

# Focus Areas and Measures to Improve Road Traffic Safety at the Local Level

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**Abstract** Earlier approach to road traffic safety system proceeded from the assumption that the driver must adapt to the traffic system. Modern approach to road traffic safety system recognizes that traffic system must be adapted to a traffic participant: drivers, pedestrians, particularly vulnerable participants: children, elderly, persons with reduced mobility. The starting point is the acceptance of human error and vulnerability of the human body, and in accordance with that, understanding that traffic accidents cannot be completely avoided, but the death and severely injuring of traffic participants may be reduced. For this purpose, the control function of road traffic safety system promotes interventions, by whose implementation results are achieved. Road traffic safety system management, in addition to national, must take place at the local level. Although the local system of road traffic safety can be, in functional terms, set analogous to national system, its frames are much narrower and thus put much more specific and evolving demands on local road safety management for adjusting the local management system to local conditions. In this context, local traffic safety goals should focus on areas where the effect of local intervention improves traffic safety. This paper has developed the concept of traffic safety management process at the local level, encouraged by the Global Plan of the UN Decade of Action for Road Safety 2011-2020, which is modeled by conversion "National Pillars Activities" in "Local Focus Areas and Measures" and based on the analysis of general statistics on traffic accidents and in-depth analysis of traffic accidents with killed and seriously injured persons on local roads. With a focus on results to improve traffic safety in local communities of Montenegro, three areas are identified and twenty measures in them, whose implementation would obtain the greatest possible impact in adapting local road traffic safety system to road users, which is a precondition for improving traffic safety in the local community.

**Keywords** Focus areas and measures, Road traffic safety, Local community level, Montenegro

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## 1. Introduction

A traffic accident on the road is a random, sudden and rare event that occurs during the period of observation, caused by a lack of adaptability of the individual with the environment, which is reflected in damage or injury of participants [1]. In defined environmental conditions there is a certain probability that an accident can happen. Approach to road traffic safety system proceeded from the assumption that the driver must adapt to the traffic system. By increasing the level of motorization, the number of road traffic accidents and the number of killed persons in them has increased [2]. Traffic violations on roads are a global problem and represent the ninth cause of death worldwide in 2004, a leading cause of death among young people in the age group of 15 to 29, with a tendency until 2030 to become the fifth cause of death worldwide [3]. Recognising this fact, the UN

General Assembly in 2010 proclaimed the "Decade of Action for Road Safety 2011-2020" [4]. The vision of the world is to provide safe mobility of all road users. Modern approach to road traffic safety system recognizes that traffic system must be adapted to a traffic participant: driver, pedestrian, particularly to vulnerable participants: children, elderly, persons with reduced mobility. It begins with the acceptance of human error and vulnerability of the human body, and in line with this understanding that traffic accidents cannot be completely avoided, but the death and severely injuring of traffic participants may be reduced [5-7]. The aim of the Decade is to stabilize and then reduce the number of fatalities in traffic accidents on roads and thus preserve five million lives worldwide. Global Plan of the UN Decade of Action for Road Safety 2011-2020 [3] was prepared as a guiding document that will enable the implementation and coordination of joint activities towards achieving the goals of the Decade. Global Plan is primarily an instrument of support for the development of national plans and coordination of activities globally, though it also provides recommendations for the development of local action plans. At the national level, countries are encouraged

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to implement five basic pillars of activity: management of road traffic safety, safer roads and developments, safer vehicles, safer road users and activities after the accident.

Global approach to the system of road traffic safety acknowledged that road traffic safety is a product [8]. In doing so, the “production process” of traffic safety is seen as a management system with three levels: institutional management functions, interventions and results [9-11]. To achieve the desired results, it is needed to give an integrated response of all three levels of the system.

A characteristic of the traffic safety management system is that it allows universal use on all levels and in all countries, regardless of their size or developmental performances of road safety [9, 12]. Managing road traffic safety system, in addition to national, must take place at the local level.

However, although the local system of traffic safety can be, in functional terms, set up analogous to the national system of traffic safety management, its frames are much narrower and thus set much higher and more specific requirements of local management of road traffic safety for adjusting the local system management to local conditions. In this context, local traffic safety goals should be focused on areas of activity in which the effect of local intervention improves traffic safety. General statistics on traffic accidents and in-depth analysis of accidents with killed and seriously injured persons on local roads can be used for the selection of focus areas and measures to improve road traffic safety at the local level.

