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SUSTAINABLE URBAN MOBILITY PLAN IN SMALL SATELLITE CITIES, CASE STUDY OF THE CITY OF DUGO SELO

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Abstract

Rapid urbanization in the last few decades has completely changed the mobility pattern in large and small cities, with an increase in traffic congestion, traffic accidents, and greenhouse gas emissions. With the implementation of the Sustainable Urban Mobility Plan (SUMP), the goal is to reduce the negative effects of traffic and achieve a shift towards sustainable mobility in the cities. This paper presents measures included in SUMP of the City of Dugo Selo that aim to achieve a change of mobility pattern in the city, based on information and suggestions received during the citizens and stakeholder's workshops. The City of Dugo Selo represents the satellite city of Zagreb, where the population mobility activities are mostly related to commuting with private vehicles towards Zagreb. With the measures presented in the study, the main goal is to improve the use of public transport and to implement multimodality hubs for easy transfers between transport modes. Also, the study shows measures that are focused on reducing the road transit and private traffic in the city center to free up the space for pedestrians, and public and alternative transport modes to achieve positive effects in ecological and modal shift parameters. Presented work can be used as a guide for traffic planners that are developing measures for urban mobility development in smaller satellite cities of larger cities.

1. INTRODUCTION

A sustainable urban mobility plan (SUMP) is a strategic plan designed to meet the mobility needs of people and businesses in cities and their surroundings, with the main aim of improving their quality of life. In terms of the mobility situation, smaller cities and towns tend to be car-oriented communities with a low share of public transport, where getting around by car is the easiest option as there is little congestion and few parking constraints. Since many people commute to other towns for work, school, or other daily necessities, providing attractive public transport is often a challenge [1]. Dynamical urban development and inhabitant's lifestyle changes result in a continuous increase of transport needs with the effects of an increased number of vehicles on streets, increased number of accidents or exhaust and noise emissions. With that in mind, a sustainable approach to urban mobility and transport planning is becoming a crucial part of further mobility development [2].

The process of the plan development is defined by existing guidelines from the European Commission's Urban Mobility package, and it is based on eight guiding principles. Principles provide important information and focus points on which authors of the SUMP should focus to satisfy the aim and goals of the SUMP. The main goals of the SUMP should be improving accessibility and providing safe and clean mobility for the entire urban area, implementing cooperation with a wide range of departments within the city, identifying main problems and opportunities for sustainable mobility, and ensuring integrated development of all relevant transport modes while supporting a shift towards sustainable mobility [1].

2. REVIEW OF THE CURRENT STATE

A review of the current state is the main background for the evaluation of the current development of the urban part of the city. Through spatial coverage, socio-economic characteristics, and the purpose of the area analysis it is possible to predict population main generators and attractors.

The data collection methodology for the development of the SUMP was comprehensively carried out from September to December 2022.

2.1. Main information about Dugo Selo

The city of Dugo Selo is one of 34 municipalities in Zagreb County in Croatia. It is within the gravitational area of the city of Zagreb, and it is located approximately 20 km to the east of the Zagreb city center. The city covers an area of 53,94 km^2 and has a total of 17.676 inhabitants which is 5,89% of the total Zagreb County population. Based on data from the previous three Censuses provided in the Republic of Croatia, the population in the City of Dugo Selo is constantly growing which indicates a noticeable trend of urbanization of the city [3].

The street network in the urban area of the city is relatively developed and it meets the current demand. It is mostly an orthogonal network that indicates planned city development, while the outskirts of the city have certain elements of irregular

network based on a “cul-de-sac” principle. The city’s business activities are oriented towards the city of Zagreb, with the main roads predominantly oriented in the west – east orientation, the same as the railway network that is one of the main transport modes in the city. It is important to note that despite east – west road connectivity, the city has primarily expanded in a north – south direction.

2.2. The characteristics of the existing mobility

Characteristics of existing mobility provide a foundation for understanding the current transportation state in the city and serve as a basis for identifying areas of improvement and future transportation planning. Data collection of the current mobility state was conducted via an online questionnaire which was available via Google Forms.

