



Energy Usage and Green Public Transportation in  
Future Smart Cities: An Innovative Teaching Program  
for Students, Stakeholders and Entrepreneurs  
n° 2020-1-TR01-KA203-094242



Co-funded by the  
Erasmus+ Programme  
of the European Union



# TEACHING NOTES HANDBOOK

*Energy Usage and Green Public Transportation in Future Smart Cities:  
An Innovative Teaching Program for Students, Stakeholders and Entrepreneurs*



University of Ljubljana



"Co-funded by the Erasmus+ Programme of the European Union. However, the European Commission and the Turkish National Agency cannot be held responsible for any use which may be made of the information contained therein"



## © 2022 EUGPUT project - Energy Usage and Green Public Transportation in Future Smart Cities: An Innovative Teaching Program for Students, Stakeholders and Entrepreneurs

### Editors:

Zafer Yılmaz (TED University)

Kristina Nagode (University of Ljubljana)

Öykü Yücel (TED University)

### Teaching Notes Authors:

Tomislav Križan (Atomic Intelligence)

Aleš Groznik (University of Ljubljana)

Anton Manfreda (University of Ljubljana)

Bor Krizmanič (University of Ljubljana)

Kristina Nagode (University of Ljubljana)

Luka Tomat (University of Ljubljana)

Dorinela Costescu (University Politehnica of Bucharest)

Sergiu Olteanu (University Politehnica of Bucharest)

Ivana Ninčević Pašalić (University of Split)

Maja Ćukušić (University of Split)

Silvia Golem (University of Split)

Gizem Çelik (TED University)

Öykü Yücel (TED University)

İbrahim Ünalmiş (TED University)

Seda Damla Yücel (TED University)

Zafer Yılmaz (TED University)



## Preface

The share of transportation in energy usage in the cities is very high. Authorities seek sustainable and green public transportation systems when they plan the future of the cities. Green public transportation is a multidisciplinary subject which focuses on designing the unimodal or intermodal public transportation system in the cities, energy usage in these systems, and information systems to gather information related to possible passengers. To support energy consumption solutions, we prepare a one-week teaching program made up of 7 teaching modules and one supporting module to teach the future green public transportation systems in the future smart cities on green public transportation systems in the future smart cities as an intellectual output of the EUGPUT Project - Energy Usage and Green Public Transportation in Future Smart Cities: An Innovative Teaching Program for Students, Stakeholders and Entrepreneurs (2020-1-TR01-KA203-094242) funded by Erasmus Plus K203 Strategic Partnership. Module coverage and short content description can be stated as:

- **Module 1:** The module will help project members to develop an innovative curriculum for the one-week teaching program and use innovative teaching and evaluating methodologies in 8 teaching modules.
- **Module 2:** The module will introduce learners to various concepts such as digital transformation and technology use, smart mobility and a green future, the role of a smart society, and managerial issues related to assuring a green future.
- **Module 3:** The module will introduce learners to the concept of smart grids and trends in energy use in transportation. The module will look at the transition to different renewable energy sources and how to incorporate them into the energy system.
- **Module 4:** The module will introduce learners to current public transportation technologies, air pollution problems caused by the vehicles used in current public transportation (Examples from European cities), alternative green transportation technologies, information systems, and efficient tools in green public transportation network planning of future smart cities.
- **Module 5:** The module will introduce learners to Configurations of Intermodal Public Transport Networks, Modelling Intermodal Public Transport Networks, and Planning Intermodal Public Transport.
- **Module 6:** The module will introduce learners to an overview of technologies and information systems across various green public transportation modes, whether these are used by pedestrians or integrated into bicycles, buses, and rails.
- **Module 7:** The module will introduce learners to economic determinants of public transport, externalities, how fiscal policies and subsidies can be used to promote green technologies, and alternative financing methods.



- **Module 8:** The module will introduce learners to Intellectual Property Rights, Patent Search, Development Ideas and Preparation of Project Proposals, Development Business Plans and Financial Opportunities for Green Entrepreneurship.

The innovative teaching program is a multidisciplinary and compact program for the needs of target groups designed to include trans-disciplinary approaches. Target groups include students, stakeholders (such as people from vehicle production companies, data analysts, engineers, and people from municipalities who will be the end users and policymakers of green public transportation systems), universities, teaching assistants, academicians, and entrepreneurs. The teaching manual consists of the implementation of the lesson plan which demonstrates a suggested flow for each hour. The lesson plan is divided into three parts: the beginning of the lesson, the heart of the lesson and closure activities. The manual can be used by any university, institution and/or research organization.

## Acknowledgements

We would like to thank all project partners, module owners and collaborators for their contribution and hard work in preparing the teaching notes.

The teaching notes handbook is an intellectual output of EUGPUT Project - Energy Usage and Green Public Transportation in Future Smart Cities: An Innovative Teaching Program for Students, Stakeholders and Entrepreneurs (2020-1-TR01-KA203-094242) funded by Erasmus Plus K203 Strategic Partnership.