## 2. Concept

The paper develops the concept of traffic safety management process at the local level, based on a philosophy of road safety that life and human health is more

important than its mobility and other objectives of road traffic [13, 14]; and on access that traffic system must adapt to human errors and to take into account the vulnerability of the human body [15]; and focused on practical improvement of traffic safety in local communities of Montenegro. The aim of the paper is to encourage the action towards planning, organizing and controlling activities as well as the use of available resources for realization of the set objectives in the field of road traffic safety at the local level.

Encouraged by the Global Plan of the UN Decade of Action for Road Safety 2011-2020 [3], the concept of the process of road traffic safety management at the local level is modeled by conversion "National Pillars Activities" in "Local Focus Areas and Measures". In this modeling the primary institutional management function is coordination [16]. Adjusted functioning of certain levels of management is achieved through vertical coordination: the international coordination of national activities, the national coordination of local activities, and local coordination of project activities. National objectives of traffic safety management, through vertical coordination, are proceeded to the local level, and achieved by lowering to the level of the project and the local horizontal coordination of project activities (Figure 1).

On the basis of general statistics on traffic accidents in Montenegro [17] and in-depth analysis of traffic accidents with killed and seriously injured persons on local roads in Montenegro [18, 19] three areas are identified and twenty measures in them, whose implementation would be given maximum impact in adapting the local road traffic safety system to participants in the local road traffic, which is a precondition for improving traffic safety in the local community.

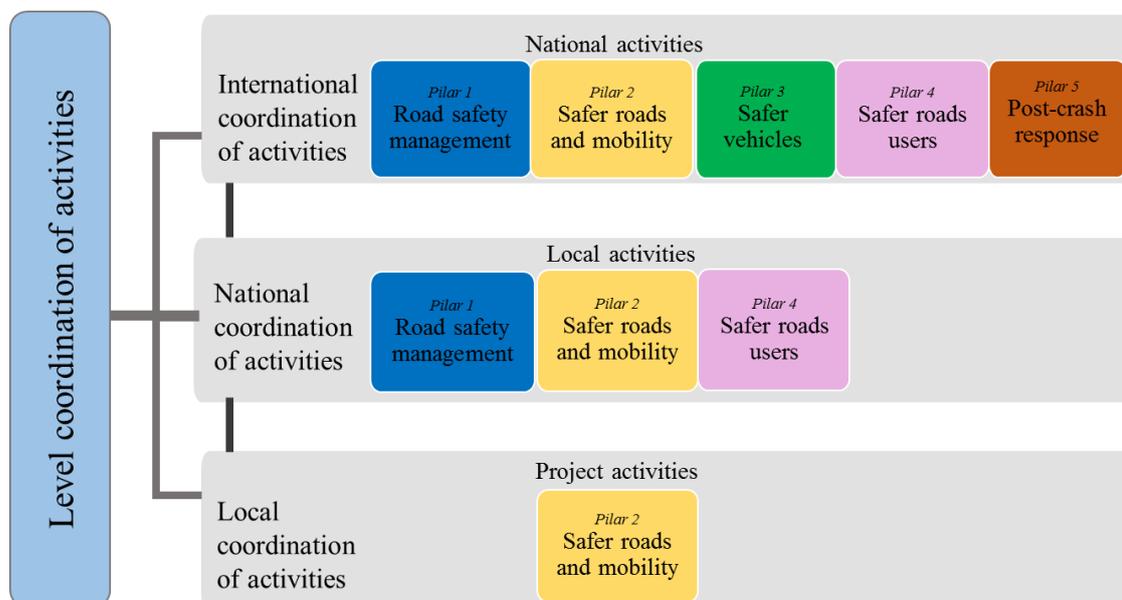


Figure 1. Coordination at the levels of activities

### 3. Traffic Safety Management on Local Roads

Institutional management functions form the basis of traffic safety management system, because they promote interventions that achieve results. Institutional management functions include: coordination, legislation, funding and locating resources, promotion, monitoring and evaluation and research, development and knowledge transfer [9].

Local strategic goals for road safety management, which should be ambitious and feasible, we should focus on areas where the impact of local interventions improves traffic safety.

Methodology of setting local strategic goals for road safety management should include: an in-depth analysis of the national safety status on the basis of data on traffic accidents; identification of areas of activity in which the effect of the national interventions can produce improvement and predict the effects of planned national interventions [20].

