



Road Safety Training through a Master Course in Belarus

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Abstract

Road safety is a multidisciplinary and multivariate scientific field, where every proposed action and measure should be developed and supported through strategies in the areas of engineering, enforcement, education and emergency medical services, taking into consideration social and economic aspects as well. However tools do not create the road safety future, trained professionals do. A robust educational curriculum is the only mean to communicate the necessary insights and knowledge within the constantly evolving environment of road safety. The objective of this paper is the comprehensive proposal for the development and testing, in Belarus, of a Masters Course in road safety according to the Bologna process requirements. In the framework of this proposal, the requirements set, the masters' curricula modules as well as the relevant expected learning outcomes are described.

Keywords: *Road Safety, Masters' Curricula Modules, Learning Outcome, Belarus, Be-Safe*

Περίληψη

Η οδική ασφάλεια είναι ένα σύνθετο, διεπιστημονικό πεδίο, στο οποίο κάθε προτεινόμενη δράση θα πρέπει να αναπτύσσεται και να υποστηρίζεται στο πλαίσιο στρατηγικών τεχνικών μέτρων, επιτήρησης, εκπαίδευσης και περίθαλψης έκτακτης ανάγκης, λαμβάνοντας υπόψη κοινωνικούς και οικονομικούς παράγοντες. Ωστόσο, το μέλλον της οδικής ασφάλειας εξαρτάται περισσότερο από την εκπαίδευση των επαγγελματιών παρά από την ύπαρξη εργαλείων. Ένα ισχυρό πρόγραμμα σπουδών είναι το μόνο μέσο για τη μετάδοση της απαραίτητης γνώσης στο συνεχώς μεταβαλλόμενο περιβάλλον της οδικής ασφάλειας. Στόχος αυτής της εργασίας είναι η ολοκληρωμένη πρόταση για την ανάπτυξη και δοκιμή, στη Λευκορωσία, ενός προγράμματος μεταπτυχιακών σπουδών στην οδική ασφάλεια, σύμφωνα με τις απαιτήσεις της Συνθήκης της Μπολόνια. Στην εργασία περιγράφονται οι απαιτήσεις, οι ενότητες του μεταπτυχιακού προγράμματος σπουδών, καθώς και τα αναμενόμενα σχετικά μαθησιακά αποτελέσματα.

Λέξεις κλειδιά: *Οδική Ασφάλεια, Ενότητες Μεταπτυχιακού Προγράμματος Σπουδών, Μαθησιακά Αποτελέσματα, Λευκορωσία, Be-Safe*



1. Introduction

Worldwide, road safety remains a issue of general concern with major societal and economic impacts. In many countries road accidents have become one of the major causes of death and road safety is regarded as an issue of public health. Although the number of deaths and seriously injured people worldwide is decreasing, the improvement rate is subject to the effectiveness of the measures applied.

In current road safety practice, a number of reference documents, such as the AASHTO Highway Safety Manual (2010), the Austroads Guide to Road Safety (2009a, 2009b), and the PIARC Road Safety Manual (2014) are being released aiming to provide sound road safety decisions and concurrently warrant the optimal use of the limited funds available.

Since road safety is a multidisciplinary and multivariate scientific field, every proposed action and measure should be developed and supported through strategies in the areas of engineering, enforcement, education and emergency medical services taking into consideration social and economic aspects as well. However, the implementation of certain countermeasures does not give any real benefit in terms of crash reduction if the proposed action is not based on thorough road safety engineering experience and practice (Cafiso et al., 2011; Montella, 2007; Montella and Mauriello, 2012; Montella et al., 2013). Tools do not create the road safety future; trained professionals do (Hauer, 2012).

In terms of training professionals, a robust educational curriculum is the key factor to communicate the necessary insights and knowledge within the constantly evolving environment of road safety. An example of such an initiative is the "Belarusian Road Safety Network" project (Be-Safe) of the Tempus Programme of the European Commission.

The Be-Safe project is a joint effort between three EU universities ("Sapienza" University of Rome, Loughborough University and National Technical University of Athens) and four Belarusian Universities (Belarusian National Technical University, Brest State Technical University, Belarusian State University of Transport and Belarusian State University of Economics).

The key objective of the Be-Safe project is to develop and test in Belarus two Masters' Curricula in road safety according to the Bologna process standards; one for the Technical Universities and one for the Economics University. The objective of this paper is the presentation of the procedure followed on this purpose, including setting objectives and requirements, developing the masters' curricula and identifying the expected learning outcomes.

