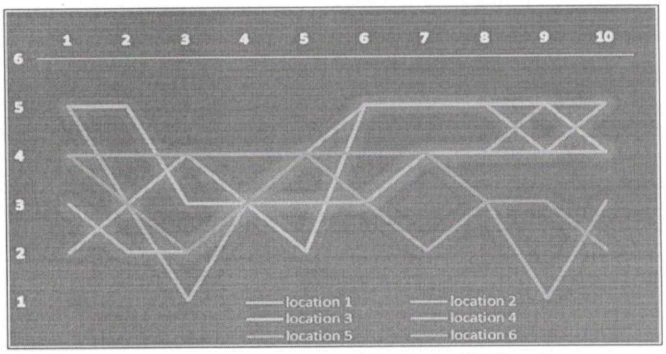

Fig. 8: Simulated Vehicle LOS*) for the studied locations
*) 1-LOS F; 2-LOS E; 3-LOS D; 4-LOS C; 5-LOS B; 6-LOS A

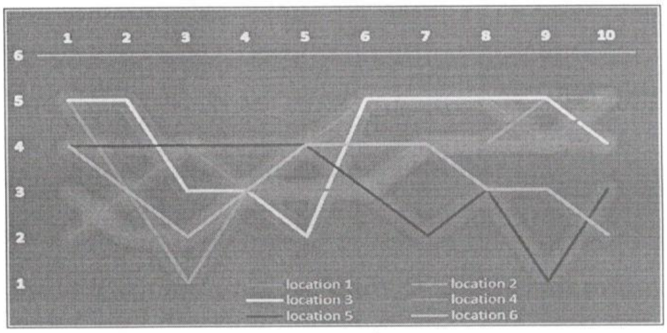

Fig. 9: Simulated Pedestrians LOS*) for the studied locations
*) 1-LOS F; 2-LOS E; 3-LOS D; 4-LOS C; 5-LOS B; 6-LOS A

III. Concludions and Recomendations

According to the simulation results, it was found that the space mean speed at the studied locations is high, and that the drivers are under low safety pressure. Unfortunately, that is why the vehicles LOS is high and reasonably low LOS for the pedestrians. Simulated output parameters shows high level of carbon monoxide and oxides of nitrogen as well as high fuel consumption at the locations.

Since the specific objectives of the study were to:

a) Gain an understanding of the interpretatio and current use of some of the most commonly used MOEs generated by traffic simulation tools at the level of dicision making.

b) Develop an innovative approach to interpret these MOEs when conducting traffic analysis studies; and

c) Demonstrate the validity of the approach through a case study.

We truly believe that this analyses will contribute towards the local government of the city of Bitola and wide versa, to create local road safety strategies, which set out how authorities plan to tackle road traffic casualties in their area and why they believe their approach will be effective. The application on microscopic simulation model SFStreetSIModel, version 2.1., showed endangered level of safety, security and ecological environment for the pedestrians. Therefore, SFStreetSIModel, version 2.1., can be used as an assist decision instrument for sustainable development of Bitola. Conclusively, well designed shared spaces could bring a balance of the needs of all road users as well as to create more pedestrian friendly public spaces.

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