### 4. Focus Areas and Measures where the Effects of Local Intervention Improves Traffic Safety

General Focus areas and measures, where the effects of local intervention improves traffic safety, can be identified in three of the five pillars of the Global Plan: management of road traffic safety, safer roads and routes and safer road users (Figure 1).

#### 4.1. Road Traffic Safety Management - Local Level

Regarding functional aspect, traffic safety management at the local level can be set by analogy to management of traffic safety at the national level, determining its purpose of encouraging the creation of multi-sectoral partnerships in developing and implementing local plans of road traffic safety and setting local targets, on the basis of which would be determined adequate intervention. Thus, their implementation and effectiveness could be monitored.

##### 4.1.1. Constitution of Local Institution for Traffic Safety

Local institutions for traffic safety should have a leading role in stimulating the creation of multi-sectoral partnerships in developing and implementing local plans of road traffic safety and setting local objectives.

Constitutional form of local institutions for traffic safety can be very different from local agencies, to legal advisors level, depending on the size of the local community and the development of road transport in the local community.

##### 4.1.2. Mobility for All Participants in Local Traffic

Mobility for all participants in local traffic should be the vision of local traffic plans. Local transport plans should be the basis of urban development plans of the local community,

based on which space of local communities is built and regulated.

Mobility for all participants in the local area, as well as local transport policy, sets the spatial requirements for the development and construction of local transport infrastructure for all road users, especially the most vulnerable (persons with reduced mobility, pedestrians, cyclists and motorcyclists).

##### 4.1.3. Setup and Support of Local Monitoring and Evaluation System for Measuring and Monitoring Traffic Safety in Local Traffic

The system of local monitoring and evaluation for measuring and monitoring safety in local traffic primarily relates to the measurement and monitoring of risk for injuries of vulnerable road users (people with reduced mobility, pedestrians, cyclists and motorcyclists), measurement and monitoring of protective equipment usage (helmet, belts, child seats) and measuring and monitoring interventions on local traffic infrastructure in order to improve traffic safety.

#### 4.2. Safer Roads and Mobility - Local Level

The functional aspect of safe roads and mobility on local levels should raise the general safety and quality level of the local road network for all users, especially for most vulnerable road users, through planning, designing, construction and exploitation of the local road network.

##### 4.2.1. Planning the Use of the Local Areas for Safe Mobility of All Road Users, Especially the Most Vulnerable Road Users

Planning the usage of local areas for the safe mobility of all road users, especially the most vulnerable road users, is realized through urban plans of local communities, which are the basis of local plans of transport, which has an outcome-safe mobility for all participants in local traffic.

The local community was originally competent to adopt the spatial plan of the local community, the master plan of the city, detailed urban plans of certain urban town settlements, urban projects for specific parts of urban units, location studies and other spatial planning acts of the local community, which should coordinate usage of the local area for purposes of the safe mobility of all road users, especially the most vulnerable.

##### 4.2.2. Pedestrian Zone

The pedestrian zone is the area of the local community special purpose for the exclusive mobility of pedestrians. In this zone, focusing on pedestrian safety can be compromised only in periods where mobility of certain vehicles is allowed, which should be limited to the mobility speed of pedestrians.

##### 4.2.3. Slow Traffic Zones

Zone of slow traffic is a local community space for special purposes in certain time intervals, with increased participation of vulnerable road users (zone of objects with

occasional mass gatherings: cultural, sports, shopping and other objects). In this zone the vehicle speed should be limited to the speed of mobility of pedestrians, and the fastest speed up to 10 km/h.

#### 4.2.4. Zone "30"

Zone "30" is part of a settlement that allows a better coexistence between cars, two-wheelers and pedestrians. In zone "30" the space to move the car in favor of bicycle and pedestrian paths should be reduced. This will create a space that will be used for social purposes.

In the zone "30", speed of vehicles is limited up to 30 km/h and as such must be marked with proper traffic signs.