# Content

## MODULE #2: SMART MOBILITY AND OTHER SMART PARTS ASSURING A GREEN FUTURE.....8

HOURS 1 & 2: Introduction to green future, digital transformation and technology use.....8

HOURS 3 & 4: Smart mobility and the green future .....12

HOURS 5 & 6: Towards a smart society .....15

HOURS 7 & 8: Managerial implications.....19

## MODULE #3: ENERGY-RELATED SMART GRIDS.....23

HOURL 1: Overview of the Course & Introduction of Electrical Grid .....23

HOURL 2: Current Energy Usage, Renewable Energy Sources and Smart Grid.....26

HOURL 3: Smart Meter and Prosumers .....28

HOURL 4: Introduction of Renewable Energy Sources into a Grid & Photovoltaics Example  
.....30

HOURL 5: E-Mobility, Electric Vehicles & Battery Technologies .....32

HOURL 6: Smart Changing .....35

HOURS 7 & 8: Final Group Work Project.....37

## MODULE #4: GREEN VEHICLES AND GREEN PUBLIC TRANSPORTATION NETWORK DESIGN .....39

HOURL 1: Review of the current public transportation means (Examples from European Cities).....39

HOURL 2: Air pollution problems caused by the vehicles used in current public transportation .....43

HOURL 3: Green public transportation vehicles to be used in future smart cities .....47

HOURL 4: Integration of green and intelligent public transportation vehicles into future public transportation technologies.....50

HOURL 5: Implementation of green public transportation vehicles into real transportation cases: Word Limit Game .....53





HOUR 6: Using information systems, efficient transportation methods and tools (i.e., GIS) in public transportation network planning .....	56
HOURS 7 & 8: Business Model CANVAS: Discussions on green public transportation alternatives in smart cities .....	59
<b>MODULE #5: INTERMODAL GREEN PUBLIC TRANSPORT PLANNING .....</b>	<b>61</b>
HOUR 1: Domains of the mobility system performance.....	61
HOUR 2: The role of intermodal public transport.....	64
HOUR 3: The Key Components of the Intermodal Urban Mobility System .....	68
HOUR 4: Particularities of the Intermodal Public Transport (1) .....	75
HOUR 5: Particularities of the Intermodal Public Transport (2) .....	81
HOUR 6: Design of the Intermodal Public Transport Network (1).....	88
HOUR 7: Design of the Intermodal Public Transport Network (2).....	91
HOUR 8: Measures to Increase the Attractiveness of Intermodal Urban Mobility .....	94
<b>MODULE #6: INFORMATION SYSTEMS AND TECHNOLOGIES FOR GREEN PUBLIC TRANSPORTATION .....</b>	<b>99</b>
HOUR 1: The future of cities and smart mobility .....	99
HOURS: 2 & 3 & 4: Information Systems and Technologies for Green Public Transportation .....	101
HOURS: 5 & 6: Foresight in Planning Smart City Services in the Mobility Segment: Scenario Exploration System.....	104
HOURS 7 & 8: Developing a relevant classification or prediction decision support model .....	110
<b>MODULE #7: ECONOMICS OF GREEN PUBLIC TRANSPORTATION SYSTEMS ...</b>	<b>112</b>
HOUR 1: Review of Demand, Utility and Relative Prices in Green Public Transportation	112
HOUR 2: Review of Supply, Externalities and Cost Benefit Analysis of Green Public Transportation.....	116
HOUR 3: Review of Fiscal Policies and Subsidies to Promote Green Public Transportation .....	119



HOUR 4: Review of New and Alternative Ways to Finance Green Public Transport Technologies.....	122
--	-----

## MODULE #8: ENTREPRENEURSHIP OPPORTUNITIES CONSIDERING SMART CITY PUBLIC TRANSPORTATION .....126

HOUR 1: Introduction of Intellectual Property Rights (IPR).....	126
HOUR 2: Entrepreneurship Ecosystem and the Relationship Between IPR and Entrepreneurship .....	129
HOUR 3: IP & Technology Commercialization Instruments .....	132
HOUR 4: Patent Search by Using Free Tools .....	135
HOUR 5: Introduction to Canvas Models and Preparing a Business Canvas Model for New Ideas .....	137
HOUR 6: Preparing a Simple Business Plan by Using the Prepared Canvas Model .....	139
HOURS 7 & 8: Providing Practical Guide about Project Management and Preparing a Simple Project Proposal for a Developed Idea.....	143

## APPENDIX – Curriculum Vitae – Authors and Collaborators .....146



## MODULE #2: SMART MOBILITY AND OTHER SMART PARTS ASSURING A GREEN FUTURE

### INSTRUCTOR INFORMATION

**Instructors:** Anton Manfreda, Kristina Nagode, Luka Tomat

**E-mails:** [anton.manfreda@ef.uni-lj.si](mailto:anton.manfreda@ef.uni-lj.si), [kristina.nagode@ef.uni-lj.si](mailto:kristina.nagode@ef.uni-lj.si), [luka.tomat@ef.uni-lj.si](mailto:luka.tomat@ef.uni-lj.si)

**HOURS 1 & 2:** Introduction to green future, digital transformation and technology use

<b>Lesson Title:</b>	<b>Introduction to green future, digital transformation, and technology use</b>
<b>Related Learning Outcomes:</b>	<p>In this lesson, learners will gain an understanding of:</p> <ul style="list-style-type: none"><li>• green future and future society concept</li><li>• the concept of digital transformation</li><li>• the key drivers and areas of digitalization</li><li>• important technological trends</li><li>• innovative business models</li></ul>
<b>Duration of the Lesson:</b>	90
<b>Dominant Instructional Method:</b>	<ul style="list-style-type: none"><li>• Lectures</li><li>• Video presentations</li><li>• Discussions</li></ul>
<b>Instructional Materials:</b>	<ul style="list-style-type: none"><li>• PowerPoint slides</li><li>• Videos</li><li>• Readings</li></ul> <p>The teaching notes are available on the project website. In addition to teaching notes, the following reading materials are advised to gain knowledge about the concepts which will be introduced during the course:</p>





