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Transport Planning–A Component of Emergency Plan Case Study: Pitesti Metropolitan Area

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***Abstract*—The transport planning activity has become more complex, taking into account the increasingly more aspects regarding social and environmental protection. The paper aims to highlight the need for transport planning activity in fundamenting the intervention plan in case of emergency. The transport planning methodology presented in this paper aims to assure the balance between transport demand and supply, both currently and in emergency situations, by simulating traffic flows in a frame of a transport model. The planning process has been applied in a frame of a case study for Pitesti metropolitan area, in which, following the analysis of the level of service relative to value of volume / capacity ratio of the transport network, was recommended the extending of the network with a new bridge over the River Arges and a new connection road between the main transport poles, the cities of Pitesti and Mioveni.**

***Index Terms*—transport planning, emergency plan, transport model, metropolitan area, accessibility**

I. Introduction

The events that require emergency interventions appear more and more frequently at international level. In order to reduce the negative effects of these events, both at the levels of population and society in general, it is advisable to draw up action plans for emergency situations on which the state authorities empowered for interventions to organize and act effectively when the intervention is required [1]-[3].

Whatever the nature of the event that requires emergency response – *(i)* natural disasters: floods, earthquakes, storms, snowstorms; *(ii)* accidents: explosions, chemical discharges into the environment, industrial accidents, radiological or nuclear incidents; *(iii)* civil or political incidents: public demonstrations, strikes; *(iv)* special events: major sports events, festivals, conferences and international summits; *(v)* terrorist or criminal incidents: nuclear, chemical, biological, radiological, armed attacks and threats or attacks – the intervention plan in case of emergency (Fig. 1) [4], among other background studies, should be based on a transport planning study in the area of analysis, so that the capacity of the transportation network to allow the achievement of the actions provided in plan [5].

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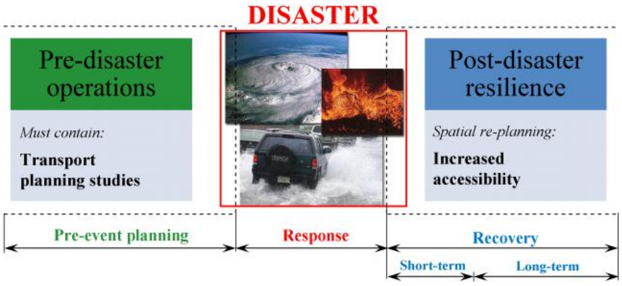

Figure 1. The action plan for emergency situations.

In this respect, the paper presents the activity of transport planning in order to fundament the action plan for emergency situations at the level of metropolitan area Pitesti from Romania.

II. Transport Planning Process

The results of transport activity are quantified through the economic development of influence area and through the quality of life in that area [6].

The performances of the transportation system influence the public policies in the field of air quality, non-renewable resources consumption, social equity, land use, economic development and, not least, in the field of safety and security of citizens [7]. Transport planning is a complex process that must take into account all areas that interact with, those from which takes information as input, as well as those over which the transport activity produces effects.

The main objective of transport planning process is to achieve the balance between transport supply and transport demand, in agreement with factors that influence these two major components without which the transport activity cannot be achieved. Therefore, transport planning studies should capture, besides the aspects of land use, as well as socio-economic and demographic characteristics and behavior of transport users, also aspects related the transport supply (the capacities of infrastructure elements composing transport networks).

By knowing this input data and information regarding users' travel behavior, obtained from origin - destination and traffic surveys, by applying the transport model known in literature as "the four-step model" *(trip generation, trip distribution, mode choice* and *trip assignment)* [8], there are obtained the traffic flows at the level of transport network that characterize the considered supply in the analysis process.

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In relation with traffic flow values and transport capacity of each element from transport network, specific to analysis time interval, is determined the level of service which users perceive when making trips [9]. Framing the level of service in classes lower than class "C" recommends interventions on transport supply, so that the process resumption to lead at network levels of service located in the upper half of the ranking. The interventions on transport supply can be materialized through measures for increasing the capacity of existing infrastructure elements or by proposing new elements in the network.