According to the collected data from a survey, the modal distribution of travel in the city of Dugo Selo indicates that over 85% of respondents who live in the city travel daily (at least 4 times a week) for work or education purposes. Among them, 68,6% use a car as their primary mode of transportation, 14,8% use the train, 13,6% utilize a combination of transportation modes, 2,2% walk, 0,6% use a bicycle or other micro-mobility modes, while less than 0,5% rely on buses for their commuting needs. The modal distribution in the city of Dugo Selo is illustrated in Figure 1.

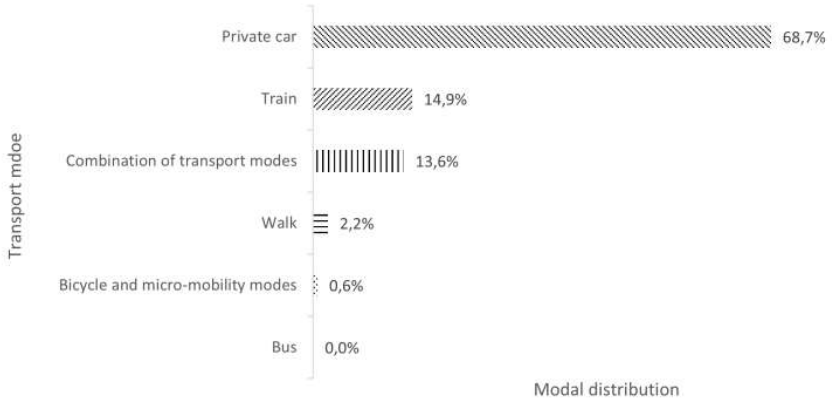

Figure 1. Modal distribution in the City of Dugo Selo

Based on the collected data, it is evident that efficient steps need to be taken at a strategic level to significantly reduce citizens’ reliance on private cars and to provide a healthy and sustainable mode of travel. In addition, it is necessary to implement additional measures that positively impact carbon footprint and reduce the number of cars relying on fossil fuels.

2.3. Existing state of road transport system

The City of Dugo Selo road network consists of a total of 144 km of road length, out of which 14,97 km (10,34%) are county roads, 20,03 km (13,83%) are local roads

and 109,76 km (75,82%) are unclassified roads. The main road routes in the city are three county roads that connect the city towards Zagreb, Ivanić Grad, and Vrbovec.

Estimation of traffic volume on the road network in and around the City of Dugo Selo was based on 5-year period data from automatic traffic counters, located on the main county roads passing through the city, as well as with on-field traffic counting conducted during the work week. Analyzed data show that road traffic is constantly increasing, with small deviations during 2020 which was affected by the COVID-19 virus pandemic. The largest increase in traffic during the analyzed 5-year period is visible on counters that are located closer to the city center, which confirms the urbanization of the city.

The city of Dugo Selo does not have an implemented parking system, but it has over 750 parking spots in the city which are all free. Most of the parking spots are used by either residents in the nearby area or by the commuters that use a combination of transport modes which are using cars combined with the train.

Road safety in road traffic was analyzed using the data available from the Police Department of Dugo Selo. From the data available it was seen that in the last 5-year period there were a total of 781 traffic accidents, out of which 466 accidents (60%) were with material damage, 307 (39%) were with injured people and 8 (1%) was with death of people. With detailed analysis, 5 intersections and 3 critical crosswalks that had the largest number of accidents on the road network were classified as critical road network sports.

2.4. Existing state of public transport system

Public transport in Dugo Selo is based on two modes, rail, and bus. As shown in Figure 1., rail is commonly used by the respondents of the questionnaire, while buses have almost no passengers at all.

Rail infrastructure in the city of Dugo Selo is based on three international railways, that provide many daily departures from the main station. On workdays, Dugo Selo main station has 230 departures, with a total of 143 departures from or towards the City of Zagreb which is the main gravitational area. For the analysis of the demand, data from the operator (*HŽ putnički prijevoz)* was used. In 2017., at the Dugo Selo station there were 992.883 passengers, while in 2021. there were 691.027 passengers. Data indicates that in the 5-year span there is a 30% decline in the number of passengers which is alarming in developing sustainable travel habits.