#### 4.2.5. Locating Schools and School Zones

Locating schools is achieved through urban plans of local communities, which have basis in local plans of transport, which should set out the requirements to ensure the safety of children on their way to and from school and school

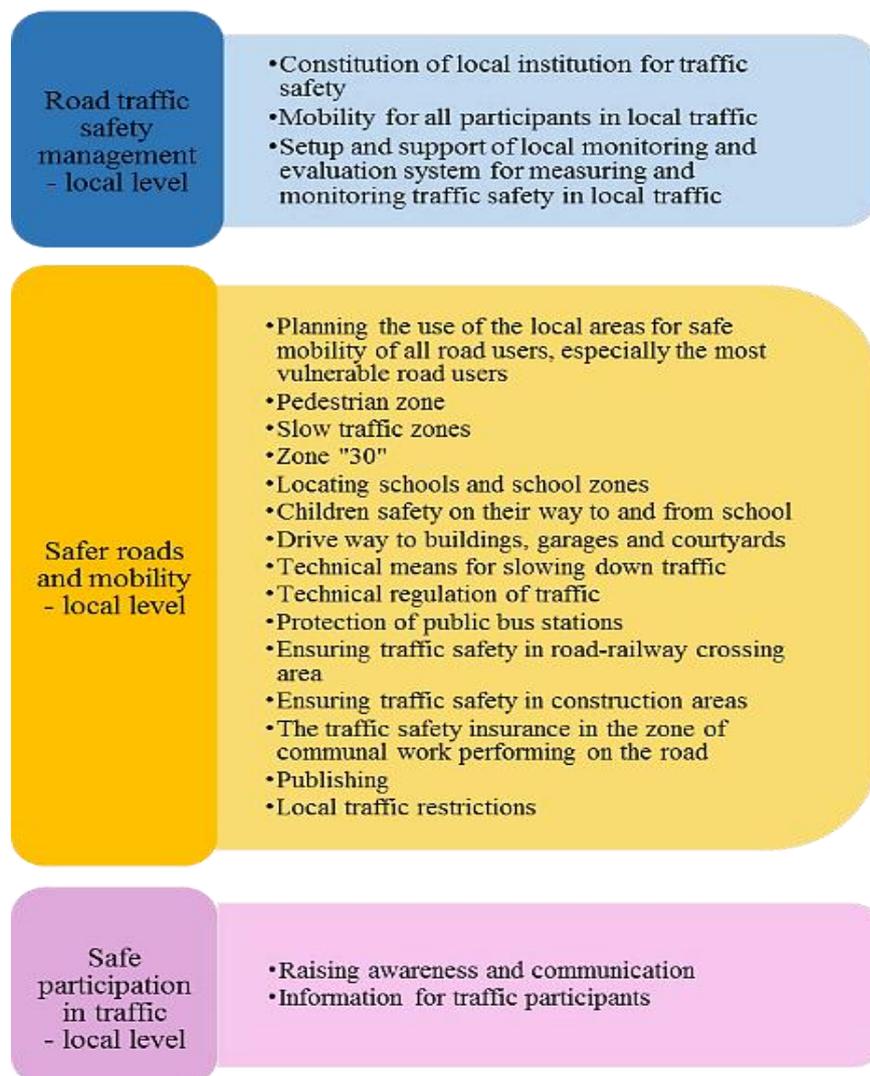
environment.

School zone is a part of the road or street, that is close to the school and as such is marked by appropriate traffic signs. Vehicle speed in the school zone in the settlements area should be limited to 30 km/h, and the speed outside settlements area should be limited up to 50 km/h, during the time of school work. In the school areas, special technical means should be applied for protecting the safety of children (funding, equipment, devices and tags that are used to provide safe participation of children in traffic).

#### 4.2.6. Children Safety on Their Way to and From School

Safety of children on their way to and from school must be at least addressed to the local traffic safety management persons, school management and parents.

Collective transport of children should be organized, if the recommendations on the safety of children on their way to and from school cannot ensure the safety of children.



**Figure 2.** Focus areas and measures to improve traffic safety at the local level

#### 4.2.7. Drive Way to Buildings, Garages and Courtyards

Vehicular entrance to buildings, courtyards or garages should be marked by traffic signs, denoting no stopping and parking on the roadway or sidewalk is allowed, and the possibility of vehicles entering and exiting is forbidden.

#### 4.2.8. Technical Means for Slowing down Traffic

With technical means for slowing down traffic, traffic participants' vehicle mobility speed is physically limited, or they are further warned that the speed at which they move is not safe. Physical barriers for traffic slowing are placed on local roads in settlements areas and streets in the school areas, kindergartens and other facilities in addition to which, for the safety of all road users, speed is additionally limited in the urban settlements area. Technical traffic slowing means are physical barriers, vibration and rustling tape and they should be marked with traffic signs.

