

## Development and Implementation of Master Programme in Smart Transport and Logistics for Cities

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### ABSTRACT

*The existing Master programs in Ukraine are based on separate branches of transport systems. The general approach used was to isolate and hence to study the single elements and to neglect the relationships between them within the whole analysis systems. Therefore, the developed educational modules, based on smart technology and environment (which exploit these neglected relationships) have not yet presented in the current curricula of Ukrainian Master programmes in transport systems. In this context, the paper presents the upgrading process of Master curriculum, designed and implemented in O.M. Beketov National University within the E+-KA2-CHBE Programme. In particular, how the local conditions and needs as well as the results of the international reviews on which the curricula were built are described. Finally, some indications for process transferability are provided.*

**Keywords:** *SmaLog, smart transport, smart logistics, curriculum development, internationalization.*

### INTRODUCTION

Europe needs more cohesive and inclusive societies which allow citizens to play an active role in democratic life. Education and youth work are key to promote common European values, foster social integration, enhance intercultural understanding and a sense of belonging to a community, and to prevent violent radicalisation. Therefore, the Programme Erasmus+ is an effective instrument to promote the inclusion of people with disadvantaged backgrounds, including newly arrived migrants (Erasmus+, 2016). In this context, some Ukrainian and Georgian universities worked together for developing an E+ proposal. The germinated proposal (Master in transport and logistics for cities – SmaLog) was positively evaluated by EU and was selected for funding within the

framework of the Erasmus+ Capacity Building in the Higher Education programme in 2017. The project started in October 2017 and will end in October 2020.

During the proposal stage, the joint analysis carried out in cooperation also with Ukrainian and Georgian stakeholders highlighted that there is a need to strengthen the role of research for improving educational programmes and to start managing transport and logistics exploiting the opportunities offered by telematics. For this reason, the SmaLog project aims at transferring to Ukraine and Georgia the most recent knowledge and good practices developed in the European Union in the field of smart transport and logistics for cities. Ukrainian and Georgian Universities are the key actors to start this process (Gruenwald et al., 2008 and 2010; Comi et al., 2018). The consortium is composed of four EU universities, four Ukraine and two Georgian universities, and one institute of advanced studies.

Starting from these concepts and knowledge developed by the European partners, the project aims to:

- develop and test in Ukraine and Georgia a 2-year University Master programme according to the Bologna process standards;
- “Train the Trainer” supporting Ukrainian and Georgian academics in defining and delivering the Masters;
- provide each Ukrainian and Georgian University with a laboratory dedicated to smart transport and logistics for cities;
- disseminate through newsletters, events, workshops and seminars the importance of research in the field of smart transport and logistics for cities;
- set up a national coordinated network of Universities, public bodies, private companies and NGOs on smart transport and logistics for cities involving Ukrainian and Georgian Universities in the wider European network of research centres.

With reference to the definition of effective and useful Master curricula on smart transport and logistics, two preconditions were identified as necessary for reaching the above aims: there is a need to clearly understand local conditions and needs both in terms of research and teaching on such a topic; on the other hand, the need to review and analyse the most relevant and recent experiences and tools in the field of smart transport and logistics for cities available at international level. This analysis, started at the beginning (from SmaLog proposal design), was deepened in the first months of project life and highlighted several important aspects.

Some gaps also emerged. For example, there is a problem of isolation from the international research world that leads:

- a need to update contents and methods of courses (and subsequent modules) for students;
- a need to update research topics in the field of smart transport and logistics for cities;
- a need to adequate technical equipment in the laboratories.