Bus transport is currently done through county and inter-county lines, since there is no official municipal transport operator that provides service inside the city. The existing lines are operated by multiple operators, with low frequencies, old fleets, and insufficient provision of information for passengers. Also, analysis of existing bus stops in the city area revealed that many of them are inadequately equipped and poorly marked, especially those located off the county roads and main city streets. Given all the available data, the modal share of under 0,5% for bus service is not surprising and it is needed to implement strategic planning on improving public bus transport and establishing inner city lines that can provide a sustainable and reliable mode of transport for all the passengers.

2.5. Micro-mobility and walking demand

Demand for micro-mobility and walking was analyzed through a questionnaire as well as with on-field counting of traffic demand. Gathered data shows that 2,2% of people are walking daily, while only 0,6% are using a bicycle or some other type of micro-mobility. On-field data shows that the main routes for pedestrians and micro-mobility users are from Dugo Selo main station towards the city center and vice versa. Analysis of the existing bike lanes in the city has shown insufficient infrastructure with a shortage of bike lanes on main routes.

3. STRATEGY DEVELOPMENT

During the strategy development process, three scenarios were developed whose impact on traffic state were evaluated through traffic model developed in modelling software PTV Visum. Each of the developed scenarios were based on advantages and disadvantages of existing traffic state with focus on vision of future city development.

3.1. Scenario development

The first developed scenario was **Business as usual**. This scenario represents the expected development of the city if current policies and measures are carried out. This scenario does not include measures focused on urban mobility or modern types of traffic control, but it is more focused on the finalization of planned projects such as the construction of the city bypass and railways overpass. This scenario can be easily described as a scenario of the current state with minimal system changes without changes in modal share.

The second developed scenario was **Urban mobility** scenario, which includes measures with a focus on the development of transportation systems to meet existing demand, without significant implementation of sustainable mobility principles. In this scenario, there is an influence of external trends such as electromobility, but the focus remains on the private car as the primary mode of transport. This scenario includes all of the planned infrastructure interventions regarding the road network following the Spatial Plans of the City of Dugo Selo. It mainly represents the planned state of the transportation system development in the city, with the assumption of accelerated progress in road infrastructure. Also, this scenario predicts an increase in road traffic demand.

The third and last developed scenario is **Sustainable urban mobility** scenario describes the state of transport demand on the road network when implementing all measures outlined in this plan. In addition to the measures provided in “Urban mobility” scenario, this scenario includes significant changes in the transportation system of the City of Dugo Selo. Those changes include establishing a city square in the central area, creating bypass routes, developing public passenger transport, promoting cycling and micro-mobility, and focusing on the systematic development of multimodal public transportation with rail and bus as the main transport modes

within the city. Due to increased investment efforts directed towards sustainable urban mobility, this scenario considers a shift in transport demand trends, favoring sustainable modes of transport.

3.2. Transport model development

For the development of a macroscopic traffic simulation model, the existing traffic model from Phase I and II of the Master Plan of the Traffic System of the City of Zagreb, Zagreb County, and Krapina-Zagorje County from 2018 was used as a basis. During the process of updating the model, a subnetwork module was used to extract the area specifically related to the City of Dugo Selo from the entire region. Traffic count data from automatic counters and field surveys were used for calibrating the traffic model. The accuracy of the model was evaluated by comparing the field-collected data with the data obtained from the simulation model. Next step of model development included prediction of traffic demand increase in the future. Using a calculation method, the projection of the demand increase on the road network is estimated for scenarios up to the year 2050. Using the average traffic growth in the previous 5-year period, AADT increase of 40,33% is expected compared to the data from 2021. Furthermore, AADT increase of 91,17% is expected in 2050, also compared to the data from 2021. Given data shows' large dependency on private cars and indicates much needed measures to control the traffic growth in the future.