	<ul style="list-style-type: none"> <li>• Wirtz, B. W. (2021). Digital Business and Electronic Commerce - Strategy, Business Models and Technology, Springer International Publishing.</li> <li>• Tomat, L., &amp; Trkman, P. (2019). Digital Transformation-The Hype And Conceptual Changes. Economic and Business Review, 21(3), 351-495.</li> <li>• Vaska, S., Massaro, M., Bagarotto, E. M., &amp; Dal Mas, F. (2021). The digital transformation of business model innovation: A structured literature review. Frontiers in Psychology, 11, 3557.</li> <li>• Westerman, G., Calm�ejane, C., Bonnet, D., Ferraris, P., &amp; McAfee, A. (2011). Digital Transformation: A roadmap for billion-dollar organizations. MIT Center for digital business and Capgemini Consulting, 1, 1-68.</li> </ul>
<b>Prerequisite Learning:</b>	No prerequisite knowledge is required.
<b>Discussion Questions:</b>	<ul style="list-style-type: none"> <li>• How do you perceive a future society?</li> <li>• What is the difference between green future and sustainability?</li> <li>• What are the driving forces of digital transformation?</li> <li>• What are the reasons for the increase in the popularity of digitalization in research and practice?</li> <li>• What is the relation between digital transformation and smart city?</li> <li>• Which are important technological trends that affect the digital transformation and enable creation of new innovative business models towards green smart cities of the future?</li> </ul>
<b>Formative Assessment Activities:</b>	<ul style="list-style-type: none"> <li>• No formative assessment activity in the first part.</li> </ul>



	<ul style="list-style-type: none"><li>• A short knowledge survey (quiz) on how learners perceive digital transformation will be created.</li></ul>
--	--

## IMPLEMENTATION OF THE LESSON PLAN

### Beginning of the Lesson (10 minutes)

First, the idea of the whole teaching program will be presented briefly. After that, the structure of the first module and the instructors will be introduced together with the course objectives and the learning outcomes of the whole module and the first part. Short knowledge survey on how learners perceive digital transformation will be created at the beginning.

### Heart of the Lesson (70 minutes)

#### **PART A (30 min)**

In the first part, a discussion on the view of future society will be initiated. Learners will be asked to present their views. The discussion will continue by focusing on a green future concept. Learners will provide their views either in a paper format or by using the software. After an initial discussion, a few ideas will be selected and presented to all learners. Learners will try to reach a consensus on a common definition. Once parts of a definition will be agreed upon, learners will try to identify measures for a green future using the same methods (paper or software). These potential measures will be saved throughout the whole of Module 2. The lecture will continue with PowerPoint presentations and videos presenting established definitions regarding sustainability and a green future. Learners will have the option to modify their measures based on new knowledge.

#### **PART B (40 min)**

The lecture will be based on PowerPoint presentation, videos, and readings from the relevant topics, covering the following:

- the concept of digital transformation as a driving force of changes focusing on key areas of digitalization: customer experience (including customer engagement), business model and process digitization.



- A conceptual standpoint with change management (organizational change) showing the possibilities to apply the concept through city perspective (digitalization of urban mobility).
- The reasons for the increase in the popularity of digitalization in research and practice.
- Important technological trends that affect the digital transformation of smart cities towards sustainable development.
- Presentation of innovative business models
- Emphasizing the importance of disruptive technology in the creation of innovative business ecosystems.

Results of the short knowledge survey on how learners perceive digital transformation will be reviewed. The instructor will compare the results with the lecture content and discuss them with the learners to set the common basis for the introduced concepts being used later during this module.

### **Closure Activity (10 minutes)**

At the end of the first hour, the topic will be summarized by the instructor. In addition, the objectives of the module will be revised. Selected learners will be asked to give a reflection on what they have learned in a one-minute oral presentation.



## HOURS 3 & 4: Smart mobility and the green future

<b>Lesson Title:</b>	<b>Smart mobility and the green future</b>
<b>Related Learning Outcomes:</b>	<p>In this lesson, learners will gain an understanding of:</p> <ul style="list-style-type: none"> <li>• smart mobility dimension of the smart city concept.</li> <li>• the interplay between smart mobility and a green future.</li> <li>• innovative business models and case studies.</li> </ul>
<b>Duration of the Lesson:</b>	70
<b>Dominant Instructional Method:</b>	<ul style="list-style-type: none"> <li>• Lecture</li> <li>• Video presentations</li> <li>• Discussions</li> </ul>
<b>Instructional Materials:</b>	<ul style="list-style-type: none"> <li>• PowerPoint slides</li> <li>• Videos</li> <li>• Readings</li> </ul> <p>The teaching notes are available on the project website. In addition to teaching notes, the following reading materials are advised to gain knowledge about the concepts which will be introduced during the course:</p> <ul style="list-style-type: none"> <li>• Benevolo, C., Dameri, R. P., &amp; D'auria, B. (2016). Smart mobility in smart city. In Empowering organizations (pp. 13-28). Springer, Cham.</li> <li>• Clapp, C. (2018). Investing in a green future. Nature Clim Change 8, 96–97.</li> <li>• Shemyakina T.Y., Astafieva O.E., Gorelova O.A. (2021) Scenarios of Smart Cities Creation as a Trend of Sustainable Development. In: Popkova E.G., Sergi B.S. (eds) "Smart Technologies" for Society, State and Economy. ISC 2020.</li> </ul>



	<p>Lecture Notes in Networks and Systems, vol 155. Springer, Cham.</p> <ul style="list-style-type: none"> <li>El-Sherif, D. M. (2021). Urban mobility systems components. In: Vacca, J. R. (eds) Solving urban infrastructure problems using smart city technologies. Elsevier.</li> </ul>
<b>Prerequisite Learning:</b>	No prerequisite knowledge is required.
<b>Discussion Questions:</b>	<ul style="list-style-type: none"> <li>What aspects of urban transport system are the most important?</li> <li>How is mobility a vital part of a thriving urban economy? How can mobility solutions that do not consider sustainability also be detrimental to urban life?</li> <li>What are the top priority problems in urban areas and how can they be solved?</li> </ul>
<b>Formative Assessment Activities:</b>	<ul style="list-style-type: none"> <li>Solving true/false questions through a web application, followed by a short discussion about results.</li> </ul>

## IMPLEMENTATION OF THE LESSON PLAN

### Beginning of the Lesson (5 minutes)

The agenda and the purpose of the current hour will be presented along with short instructions on the formative assessment activity that will be given to the learners. We will shortly explain the importance of smart mobility in the context of urbanization, digitalization, and sustainable development.

