

# New Mobility – High-Speed Transport Systems and Transport-Related Human Behaviour

## executive project summary

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<b>research area:</b>	economic, geographical, and political aspects of high-speed rail transport

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## ABSTRACT

The main research object of the project is the analysis and prediction of the transport behaviour of the population in connection with the planned introduction of high-speed rail transport in the Czech Republic using a new analytical method based on the use of so-called “big data” of mobile operators, direct monitoring and measurement of traffic intensity, behavioural economic experiments and contextual parallel consumer wishes.

On 22 May 2017, the Government of the Czech Republic approved the Programme for the Development of the Fast Rail Links in the Czech Republic; it is expected that public investments in the order of hundreds of billions of crowns will not only bring higher travel comfort, but will also help to meet environmental objectives, improve the accessibility of metropolises and peripheral regions and, overall, stimulate economic and social development in the Czech Republic. Foreign experience shows that high-speed rail transport can become an effective backbone of passenger transport and economic development of the state, as well as an underused transport system, both investment and operationally inadequately burdensome public sources. In the Czech Republic, however, the database and information necessary for effective decision-making on the meaningfulness of investments in high-speed transport systems are missing. In order to assess and predict the socio-economic implications of new transport options it is essential to recognize and understand the mobility behaviour of the population: what motivates or demotivates inhabitants to use a particular means of transport on a particular route, what are the obstacles to mobility and what is its potential? At the same time, in the Czech discourse, there is no interdisciplinary research workplace that would systematically monitor and analyse information on current behavioural mobility of the population, develop basic and applied research in this field, propose new procedures and methods, help implement them and be able to independently design and evaluate a complex solution.

The project creates an institutionalized scientific research platform bringing together research institutions with companies under the effective support of cooperating institutions and foreign experts. The added value of the project is concentrated in the framework of basic interdisciplinary research into transport economics, competition economics and transport geography, applied research into transport demand analysis, predictions of traffic flow intensity and prediction of impacts on the development of regional economies in the context of the construction of high-speed railways in the Czech Republic.

## PROJECT PARTNERS

### ▪ Academia:

- Masaryk University Brno (Faculty of Economics and Administration, Faculty of Science) *MUNI*
  - Institute for Transport Economics, Geography and Policy *ITREGEP*
  - Institute of Tourism *INCERU*
  - Institute for Public Administration *IVS*
  - Masaryk University Experimental Economic Laboratory *MUEEL*
- Charles University Prague (Faculty of Social Sciences, Faculty of Science) *CUNI*
- working group from the Institute for Transport Studies, University of Leeds *ITS*
- working group from the Wirtschaftsuniversität Wien *WU*
- working group from the University of Žilina in Žilina *ŽU*
- working group from the University of South Bohemia, České Budějovice *JČU*
- working group from Comenius University in Bratislava, Bratislava *UKB*
- working group from Uniwersytet Jagielloński, Kraków *JU*

### ▪ Corporations with a financial contribution:

- České dráhy, a.s. (Czech Railways) *ČD*
- Železničná spoločnosť Slovensko, a. s. (Slovak Railways) *ZSSK*
- Oltis Group, a.s. *OG*

### ▪ Corporations without financial participation:

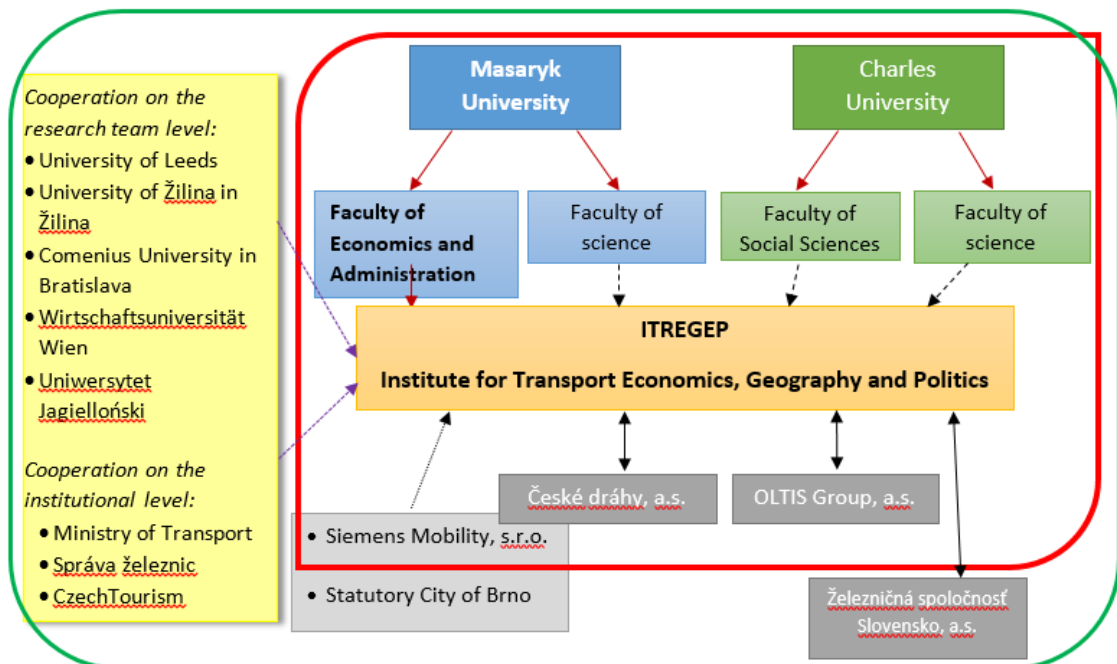
- Siemens Mobility, s.r.o *SIEM*
- The City of Brno *MMB*

### ▪ Cooperating institutions:

- The Ministry of Transport of the Czech Republic *MD*
- Správa železnic (Czech infrastructure manager) *SŽ*
- Czech Tourist Authority - CzechTourism *CzT*

The cooperation of the project partners will be organized on a closer and wider platform. The basis of the closer platform will be cooperation between the applicant and selected entities, which have accepted the role of partner in the submitted project, within the joint workplace of MUNI and CUNI - the Institute for Transport Economics, Geography and Policy. Collaboration within the wider platform will also include all other partners and collaborating institutions (see Chart 1). Creating a closer and wider platform will not limit the cooperation with other subjects; on the contrary, a wider, dynamic network of cooperating entities will emerge through the synergy effect.

Chart 1: Projects partners and platforms



**Legend:**

Existing cooperation in the form of contractual relations / contractual research  $\longleftrightarrow$

Collaborating research units  $\dashrightarrow$

Collaborating application / research institutions  $\dashrightarrow$

Identification of the hierarchical structure of institutions  $\rightarrow$

Delimitation of closer partnership cooperation set up by the submitted project

Delimitation of broader partnership cooperation

## STRUCTURE AND RESEARCH OBJECTIVES

The entire project is divided into four research objectives, which are further divided into working modules. The modules complement each other, build on each other and are focused on solving partial research problems and performing partial project activities. The individual modules have their own specific objective and subject of investigation; they have a fixed solution schedule and a defined interdisciplinary and intersectoral research team with assigned responsibilities. (see Chart 2). The logic is based on investigation from general and partial problems to specific case studies and comprehensive design solutions, where some modules form inputs for the solution of other modules, some modules complement each other and together form the identification of the problem, analysis and a proposal for its solution. The research is complemented and followed by activities in which the project results are published, disseminated and popularized, are passed on to stakeholders and platforms are developed for follow-up cooperation and research in the investigated area.