4. SUGGESTED SUMP MEASURES

In 1981, Doran [4] developed "SMART" goals with aim to achieve goals that are specific, measurable, assignable, realistic and time related. In the process of the goal development for our SUMP, the main aim was to implement SMART goals that are easy to implement and evaluate during the definite time period.

SUMP goal development was based on a list of steps derived from various sources, including the data on the current state, public and stakeholder opinions, best practices in other European cities, sustainable urban mobility guidelines, and professional standards. Based on given elements, main conclusions drawn from the analysis are as follows:

- Personal motor vehicle transport is the dominant mode of transport,
- Focus on developing infrastructure for all modes of transportation, especially multimodal and sustainable modes,
- Improvement of traffic safety,
- Enhancing connectivity with the outskirts of the city and distant settlements,
- Improvement measures should be implemented for each mode of transport.

Suggested measures were separated into six groups, with each group focusing on the dedicated essentials for creating sustainable urban transport.

As a first group of measures increasing traffic safety in the city was presented. Measures included improvement of critical intersections and crosswalks, improving

visibility and longevity of road markings, and conducting promotional campaigns to increase traffic awareness.

The second group of measures were focused on measures whose aim was to ensure comfortable, efficient, and available public transport with a focus on multimodality. Since analysis has shown that the majority of people use cars as their main type of transport, it was needed to implement measures to stimulate modal change. The first and the main suggested measure included establishment of local public transport with modernization of bus stops. Also, development and implementation of multimodal hubs present an important part of this group's measures. Other important goal is to introduce Intelligent transport systems into the city through measures like the digitalization of ticket purchases, prioritization of public transport on the intersections and modernization of passenger information systems.

The third group of measures focuses on improvement and extension of bicycle and micro-mobility infrastructure with the aim of increasing the number of users. Main measures include further development of bicycle infrastructure, implementation of public bicycle parking spots and introduction of bike sharing. Also, as an improvement in multimodal sector, introduction of Park&Bike and Bike&Ride services are important measures in this group.

The fourth group puts focus on walkable and safe city for pedestrians. Throughout presented measures, the goal is to improve and extend infrastructure for pedestrians and handicapped, implementation of shared space and pedestrian zones to improve and ensure safe environment for pedestrians in the city.

The fifth group focuses on clean and sustainable modes of transport. Measures presented in this group include subventions for "green" and hybrid vehicles, construction of fast chargers and parking spots for electric vehicles, implementation of ITS solutions for traffic control in the city as well as reduction of private vehicles in the city center.

The sixth and the final group focuses on sustainable road transport and parking policies. Measures include reconstruction of the city network, optimization and regulation of traffic flow, implementation parking policies led by the city, and introduction of Park&Ride and Car sharing systems that would have positive effects on the modal share.

As a final step in measure development, prioritization of measures was completed by the method of multicriteria analysis. The criteria for the ranking were based on socioeconomic benefits, costs, complexity, public and stakeholders stance and complementary with the other measures. After the process of the prioritization process, highest scoring measures were implementation of public transport lines, improving the pedestrian infrastructure and introduction of Park&Ride and Car sharing systems. Given the results, those measures were pointed out as the main priority for the future development.

5. CONCLUSION

Implementation of SUMP measures in small cities are crucial, particularly with constant population growth and increased dependency on cars. This study emphasizes the importance of implementing measures that effectively reduce car dependency and promote urban and sustainable mobility such as walking, cycling and public transit.

The study highlights the need to invest in infrastructure for multiple modes and promote multimodality, ensuring seamless integration and connectivity among different modes of transport. Additionally, it underscores the significance of enhancing safety, accessibility and convenience for sustainable transport options. To achieve the desired outcomes, it is essential to engage citizens and stakeholders throughout the planning process, incorporating their perspectives and feedback.

Implementation of SUMP measures in small cities presents great potential to reduce car dependency and to create sustainable communities. By embracing a holistic approach and implementing comprehensive strategies, cities can pave the way for a more environmentally friendly, socially inclusive and economically vibrant future.

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