### Heart of the Lesson (55 minutes)

We will present the smart mobility dimension of the smart city concept considering the green future. The lesson will be divided into 7 parts. In the first part (5 min), we will remind them of the smart city concept and its characteristics. We will highlight the role of smart mobility in





the smart city concept. In the second part (5 min), we will briefly introduce the following parts of a smart mobility system: Intelligent transportation systems (ITS), automotive technology, information, and communication technologies (ICT) and embedded systems. In the third part (15 min), we will explain ITS and ICT in more detail, focusing on the data collection, data analysis and data/information transfer processes in ITS. In the fourth part (10 min), we will ask them to write their associations regarding smart mobility applications. For this exercise, a computer application will be used to gather their answers. We will go through them together and sort them into the appropriate smart mobility areas by Faria et al.'s (2017) division of it. In the sixth part (10 min), we will touch on the sustainability aspect of smart mobility. In the seventh part (10 min), we will present some real-life examples of cities around the world that implemented smart mobility activities to solve various challenges related to urbanization.

### Closure Activity (10 minutes)

At the end of this hour briefly summarize the main insights and present the students with the instructions for an assessment activity, which will be held online with the use of a web application. The true/false questions asked are the following (taken from the book Solving urban infrastructure problems using smart city technologies; Elsevier; ed. Vacca; 2021)

True/false questions:

- Rapid urbanization occurring across the world increased the volume of passengers and freight moving within urban areas.
- There are several terminologies highly interconnected with mobility, namely transportation, accessibility, and urban mobility.
- Mobility is not just having access to two modes of transportation options that anyone can count on to get to the desired destination.
- Accessibility should not be at the core of urban mobility.
- Mobility is approached as a service: the method by which we procure food, engage in economic activity, access entertainment, or meet with friends and family – all through seamless movements from place to place.



## HOURS 5 & 6: Towards a smart society

<b>Lesson Title:</b>	<b>Towards a smart society</b>
<b>Related Learning Outcomes:</b>	<p>In this lesson, learners will be able to:</p> <ul style="list-style-type: none"> <li>• gain an understanding of the concept of a smart city and smart community.</li> <li>• assess the advantages and disadvantages of implementing smart city initiatives.</li> <li>• evaluate the difference between smart and traditional cities.</li> <li>• assess future trends related to smart cities.</li> <li>• gain an understanding of the user adoption of the concept.</li> </ul>
<b>Duration of the Lesson:</b>	70
<b>Dominant Instructional Method:</b>	<ul style="list-style-type: none"> <li>• Lecture</li> <li>• Video presentations</li> <li>• Discussions</li> </ul>
<b>Instructional Materials:</b>	<ul style="list-style-type: none"> <li>• PowerPoint slides</li> <li>• Videos</li> <li>• Readings</li> </ul> <p>The teaching notes are available on the project website. In addition to teaching notes, the following reading materials are advised to gain knowledge about the concepts which will be introduced during the course:</p> <ul style="list-style-type: none"> <li>• Eremia, M., Toma, L., &amp; Sanduleac, M. (2017). The smart city concept in the 21st century. <i>Procedia Engineering</i>, 181, 12-19.</li> <li>• Novotný, R., Kuchta, R., &amp; Kadlec, J. (2014). Smart city concept, applications, and services. <i>Journal of</i></li> </ul>



	<p>Telecommunications System &amp; Management, 3(2), 1-5.</p> <ul style="list-style-type: none"> <li>Nam, T., &amp; Pardo, T. A. (2011, June). Conceptualizing a smart city with dimensions of technology, people, and institutions. In Proceedings of the 12th annual international digital government research conference: digital government innovation in challenging times (pp. 282-291).</li> <li>Meerow, S., Newell, J. P., &amp; Stults, M. (2016). Defining urban resilience: A review. Landscape and urban planning, 147, 38-49.</li> <li>Ribeiro, P. J. G., &amp; Gonçalves, L. A. P. J. (2019). Urban resilience: A conceptual framework. Sustainable Cities and Society, 50,</li> <li>Fakhimi, A. H., Khani, A. H., &amp; Sardroud, J. M. (2021). Smart-city infrastructure components. In: Vacca, J. R. (eds) Solving urban infrastructure problems using smart city technologies. Elsevier.</li> </ul>
<b>Prerequisite Learning:</b>	No prerequisite knowledge is required.
<b>Discussion Questions:</b>	<ul style="list-style-type: none"> <li>What are the main characteristics of a smart city?</li> <li>What role does technology play in a smart city?</li> <li>Which systems can a smart city concept be applied to?</li> <li>Which are the main principles of urban resilience?</li> <li>What is the relationship between smart cities, urban resilience, and digital transformation?</li> <li>What are the benefits of smart cities considering urban resilience measures?</li> </ul>



	<ul style="list-style-type: none"><li>• What are the resilience-related risks and challenges of digital cities?</li></ul>
<b>Formative Assessment Activities:</b>	<ul style="list-style-type: none"><li>• A short group work assignment on how to apply innovative business models and services presented in the previous parts into a concrete domain specific example.</li></ul>

## IMPLEMENTATION OF THE LESSON PLAN

### Beginning of the Lesson (10 minutes)

First, the agenda and the purpose of the current hour will be presented along with short instructions on the formative assessment activity that will be given to the learners.

### Heart of the Lesson (30 minutes)

We will present the basic concept of a smart city through the lens of sustainable and green development as well as explain the main characteristics that define a modern smart city in terms of economics, environment, resources, resilience, innovativeness, liveableness, and inclusiveness.