Table 1 shows all the modules, the timetable for their solution and the names of the responsible guarantors. The concept of the research is designed so that the output of each of the investigated modules is, apart from the separate outputs (publication of basic research results, analysis and recommendations of research applications, reports from pilot applications), also partial documentation for investigating the issues of the next module.

Chart 2: Research plan and modules

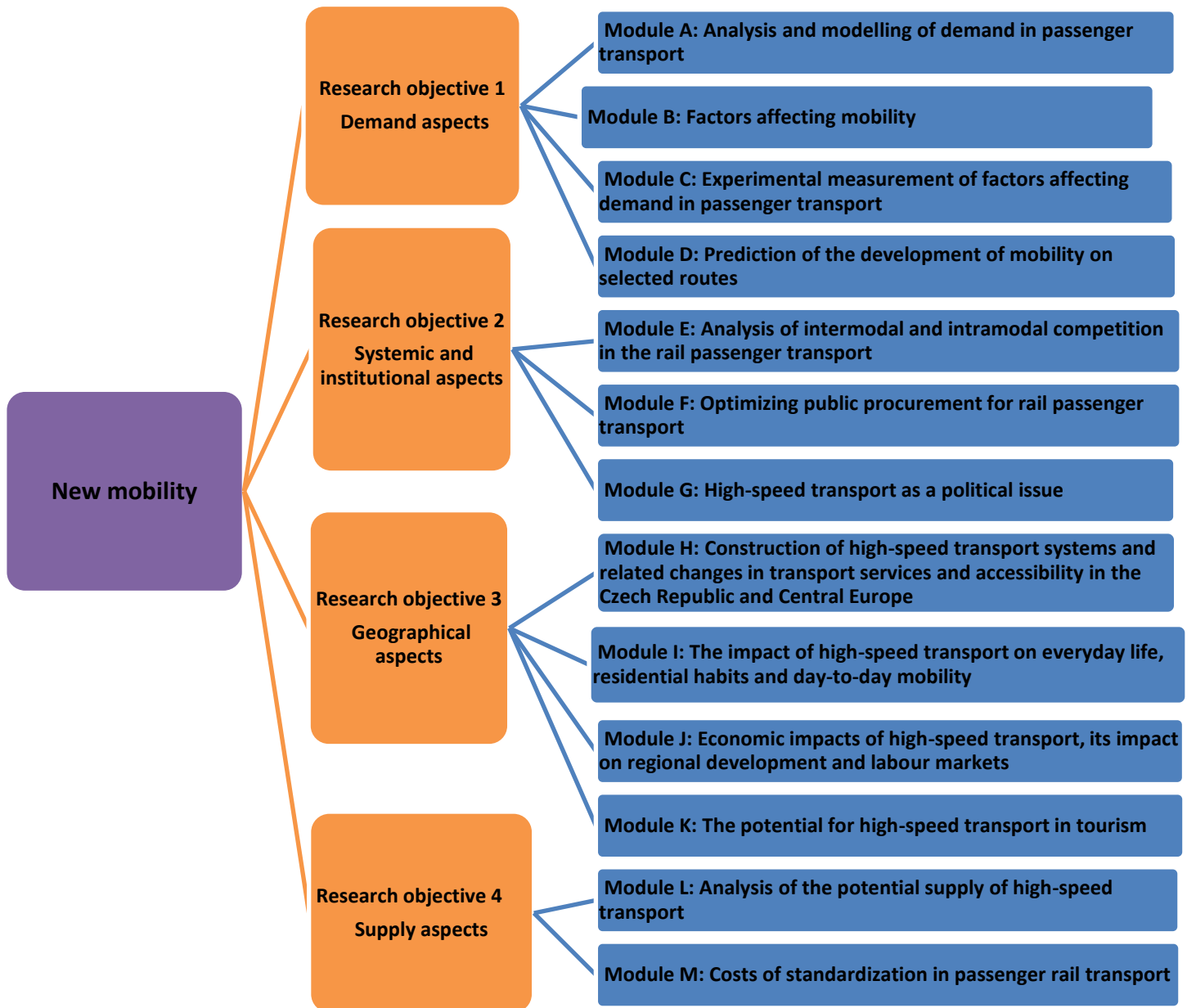


Table 1: Timetable

MODULE	RESEARCH OBJECTIVE	GUARANTOR OF THE MODULE	2018	2019	2020	2021	2022
A	1	Kvizda					
B	1	Marada					
C	1	Křčál					
D	1	Kvizda					
E	2	Tomeš					
F	2	Nigrin					
G	2	Nigrin					
H	3	Seidenglanz					
I	3	Seidenglanz					
J	3	Viturka					
K	3	Šauer					
L	4	Hrabáček					
M	4	Pospíšil					



## RESEARCH OBJECTIVE 1 DEMAND ASPECTS OF HIGH-SPEED RAIL TRANSPORT

The construction of high-speed rail places high demands on public investments, the amount of which should correspond to the degree of satisfaction of the travel needs of the population. However, these needs, i.e. demand for transport, are not easy to quantify and predict. Demand for transport is a derived demand which depends on a number of factors; the development of new transport technologies is changing the transport behaviour of the population, while new technologies enable new ways of monitoring, analyzing and predicting demand for transport. Research objective 1 is focused in the first phase (2018-2020) on the use of new technologies for the monitoring and analysis of population mobility by residual mobile operator data (Module A), the identification of the main factors influencing the time-space routines of the population and thus the demand for transport (Module B) and the experimental verification of the validity and intensity of selected factors (Module C). In the second phase (2021-2022), the objective of the research will integrate the previous findings and apply them in the prediction of population mobility on selected lines and regions in the context of the considered high-speed connections (Module D). The main objective of Research objective 1 is to improve the methods of transport demand analysis by means of experiments and new technologies for monitoring population mobility and their application in the investment and operational planning of transport services in the territory.

### MODULE A: ANALYSIS AND MODELLING OF DEMAND IN PASSENGER TRANSPORT

**Objective of the module:** Improvement of methods for the analysis of demand for transport in the context of high-speed transport.

**Module guarantor:** Martin Kvizda (MUNI)

**Research team:** MUNI, ČD, ZSSK, ITS, ŽU

The aim of the module is the innovation of methods of analysis and modelling of existing demand for passenger transport based on the utilization and interconnection of standard work practices (consumer surveys, census of passengers, sold tickets, monitoring and analysis of individual car traffic on selected segments, road traffic census) with new technologies and possibilities of data sources (residual data of mobile operators about movements of registered SIM cards in a space, identification of basic sociological characteristics of SIM card holders, taking into account the frequency of travel of

individual passengers of the size of the respective customer groups based on the identification of SIM cards). The advantage of these innovative workflows is the knowledge of the demand for passenger transport in its complete form, i.e. in a form that is not derived from mere, albeit, representative, samples, but from a complete database of movements on a given route. An advantage is the knowledge of the time parameters of the journeys made (day, daytime), making it possible to compare flat and peak demand times. The working schedule for data collection will be validated for national transport demand as well as demand on foreign segments (using SIM localization data also in close areas abroad, identifying cross-border mobility, analyzing key relations in metropolitan areas of neighbouring countries to / from the metropolitan centre and in transit, etc.), including models and trends in the mobility of the Czech Republic's inbound and outbound tourism, and trends in the population's mobility of weekend recreation.