The structure of transport planning process, which includes the above mentioned aspects, is shown in Fig. 2.

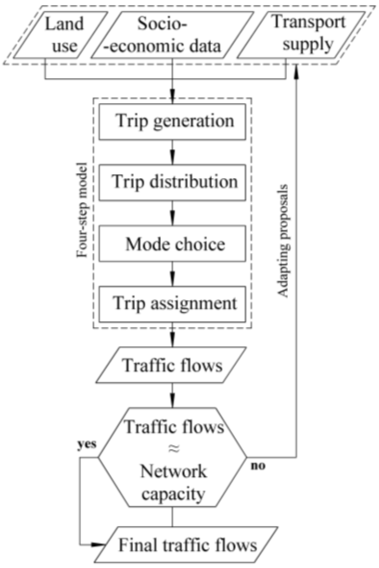

Figure 2. The transport planning process.

III. Case Study

The case study, in which was applied the methodology of transport planning in the frame of an action plan for emergency situations, is performed for the city of Pitesti, Romania. During this period in Romania takes place the territorial reorganization process that involves inserting regions and decentralization at administrative level. At the same time, the territory around large cities is reorganized as metropolitan areas. Pitesti Municipality, which according to the general census of population from 2011 has 155383 inhabitants, will become the nucleus of the metropolitan area Pitesti (Fig. 3), being assigned with the limitrophe localities Albota, Bascov, Bradu, Maracineni, Mioveni, Mosoaia and Stefanesti (Table I).

TABLE I. Component Localities - Population

Component locality	Number of inhabitants
Pitesti	155383
Albota	3842
Bascov	10218
Bradu	7130
Maracineni	5193
Mioveni	31998
Mosoaia	5693
Stefanesti	5314

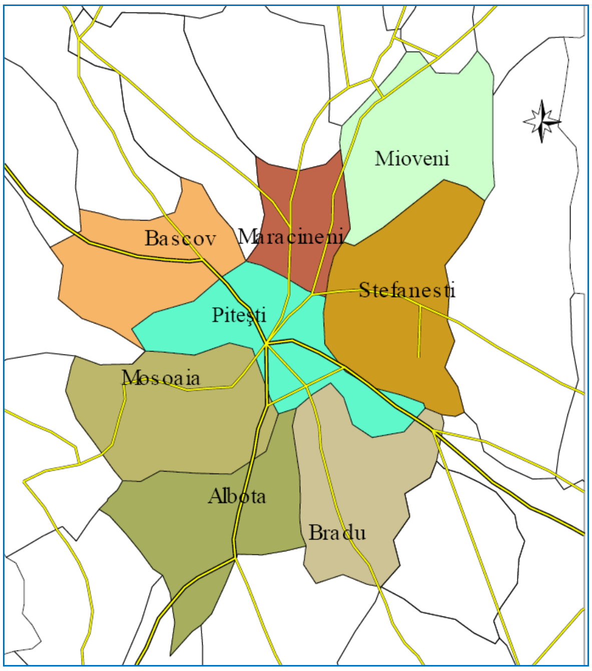

Figure 3. The metropolitan area Pitesti–component localities.