We'll explain the role of technology in the smart city and present short case studies of best practices to reflect the applicability of the smart city concept to various ecosystems. Next, we'll introduce and define the main principles of urban resilience and substantiate their applicability to foster smart city development through urban planning. We'll also discuss the relations in the "golden sustainable development triangle", namely smart city, urban resilience, and digital transformation. Finally, we'll present the benefits and the challenges of a smart city implementing urban resilience measures.

### Closure Activity (30 minutes)



At the end of this hour, we'll briefly summarize the main insights and present the students with the instructions for an assessment activity, which will take place in a form of group work, where students will be given the real city case aiming to prepare the initial framework to foster the smart and resilient development of that specific city.





## HOURS 7 & 8: Managerial implications

Lesson Title:	Managerial implications
Related Learning Outcomes:	<p>In this lesson, learners will gain an understanding of:</p> <ul style="list-style-type: none"> <li>the concept of business intelligence and analytics.</li> <li>the concept of change management.</li> <li>governance frameworks.</li> </ul>
Duration of the Lesson:	135
Dominant Instructional Method:	<ul style="list-style-type: none"> <li>Lecture</li> <li>Video presentations</li> <li>Group work</li> <li>Discussions</li> </ul>
Instructional Materials:	<ul style="list-style-type: none"> <li>PowerPoint slides</li> <li>Videos</li> <li>Readings</li> </ul> <p>The teaching notes are available on the project website. In addition to teaching notes, the following reading materials are advised to gain knowledge about the concepts which will be introduced during the course:</p> <ul style="list-style-type: none"> <li>By, R. T. (2005). Organisational change management: A critical review. Journal of change management, 5(4), 369-380.</li> <li>Saqib, M., Qudah, E. Z. T., Hamad, B. M. I., &amp; Al Ghassani, K. S. A. (2018). Systematic &amp; Synthesized Critical Literature of Big Data, Business Intelligence-Analytics &amp; Smart Cities to the Current Era. The Journal of Social Sciences Research, 139-146.</li> </ul>
Prerequisite Learning:	No prerequisite knowledge is required.



<b>Discussion Questions:</b>	<ul style="list-style-type: none"> <li>• What is perceived by business intelligence and analytics (BI &amp; A)?</li> <li>• What are the main issues behind change management?</li> <li>• How can BI&amp;A support the digital transition and organizational change?</li> <li>• How should future smart city development be governed?</li> <li>• Why is efficient development policy planning (and implementation) important?</li> <li>• How should efficient policy development plan including BI &amp; A approaches be prepared to support decision making processes at the governance level?</li> <li>• How should green future be measured (referring to introduction Part 1)?</li> </ul>
<b>Formative Assessment Activities:</b>	<ul style="list-style-type: none"> <li>• Group assignment: preparation of the strategy for specific city/community to become leading smart mobility city/community in the region including the aspects of green future</li> </ul>

## IMPLEMENTATION OF THE LESSON PLAN

### Beginning of the Lesson (5 minutes)

Firstly, the teaching objective and learning outcomes will be presented. Group assignment will be briefly described and introduced (detailed explanation will be given before the assignment in the heart of the lesson).

### Heart of the Lesson (115 minutes)



### **PART A (45 min)**

The lecture will be based on PowerPoint presentation, videos, and readings from the relevant topics, covering the following:

- Presentation of the Business Intelligence and Analytics (BI&A) concept as one of the key factors of modern economies and a prominent enabler of a digital transformation process.
- Explanation of the intersection of BI&A with the change management concept
- Providing insights into organizational change management process covering its important aspects and approaches.
- Preparation of the change management strategy.
- Management and governance of digital transition and organizational change through decision-making based on policy planning and implementation.
- Presentation of various policy-making models.

### **PART B (70 min)**

Group assignments will be given. Learners will be divided into groups consisting of 4-6 learners (depending on the size of the class as well as the backgrounds and interests of the learners). Each group will need to prepare the strategy for “their selected” city/community to become the leading smart mobility city in the region.

Each learner in the group will have a specific role (e.g. representative of the city administration, representative of the city decision-making body, representative of a smart ICT system vendor, representative of the early adopter citizen, representative of the negativistic citizen representative of the smart mobility and/or green-oriented NGO institution, mayor...) having a specific, role-related responsibility (e.g. participant that will have the role of the mayor will need to prepare electoral program as he/she would be running for the mayor on green mobility/smart city of his/her city).

During the preparation of the strategy, specific representatives from each group can organize meetings to discuss topics of interest (simulating e.g., Covenant of Mayor event, Smart cities IoT platforms developers’ events etc.) to exchange good practices from different cities. It will be done by using the jigsaw method so that learners having the same role in different cities will join the same table and discuss relevant challenges and issues. After their meeting and discussion, learners will be rejoined their selected city/community and further discuss the opportunities, targets and policies.



The outcome of the group assignment will be the smart city development strategy consisting of at least one policy implementation plan prepared based on one of the models presented during the lecture. After each group finishes with the initial strategy preparation, all groups will evaluate the work of the other groups providing them with relevant feedback, upon which the initial strategies will be improved. At the end of the assignment, groups will briefly present their strategy to other learners and the instructor, who will lead the debate and discussion about the tackled topics striving to reach common nexus towards green and sustainable development of future smart cities among the participants.

### **Closure Activity (15 minutes)**

At the end of the whole Module and covered topics will be summarized by the instructor. In addition, the objectives of the module will be revised. A short discussion on learning outcomes will also be initiated.