#### 4.2.9. Technical Regulation of Traffic

Technical regulation of traffic is determined by the regime of traffic and in particular: traffic direction, speed control depending on the density of traffic flow, speed limit depending on the condition of the motorway and weather conditions, the determination of one-way roads and streets, the determination of roads and streets in prohibiting traffic or mobility of certain types of vehicles, speed limit for all or certain categories of vehicles, determination of space for parking and stopping of vehicles, routing and rerouting of traffic participants, safe and effective regulation of traffic at intersections, determining the location of bus stops.

#### 4.2.10. Protection of Public Bus Stations

At public bus stations the protection of passengers should be ensured while waiting the arrival of public transport vehicles and when entering and leaving the public transportation vehicles, equipping bus stations and marking with appropriate tags.

#### 4.2.11. Ensuring Traffic Safety in Road-Railway Crossing Area

The zone of traveling transition, observed as a road that vehicle must cross when it meets at a distance of its stop time to the place of safety stopping in front of limit stripe profile, need to be ensured with the devices for closing road traffic (bumpers or semi barriers) or devices for giving light and sound signs, to ensure sufficient transparency and adequate equipment, such as the traffic signs and signal insignia. The permanent traffic road signs should be completed by setting signals that give occasional signal signs, such as the road light signal – twinkle and acoustic (sound) signal.

#### 4.2.12. Ensuring Traffic Safety in Construction Areas

The zone of building site need to be provided by fence and optionally by marquee, because of pedestrians and vehicles

protection.

#### 4.2.13. The Traffic Safety Insurance in the Zone of Communal Work Performing on the Road

The local communal service that performs communal work on the road needs to ensure the place of the communal work by performing suitable ramparts and marking it with suitable signalization.

#### 4.2.14. Publishing

The recommendations for the advertising, the content of advertising, the content of the illuminating adverts, the location of places for adverts, the dimensions of the billboards and advertising monitoring need to insure that advertising don't have negative influence on the safety participant in the traffic.

#### 4.2.15. Local Traffic Restrictions

The local limits in the traffic are related on the speed limit, the limit in purpose of the traffic tape, the prohibition of standing and parking, parking with payment and etc.

### 4.3. Safe Participation in Traffic - Local Level

The development of local programs is aimed at improving the behavior of local traffic participants, especially vulnerable road users. It is about raising public awareness of the importance of safe conduct in traffic and the use of protective devices (belts, helmets, child seats), and reducing the number of those who drive under the influence of alcohol, excessive speed and other risky behavior in traffic.

#### 4.3.1. Raising Awareness and Communication

To raise public awareness about the importance of safe conduct in traffic and the use of protective devices (belts, helmets, child seats), and reducing the number of those who drive under the influence of alcohol, excessive speed and other risky behavior in traffic, local campaigns should be conducted, which should involve local public figures. In particular, campaigns aimed at promoting safety for vulnerable road users should be implemented.

#### 4.3.2. Information for Traffic Participants

Information for road users about local conditions and limitations, special rules relating to the use of bicycles (bike visibility at night, marking of bikes), special rules relating to the use of motorized two-wheeled vehicles (mopeds and motorcycles), special rules relating to specific categories of public transportation and public transportation vehicles and marking of buses and school buses, visibility at pedestrian crossings, information that aim to facilitate the mobility of persons with reduced mobility and the elderly, information relating to the maintenance of pedestrian sidewalks during winter season and other.

### 5. Discussion

The analysis of the general statistics about the road traffic deaths in Montenegro [21] (Figure 3) in the time interval 2000-2015 identifies two periods: 2000 to 2007 period represents the trend of deterioration in road safety and 2008-2015 represents the trend of improving road safety. Changes in the number of people killed or seriously injured are best described by quadratic curves (coefficient of determination is 0.52 for people killed and 0.63 for seriously injured - Figure 3). The turning point in the status of road safety is related to the adoption and implementation of national strategies on road safety: Transport Development Strategy [22] Strategy of the Development and Maintenance of State Roads [23] and the Strategy of Road Transport Safety Improvement 2010-2019 [24], which defines areas of action and measures to be taken to raise the level of road safety.