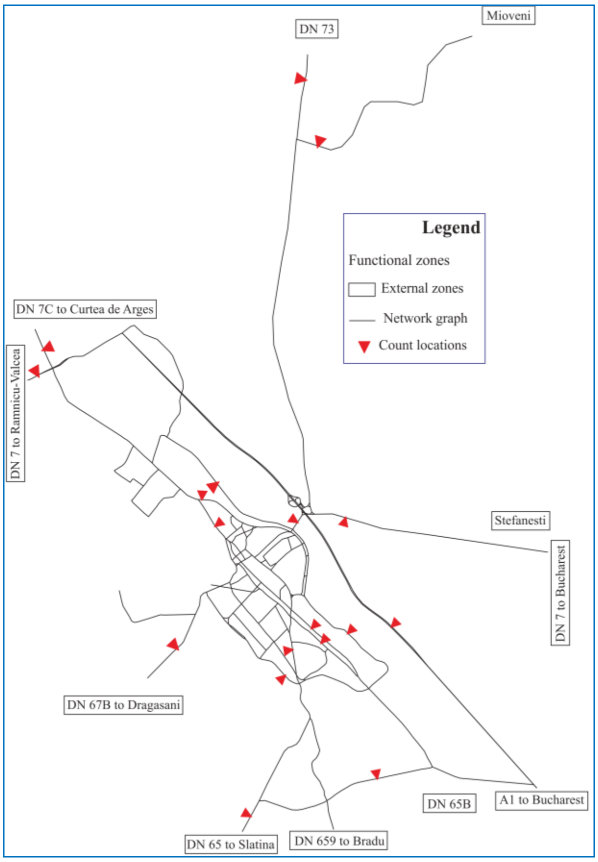

Figure 4. The survey points in the studied area.

Among these, Stefanesti and Mioveni are cities, the other ones being communes. The number of inhabitants of the new administrative entity will be 224771.

The transport planning, at the level of metropolitan area Pitesti, for the substantiation of intervention plan in emergency cases, followed the methodology presented in the second chapter. In the planning process were used the facilities provided by VISUM software, specialized in transport planning.

The particularity of studied area is given by the sectioning of territory, on North West - South East direction, by a natural barrier, Arges River, which traverses the localities Bascov, Pitesti and Bradu. The connection between the localities placed in North East side of the metropolitan area (Maracineni, Mioveni, Stefanesti) and Pitesti within the road network is provided by a single road bridge whose capacity is 2200 private car units / hour / direction.

The calibration and the validation of the transport model were realized based on traffic and origin - destination surveys carried out in 2012. Surveys were conducted in 18 points located in the studied area (Fig. 4), the processing of the recorded data providing information on user behavior, hourly variation of trips, trips purposes, the loading degree of the vehicles.