## MODULE #3: ENERGY-RELATED SMART GRIDS

### INSTRUCTOR INFORMATION

**Instructors:** Aleš Groznik, Bor Krizmanič

**E-mails:** [ales.groznik@ef.uni-lj.si](mailto:ales.groznik@ef.uni-lj.si), [bor.krizmanic@ef.uni-lj.si](mailto:bor.krizmanic@ef.uni-lj.si)

### HOOR 1: Overview of the Course & Introduction to Electrical Grid

<b>Lesson Title:</b>	<b>Overview of the course &amp; introduction of electrical grid</b>
<b>Related Learning Outcomes:</b>	Upon successful completion of this hour, learners will be able to: <ul style="list-style-type: none"><li>• Explain general concepts, components, and technologies regarding traditional power grids.</li></ul>
<b>Duration of the Lesson:</b>	50
<b>Dominant Instructional Method:</b>	Lecture, discussion, questioning, brainstorming.
<b>Instructional Materials:</b>	<p>The teaching notes are available on the project website. In addition to teaching notes, the following reading materials are advised to gain knowledge about the concepts which will be introduced during the course.</p> <ul style="list-style-type: none"><li>• Sorebo, G. N., &amp; Echols, M. C. (2011). <i>Smart grid security: an end-to-end view of security in the new electrical grid</i>. CRC Press.- Chapter 1, 1.1. Definition: Traditional Power Grid</li><li>• Kaplan, S. M. (2009, April). Electric power transmission: background and policy issues. Library of Congress, Congressional Research Service.</li><li>• Bryant, S. T., Straker, K., &amp; Wrigley, C. (2018). The typologies of power: Energy utility business models in an increasingly</li></ul>





	<p>renewable sector. <i>Journal of Cleaner Production</i>, 195, 1032-1046.</p> <ul style="list-style-type: none"><li>• The Copper Development Association Inc. (n.d.). <i>Grid Infrastructure</i>. Retrieved from <a href="https://www.copper.org/environment/sustainable-energy/grid-infrastructure/">https://www.copper.org/environment/sustainable-energy/grid-infrastructure/</a></li></ul>
<b>Prerequisite Learning:</b>	<p>No prerequisite is required; however, learners are advised to read</p> <ul style="list-style-type: none"><li>• The teaching note which is available on the project website.</li><li>• Supplementary materials given in the next section.</li></ul>
<b>Discussion Questions:</b>	<ul style="list-style-type: none"><li>• What is electrical grid?</li><li>• What are the main components of the electrical grid?</li><li>• Why is topic of this module important?</li></ul>
<b>Formative Assessment Activities:</b>	<ul style="list-style-type: none"><li>• Questioning</li><li>• Mentimeter</li></ul>

## IMPLEMENTATION OF THE LESSON PLAN

### Beginning of the Lesson (20 minutes)

General information about the Module is given. Then, there is a brief introduction by lecturers and an informal discussion with participants to learn about and understand their background and knowledge of the overall module topics.

Learners will be informed about the module subjects of 8 hours and expected learning outcomes (10 min).

Learners get an exam to test their pre-lecture knowledge on the topic of the module (10 min).



Pre-post evaluation  
questions Module 3.d

The introductory part is concluded with a short presentation of why the topic of this module is important (5 min).



### Heart of the Lesson (25 minutes)

Learners will be asked to discuss why they think this topic is important.

The instructor will make a brief introduction to the topic of the electrical grid and its importance. The instructor will be using the lecture presentation slides.

Learners will be asked to use the Mentimeter tool to answer the question “What is the electrical grid?”. This activity will be followed by a short discussion about the results.

Next, the teacher will give a lecture on the electrical grid. The instructor will be using the lecture presentation slides.

### Closure Activity (5 minutes)

The instructor will make a summary of the lecture (key takeaway points).



## HOOR 2: Current Energy Usage, Renewable Energy Sources and Smart Grid

<b>Lesson Title:</b>	<b>Current Energy Usage, Renewable Energy Sources and Smart Grid</b>
<b>Related Learning Outcomes:</b>	<p>Upon successful completion of this hour, learners will be able to:</p> <ul style="list-style-type: none"> <li>• List and differentiate between different energy sources.</li> <li>• Know approximate ratios in the use of different energy sources.</li> <li>• Explain problems with renewable energy sources.</li> <li>• Explain the concept of smart grids.</li> </ul>
<b>Duration of the Lesson:</b>	50
<b>Dominant Instructional Method:</b>	Lecture, discussion, questioning.
<b>Instructional Materials:</b>	<p>The teaching notes are available on the project website. In addition to teaching notes, the following reading materials are advised to gain knowledge about the concepts which will be introduced during the course.</p> <ul style="list-style-type: none"> <li>• Sorebo, G. N., &amp; Echols, M. C. (2011). Smart grid security: an end-to-end view of security in the new electrical grid. CRC Press. - Chapter 1, 1.1. Definition: Traditional Power Grid</li> </ul>
<b>Prerequisite Learning:</b>	Attendance at the first lesson of module 3. No other prerequisite knowledge is needed.
<b>Discussion Questions:</b>	<ul style="list-style-type: none"> <li>• What are the problems associated with fossil fuels?</li> <li>• List the different renewable energy sources.</li> <li>• Which energy sources are the most important in the production of electricity?</li> <li>• What is a smart grid?</li> </ul>



<b>Formative Assessment Activities:</b>	<ul style="list-style-type: none"><li>• Questioning</li><li>• Active participation</li></ul>
---	--



## IMPLEMENTATION OF THE LESSON PLAN

### Beginning of the Lesson (10 minutes)

The lesson starts with a Kahoot quiz to look at what was discussed in the previous lesson and to test knowledge of the topic of the second lesson. The quiz is followed by a short discussion about the results of the quiz.

1. Q: What are the main components of the electrical grid?  
A: Power or generating plants, electrical substations, transmission network, distribution network, consumers.
2. Q: What is the number one problem for current power grids on a daily basis?  
A: Problems with peaks.
3. Q: In your opinion, which renewable energy source is currently the most important in global electricity generation?  
A: Hydropower energy
4. Q: In your opinion, what is the main problem of renewable energy sources to ensure the stable operation of the electricity grid?  
A: Unstable electricity production pattern.