2. Road safety situation in Belarus

A road safety performance comparison between Belarus and EU States, based on basic road fatality figures, revealed that during the period 2000-2010, although road fatalities in Belarus decreased about 25%, the overall road safety performance was reported rather weak compared to the majority of EU States (-43%). In the period from 2011 to 2013, Belarus achieved a noticeable decrease by another 25% reduction in road fatalities, a performance figuring among the best in EU (Figure 1) (Be-Safe, 2015).

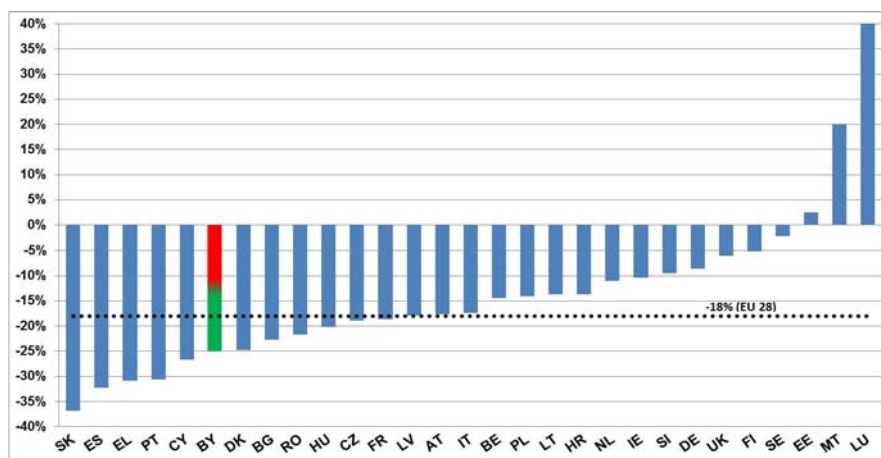


Figure 1: *Percentage change in road fatalities between 2010-2013*

The comparison of road fatalities per million of inhabitants in EU States and Belarus in 2010 and 2013 respectively is presented in Figure 2.

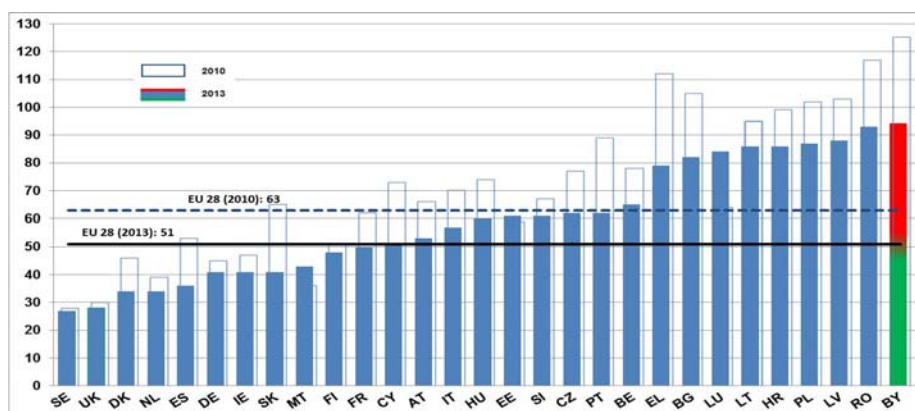


Figure 2: *Road fatalities per million of inhabitants in EU and Belarus, in 2010 and 2013*

Regarding Belarus, it can be seen that despite the significant reduction in the number of road fatalities per million of inhabitants, the country performed worse than all EU States both in 2010 and in 2013.



The comparison between the overall road fatalities figures in 2001 - 2013, showed that the relevant reduction trend in Belarus (44%) is lacking behind EU's average figure (53%).

Road safety is considered a key issue in Belarus. In 2006, the Council of Ministers of the Republic of Belarus approved the Concept of Road Safety in the Republic of Belarus aiming at reducing road accident fatalities by 25% in 2015 compared to 2005 figures. However, according to Local Academics, this effort is hindered by certain barriers such as:

- Road safety is not managed on an evidence base and there seems to be insufficient funding for related research.
- No funding is available for the implementation of the Plan on the Concept of road safety.
- There is not a clear administration in charge of road safety. The Belarusian Police is partially involved, since the responsibility is dispersed amongst a number of ministries and agencies.

