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ScienceDirect

Transportation Research Procedia 24 (2017) 41–49

Transportation Research Procedia

www.elsevier.com/locate/procedia

3rd Conference on Sustainable Urban Mobility, 3rd CSUM 2016, 26 – 27 May 2016, Volos, Greece

Small scale intervention in a major city center interchange. Economic, environmental and sustainability analysis.

Barmpas. G [a*], Kopsacheilis. A [a], Dr. Politis. I [a]

[a] *Laboratory of Transportation Engineering, Department of Civil Engineering, Aristotle University of Thessaloniki, Greece*

Abstract

A congested intersection is one of the major contributors of traffic delay, air and noise pollution in an urban area. A possible redesign of such an intersection can considerably reduce the above mentioned impacts and therefore achieve environmental and economic profits. The signalized intersection, under examination is one of the most congested in the city of Thessaloniki, located in northern Greece. Within the framework of this study, alternative design infrastructure schemes are proposed and examined through the use of microsimulation techniques. Each scenario consists of the construction of an underground bypass as well as a set of various traffic management interventions. In phase A of the study a full horizontal and vertical alignment study was conducted in order to secure the applicability of the proposed scenarios. In the second phase, the alternative scenarios are evaluated through microsimulation techniques and the software platform AIMSUN was used for traffic simulation. In order to model and calibrate the existing situation, a video of the morning peak hour was recorded followed by additional in-situ measurements. The main traffic indicators that were taken into account for calibration and validation were: the GEH index, the mean section queue length per 15min intervals, the traffic volume per 15 min intervals and the average travel time. In the final phase of the study, the proposed interventions were evaluated by comparing the profits from delay time and air pollutant emissions, with their total cost. Additionally, sustainability is evaluated through a survey targeted on postgraduate students, researchers and professionals.

Peer-review under responsibility of the organizing committee of the 3rd CSUM 2016.

Keywords: Microsimulation; model calibration; urban environment; financial evaluation; sustainability;

*Corresponding author. Tel.: +00302310995826; fax: +0-000-000-0000 . E-mail address: geompar@civil.auth.gr

1. Introduction

In modern urban regions, congestion is a significant and frequent problem. High traffic volumes combined with insufficient road infrastructure result in time delays and air pollution, which degrade the citizens' quality of life. Especially in regions where few alternative means of mass transport are in operation, the problem is worsened, as more and more citizens choose their private car as the preferred mean of transport.

This study refers to an urban area with all the above-mentioned characteristics. The city of Thessaloniki, is the second largest city in Greece, with a population close to 1 million citizens. Despite the high population, the city is served only by bus, with a metro system still under construction. As a result, congestion is often encountered. More than that, the city is steadily among the 5 top European cities, regarding air pollution in the last 5 years. (EEA, 2012)

2352-1465
Peer-review under responsibility of the organizing committee of the 3rd CSUM 2016.
10.1016/j.trpro.2017.05.066

With all these into consideration, new ways of traffic management need to be applied, which will improve the citizens' quality of life.

Even though the problem of a congested intersection is often encountered, the aim of this study is to evaluate the proposed interventions by a different approach. The evaluation differs by taking equally into account both a financial as well as a qualitative sustainability assessment. Within the framework of this study, the interventions are evaluated through the use of microsimulation techniques and their effectiveness is examined, by comparing traffic and economic indices. Finally, an integrated assessment of the project is performed in terms of economic, environmental and social sustainability.

2. Study area

The intersection in the area, which is examined in this study, is one of the most congested in the city. Five main roads are merged, resulting in significant traffic volumes during most hours of the day. The intersection is signalized by a state-of-the-art system, which is actuated by the traffic conditions of the surrounding network (T.I.U.M.M.S., 2016). At the same time, high pedestrian volumes are observed, due to a high number of nearby points of interest, such as an archaeological museum, an open-air theatre, a park, and Thessaloniki's international exhibition facilities.

3. Methodology

The methodology of the study is separated into 3 phases, as presented in the flow chart in **Error! Reference source not found.**. In phase A, the existing situation was identified through comprehensive data collection. In order for the scenarios to be realistic and applicable, data collection needs to be accurate. Additionally, all the proposed interventions were composed by taking into consideration the principles of sustainable urban mobility. Some of the initially proposed interventions are eliminated, due to topography constrains. For the selected scenarios, a full horizontal and vertical alignment study was conducted, based on national and foreign guidelines. The output of phase A includes the scenarios that will be assessed through microsimulation.

The second phase includes microsimulation traffic analysis, used in order to assess the scenarios selected in phase A. The microsimulation exercise was undertaken using the platform of Aimsun by TSS (Aimsun User's manual, 2011). At first, the network supply was coded for the base case scenario (current layout), using the data collected on phase A. Afterwards, the model was calibrated and validated by using specific comparative indicators. Using the calibrated model of the present situation as the base case, the proposed scenarios were coded and simulated. After the completion of phase B, specific traffic and environmental related data were extracted, and compared.

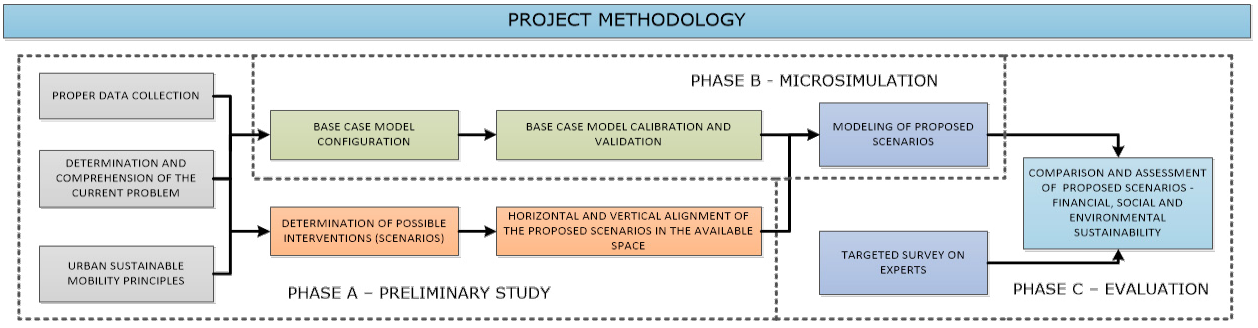

Figure 1: Project Methodology – Flow chart

In the last phase of the study, the qualitative and quantitative evaluation of the proposed scenarios is performed, using the outputs of the second phase. The quantitative evaluation refers to the model's results. The qualitative assessment refers to a questionnaire survey targeted on experts (postgraduate students, researchers and professionals) and focused on the sustainability of the intervention.