The analysis of road traffic accidents deaths in Montenegro at the level of local communities in the period 2013-2016 (Figure 4) determined that the public risk in road traffic varies dramatically, reaching the record rates in small municipalities, which declines over time: 262.5 in Kolasin Municipality and 193.2 in the Municipality of Savnik in 2013; 92.4 in the Municipality of Pluzine in 2014; then in 2015, 84.1 in the Zabljak Municipality; and finally in 2016, 39.4 in the municipality of Andrijevica. Examining the correlation between risk in local communities with the development level, which indicates the ratio visible in Figure 4, a weak indirect correlation was found, due to the low participation of death occurring on local roads and streets of the settlement in the total number of deaths – from 65 killed in 2016, 47 are killed on state roads, and 18 on municipal roads and streets in 21 municipalities in Montenegro (Figure 5).

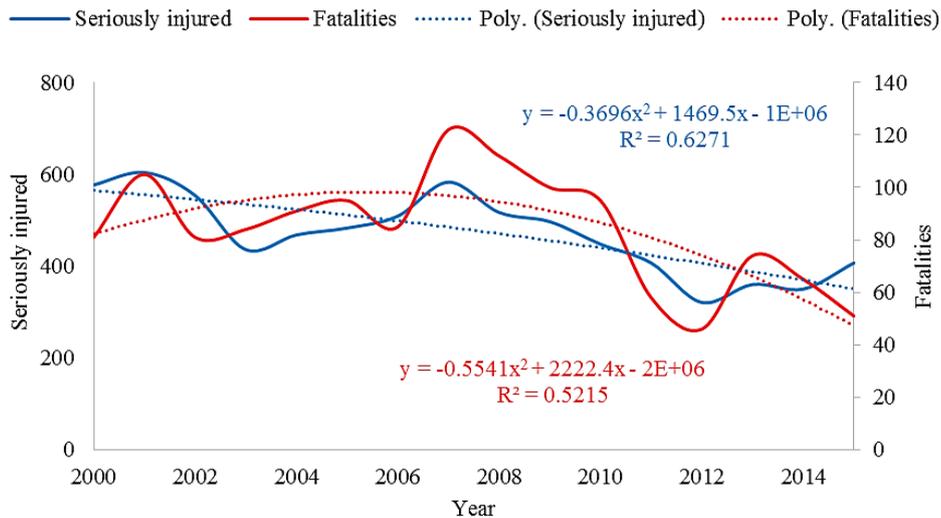


Figure 3. Killed and seriously injured in road traffic in Montenegro, 2000-2015

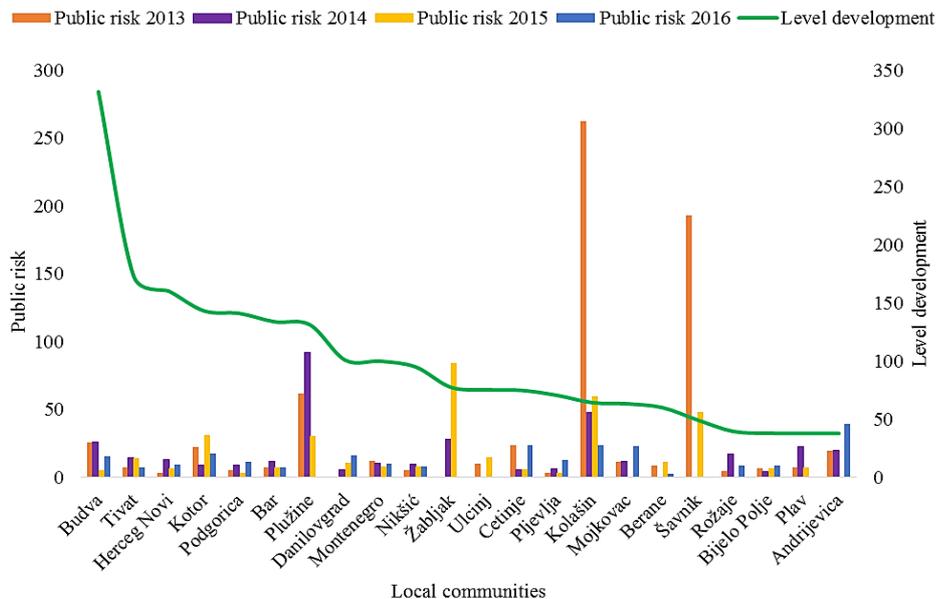


Figure 4. Public risk in local communities in Montenegro, 2013-2016

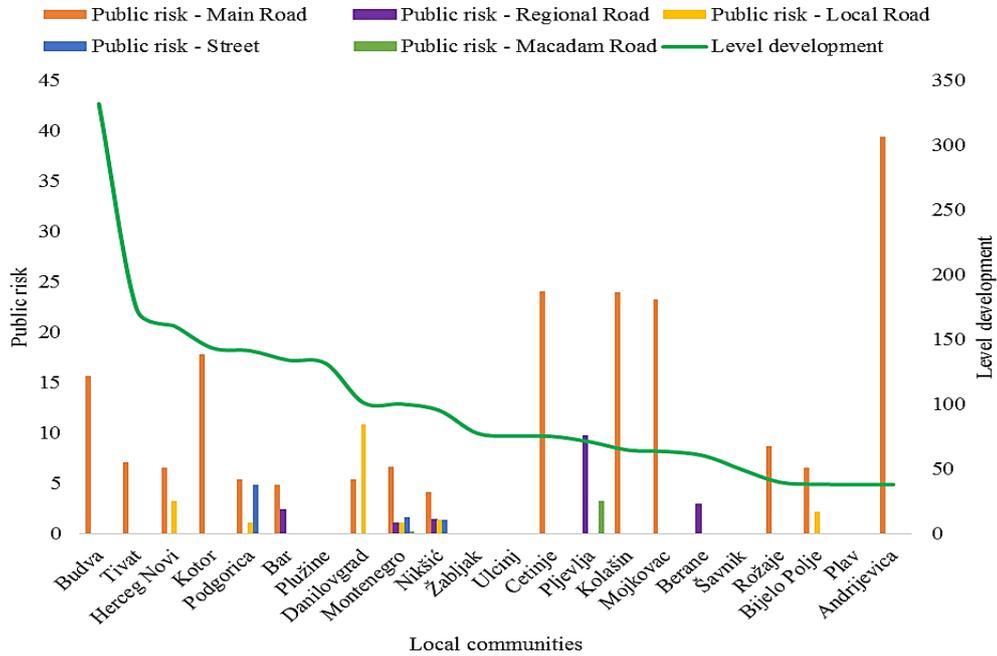


Figure 5. Public risk in relation to the road category in Montenegro, 2016

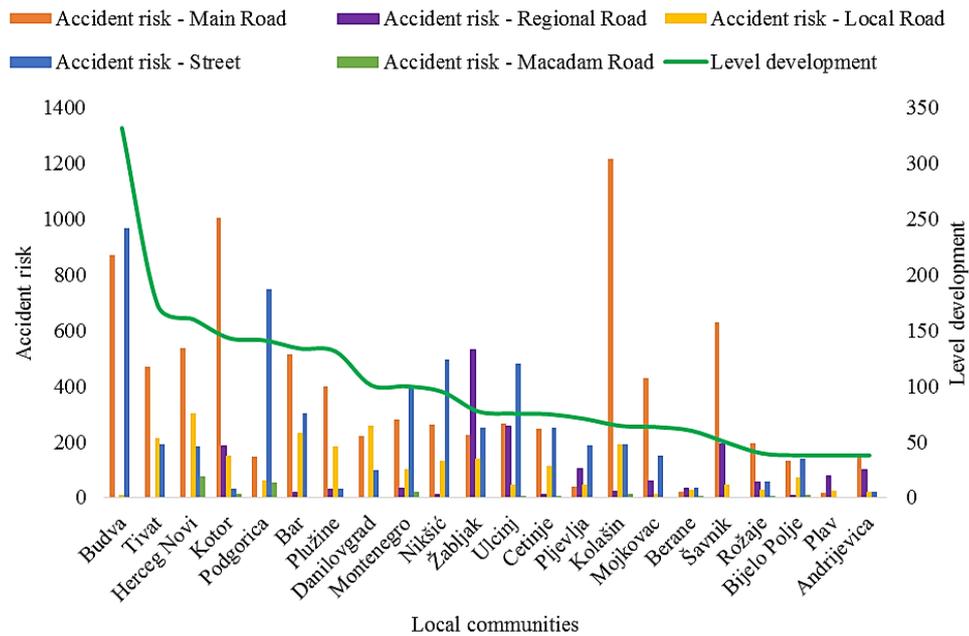


Figure 6. Accident risk in relation to the road category in Montenegro, 2016

Such a distribution of the number of killed in connection to the road category is related to the low speed vehicles on municipal roads and streets of settlements. Since the limit for testing connectivity status of traffic safety in the local community with the level of development of that community is a small sample of the number of killed, testing was performed on an expanded sample of the total number of traffic accidents (Figure 6).