It is obvious that current road safety performance in Belarus is improving rather slowly and requires further effort from all road safety authorities and other stakeholders. Moreover, the notable road safety improvement during the second decade of 2000 should be further organized and monitored.

3. Identification of user needs and requirements

During the first steps of the Be-Safe project, an analysis carried out in cooperation with Belarusian Universities and stakeholders highlighted the need to strengthen the role of research and start managing road safety policy on an evidence-base in Belarus.

Aiming to deliver an efficient and comprehensive Master's curricula, certain issues were thoroughly examined at the project's opening stage. At the outset, there was a necessity to review and analyse the most relevant and recent experiences and tools in the field of road safety; available at international level. However, the most important aspect was to clearly understand local conditions and needs in terms of both research and teaching at the field of road safety. The relevant analysis highlighted several important findings which are briefly stated below.

A curricula review was carried out intending to stress the type of available post-graduate courses related to road safety at international level by Universities and other training and educational centres. The goal was to understand whether these courses meet the Belarusian demands for road safety professionals both in public and private sectors. The review specifically focused on:

- Identifying course objectives and intended users
- Identifying the main course contents, learning objectives and competencies
- Identifying duration and effort required [in term of ECTS (2009) credits]



The international review of road safety courses revealed a total of 3 Masters of Science in road safety and several road safety post-graduate (non-degree) courses. Both Masters' contents and road safety post-graduate course contents vary a lot according to the targeted users. Some international courses/masters are designed for low and medium income countries. These countries are experiencing a rapid motorization and the number of road fatalities is growing. Therefore, strong emphasis should be given to capacities such as the ability to make a Road Safety Plan and to support the development of programmes in the area of education, enforcement and engineering. A similar scenario is replicated in Belarus, and therefore, a thorough review of the contents and the learning objectives of these courses was performed before developing the Belarusian road safety Master curricula.

Furthermore, the requirements of the Bologna process were considered in the development of the Masters programmes in Belarus to ensure transparency and recognition of the individual courses. It was decided that the new Masters programme will be set-up accordingly, as a 1 year - 60 European Credit Transfer System (ECTS) credit taught Masters with transparent quality assured content that will allow the course to be recognised within the Lisbon Convention and on par with the European Area of Higher Education (EAHE).

The Masters will incorporate the following five elements which represent the minimum requirement for consideration when developing a Masters' programme and this should ensure a programme that is then comparable to other higher education institutions in Europe:

- **Level:** The Masters programme will provide a holistic course combining the required skill set through individual modules.
- **Workload:** The workload comprises taught lectures, self-study, coursework and a short dissertation thesis. Credits will be assigned to individual modules assessed by the achievement of the learning outcomes through examinations, coursework and the dissertation.
- **Quality:** Quality will be considered in three stages namely the internal assessment of students academic achievement, fit for purpose of the Master programme against set criteria to review the course content, academic rigor and institutional support and ranking of the establishment (university, school or department) at national or international level.
- **Profile:** The profile of the Masters will describe in detail general and specific descriptions of purpose, content and student development to map the qualification to future work or study requirements
- **Learning outcomes:** The Masters programme will have clearly stated learning outcomes to identify what the student is expected to know understand and demonstrate after completion of the course.

In order to understand local background conditions, taking into consideration the current administrative and academic structure of local Universities, a User Needs Analysis (UNA) was carried out by delivering a questionnaire to the local academics where the following objectives were addressed:

- thorough understanding of the background conditions in terms of current Masters availability and students' earlier preparation



- thorough understanding of the local situation in terms of contents and equipment currently available for the Masters
- thorough understanding of the local needs in terms of Masters' contents on road safety
- thorough understanding of the local needs in terms of new equipment to be provided for the Masters'
- skills needed to be provided in the Masters' Curricula in order to improve the employment opportunities of Masters' graduates.

The local University educational system revealed an adequate level of designing, managing and analysing road safety. Figures regarding foreign students show that the Belarusian University educational system attracts students from the former Soviet Union Republics as well as China and Turkey. Moreover, local Technical Universities often support local administrations on road safety related projects and are also involved in projects in the former Soviet Union Republics.

Regarding road safety research activities in Belarus, there seems to be a problem of isolation from the international research world. This isolation is due to: insufficient funding, linguistic problems and inadequate international relationships. This isolation leads to a necessity of updating contents and methods of courses for students, followed by a need to update research topics in the field of road safety. Another highlighted issue was the low level of technical equipment in the current laboratories.