Measurement of actual mobility will be carried out by means of residual data from mobile operators (big data) on several lines where the construction of high-speed lines is expected. In the largest extent of the analyzed data, the Prague - Ostrava (- SK / PL border) line will be the subject of research, where the monitoring of intermediate stations will be carried out, all routes will be differentiated by rail and road transport, the allocation of individual routes will reach the level of specific connections, and the time range of the collection will be one typical week with the distinguishing of individual days, including the identification of return routes. To a lesser extent (without monitoring of the intermediate stations), monitoring will be carried out on the Prague - Brno line (SK / A border) and on the smallest scale (without monitoring of the intermediate stations and with allocation of the individual routes only in hourly installments), monitoring will be carried out on the Prague - Děčín (- border with Germany), Prague - Plzeň (- border with Germany) and Brno - Ostrava (- Slovakian / Polish border) lines. To investigate the potential importance of cross-border transport flows, particular attention will be dedicated to analyzing data from the lines (Prague -) Ostrava - Žilina - Poprad - Košice and the lines (Prague -) - Břeclav - Kúty - Bratislava - Budapest as major feeders of the future Czech high-speed lines. The data will be analyzed in one of the above structures based on their availability from mobile operators. The measurement results will mainly be shared with Modules B, E, H, I and K.

Module A is a basic input for Module D. The specific output of this module will be an **improved design of consumer surveys, analysis of residual data from mobile operators, and the utilization of population mobility data** (especially finding the actual sample size) and **determining how to link consumer survey results with real mobility monitoring**. The method will be pilot-tested and validated and **professional studies will be published separately in the form of scientific articles**.

## MODULE B: FACTORS AFFECTING MOBILITY

**Objective of the module:** Identification of the main factors influencing the intensity and structure of population's mobility and the processes of acceptance of new transport systems and technologies, their application in (day-to-day) space-time strategies.

**Module guarantor:** Miroslav Marada (CUNI)

**Research team:** CUNI, MUNI, ČD, JČU

The main objective of this module is to identify the factors influencing the adaptation of the population's mobility behaviour in the case of the offer of new transport technology, with particular emphasis on high-speed rail transport. An analysis of the current state of traffic flows between metropolitan centres in the context of the planned high-speed railways will be carried out as well as between other centres at different levels (regional and local) and peripheral (border and inland) areas. In addition, an analysis of the state of mobile behaviour of an everyday and non-daily character will be carried out. The research will be based on extensive research work aimed at obtaining information on real changes in mobility behaviour after opening high-speed lines in various European countries and regions. The result will be a comparative study and identification of the main factors influencing mobility, including their weighting at individual levels, i.e. differences in factors affecting passenger behaviour on the regional and supra-regional level. Attention will also be paid to transport induction, i.e. the transport potential generated by the new transport infrastructure and new transport opportunities. Within the module, a pilot consumer survey will be carried out by a questionnaire survey on a representative sample of the population willing to commute for work during a better time availability (due to potential HSR construction).

Module B is the basic input for Module D. The main output of this module will be a **self-published scientific study in the form of a scientific article**.

## MODULE C: EXPERIMENTAL MEASUREMENT OF FACTORS AFFECTING DEMAND IN PASSENGER TRANSPORT

**Objective of the module:** Improvement of transport demand analysis workflows.

**Module guarantor:** Ondřej Krčál (MUNI)

**Research team:** MUNI, ČD, WU

The module focuses on research into one of the key factors influencing the demand for passenger transport, especially in the context of high-speed transport: the value of travel time. New methods of estimating the value of travel time in different contexts through incentive experiments will be investigated and verified in practice within the module. These methods will complement and refine standard methods based on hypothetical value estimation through questionnaire surveys. Experimental methods for measuring the value of unexpected travel time and comfort values will also be investigated. The data will be obtained through a standard questionnaire survey supplemented by an experimental ascertainment of what kind of truly perceived value these parameters have, based on the preferences they have shown. The method will work with real motivation based on the immediate payment of a cash reward to respondents. The pilot verification of experimental methods will take place at the MUEEL.

Module C is the basic input for Module D. The main output of this module will be an **improved design of consumer surveys and the use of population mobility data; case studies on selected transport segments will be published separately in the form of scientific articles.**

## MODULE D: PREDICTION OF THE DEVELOPMENT OF MOBILITY ON SELECTED ROUTES

**Objective of the module:** Estimation of potential traffic flows on selected segments

**Module guarantor:** Martin Kvizda (MUNI)

**Research team:** MUNI, ZSSK, OG, UK, ČD, ITS, WU, ŽU

The module integrates the theoretical knowledge and results of the pilot applications from the previous modules A, B and C; the module is also significantly based on the results of other research objectives, especially the modules I, J, K, L. On the basis of the identified general factors influencing the intensity of mobility and on the basis of an estimate of the impact of the new parameters of the transport supply, the potential level of change in the current level of mobility on selected routes will be assessed: Prague - Brno (- border SK / A), Prague - Ostrava (- border SK), Prague - Děčín (- border with Germany), Prague - Plzeň (- border with Germany), Brno - Ostrava (- Slovakian / Polish border). The result will be variants of future mobility on a given route for different transport concepts (travel time, connection frequency, fares, etc.). Part of the research will also be the identification of modal split, travel motives and their share (typical segments with a higher share of tourist travel, business trips, commuting to school, etc.).

Module D is one of the main outputs of the project, integrating the findings and conclusions from the whole project. The main output of the module will be a **variant prediction of the potential demand for high-speed transport on selected lines independently published in the form of scientific articles.**

## **RESEARCH OBJECTIVE 2 SYSTEMIC AND INSTITUTIONAL ASPECTS OF HIGH-SPEED RAIL TRANSPORT**

Rail transport is undergoing extensive liberalisation, and is subject to extremely intense competition. At the same time it fulfils the social goals in the area of reducing the environmental impacts of transport and public transport services. In order to model and predict the demand for high-speed transport and to quantify its effects, it is necessary to consider the transport market in the specific institutional frameworks: whether this transport segment will be open to competition, whether procurements will be conducted and with which parameters, or whether franchising will be set up, etc. The different institutional arrangement of the transport market will bring about completely different concepts of transport service and cost characteristics. It will stimulate other demands for transport and, as a result, will be reflected in the different intensity of the traffic flow generated by high-speed rail. In order to be able to predict the contribution of the construction of high-speed rail, we need to know the consequences of individual alternatives to institutional characteristics. Research objective 2 is focused on the analysis of the effects of competition on the market (Module E) and on the issue of the political pushing through of a particular transport concept (Module G) in a cross-sectional manner, in the final stage (2021-2022) also on the optimization of tender criteria (Module F). The main objective of Research objective 2 is to identify the fundamental consequences of individual alternatives of the institutional structure of the transport market and to formulate recommendations for setting the key parameters of the competitive environment on this market.

