Doctoral Dissertation Thesis Topics for academic year 2024/2025
Study program: Technology and Management in Transport

Research on artificial intelligence methods for solving the problem of delivering parcels in the last and penultimate mile
Supervisor: Assoc. Prof. Libor Švadlenka, Ph.D.
Supervisor specialist: Ing. Stefan Jovčić, Ph.D.
Form of study: full-time

Annotation
In the last decade, an annual growth of approximately 15% can be observed in the volume of e-commerce shipments that need to be delivered to end customers in the final stage. Especially in cities, this trend causes problems manifested mainly by congestion, air pollution, noise and other negative externalities. Therefore, it is necessary to look for and implement ways of long-term sustainable delivery of parcels within the last mile (use of e-cargo bikes, urban micro-depots, self-service delivery boxes, low-emission zones, etc.).

The resulting measures reflect the different expectations of the individual interested parties – specifically the city management, then the deliverers of the parcels (logistics companies), the final customers (recipients of the parcels) and, last but not least, the residents living in the city centers or the operators of shops in these areas.

Research in this area will aim to create a predictive and decision-making model using the potential of MCDM (multi-criteria decision-making) techniques, e.g. ARAS, VIKOR, WASPAS, CODAS, COPRAS, BWM, MARCOS, EDAS, AROMAN, FullEX, etc. For to create the model, AI techniques (machine learning, neural networks, etc.) and IoT elements (devices equipped with sensors, software and other technologies for mutual data exchange) will be applied. Employing the mentioned techniques in combination with the properties of IoT devices, it will be possible to comprehensively manage (especially) delivery/collection routes in city centers, the capacity of transshipment points, etc., about different means of transport or to different sizes of cities. To achieve the stated goal, the doctoral student will analyze the current state of the problem in the Czech Republic and abroad.

Rail-enabled urban logistics
Supervisor: Assoc. Prof. Libor Švadlenka, Ph.D.
Supervisor specialist: Ing. Libor Bauer, Ph.D.
Form of study: full-time

Annotation
Urban logistics is essential for cities but contributes to congestion, emissions, noise and inefficiency. Integrating rail into urban logistics provides an opportunity to enable cleaner and more efficient distribution of goods. Urban freight faces pressing challenges including rising costs, negative environmental impacts, inefficient operations and congestion. Rail offers advantages for freight movement including economies of scale, lower externalities per ton-km and avoidance of road congestion.

This PhD thesis will analyze the current role and potential of rail in urban logistics through an extensive literature review, evaluation of global best practices, collaborative design process, simulation modeling and real world pilot projects. It will provide data, models, and guidelines to support adoption of sustainable urban rail logistics.

The aim of the PhD thesis will be to create a functional urban logistics system implementing rail transport.

Research will apply a mixed methods approach (Fuzzy Logic, Multi-Criteria Decision-Making, Deep Learning, Machine Learning, Global Information System, etc.) combining literature analysis, case studies, collaborative design and simulation modeling.

Decision Making Models for Transportation Issues based on Uncertainty
Supervisor: Assoc. Prof. Jiří Křupka, PhD.
Supervisor specialist: will be specified
Form of study: full-time

Annotation
The dissertation will deal with decision making modelling of a selected problem that touches on transportation issues. The thesis summarizes and analyses the available information on methods that are able to deal with uncertainty. A set of models will be proposed based on a systems approach and soft systems methodology. The core of which uses e.g. fuzzy and rough set theory, and a combination of these. The models will be verified by a case study.

Decision Support System for Sustainable Mobility in Smart City Context
Supervisor: Assoc. Prof. Jiří Křupka, PhD.
Supervisor specialist: Ing. Monika Skalská, Ph.D.
Form of study: full-time

Annotation
The aim of the dissertation will be to design models based on Machine Learning, Soft Computing or Artificial Intelligence to support decision making in the field of sustainable mobility in the context of Smart Cities. The models will reflect the relationships and changes in the public and private sectors. These changes in urban/regional infrastructure as well as changes in business activities, mainly due to Industry 4.0, are expected to influence sustainable mobility in the city/region. This includes impacts e.g. on transport and land-use planning, the implementation of new smart systems, energy savings, human resource development, satisfaction of transport users or residents, safety, etc. The proposed models can operate with data describing positive and negative externalities of transport activities in relation to the sustainability of the territorial unit.

Modelling of Logistic Processes within the Selected Unit of the Logistic Chain
Supervisor: Assoc. Prof. Jiří Křupka, PhD.
Supervisor specialist: Ing. Roman Hruška, Ph.D.
Form of study: full-time

Annotation
The aim of the dissertation is to research the influence of selected parameters of logistic processes on the behaviour of the logistic system within the researched unit of the logistic chain to minimize costs and duration of logistic processes.
The dissertation will deal with the issue of modelling of logistic processes within the selected unit of the logistic chain. The units of the logistics chain are production companies, warehouses, logistics centres, shops, airports, seaports, railway stations, etc. Logistics is a complex system in the context of supply chain management whose behaviour is influenced by a few parameters (order cycle, delivery time, stock management system etc.). The logistics chain connects the consumption market with the resource markets (materials, raw materials, semi-finished products, etc.).
The developed model will be used to support decision-making on logistic processes in accordance with the concept of sustainable logistics. The proposal of the simulation model will be based on the analysis of the national and foreign approach to this issue.

Student will use dynamic simulation methods to analyse and subsequently optimise selected logistic processes. He/She will have at the disposal of WITNESS Horizon simulation software.