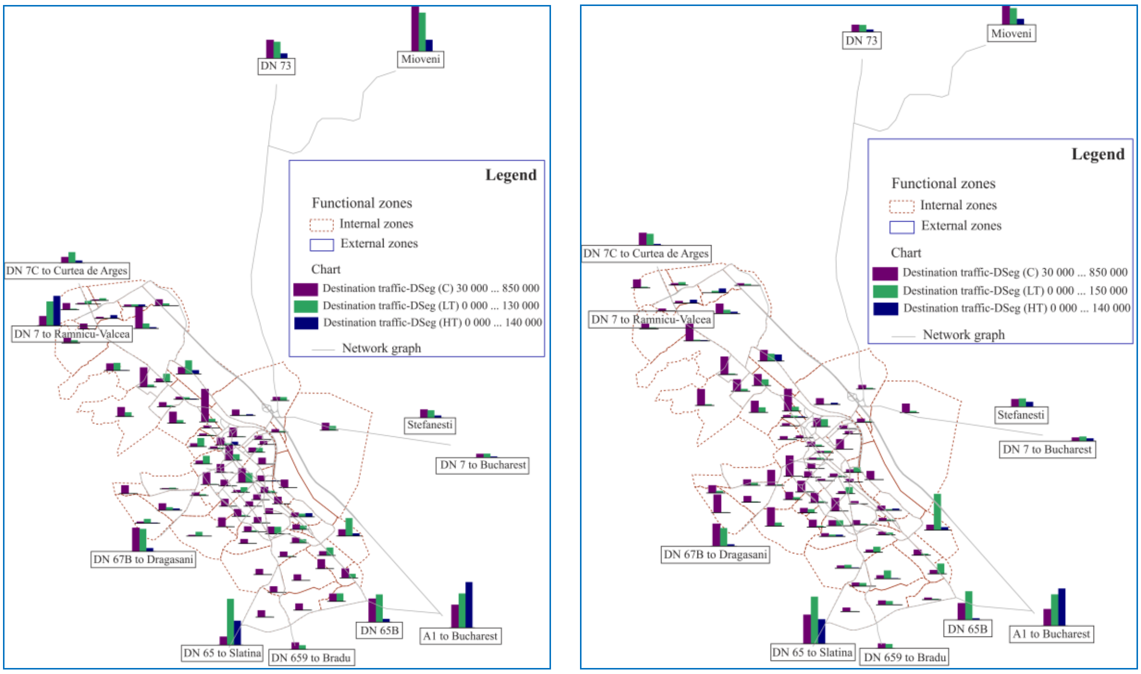

Figure 5. The potentials of generating and attracting trips.

IV. Results and Discussion

The processing of socio-economic and demographic data and land use functions within the study area led to the estimation of generating and attracting potentials of trips for each considered traffic area (103 traffic areas, of which 11 exterior areas) [10]. In Fig. 5 are represented the potentials of traffic zones for generating and attracting trips, by type of vehicles recorded in peak traffic hour, 16:00 to 17:00. It can be noticed that next transport pole (in terms of generated and attracted trips), beside Pitesti Municipality, whose total potentials are obtained by aggregating the potentials of interior zones, is Mioveni city.

The connection between the two major transport poles in the analyzed network is achieved through a single linking element, the bridge over Arges River, whose *volume / capacity* ratio in the peak traffic interval is 1.3, representing a dysfunction in the network. This can be observed in Fig. 6, where are plotted the origin - destination pairs that cross the bridge over the Arges River.

Also, another dysfunction of the network occurs at the level of road junction in which are converging national roads DN 73 and DN 7, accesses to the highway A1 and the bridge over Arges River (Fig. 7). In the analyzed peak traffic hour, this is enrolled in level of service "E", in terms of average delay of vehicles, of 37.6 seconds/vehicle [10].

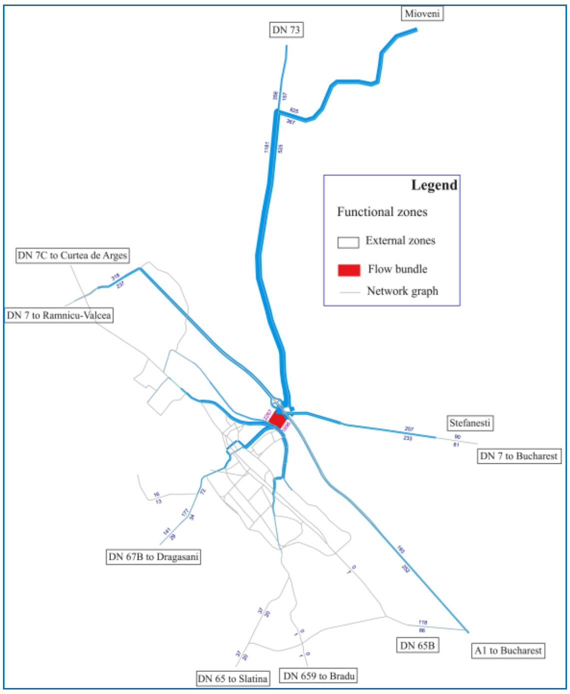

Figure 6. The loading of the bridge over Arges River.

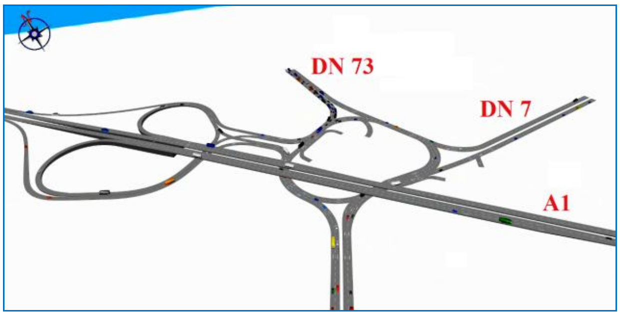

Figure 7. Microsimulation of traffic flows at junction between A1, DN 73 and DN 7.