## MODULE E: ANALYSIS OF INTERMODAL AND INTRAMODAL COMPETITION IN RAIL PASSENGER TRANSPORT

**Objective of the module:** Identifying problems arising from different concepts of (not) regulating the passenger transport sector and designing solutions.

**Module guarantor:** Zdeněk Tomeš (MUNI)

**Research team:** MUNI, ČD, UK, ZSSK, ITS

The subject of this part of the research will be the analysis of the concentration and competition in the passenger transport sector and an intermodal comparison. Attention will be focused on the economy of high-speed transport, cost analysis and the identification of cost strategies of anticipated operational concepts. The research team will prepare case studies on selected routes, analysis of competition in the market in passenger rail transport and will also deal with competition on the market (competitive tendering). Building on the research under Modules A, D and F, an intermodal comparison of the connectivity of metropolitan centres in the Central European region will be carried out from the point of view of air, high-speed, conventional rail, bus and individual road transport. The aim is to identify effective geographic zones for the use of a particular mode of transport as a factor significantly influencing intermodal competition.

Module E represents the basic input for Modules L and D; at the same time, it represents one of the main outputs of the project, integrating the knowledge and conclusions of modules A, L and H. The output of this module will be the internal working documents of the project and a **scientific study in the form of a scientific article**.

## MODULE F: OPTIMIZING PUBLIC PROCUREMENT FOR RAIL PASSENGER TRANSPORT

**Objective of the module:** Design of the optimal structure of tendering procedures.

**Module guarantor:** Tomáš Nigrin (UK)

**Research team:** UK, MUNI

The subject of the research will be the analysis and comparison of tendering procedures in public passenger transport in the reference countries and in the individual regions of the Czech Republic; the result will be the identification of the strengths and weaknesses of tendering procedures. On the basis of foreign experience, methodical procedures and recommendations will be developed for the design of public procurement for the exclusive right to operate railway lines in the given territory. Public procurements should lead to improvements in transport services and a price reduction in operation for the client. Otherwise, a breakup of the network could occur and a worsening of the position of rail transport in the transport sector. Research on the optimization of public procurement in passenger rail transport has significant application potential as it will show a trend that can improve the services offered in rail transport, thus leading to the savings of public funds, while at the same time resulting in the achievement of the main objective of the module: the design of an optimal public procurement structure. In fact, the amount of funds spent each year on public transport subsidies in the Czech Republic makes the optimization of public procurement a very important and beneficial topic whose processing can contribute to a significant saving of public funds. For the considered high-speed rail lines in the Czech Republic, the method of regulating the competitive environment, along with the requirements formulated in the tendering procedures, is a fundamental parameter of the future operational concept; for this reason, it is also necessary to include tendering procedure conditions in the transport prediction.

Module F represents one of the main outputs of the project, integrating knowledge and conclusions especially from modules G and E, while also interpreting results in a narrow context with Module D. The main module output will be recommendations for procurements in the form of internal working documents of the project and as a **separately published study in the form of a scientific article.**



## MODULE G: HIGH-SPEED TRANSPORT AS A POLITICAL ISSUE

**Objective of the module:** Identification of the risk factors for planning and promoting the construction of high-speed transport infrastructure.

**Module guarantor:** Tomáš Nigrin (UK)

**Research team:** UK, MUNI, ČD

The subject of this part of the research objective will be the analysis of political decisions leading to the construction of high-speed transport systems and political communication with the public on the basis of foreign experience. In addition, an analysis of the political context leading to the construction of high-speed transport systems abroad will be carried out, including any further legislative amendments. It will also examine the attitude of individual political actors on the issue of HSR construction, the formulation of conceptual goals in this field and the identification of conditions for successful implementation. An integral part of the research will also be a retrospective analysis of the development of this topic in the Czech Republic from a political perspective and the identification of key stakeholders within the project preparation and implementation phases (including identification of their objectives, motivations, requirements, etc.). In this area of research, we will also include the identification of key phases and individual processes of preparation and implementation of the project in the territory. Comparison of the above-mentioned partial outputs with foreign experience and practice (analysis of case studies from countries where these projects have already been carried out or rejected) will be another part of the research into the political contexts.

Furthermore, the polarization of society and the development of various groups, mostly acting against the project usually occurs. One part is formed by groups of environmental activists, others by local residents directly affected by the construction (movements of the sort NIMBY - Not In My BackYard or BANANA - Build Absolutely Nothing Anywhere Near Anybody). The aim of the project will be to design an ideal method of political communication for the construction of HSR so that a proper democratic debate can take place, and all the relevant actors may be taken into account; however, it is important not to block the discussion and therefore the entire project.

Module G represents one of the main outputs of the project, integrating knowledge and conclusions especially from module L, while interpreting results in close context with Modules D and E. The practical output of the module will be the drafting of legislative solutions and communication strategy in the form of internal working documents of the project and a **separately published study in the form of a scientific article**.

## **RESEARCH OBJECTIVE 3 GEOGRAPHICAL ASPECTS OF HIGH-SPEED RAIL TRANSPORT**

High-speed rail can be seen as a commercial project, in which case the assessment of the potential demand for transport and the degree of satisfaction is crucial for its evaluation. Nevertheless, it is necessary to add an analysis and prediction of the effects that high-speed rail will bring to society and the national economy as a whole. The first phase (2018-2020 / 2021) of Research objective 3 is focused on the analysis and identification of changes in regional transport services after the construction of high-speed rail (Module H), for the analysis of the impact of high-speed transport on the regional economy and labour markets (Module J) and the development of tourism (Module K). In the second phase (2021-2022), the research objective will integrate previous knowledge and apply it in predicting the impact of high-speed transport on everyday life, residential habits and day-to-day mobility (Module I). The main aim of Research objective 3 is to predict the impact of high-speed rail on the general mobility of the population and its major benefits for the development of regional economies and labour markets.

## MODULE H: CONSTRUCTION OF HIGH-SPEED TRANSPORT SYSTEMS AND RELATED CHANGES IN TRANSPORT SERVICES AND ACCESSIBILITY IN THE CZECH REPUBLIC AND CENTRAL EUROPE

**Objective of the module:** Analysis of changes in the availability of selected regions due to the construction of high-speed lines, determination of possible concepts of their transport service, estimation of their spatial impacts.