Moreover, the requirements of the Directive 2008/96/EC concerning the establishment and implementation of certain procedures for the management of road infrastructure safety such as Road Safety Impact Assessment (RSIA), Road Safety Audits (RSA), Management of Road Network Safety (RNS) and road safety inspections (RSI) were taken into consideration. These procedures constitute essential tools for evaluating certain criteria at the initial planning phase, detecting road safety issues, hierarchizing the potential technical-socio-economic impacts, analysing scenarios, proposing interventions and finally controlling their implementation and effectiveness. Therefore, it was very important to include those procedures in the Masters curricula. In addition, different needs for a road safety expert with an Economics background compared to one with a Technical background were identified. For this reason, the Economics University Master curriculum should focus mostly on RSIA and RNS while the Master curriculum for Technical Universities should focus on all the four tools defined in the Directive 2008/96/EC.

4. Master programme

As stated, road safety experts with an Economics background compared to those with a Technical background were found to have different needs. Therefore, two master curricula were structured; one for Engineering Faculties and one for the Economics Faculty. The key components of the Masters for both the Technical and Economics Faculties are as follows:



- **State component** which includes modules common to all the Belarusian Masters belonging to a specific category and are approved by the Ministry of Education of the Republic of Belarus.
- **University component** where the theoretical background of the core competences on the road safety related topics, will be provided. This component has a total of 30 ECTS and 750 hours. Of these hours 50% are of lessons and 50% are of self-studying.
- **Research activities & small thesis** on a given topic defined by the academics. It includes the drafting of a small thesis. This component has a total of 12 ECTS and 300 hours. These hours will be mostly of self-studying with tutoring from local academics.
- **Practical activities** including on-site, laboratory and practical activities. Specifically, for each core competence excluding “Basic concepts of road safety”, 20 hours have been allocated as practical activities for a total of 100 hours and 4 ECTS. Of these hours 50% are for practical activities with academics and 50% are self-studying.

4.1 Master Programme for Technical Universities

The Master for the Technical Universities, need to focus on specific aspects related to engineering and management aspects. In particular, the objective of this Master is to create road safety professionals able to:

- define Road Safety management processes
- deal with collection, aggregation and analysis of traffic accident data
- thoroughly analyze accidents and select the most effective countermeasures
- perform the basic aspects of road safety audits and inspections, and concurrently evolve their experience and expertise on a continual basis relying on the provided theoretical background
- plan road safety strategies for the short, medium and long term

The Masters Curriculum for technical universities will, thus, deal with topics such as road safety management, analysis of road safety data (crash data, safety performance indicators, exposure data, background data), selection of countermeasures (e.g. for infrastructure, vehicles, education and enforcement, etc.), definition of plans, etc.

The main ambition of this Master is to license road safety professionals able to work as:

- Experts for Public Administrations, mainly focusing on designing road safety strategies, designing road safety action plans, including selection of road safety interventions and road safety management
- Experts for transport companies, mainly dealing with internal road safety management, in-depth analysis, road safety audits and inspections
- Consultants, able to provide high level independent expertise to Administrations and Companies on road safety issues related with technical aspects
- Researchers

Table 1 shows the Master’s components followed by the ECTS’, divided in State and University components, Research Activities and Practical Activities respectively. Each core competency included in the so-called “University component” of the curriculum, represents a module of the course.

Table 1: Master’s components for Technical Universities.

Curriculum components	Hours	ECTS
<i>State component</i>	350	14
<i>University component</i>	750	30
T1 Basic concepts of road safety	125	5
T2 Road Safety Management	100	4
T3 Collection and Analysis of crash data	100	4
T4 Contributing crash factors, countermeasure selection and evaluation	125	5
T5 Road safety policies and plans	150	6
T6 Road Infrastructure Safety Management	150	6
T7 <i>Research activities & small thesis</i>	300	12
T8 <i>Practical activities</i>	100	4
Total	1500	60

A selection of the expected learning outcomes (NCHRP, 2006), derived from for each module is briefly outlined below.