Correlation and regression analysis showed significant direct correlation between the number of traffic accidents in settlements with the level of development of the local community (correlation coefficient 0.67; significance of the

correlation coefficient 0.0006; the coefficient of determination 0.45; Figure 7).

Linking the total number of traffic accidents on the streets in the local community with the level of development of the local community has a special significance, because Montenegro is a developing country, with record rates of GDP growth in Europe, which is why the development of some local communities is very intensive and as such generates traffic safety deterioration, which should be stopped by prompt measures and should realize a turning point in improving traffic safety in settlements that are intensively developing.

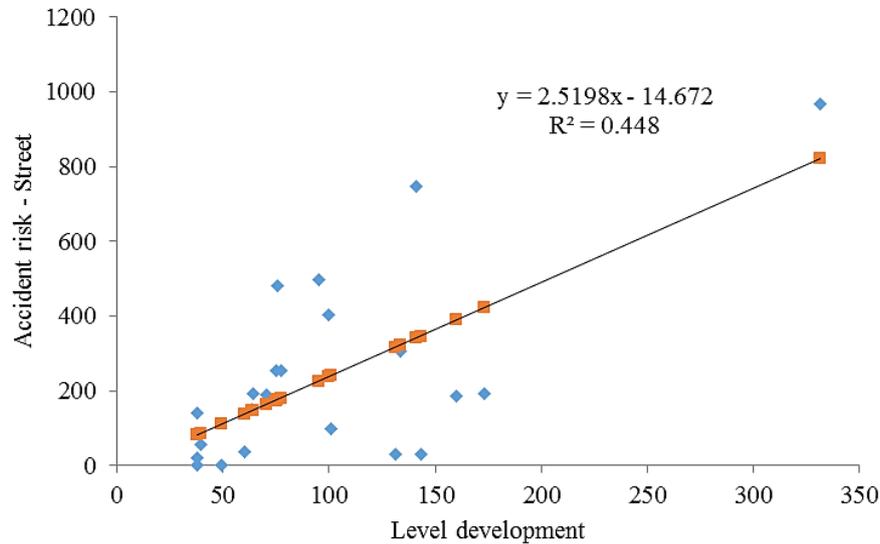


Figure 7. Regression between accident risk and level of development of local communities

## 6. Conclusions

Road traffic safety system management, in addition to national, must take place at the local level.

National objectives of traffic safety management, through vertical coordination, are proceeded to the local level, and achieved by lowering to the level of the project and the local horizontal coordination of project activities.

In this context, local traffic safety goals should be focused on areas where the effect of local intervention improves traffic safety.

The paper has developed the concept of traffic safety management process at the local level, encouraged by the Global Plan of the UN Decade of Action for Road Safety 2011-2020, which is modeled by conversion "National Pillars Activities" in "Local Focus Areas and Measures" and based on the analysis of general statistics on traffic accidents and in-depth analysis of traffic accidents with killed and seriously injured persons.

Focus areas and measures, where the effects of local interventions improves traffic safety, are identified in three of the five pillars of the Global Plan: management of road traffic safety, safer roads and routes and safer road users. Twenty measures were selected in them, whose implementation would obtain the greatest possible impact in adapting local road traffic safety system to road users, which is a precondition for improving traffic safety in the local community.

Traffic safety management at the local level should be functionally oriented towards encouraging multi-sectoral partnerships in developing and implementing local plans of road traffic safety and setting local objectives, on the basis of which would be determined adequate interventions and monitoring their implementation and effectiveness.

Safer roads and mobility on local levels should raise the general level of safety and quality of the local road network for all users, especially most vulnerable road users through

planning, designing, construction and operation of the local road network.

The aim of the paper is to encourage the action towards planning, organizing and controlling activities as well as the use of available resources for realization of the set objectives in the field of road traffic safety at the local level; and it is focused on practical improvement of traffic safety in local communities of Montenegro. In this context, a significant direct correlation between the number of traffic accidents on the streets of the settlement with the level of development of the local community, determined by this research, is of special importance for Montenegro, due to the dynamic development, which generates traffic safety deterioration in settlements that are intensively developing, which should be stopped by prompt measures and realize a turning point in improving traffic safety.

Special emphasis in improving traffic safety in the local community should be given in the field of development of local programs to improve the behavior of the broadest set of road users, especially vulnerable road users, which primarily involve the raising of public awareness of the importance of safe behavior in traffic, use of protective equipment and reducing the number of participants with risk behavior in traffic.

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