**Module guarantor:** Daniel Seidenglanz (MUNI)

**Research team:** MUNI, UK, ČD, ZSSK, UKB, JU

The transport infrastructure significantly influences the socioeconomic potential of a territory and is considered to be an important tool for its change and development. The subject of this part of the research objective will be an evaluation of the possible impacts linked to the implementation of high-speed transport systems, especially taking into account the analysis of impacts caused by the change in availability between metropolitan areas, border areas and internal peripherals. The assessment will be carried out on several levels - intraregional impact research will focus on the availability of space within metropolitan areas newly linked to emerging HSR systems (micro-regional view). The interregional character will evaluate the impacts on increasing the mutual connectivity of higher and lower order metropolitan centres within the Czech Republic (interregional view). The macro-regional evaluation will consist in identifying the potential of linking metropolitan areas of the Czech Republic to major foreign metropolitan areas in the (central) Europe (macro-regional view).

Changes in accessibility in the Czech Republic and Central Europe are not only affected by infrastructure investments, i.e. by the construction of high-speed lines themselves, but also in the manner of the transport services offered. The module will therefore include the design and analysis of possible transport concepts for differently defined transport segments (e.g. international transport, long-distance domestic transport, regional transport, ways of operating regional terminals), as well as an analysis of their spatial impacts.

Module H represents the basic input for Module I and works with inputs coming mainly from Modules B and L. The main output of the module will be internal working documents of the project and **case studies for selected regions separately published in the form of a scientific article.**

## MODULE I: THE IMPACT OF HIGH-SPEED TRANSPORT ON EVERYDAY LIFE, RESIDENTIAL HABITS AND DAY-TO-DAY MOBILITY

**Objective of the module:** Estimation of the influence of different concepts of transport services of the territory by high-speed transport on the differentiated lifestyle of the population.

**Module guarantor:** Daniel Seidenglanz (MUNI)

**Research team:** MUNI, UK, ČD, ZSSK, JU, UKB

The subject of the research in this module will be the evaluation of the impacts of transport accessibility and the serviceability of the territory provided by high-speed rail on how the spatial framework of the everyday life of the population will change. Attention will be given to the topic of residential and occupational habits and also to the broadly defined issues of non-working and leisure time mobility. In connection with the introduction of high-speed transport, it is reasonable to assume the possibility of regular commuting for longer distances, so that choices of the place of residence, workplaces and places of realization of other common life needs, such as the use of various services, cultural events, leisure, entertainment, etc., will greatly increase. Attention will be paid to the related aspects and manifestations of such processes as suburbanization, semi-suburbanization, de-surbanization and metropolization. In addition to quantified studies, research based on qualitative methodology will be used, which will benefit from a more structured view of the willingness of differently defined social groups to include the possibilities offered by high-speed transport in their space-time routines.

Module I represents one of the main outputs of the project, integrating knowledge and conclusions especially from modules H, J and K, while interpreting results in a narrow context with modules D, E and G. The main module output will be internal working documents of the project and **case studies for selected regions separately published in the form of a scientific article.**

## MODULE J: ECONOMIC IMPACTS OF HIGH-SPEED TRANSPORT, ITS IMPACT ON REGIONAL DEVELOPMENT AND LABOUR MARKETS

**Objective of the module:** To identify the impact of transport operator levels on the economy, labour markets, regional development and the status of regional convergence / divergence.

**Module guarantor:** Milan Viturka (MUNI)

**Research team:** MUNI, UK, ČD

The subject of the module will be the research and evaluation of possible positive and potential negative impacts linked to the construction of high-speed transport systems on regional development as well as on the development of labour markets. It will be possible to analyze the localization logic of selected types of economic subjects and the related topic of regional convergence, respectively divergence. Potential changes in trends in commuting to work, schools and for other types of activities will be monitored, especially in connection with the changing range of metropolitan regions and the size of the commuting facilities. In addition to regular commuting, the potential impact of high-speed transport on journeys of a less regular nature will be assessed, but they are very important for maintaining business and economic ties. Attention will also be paid to the perception of changes in the servicing functions of the higher (metropolitan) order, i.e. the influence of the change in the transport serviceability of the territory and the accessibility of the metropolises to the transformation of the higher order servicing functions within the Czech Republic and in the international context. Unlike Module I, focusing on mobility behaviour as such, Module J research will focus on the implications of this behaviour for regional economies and development. The outputs of the module will especially contribute to addressing the issue of increasing the social efficiency of public projects and promoting horizontal integration, taking into account the potential impacts on the quality of life in the spirit of the concept of “think globally, act locally”.

Module J represents, together with Modul H, the basic input for Module I. The main output of the module will be internal working documents of the project and **case studies for selected regions separately published in the form of a scientific article.**

## MODULE K: THE POTENTIAL FOR HIGH-SPEED TRANSPORT IN TOURISM

**Objective of the module:** To identify current spatial preferences of tourists in relation to the mode of transport used and estimate their future changes due to the introduction of high-speed transport.

**Module guarantor:** Martin Šauer (MUNI)

**Research team:** MUNI, UK, ČD

The subject of this part of the research will be the analysis of the spatial behaviour of visitors in the context of the considered high-speed rail. The research will be carried out on two levels: (i) identification and analysis of transport behaviour during the journey to the destination and back. Here, in the context of high-speed transport systems, emphasis will be placed on the international dimension of tourism flows and the associated issues of the choice of transport modes (how the future supply of transport systems can meet the needs of international tourism). (ii) The second issue is the research of the impact of changes in the availability of metropolitan centres on the spatial behaviour of tourists within destinations and, secondly, on destination processes at the regional and local level, for example, the inclusion of new attractions near new high-speed rail terminals into a wider metropolitan destination offer.

The research of factors influencing the mobility behaviour of visitors will be based on two basic sources: firstly, general demand models developed mainly for international tourism, the second source of analysis will be a field survey of demand focused on exploring the value of travel time, price influence, alternative costs in relation to motivation and the attractiveness of target destinations (cooperation within Module B). At the same time, experimental verification of the assumptions of the influence of individual factors on mobile behaviour (Module C) will be carried out. The result will be the identification of the main factors influencing mobility at individual order levels (domestic and foreign tourism) and the subsequent segmentation of the market for groups of visitors with similar or identical behaviour. The results of the previous parts of the research will be the input for the evaluation of the impact of high-speed rail on the functional-spatial tourism system. Attention will be paid both to the impacts on the competitiveness of metropolitan areas and cities and to the wider spatial effects in their hinterland (model for selected regions).

This module will make a significant contribution to the specification of the general demand models developed under Research objective 1 and to the assessment of the impact of high-speed rail development on the functional-spatial tourism system. Both the total and partial outputs will then be partial inputs into the other modules of Research objective 3. Module K represents the basic input for Module I. The main output of the module will be internal working documents of the project and **case studies for selected regions separately published in the form of a scientific article.**

## **RESEARCH OBJECTIVE 4 SUPPLY ASPECTS OF HIGH-SPEED RAIL TRANSPORT**

Research objective 4 provides the project with the latest factors necessary for a comprehensive analysis of the socioeconomic effects of high-speed rail. It is not possible to analyze and predict the potential demand for high-speed transport leaving out supply and concepts of transport services. In the framework of the plan, the cost structure of the carrier on the high-speed rail in different institutional environments will be assessed, for which a prerequisite for the implementation of the consumer survey and demand is modelling. In line with the European single transport market concept (which will be reflected in the high-speed transport segment), the cost of vehicle standardization will be identified and predicted as another significant cost factor for high-speed transport services in the area. In the first stage (2018-2021), Research objective 4 is focused on identifying possible high-speed transport concepts and determining variants of transport services on selected segments (Module L). In the second phase (2020-2022), the research objective will primarily define and quantify the implications of standardization for carrier costs (Module M).