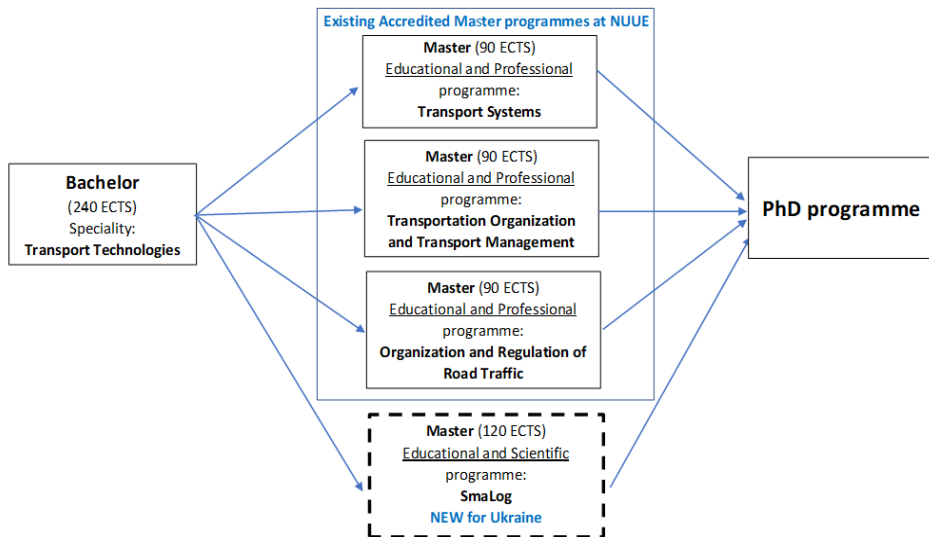
Finally, the preparatory analysis allowed user needs to be identified and to point out that, while Master on transport field are already available both in Ukraine and Georgia, there is not a specific Master that prepare technicians (or researchers) in exploiting the new opportunities offered by telematics. Besides, not almost all local partners are fully research experience in smart transport and logistics within cities.

Therefore, the main objective of paper germinates, i.e. to present the curriculum process development of Master in Smart Transport and Logistics for Cities in one of the partner institutions involved in SmaLog (O. M. Beketov National University of Urban Economy in Kharkiv – Ukraine) in order to point out how this experience can be useful for improving master curricula including more and updated challenges in other Ukrainian or Georgian universities.

The paper is structured as follows. Section 2 presents the structure of master programme, while Section 3 recalls the main opportunities offered to students. Finally, some conclusions and the road ahead are drawn in Section 4.

## MASTER PROGRAMME STRUCTURE

Existing curricula of Master Programmes are based on separate branches of transport systems in O. M. Beketov National University of Urban Economy in Kharkiv (NUUE). European educational and scientific programmes consider city transport on a systemic way, pointing out that city transport systems concern many different stakeholders, which takes into account while developing sustainable transport system (NUUE, 2019). In particular, the existing curricula in NUUE have not presented such approach yet. Educational modules, based on smart technology, which pays attention to environment, have not yet presented in the current curricula of master’s programmes. There is a shortage in the application of systematic modelling tools and decision making in transport systems that are widely used in EU and in the world. Simultaneously, the current curricula of master’s programmes in EU partner-universities include modules addressed to meet the requests of operators and users, with the aim to build competences for future city needs. They are more devoted to the management and control of the current transport services with telematics. EU partners, which have significant experience in this field, hence help to create the methodological support, strengthen the internationalization of HEIs and the capacity to be network effectively in research, scientific and technological innovation. Existing Master programmes at NUUE are shown on the Figure 1.



**Figure 1: Educational path at Department of Transport Systems and Logistics of NUUE.**

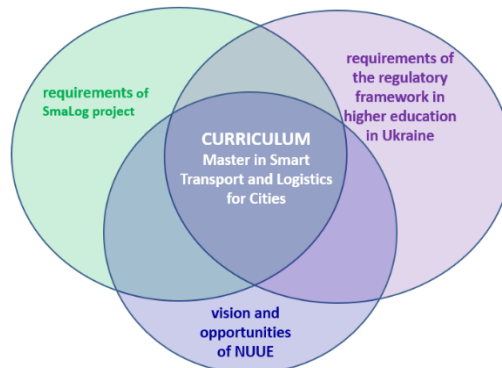
## Programme Overview and Objectives

SmaLog meets the Standard of Higher education in Ukraine refers to Specialty 275 Transport Technologies and corresponds to: the National Qualifications Framework – Level 8; the Framework for Qualifications for the European Higher Education Area FQ-EHEA – Second cycle; the European Qualifications Framework for lifelong learning in the EQF-LLL – Level 7. The approach of curriculum development, based on requirements of the regulatory framework in higher education in Ukraine and requirements of SmaLog project and vision and opportunities of NUUE, is plotted in Figure 2.

The Master programme will be defined as 2-year and 120 ECTS with transparent quality assured contents in accordance with the Bologna process that will allows the course/programme to be

recognised within the Lisbon Convention and on par with the European Area of Higher Education. The Master programme consists of:

- 10 ECTS for modules that characterize general competence;
- 48 ECTS for modules that characterize professional and practical training;
- 32 ECTS for elective professional modules (students' free choice);
- 6 ECTS for Specialized Pre-diploma Training;
- 24 ECTS for Master thesis.