Basic concepts of road safety

- Describe highway safety as a complex, interdisciplinary, multimodal discipline devoted to the avoidance and/or mitigation of fatalities, injuries, and crashes.
- Understand, value, and utilize science-based highway safety research and its application as fundamental to achieving further improvements in highway safety.
- Describe the classification of highway crash and injury severity factors and their relationship to the crash event (i.e., pre-crash, crash, and post-crash) by using models such as the Haddon Matrix, Swiss cheese model, safe system approach.
- Explain the “Four E’s” of traffic safety: engineering, education, enforcement and emergency medical services.
- Describe the demographic trends underlying the need for comprehensive and integrated highway safety management (e.g. economical, social, cultural, technological, age, gender).
- Understand the historical figures, benchmarks, and decisions underlying highway safety.
- Being able to explain the difference between random and systematic variation in the number of accidents.
- Being able to give a concise definition of the expected number of accidents.
- List the most important theoretical probability distributions that have been proposed for accidents (Poisson, Negative binomial, Poisson lognormal, etc) and explain how one can determine which of these best fits the distribution of accidents in a population.

Road safety management

- Identify the safety aspects of major transportation legislation.
- List and describe the goals of interest groups with a stake in safety-related policy, legislation, and investment decisions.
- Describe the institutional roles and responsibilities within which safety is managed (e.g., local, regional, state, and federal government, transportation modes and the private sector, NGO's).
- Explain the importance of establishing a mechanism for co-ordination and commitment to clearly defined responsibilities for road safety measures.
- Explain the role of a national forum for regular follow-up of road safety policy, involving an as broad spectrum of stakeholders as possible.
- Explain the role of quantified road safety targets as part of management system and describe a process for setting targets that have an optimal level of ambition.

Collection and analysis of crash data

- Understand the types of accident data and how it is collected and their strengths and weaknesses.
- Be able to interpret the information in accident databases in the correct context.
- Understand the role of quantitative and qualitative analysis of accident data and when they are appropriate to use.
- Design an appropriate research approach for a specific problem.
- Identify available data for use in road safety management.
- Select suitable data and analytical approaches for particular road safety problems.
- Understand how to initiate new data collection system to address road safety challenges.
- Critically evaluate the current local road safety problems.
- Formulate analytical solutions to current road safety problems.

Contributing crash factors, countermeasure selection and evaluation

- Identify current and potential highway safety problems using suitable scientific methods (e.g., those controlling for regression-to-the-mean).
- Identify the linkages among human factors and behavior, vehicle design, roadway design, the environment and their interactions with respect to identified crash problems.
- Identify effective countermeasures that address specific crash factors.
- Establish priorities for alternative interventions/countermeasures based upon their expected cost and effectiveness and select countermeasures to implement (e.g., utilizing current science-based research methods such as NCHRP Report 500 series and NHTSA/FHWA Highway Safety Guidelines).
- Evaluate the effectiveness of the implemented intervention/countermeasure using appropriate statistical techniques in safety management [e.g., use of Empirical Bayes (EB) and/or case-control designs].

Road safety policies and plans

- Evaluate the implementation of road safety measures based on in-depth understanding of road safety issues and utilizing evidence-based planning approach.
- Realize the importance of monitoring road safety interventions and utilize tools for road safety accountability.
- Evaluate the combined effects of several road safety measures through the implementation of pilot studies, cost benefit – cost effective analyses as well as post implementation monitoring.
- Utilize scientific management techniques in planning, implementing, and evaluating highway safety programs.
- Identify strategies to integrate and amplify safety in transportation planning processes.
- Set up intermediate quantitative targets.

Road infrastructure safety management

- Identify the safety impact in human capacity of certain infrastructure components and design elements.
- Get acquainted with the methodologies promoting road safety outlined in Directive 2008/96/EC in order to adapt their efficiency in local conditions.
- Perform basic aspects of Road Safety Auditing and Inspection on predefined checklist.
- Justify the implementation of a certain Network Safety Ranking methodology by evaluating different approaches.
- Suggest road element combinations to be evaluated not necessarily imposed from design guidelines.
- Define, evaluate and assess through cost-benefit analysis road safety issues that promote selection of proposed solution.

4.2 Master Programme for Economics University

The Masters for the Economics University should emphasize specific aspects related to macro and micro-economics as well as econometrics. In particular, the Masters aims in forming road safety professionals able to:

- define Road Safety policies
- utilize data collection processes and methodologies
- predict or assess the results (impacts) of these policies
- define strategies to improve the safety of (public and private) company workers

The Master Curriculum for the Economics University should, therefore, focus on topics such as prediction models, estimation of social costs of road accidents, assessment of impacts, company safety management, policies definition, etc.