## MODULE L: ANALYSIS OF THE POTENTIAL SUPPLY OF HIGH-SPEED TRANSPORT

**Objective of the module:** Identifying possible high-speed transport concepts and determining variants of transport services on selected segments.

**Module guarantor:** Jan Hrabáček (ČD)

**Research team:** ČD, MUNI, UK, ZSSK

This part of the research objective will consist mainly in the analysis and comparison of high-speed transport concepts, the analysis of existing variants of high-speed transport concepts in European countries (accentuation of international / national links, the primary service of metropolitan markets, the scope and form of the operation of regional centers, the size and settlement importance of the served regional centres, and frequency of service of different types of routes and centres, tariff analysis, etc.). The research will also include cost analysis and a comparison of operational concepts, cost analysis of railway carriers, analysis and estimation of cost curves, and identification of how much competition does / does not contribute to competition and market competition to minimize unit costs in the sector. On the basis of the operational data of the project partners (ČD and ZSSK), transport and supply patterns will be developed in national and international high-speed transport and alternative vehicle strategy models (vehicle type, capacity, congestion capability in traffic during peak periods). The identification of micro-terrestrial characteristics of existing terminals will be made - typology of terminals according to location: city centre, city outskirts, wider suburb, airports, etc.). The solutions will be intertwined and compared to projects of a similar type based on the practical experience of foreign carriers. The cost analysis will also address the link to public budgets in terms of transport financing ordered under the public service obligation - based on transport models, pricing strategy and vehicle strategy.

Module L is one of the main inputs of Module I and its conclusions are necessary for consumer surveys within Modules A, B and H. The main part of the module outputs will consist of analysis and the internal working documents of the project, which will be used in follow-up **studies published in the form of a specialized article**. An important output will be the **implementation of variants of operational concepts and the setting of prerequisites for financing the operation from public sources**.

## MODULE M: COSTS OF STANDARDIZATION IN PASSENGER RAIL TRANSPORT

**Objective of the module:** Definition and quantification of the impact of standardization on carrier costs.

**Module guarantor:** Tomáš Pospíšil (ČD)

**Research team:** ČD, MUNI, OG, ZSSK

The module will analyze the actual financial impact of existing and newly introduced standards, in particular TSI (technical specifications for interoperability), on carriers, an analysis of the impact of these systems and standards on the intermodal competitiveness of rail transport, the costs of international standardization and their impact on intermodal and intramodal competitiveness and rail safety. The output of the model will be the quantification of actual costs and the assessment of the impact on competitiveness in the context of the considered concepts of high-speed rail transport. By using the TSI, communication between the stakeholders (between the infrastructure manager and the carrier or between the carriers) is made more effective and the error rate is significantly eliminated. A similar system, which should be subject to detailed examination, is also the deployment of the ERTMS system and, in particular, its ETCS component. The ETCS system contributes to enhancing railway safety, enables higher travel speeds on the built corridors and, as a result, again leads to the increased competitiveness of the railways compared to other modes of transport. The aim of the research is to identify the basic impacts of the implementation of individual standardization systems and tools, to determine how these impacts can be compared, quantified and interpreted, which tools should be used to evaluate their impacts and, last but not least, what data the individual actors of the railways should collect so that the evaluation is at all feasible.

Module M is a necessary complement of modules E and L and its conclusions are reflected in modules A, B and H; at the same time, it is also one of the project outputs identifying the key cost parameters of future high-speed transport services. The outputs of this module will take the form of internal project work materials, which will be used in follow-up studies **published in the form of an expert article.**

## ACQUIRED SERVICES AND DATA

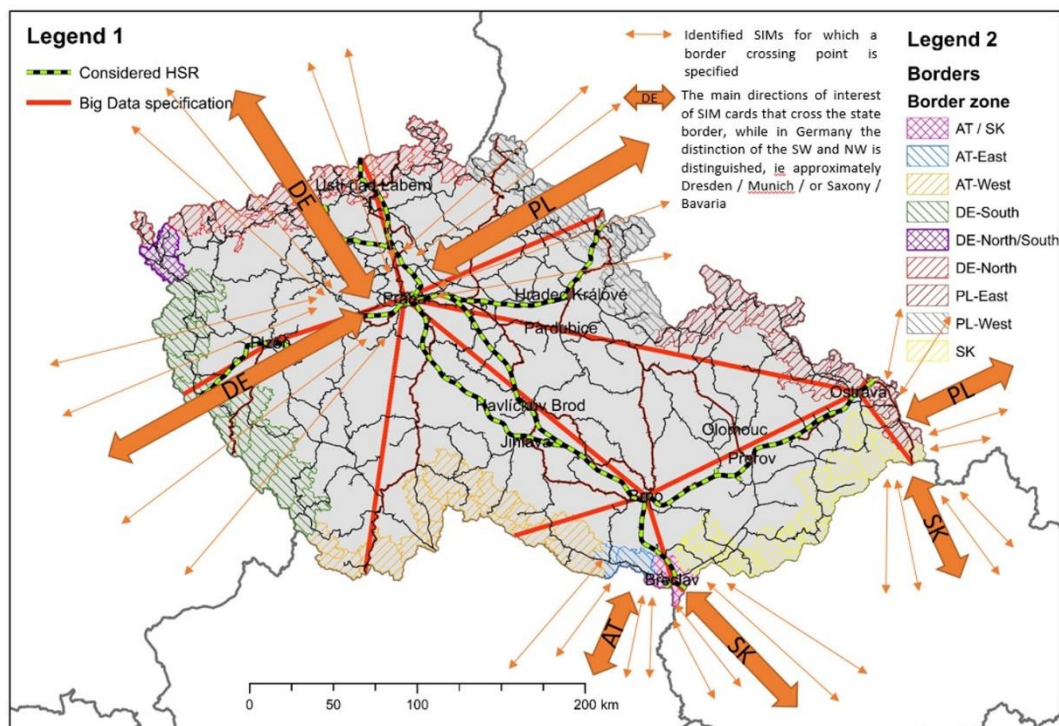
### Big data from the mobile operator

Guarantor: Masaryk University

Term: 2019

Supplier: T-Mobile Czech Republic a.s.

Objective: Analytical processing and delivery of a structured set of signaling data of a mobile operator, including a complete methodology of their processing and interpretation.



### Passenger Demand Forecasting Handbook

Guarantor: Masaryk University

Term: 2019

Objective: Access to a database of traffic surveys and analyzes, conducted and updated on an ongoing basis by the Institute for Transport Studies (University of Leeds), necessary to compare research results and the ongoing correction of the used methods

### Investigation of mobility behaviour of transport users - cars

Guarantor: Masaryk University

Term: 2019

Supplier: AUGUR Consulting s.r.o.

Objective: Investigate factors influencing the use of a particular means of transport. The results of the survey serve as feedback of opinions, attitudes and reasons on the basis of which passengers choose (do not choose) a particular transport mode.