**Figure 2: The approach of curriculum formation at O. M. Beketov National University of Urban Economy in Kharkiv (NUUE).**

SmaLog programme includes modules of professional and practical, social and humanitarian, fundamental, natural science and general economic training, which are of an integrative nature, the content orientation of special courses and subjects of free choice of students. Professional modules are organized in four main study areas of transport, Table 1:

- passenger transportation: methods and models for supporting the assessment and the implementation of new actions for the improvement of urban passenger transport;
- freight transportation: methods and models for supporting the assessment and the implementation of new actions for the improvement of urban freight transport;
- traffic: methods and models for simulating city traffic and related impacts;
- smart: how telematics can drive and support improving city sustainability and liveability.

**Table 1: Professional modules of Master programme SmaLog**

Module	Credits, ECTS
<b>1<sup>st</sup> and 2<sup>nd</sup> semesters, September 2018 – June 2019</b>	
MODULE 1. Smart Transport and Logistics for Cities	5
MODULE 2. Traffic Flows Simulating and Management	5
MODULE 3. Traffic Control	5
MODULE 4. City Passenger Transport	4
MODULE 5. Freight Transportation Simulation	6
MODULE 6. Smart Transport	5
MODULE 7. Integrated Transport Systems in City Logistics	5
MODULE 8. Smart Transport and Logistics for Cities Project	3
<b>3<sup>rd</sup> and 4<sup>th</sup> semesters, September 2019 – June 2020</b>	
MODULE 9. Human and Environmental Impacts, Safety and Sustainability	5
MODULE 10. Traffic Flows Management in the City Center	5
MODULE 11. Efficiency of Cities Transport Systems	5
MODULE 12. Master Thesis	24

The educational objectives provide to obtain theoretical knowledge, skills and competencies sufficient to develop new ideas, solve complex problems in the field of transport technologies, which study the laws that determine the conditions for the rational organization of transport services and transport processes and encompass problems of building and ensuring the effective operation of transport components, development of its material and technical base.

Learner must satisfy the programme requirements in the programme specification, which includes: theoretical classroom instruction on subjects (lectures, seminars and practical studies), consultations and student independent work, including fulfilment of a course project and paper on speciality; pre-diploma training and defence thesis. Credits are awarded based on student's successful passing of written/oral tests and exams in subjects, defence of a course project, and defence of a report on the training, defence of Master's thesis.

## Objectives

The aim of the educational program is to obtain competences sufficient to solve complex problems in the field of transport systems of urbanized territories based on best practices and technologies developed in European countries in the field of intelligent urban transport and logistics.

Based on results of the *user needs analysis* and on discussions with Ukrainian local experts and stakeholders a set of “core competencies” for technical SmaLog professionals has been identified. These competencies are intended to provide a broad framework for educating SmaLog professionals. They represent a fundamental set of knowledge, skills, and abilities needed to effectively function as a professional in smart transport and logistics for cities. Graduates will have the competencies:

- for increasing the efficiency of city logistics, traffic and passenger transportation within the city exploiting the opportunities of intelligent transport systems;
- for analysing city transport systems, in particular using smart transport systems and information communication technologies;
- for research, assessment and management of the operation of transport systems in the cities;
- for the management of freight, passenger transportation, traffic control within the city;
- for the implementation of Information Communication Technologies and Intelligent Transport Systems in urban contexts.

## Learning Outcomes

Learning outcomes of SmaLog are defined with the five Dublin descriptors.

1) Knowledge and understanding:

- modelling of transport processes and systems in the cities with particular attention to smart technologies;
- planning, organization, control of transport processes in the cities taking into account environmental impact and sustainability;
- the economic, environmental substantiation of decisions on the organization of transportation in the cities, namely city logistics measures;
- conditions of efficient integration of international transport systems in the cities including intelligence transportation system;
- design of warehousing by cargo delivery, system planning of logistics transport systems;
- organization of professional safety management.