### Heart of the Lesson (40 minutes)

The instructor begins with a lecture on established energy sources. The instructor tries to get the students involved by helping them list (5 min).

Then, the instructor follows a short discussion on nuclear energy (5 min).

The instructor presents the problems of fossil fuels, global primary energy consumption, and renewable energy sources (15 min).

Lastly, the instructor follows the presentation of the smart grid (15 min).

### Closure Activity (0 minutes)

This hour does not have any special closure activity.



## HOOR 3: Smart Meter and Prosumers

<b>Lesson Title:</b>	<b>Smart meter and Prosumers</b>
<b>Related Learning Outcomes:</b>	Upon successful completion of this hour, learners will be able to: <ul style="list-style-type: none"><li>• Know what smart meter is.</li><li>• Explain the concept of smart metering.</li><li>• Explain the concept of prosumer.</li></ul>
<b>Duration of the Lesson:</b>	50
<b>Dominant Instructional Method:</b>	Simulation, lecture, discussion, questioning
<b>Instructional Materials:</b>	The teaching notes are available on the project website.
<b>Prerequisite Learning:</b>	Attendance at the first lesson of module 3. No other prerequisite knowledge is needed.
<b>Discussion Questions:</b>	<ul style="list-style-type: none"><li>• What is smart meter?</li><li>• What are benefits of smart metering?</li><li>• Who is a prosumer?</li></ul>
<b>Formative Assessment Activities:</b>	<ul style="list-style-type: none"><li>• Individual participation in the simulation</li><li>• Questioning</li><li>• Active participation</li></ul>

### IMPLEMENTATION OF THE LESSON PLAN

#### Beginning of the Lesson (10 minutes)

The lesson starts with an online interactive simulation. The aim is for learners to better understand the concept of a smart grid and the difference between a traditional grid. Learners visit the webpage with the tool, click through the simulation and read the explanations, but don't focus on the descriptions of the JRC action. In the end, a short discussion is performed if the learners find something particularly interesting.

#### Heart of the Lesson (40 minutes)





The instructor presents concepts of smart meters and smart metering (20 min).

A short discussion on the topic what it means to be a prosumer (5 min).

The instructor presents concepts of prosumer (15 min).

### **Closure Activity (5 minutes)**

A very short summary of the module up to this point: Selected learners will be asked to tell in a few sentences what they have learned so far. Other learners can participate. The instructor helps learners list and describe the topics.



## HOUR 4: Introduction of Renewable Energy Sources into a Grid & Photovoltaics Example

<b>Lesson Title:</b>	<b>Introduction of Renewable Energy Sources into a Grid &amp; Photovoltaics Example</b>
<b>Related Learning Outcomes:</b>	<p>Upon successful completion of this hour, learners will be able to:</p> <ul style="list-style-type: none"> <li>• Explain problems with renewable energy sources.</li> <li>• Explain the grid-tied solar PV system.</li> <li>• Understand the duck curve problem.</li> </ul>
<b>Duration of the Lesson:</b>	50
<b>Dominant Instructional Method:</b>	Lecture, discussion, questioning.
<b>Instructional Materials:</b>	<p>The teaching notes are available on the project website. In addition to teaching notes, the following reading materials are advised to gain knowledge about the concepts which will be introduced during the course.</p> <ul style="list-style-type: none"> <li>• California independent system operator. (2016). What the duck curve tells us about managing a green grid. Available on: <a href="https://www.caiso.com/Documents/FlexibleResourcesHelpRenewables_FastFacts.pdf">https://www.caiso.com/Documents/FlexibleResourcesHelpRenewables_FastFacts.pdf</a> (Accessed 20 January 2022).</li> </ul>
<b>Prerequisite Learning:</b>	Attendance at the first lesson of module 3. No other prerequisite knowledge is needed.
<b>Discussion Questions:</b>	<ul style="list-style-type: none"> <li>• What is the main problem with renewable energy sources in the grid?</li> <li>• What are the main components of rooftop PV system?</li> <li>• What specifically can be problematic for the power grid with solar energy?</li> </ul>
<b>Formative Assessment Activities:</b>	<ul style="list-style-type: none"> <li>• Participation in group work</li> </ul>



	<ul style="list-style-type: none"><li>• Questioning</li><li>• Active participation</li></ul>
--	--

## IMPLEMENTATION OF THE LESSON PLAN

### Beginning of the Lesson (5 minutes)

The lesson starts with a Kahoot quiz to look at what was discussed in the previous lesson and to test knowledge of the topic of the previous lesson. The quiz is followed by a short discussion about the results of the quiz and additional questions.

1. Which RES have the largest share on a global level? Sort them.
  - solar energy
  - natural gas
  - wind energy
  - hydro energy
  - nuclear energy
2. Discussion: Do any of the learners already have experience with their electricity production? If there is a prosumer among us, let him say something about his own experience.

### Heart of the Lesson (45 minutes)

The instructor presents problems the renewable energy sources in the context of power grid integration (10 min).

This is followed by an overview of photovoltaics (10 min) and an introduction of photovoltaics into the grid (5 min). Both are done by the instructor.

The whole second part of the lesson is dedicated to case study of problems with a large share of PV in California (20 min). First, the learners have to read the report by the California grid operator (10 min). Then the students have to discuss and answer the questions in groups. They present the answers which are combined by discussion (10 min).

### Closure Activity (0 minutes)

This hour does not have any special closure activity.