#### **Investigation of mobility behaviour of transport users – bus/train**

Guarantor: Masaryk University

Term: 2019

Supplier: AUGUR Consulting s.r.o.

Objective: Investigate factors influencing the use of a particular means of transport. The results of the survey serve as feedback of opinions, attitudes and reasons on the basis of which passengers choose (do not choose) a particular transport mode.

#### **Survey on the preference of HSR to other modes of transport**

Guarantor: Charles University

Term: 2019

Supplier: AUGUR Consulting s.r.o.

Objective: To find out under what conditions people would choose to travel by high-speed rail against the use of other modes of transport (car, bus, but also aircraft and conventional rail) in interregional and interstate transport.

#### **Investigation of mobility behaviour of domestic and foreign visitors**

Guarantor: Masaryk University

Term: 2019

Supplier: AUGUR Consulting s.r.o.

Objective: To find out how improving the accessibility of the destination influences the decision-making process on the choice of the place of visit / stay and its behavior in

#### **Survey on mobility behaviour of tourism participants - South Korea**

Guarantor: Masaryk University

Term: 2019

Supplier: AUGUR Consulting s.r.o.

Objective: To find out current travel habits when traveling to the Czech Republic and Central Europe and to recognize the role of destination accessibility in the decision-making process of respondents.

#### **Survey on the preference of HSR to aircraft**

Guarantor: Charles University

Term: 2019

Supplier: AUGUR Consulting s.r.o.

Objective: Investigate factors determining the use of a particular means of transport, VRT substitution with aircraft and bus.

### **Investigation of potential change of mobility behaviour on RS1**

Guarantor: Masaryk University

Term: 2020

Supplier: AUGUR Consulting s.r.o.

Objective: To find out the respondents' attitudes to different VRT traffic models in relation to their current traffic behaviour.

### **Investigation of changes in mobility and residential behaviour**

Guarantor: Masaryk University

Term: 2020

Supplier: AUGUR Consulting s.r.o.

Objective: (I.) Investigation of changes in mobility and residential behavior (location of residence, location of other important routine activities - work, school, shopping, services, culture, entertainment, leisure, etc.), which were influenced by the improvement of rail transport supply (acceleration, higher train) on the route connecting Pilsen and Prague. (II.) Investigating the strength of the impact of improved supply of rail transport in changing mobility and residential behavior, investigating the impact of other factors.

### **Survey of passengers' preferences on the route Prague - Munich (train)**

Guarantor: Charles University

Term: 2020

Supplier: AUGUR Consulting s.r.o.

Objective: Investigation of factors that make use of the train on the Prague-Munich route with an emphasis on safety, spending time during the journey and environmental attitudes.

### **Export of data from the IDOS on-line timetable**

Guarantor: Charles University

Term: 2020

Supplier: IDOS.cz

Objective: Monitoring the actual supply of transport services and the basis for comparing the real movement of passengers with the data of mobile operators (i.e. deduction of the used mode of transport); for selected lines and regions, the complete multimodal variants of public transport connections will be exported.

## OUTPUTS OF THE PROJECT

Main outputs of the projects:

1. Establishment of common institutionalized platforms to enable long-term cooperation of key partners;
2. Joint publications, jointly submitted grant projects, organization of joint activities.

### PUBLICATIONS

Professional publications are necessary and key outputs. The treatment of intellectual property will be specified by the partners in individual documents – agreements or declarations, which will be created gradually according to the need and nature of individual data sets. In terms of project solution, it is important to ensure the protection of sensitive data, which could be the subject of business secrets, or would be covered by the Personal Data Protection Act. This especially concerns the data provided for research purposes by the partners: České dráhy, a.s. and Železničná spoločnosť Slovensko, a.s. The research team will be provided with data that could be subject to intellectual property issues that will be analyzed and processed in expert studies. Only results that will be explored based on the work with this data will be published.

<b>Publication of outputs total:</b>	<b>quantity</b>
Scientific articles	41
Publications in the co-authorship of research organizations and enterprises	15
Publications with foreign co-authorship	8
Internal analyses, studies – one analysis for each module	17

### JOINT ACTIONS

#### **A) Prague Conference on Central and East European Countries' Railways - PCCEECR**

The international conference will be held in 2020 and 2022 and then every two years after the end of the project. The purpose of the conference is to invite to discussion foreign experts. Each conference will be focused on issues related to the use of new technologies for the detection, analysis and prediction of population mobility and the impact of new

technologies, especially high-speed rail, on changing the population mobility. The main speakers will be foreign experts participating in the project in the framework of employment, work contracts or per diem work. The conference will be co-organized by Masaryk University and Charles University on the premises of Charles University in Prague; the conference will tentatively be held at the end of May.

#### **B) Seminar Telč**

Every year a discussion seminar will be held focused mainly on the meeting of the project investigators with the Czech and Slovak professional public. Its main purpose will be the presentation of partial results within all investigated modules, a common discussion of potential problems and mutual critical opposition of research results and their pilot applications. The main speakers will be workers participating in the project in the framework of work contracts or per diem work. The seminar will be co-organized by Masaryk University and Charles University on the premises of MUNI in Telč; the seminar will be held every year at the beginning of November.

#### **C) Round Table**

A round table will be organized twice during the implementation of the project (in the years 2019 and 2021) and then also after the end of the project. Current issues related to the development of high-speed mobility will be addressed primarily from economic perspectives. External experts will be invited to the round table discussion (mainly from Poland, France, Germany, Austria and Slovakia); the subject of the meeting will be the sharing of European experience with the competitive environment in passenger rail transport on the main lines and methods of regulation. The aim of these round tables is to transfer experience and know-how among the stakeholders in the framework of the given issue. The round table will be organized by Masaryk University on its own premises in Brno.

#### **D) Seminar of HSR stakeholders**

A discussion seminar of HSR stakeholders will be held every year. The seminars will contribute to the dissemination of the results of the project not only among the professional public, but also among representatives of the political representation from the Transport Committee of the Senate of the Czech Republic and the Chamber of Deputies of the Czech Republic who are involved in the political decision-making process directly affecting the railway transport sector. Besides Senators and Deputies of the Parliament of the Czech Republic, senior officials of the Ministry of Transport of the Czech Republic, representatives of carriers and construction companies will also be invited to the seminar. The seminar will be organized by Charles University on its own premises; the seminar will



always be held around the beginning of December. The following topics are planned: Possibilities for the development of HSR in the Czech Republic (2018), foreign experience with HSR (2019), and geographical aspects of HSR in relation to regional development (2020), Supply aspects of high-speed transport in the Czech Republic (2021) and the systemic and institutional aspects of HSR (2022).

#### **E) Interdisciplinary platform workshop**

The interdisciplinary platform workshops will be organized in September 2018, 2020 and 2022. These workshops are an opportunity to consult on the issues of HSR and project outputs in particular from a spatial point of view. The workshops will be attended by representatives of all partners involved and collaborating institutions. In addition, representatives of public administration institutions and institutions which are directly affected by the spatial aspect will also be invited to the discussions. This will lead to a bi-directional transfer of information and know-how. The benefits of the workshops will also be the presentation of examples of good practice from abroad. Workshops will be organised by MUNI on its own premises always at the end of September.