2) Applying knowledge and understanding:

- to be able to formalize and determine the parameters of the transport processes and to form a strategy for transport processes management with particular attention to ITS;

- to be able to choose models, types and the number of vehicles for technical support of transport process, form of transportation routes, schedule vehicle movements at cargo transportation, to develop the technology of transporting in main communication, to choose the forms and methods of control over the implementation process due to achieving sustainable transportation system in the cities;
  - to be able to analyse the existing situation, to choose the strategic directions of the city passenger transport development based on transit-oriented methods and ICT;
  - to be able to implement modern approaches to traffic management, to assess the effectiveness of the implementation of measures of improving road safety in the cities.
  - to be able to justify and consult on the economic expediency of transport efficiency in the cities, city logistics applications;
  - to perform design of warehousing system, city logistics systems;
  - to assess, monitor and formulate a system of professional safety management.
- 3) Making judgments. Ability to perform scientific and research and design works dealing with the problems of traffic, passenger transportation and city logistics with particular attention to smart cities.
- 4) Communication skills. The ability to relate and work in groups, in a professional context both nationally and internationally, is taken into account throughout the course of study. Communication skills are first and foremost evaluated during the checks on both the final exam and the courses required by the curriculum. All the orientations promote activities such as curricular internships, internships and projects (including interdisciplinary) in companies of products and services, in which the student is placed in a position to measure himself with interlocutors at different levels of specialization and with different cultural backgrounds.
- 5) Learning skills. The structure of the teachings and of the other formative activities, foreseeing in most cases seminary components, of bibliographic research and planning, makes the master's degree able to: read, understand and use a scientific text (also not applicable to specific areas of mathematics, physics and industrial engineering) at university and post-university level; to use reference manuals for the practices in use in the different industrial realities concerning specific problems; autonomously to use manuals for the use of software of different types and applications; to proceed autonomously to professional and cultural updating; to undertake post-graduate studies. The learning ability of the graduating student is verified through the specific tests.

## Studying Process

In accordance with the Enrolment Conditions approved by Ministry of Education and Science of Ukraine (Entrance, 2019), to be admitted to a Master degree course, students must have at least a Bachelor degree. The procedure for admission to Master degree based on the students rating and examination. Rating includes average grade according to Bachelor diploma. Examination procedure includes two exams: professional entrance examination in a specialty and foreign language. The admission procedure is from July to August, each year. Department of Transport Systems and Logistics is owned Laboratory “Ergonomic and Transport Problems” and “Information Technologies”. Students can attend it during studying. The classes are also held in the laboratory of “Automated Control Systems on Transport” of NUUE.

The tutoring activity is one of the institutional tasks of professors and researchers, as an integral part of their teaching commitment aimed at guiding students' cultural education and studying support. The tutoring activities are scheduled by the Faculty at the beginning of each academic year. Each student has a tutor, who can be consulted for evaluations and general suggestions regarding the progress of the student's study activities. The achievement of the Master's degree involves defence of the thesis. Students begin to write thesis and defend in 4th semester. Master thesis includes 24 ECTS. Before starting to develop a thesis, student has to pass all modules of Master programme and Specialised Pre-diploma Training. For defence of the thesis student develops thesis on a topic

proposed by a professor of Transport Systems and Logistics Department. The Master's degree sessions are set by Head of Educational and Methodological Department within the time intervals set in the curriculum. Examination Commission for thesis defence consists of 5 representatives – at least one external expert from industry, others are professors of Department. Examination Commission process are public and open for all stakeholders.

There are two options to finance students studying: government payment (budgetary) and own student payment (contract). For budgetary payment Ministry of Education and Science of Ukraine offers different number of places each year. Number of contracts for students are limited by number of licences from Ministry of Education and Science of Ukraine.

A unique opportunity of the project is the additional mobility within the framework of the project both for students and teachers, i.e. Special Mobility Strand. Students can study for one full semester in the four involved programme country universities. Thus, they will get acquainted with the peculiarities of the educational process in EU universities, attend the class and pass the exams in accordance with the agreed learning agreements as currently occurs for EU students. This will significantly increase the level of training of students and the professional knowledge of teachers.

## EMPLOYMENT OPPORTUNITIES

Large cities of Ukraine are in the stage of rapid development of modern Intelligent Transportation Systems and their implementation, so the transport industry is in urgently need of qualified specialists. Working places for graduates could be universities or scientific organizations, scientific positions in communication, transportation, management, state institutions, private companies, consulting etc. Teachers' positions in the institutions of higher education could be a work opportunity, too. The detailed list of employment opportunities is presented in Table 2.