The main goal of this Master is to authorize road safety professionals able to work as:

- Experts for Public Administrations, mainly focusing on definition of road safety policies and assessment (e.g. through econometrics models) of road safety interventions.

- Experts for Companies, mainly dealing with risk assessment of vehicle fleets and drivers (workers), mobility management, and specification of the minimum requirements for a Road Traffic Safety Management System (e.g. ISO 39001).
- Consultants, able to provide high level independent expertise to Administrations and Companies on road safety issues related to economic aspects.

Similar to the Technical Universities, Table 2 illustrates the Economics' University Master's modules followed by the ECTS separated once again in the State and University components, Research Activities and Practical Activities.

Table 2: Master's components for Economics University

Curriculum components		Hours	ECTS
<i>State component</i>		350	14
<i>University component</i>		750	30
E1	Basic concepts of road safety	125	5
E2	Road Safety Management	100	4
E3	Road safety policies and plans	150	6
E4	Econometric models for policy impacts evaluation and forecasting	125	5
E5	Economic evaluation and efficiency assessment tools	175	7
E6	Commuters and professional drivers road safety	75	3
E7	<i>Research activities & small thesis</i>	300	12
E8	<i>Practical activities</i>	100	4
Total		1500	60

Since modules E1, E2 and E3 of the Economics University are similar to the relevant modules of the Technical Universities, the following paragraphs describe in brief the expected learning outcomes for the remaining ones.

Econometric models for policy impacts evaluation and forecasting

- Perform road safety data collection, storage and processing
- Perform accident data analysis.
- Develop statistical models for time series analysis and prediction.
- Evaluate effectiveness of policies and programmes.

Economic evaluation and efficiency assessment tools

- Recognise and interpret the key factors that contribute to crashes (human, vehicle, road).
- Identify suitable countermeasures to reduce accidents using a combination approach incorporating engineering, enforcement and education.
- Evaluate proposed countermeasures and extrapolate the expected benefits of implementing a countermeasure versus not implementing it.
- Assess the effectiveness of countermeasures through using different Efficiency Assessment Tools and interpret the evaluations in the correct context; e.g. life saves.



- Apply Cost Benefit Analysis into Road Safety applications and measures, including key parameters selection such as discount rates, ROI, Pay Back period targets, etc.
- Apply Cost Effectiveness Analysis from the point of view of different stakeholders.
- Apply review multi-criteria analysis for the evaluation of Road Safety measures (a priori and a posteriori).
- Estimate economic impacts of specific measures (both primary and secondary).

Commuters and professional drivers' road safety

- Describe the size and nature of the problem.
- Identify the key concepts of ISO 39001 Road Traffic Safety (RTS) Management.
- Set, measure and monitor RTS performance.
- Review organizational RTS performances and determine the risks and opportunities.
- Set appropriate RTS objectives and targets to achieve.

5. Conclusions

A robust educational curriculum is essential to communicate to road safety professionals the necessary insights and knowledge gained within the constantly evolving environment of road safety. Based on this, the "Belarusian Road Safety Network" project (Be-Safe) of the Tempus Programme of the European Commission aims to develop and test in Belarus two 1st level University Masters (60 ECTS) according to the Bologna process standards, one for the Engineering Faculties and one the Economics Faculty.

Aiming to deliver an efficient and comprehensive Master's curricula on road safety, two preconditions are required. On one hand, there is a need to review and analyse the most relevant and recent experiences and tools in the field of road safety available at international level where on the other, there is a need to clearly understand local conditions and needs both in terms of research and teaching on road safety. Despite the analytical approach followed for the identification of the user needs and requirements within the Be-Safe project, further analysis - through a multi-criteria methodology could also be applied on that purpose.

The international review of road safety post-graduate courses as well as of the main general requirements that a road safety Master programme needs to fulfil, allowed setting-up the general structure of the relevant Masters in Belarus. Following, the exploration of the particular road safety as well as educational needs and characteristics of Belarus led to the identification of the appropriate particular elements of the Master programmes. In any case, the implementation of the developed Master programmes should be subject to further evaluation based on robust and specific relevant procedures in order to tackle any existing deficiencies.

The objectives of the Be-Safe project concern transferring to Belarus the most recent knowledge and good practices developed in the European Union in the field of road safety and local Universities are the key actors to start this process.



6. Acknowledgement

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