#### **F) Participation in events abroad**

The project presumes the active participation of the research team members at professional conferences in the form of a presentation which will present the solution of some sub-areas of the project. Due to the importance of the application level of the project, it is possible that during the implementation the team members will also attend a workshop, a conference or trade fair that will be focused on the application and for which active scientific participation will not be possible.

<b>Joint actions:</b>	<b>quantity</b>
Prague Conference on Central and East European Countries' Railways (2020, 2022)	2
Seminar Telč (2018, 2019, 2020, 2021, 2022)	5
Round Table (2019, 2021)	2
Seminar of HSR stakeholders (2018, 2019, 2020, 2021, 2022)	5
Interdisciplinary platform workshop (2018, 2020, 2022)	3



## INVOLVEMENT OF REPRESENTATIVES OF THE PARTNERS IN TEACHING AND MENTORING OF STUDENT THESES

Experts from the participating institutions will provide guidance and consultations on student theses for MUNI and CUNI on the theme corresponding with the project. During the implementation of the project, at least **20 theses or dissertation topics** will be listed for which the partners will act as a consultant, external examiner or supervisor.

On the premises of MUNI and CUNI, **at least 10 lectures or presentations will be organized in regular subjects** (especially in Transport Economics, Economic aspects of European integration, Economic theory for the public sector, Geography of transport and Transport systems). Academic staff from universities participating in the project will also be involved in the internal education and training of partners.

<b>Student theses and teaching:</b>	<b>quantity</b>
student final (thesis, dissertation) papers	20
one-time lectures and seminars at the universities	10

## COMMON PLATFORMS

One of the main outputs of the project is the creation of a joint workplace of Masaryk University and Charles University on the basis of the existing Institute for Transport Economics, Geography and Policy (ITREGEP). The Institute will gradually take over the coordination function of cooperation between all partners. The second platform is the Telč group, transforming itself from today's free association into a permanent, institutionalized working group.

## JOINT INTERNATIONAL PROJECTS

We assume the involvement of the applicant or project partner **in at least 2 international projects**, while we estimate the submission of about **6 applications** for support in certain international grant schemes: H2020 (especially Shift2Rail), EEA Grants/Norway Grants, International Visegrád Funds, Swiss-Czech Cooperation Programme, ERC, and others. The module guarantors are responsible for the preparation and submitting of individual project applications.

<b>Joint projects:</b>	<b>quantity</b>
Acquisition of joint international projects (H2020, Visegrád fund, ... )	2
Submission of joint project applications	6

## MANAGEMENT AND ADMINISTRATION

**Principal investigator:** Martin Kvizda. The principal investigator is responsible for the comprehensive coordination of the project and the fulfilment of its objectives and outputs. He is responsible for the timetable and guarantees the cooperation of the partners involved. He is responsible for the conceptual approach to research activities and cooperation. He is the chief bearer of the strategic management of the project, coordinates the activities of the members of the consortium and directs both the activities of the expert team and as well as supervising and monitoring the activities of the administrative team. He has the authority to decide on all financial and personnel issues related to the project.

The administrative part of the project team is led by the **Main Manager of the project**. Key positions are also **Project Manager** and **Financial Manager**. Other administrators work at each partner institution. The administrative team is responsible for technical and administrative activities and provides all the necessary background for the seamless professional activities of the project.

**The Strategic Management Committee (SMC)** consists of the principal investigator, representatives of all partners, representatives of cooperating institutions who will have a consultative and advisory voice on the SMC; selected module guarantors will also participate in its sessions according to the current needs of the project management. The purpose of the SMC Committee is to strategically guide the process of the solution of the project in order to achieve the planned goals and to organize and coordinate the work of individual research teams and objectives. The SMC will also coordinate project activities with other ongoing international projects that the consortium plans to submit. The SMC will also be responsible for cooperation agreements between the partners involved, licence agreements for data use, and issues of business secrets and intellectual property will also be dealt with there. The SMC will address possible changes in the occupation of positions of guarantors of modules and objectives, create a plan for the communication and dissemination of project outputs, approve new partners joining a consortium, audit project accounting, and monitor budget spending. The Strategic Management Committee is chaired by the principal investigator who sets up the agenda for its meeting.

The project team is composed of representatives of all partners involved. For each of the topics under consideration, **research teams** are set up across selected partners dealing with a specific area of the problem and form research module. Each research team has its **module guarantor** that manages, coordinates, and evaluates team activities. The module guarantor regularly prepares the Monitoring reports.

**Technical Management Committee (TMC)** consists of guarantors of individual modules, the principal investigator and selected partners in the consortium. The TMC monitors and evaluates the work and results achieved in each research module, coordinates their implementation process and use of results. The TMC is the decisive body for the technical solution of the project and creates a platform for investigating and solving problems, sharing results and building a common knowledge base using the advice from external experts. The main goal of the TMC is to ensure the smooth running of the project and the implementation of its activities through the definition of the project's work plan and the control of its performance, mainly discussing monitoring reports. If necessary, the TMC is authorized to make technical changes to the project and, in critical cases, passes them on for approval to the SMC. The TMC always meets before submitting the current monitoring report. The Technical Management Committee is chaired by Tomáš Nigrin (CUNI), who sets out the agenda of the meeting together with the principal investigator.

**Monitoring reports** are submitted every 6 months (the first report 3 months after the start of the project) within the deadlines set by the project timetable. Before submitting the monitoring report, the module guarantors shall prepare a brief report on the progress of the course of the project over the last 6 months, containing all relevant information on the results, delays, problems, etc. (up to a maximum of 1 page A4). Based on background information from guarantors and after discussion in the TMC, the administrative team will prepare a formalized version of the monitoring report.

**The Advisory Group (AG)** is composed of representatives of collaborating institutions who have expressed their interest in the project and its results. In the course of the project, the AG will act as a consultative and advisory body; it is expected to gradually increase the number of AG members.

**Chief Advisor:** Professor C. A. Nash (MUNI), evaluates all the project outputs and strategic objectives formulated by the SMC at the request of the principal investigator.

**Capsa.cz** is the basic communication platform of the project. Each member of the research team and the administrative team has access to the appropriate parts of the platform. The platform collects all formal documents and project documents, work materials and studies, outputs, data files, etc. accessible to individuals within the scope defined by the SMC on one repository available for team members on the link: <https://novamobilita.capsa.cz/>.

Table 2: Project management

Partner	SMC	TMC	Guarantor	Administration	Advisory
Masaryk University	✓ (chair)	✓	✓	✓ (coordinator)	
Charles University	✓	✓ (chair)	✓	✓	
České dráhy, a.s.	✓	✓	✓		
Oltis Group, a.s.	✓	✓			
ZSSK, a.s.	✓	✓			
Siemens Mobility, s.r.o.	✓				
City of Brno	✓				
CzechTourism					✓
Ministry of Transport					✓
Správa železnic					✓

Diagram 1: Management of the project