**Table 2: Employment opportunities**

<b>Indicator</b>	<b>Description</b>
Positions that can be held by a graduate	director of a transport company, head of the transport department, transportation manager, transport engineer, urban planning engineer, traffic service manager, inspector, design engineer, new equipment and technology introduction engineer other.
Possible place of work	public authority, department of infrastructure, transport enterprises, research and design institutes, etc.
Areas of activity	the implementation of organizational and management activities in the state transport administration, transport departments of local governments and in transport enterprises of various forms of ownership.
Tasks that can perform	city logistics measures of optimisation, road traffic measures of optimisation, passenger measures of optimisation, possession of the regulatory framework for the functioning of the transport management system, the economy and the principles of conducting commercial work in transport, organizing the interaction of different types of transport, the basics of foreign economic relations.

## CONCLUSIONS

The paper presented the developing process implemented at O.M Beketov National University of Urban Economy in Kharkiv. The implementation of SmaLog program will allow to update topics and methods of courses for students with the most recent international experiences; to update research topics in the field of smart transport and logistics for cities with the most recent international experiences; to involve teachers in the international research networks.

SmaLog curriculum will be based on Master program at Transport Systems and Logistics Department of O. M. Beketov National University of Urban Economy in Kharkiv, that will replace existing Master programme in Transport Systems.

Using the acquired knowledge, European and world experience in urban transport functioning, graduates of the programme can be employed for key places in transport for developing of sustainable transport system in Ukrainian cities.

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## REFERENCES

Comi, A., Buttarazzi, B. & Schiraldi, M. (2018). Smart urban freight transport: tools for planning and optimising delivery operations. *Simulation Modelling Practice and Theory* 88. Elsevier Ltd, pp. 48-61.

Comi, A., Zhuk, M., Kovalyshyn, V. and Hilevych, V. (2018). Master Program SmaLog: An Integrated Vision for Improving Transport in Cities, *11th ICEBE & 7th ICIE & PEESA III*. pp. 35–40. Wismar: Robert-Schmidt-Institut.

Entrance (2019). The Enrolment Conditions (2019). *Ministry of Education and Science of Ukraine*. Retrieved July 5, 2019, from <https://mon.gov.ua/ua/news/vstup-2019-zatverdzheno-umovi-prijomudo-vishiv-na-vstupnikiv-chekeyut-zmini-u-tvorchih-konkursah-prohidnih-balah-ta-pilgah>

Erasmus (2016). *Erasmus+ - Programme Guide*. European Commission, Brussels.

Gruenwald, N., Klymchuk, S., Zverkova, T. and Sauerbier, G. (2010). University students' difficulties in solving application problems in calculus: Student perspectives. *Mathematics Education Research Journal* 22(2), pp. 81-91.

Gruenwald, N., Klymchuk, S., Zverkova, T., and Sauerbier, G. (2008). Increasing engineering students' awareness to environment through innovative teaching of mathematical modelling. *Teaching Mathematics and its Applications* 27(3), pp. 123-130.

NUUE (2019). *Master Curricula development and implementation at O. M. Beketov National University of Urban Economy in Kharkiv – NUUE*. [www.smalog.uniroma2.it](http://www.smalog.uniroma2.it).

Russo, F. & Comi, A. (2018). From city logistics theories to city logistics planning. *City Logistics 3 – towards sustainability and liveable cities*, Taniguchi E. and Thompson, R.G. (eds), ISTE Ltd, John Wiley and sons, London, UK, pp. 329-348.

SHEU (2016). The Standard of Higher Education in Ukraine. Specialty 275 Transport Technologies (by mode) (2016). *Ministry of Education and Science of Ukraine*. Retrieved July 5, 2019, from [https://mon.gov.ua/storage/app/media/vyshcha/naukovo-metodychna\\_rada/proekty\\_standartiv\\_VO/275-transportni-texnologiyi-magistr-11.042.017.docx](https://mon.gov.ua/storage/app/media/vyshcha/naukovo-metodychna_rada/proekty_standartiv_VO/275-transportni-texnologiyi-magistr-11.042.017.docx)

SmaLog (2017). Master in smart transport and logistics for cities (2017). Summary. *University of Rome Tor Vergata*. Retrieved July 1, 2019, from <http://smalog-2017.uniroma2.it/>