Taking into account that the intervention structures in emergency situations – firefighters, ambulance, hospitals – are based in Pitesti Municipality, the accesibility in the cities from metropolitan area is limited on this sector of the network, consisting of the bridge over Arges River and the road junction where it converge.

Therefore, in order to improve accessibility in emergency cases, was studied the situation in which the road network is complemented by a new bridge in the area of Stefanesti city, located in the extension of the communal road DC 80 and introducing of this road in the main graph, after rehabilitation (in the moment this is an unpaved road). The redistribution of traffic flows in the case of transport network development is represented in Fig. 8.

The redistribution of traffic flows was obtained after traffic macro-simulation carried out in the frame of transport model calibrated and validated for the current situation, at the level of year 2012, in which were introduced the new infrastructure elements.

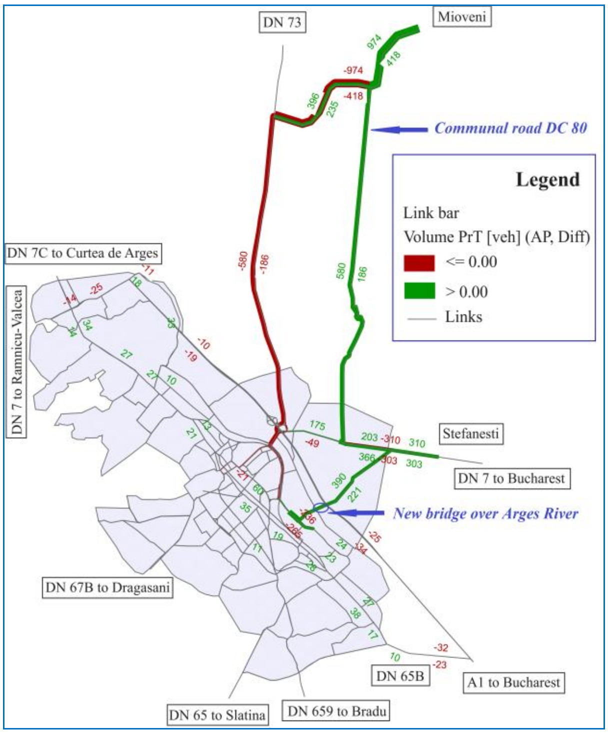

Figure 8. Redistribution of traffic flows - the situation with new bridge over Arges River.

The trips recorded on the alternative link proposed in the road network (the new bridge and the communal road DC 80) have as zones of origin and destination the main transport poles from metropolitan area – the cities of Pitesti, Mioveni and Stefanesti – trips which, in current situation, use the only bridge over Arges River, fact that can be observed in Fig. 6. Thus, through the proposals of transport planning in metropolitan area Pitesti, is obtained an increased population mobility and, implicitly, more accessibility in emergency situations.

V. Conclusions

By deploying the component steps of planning transport, were identified the main dysfunctions of transport network in relation with meeting the travel demand in the study area, at the level of peak traffic hour registered in working days. The analysis of the results showed a situation in which the transport activity, under normal conditions, takes place with difficulty, so that was studied the situation in which the road network was completed with new infrastructure elements, which forms alternative route for traveling between the main transport poles the analyzed area. Following the redistribution of traffic flows, it was obtained the decreasing of traffic volumes on the overworked sectors (existing bridge over Arges River and the junction between A1 - DN 73 - DN 7) with 28 %, the level of service, taking into consideration the average delays per vechicle, belonging to class "C".

The paper highlights the importance of planning in the field of transport at the level of urban agglomerations and the interaction between transport planning processes and the ones for interventions in emergency situations.

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