## HOOR 5: E-Mobility, Electric Vehicles & Battery Technologies

<b>Lesson Title:</b>	<b>E-Mobility, Electric Vehicles &amp; Battery Technologies</b>
<b>Related Learning Outcomes:</b>	<p>Upon successful completion of this hour, learners will be able to:</p> <ul style="list-style-type: none"> <li>• Explain the benefits of electric vehicles.</li> <li>• Understand the difference between different types of electric vehicles.</li> <li>• Discuss electro-mobility trends.</li> </ul>
<b>Duration of the Lesson:</b>	50
<b>Dominant Instructional Method:</b>	Lecture, discussion, questioning.
<b>Instructional Materials:</b>	<p>The teaching notes are available on the project website. In addition to teaching notes, the following reading materials are advised to gain knowledge about the concepts which will be introduced during the course.</p> <ul style="list-style-type: none"> <li>• ENTSO-E. (2021). ENTSO-E Position Paper: Electric Vehicle Integration into Power Grids. Available at: <a href="https://eepublicdownloads.entsoe.eu/clean-documents/Publications/Position%20papers%20and%20reports/210331_Electric_Vehicles_integration.pdf">https://eepublicdownloads.entsoe.eu/clean-documents/Publications/Position%20papers%20and%20reports/210331_Electric_Vehicles_integration.pdf</a></li> </ul>
<b>Prerequisite Learning:</b>	Attendance at the first lesson of module 3. No other prerequisite knowledge is needed.
<b>Discussion Questions:</b>	<ul style="list-style-type: none"> <li>• Have you ever used an electric vehicle?</li> <li>• Are you thinking of buying an electric vehicle?</li> <li>• What are your biggest concerns about using EVs?</li> <li>• What are different types of electric vehicles?</li> </ul>



	<ul style="list-style-type: none"><li>• Are electric vehicles cleaner than vehicles with internal combustion engines?</li></ul>
<b>Formative Assessment Activities:</b>	<ul style="list-style-type: none"><li>• Participation in group work</li><li>• Questioning</li><li>• Active participation</li></ul>

### IMPLEMENTATION OF THE LESSON PLAN

#### Beginning of the Lesson (15 minutes)

The lesson starts with a short group work, which is connected with a case study from hour 4. Group present their ideas in a relaxed discussion. The instructor moderates the discussion and potentially add some additional solutions as: peak-oriented renewable resources (e.g., hydropower), target energy efficiency to the hours when load ramps up sharply, energy storage in targeted locations (e.g., pumped-hydro energy facilities) batteries (electric vehicles), etc. (15 min).

#### Heart of the Lesson (30 minutes)

The instructor presents E-mobility and different types of electric vehicles (10 min). This is followed by a Kahoot quiz and discussion about learners' attitudes toward electric vehicles. Questions:

1. Have you ever used an electric vehicle?
  - never
  - once
  - occasionally
  - use EV only
2. Are you thinking of buying an electric vehicle?
  - yes
  - no
3. How likely is it that your next car will be electric?  
(5-point Likert scale)  
(10 min)



After the questions and answers, the instructor presents some trends and figures about EV adoption (5 min).

The instructor presents battery technologies used in E-mobility (10 min).

### **Closure Activity (5 minutes)**

For the closure activity, a short discussion about the topics of the lesson will be carried out.





## HOUR 6: Smart Changing

<b>Lesson Title:</b>	<b>Smart Changing</b>
<b>Related Learning Outcomes:</b>	<p>Upon successful completion of this hour, learners will be able to:</p> <ul style="list-style-type: none"> <li>• Describe the main types of EV charging.</li> <li>• Explain smart charging concept</li> <li>• Understand the challenges of some smart charging projects deployment</li> </ul>
<b>Duration of the Lesson:</b>	50
<b>Dominant Instructional Method:</b>	Lecture, discussion, case study, group work
<b>Instructional Materials:</b>	<p>The teaching notes are available on the project website. In addition to teaching notes, the following reading materials are advised to gain knowledge about the concepts which will be introduced during the course.</p> <ul style="list-style-type: none"> <li>• ENTSO-E. (2021). ENTSO-E Position Paper: Electric Vehicle Integration into Power Grids. Available at: <a href="https://eepublicdownloads.entsoe.eu/clean-documents/Publications/Position%20papers%20and%20reports/210331_Electric_Vehicles_integration.pdf">https://eepublicdownloads.entsoe.eu/clean-documents/Publications/Position%20papers%20and%20reports/210331_Electric_Vehicles_integration.pdf</a></li> </ul>
<b>Prerequisite Learning:</b>	Attendance at the first lesson of module 3. No other prerequisite knowledge is needed.
<b>Discussion Questions:</b>	<ul style="list-style-type: none"> <li>• What do you think "smart charging" of electric vehicles means?</li> <li>• What is the vehicle-to-grid (V2G) concept?</li> <li>• Do you see the potential for the V2G concept in your city/settlement?</li> </ul>
<b>Formative Assessment Activities:</b>	<ul style="list-style-type: none"> <li>• Participation in group work</li> <li>• Questioning</li> </ul>



- |  |  |
|--|--|
|  | <ul style="list-style-type: none"><li>• Active participation</li></ul> |
|--|--|

## IMPLEMENTATION OF THE LESSON PLAN

### Beginning of the Lesson (5 minutes)

A Kahoot quiz about the knowledge on the topic of this hour.

What do you think "smart charging" of electric vehicles means?

- A charging system where the battery of an electric vehicle is charged in the shortest possible time with a constant maximum possible power.
- A charging system where the electric vehicle does not need to be connected to a charging station. Charging is done wirelessly.
- A charging system where the vehicle owner leaves control of the charging of the electric vehicle to the car manufacturer.
- A charging system where, based on the sharing of data, the electric vehicle is charged at different speeds, according to different goals (lowest charging price, ensuring network stability, etc.).
- Other (write what you have in mind under the answer to the last question of the quiz)

The results of the quiz are briefly discussed in class (5 min).

### Heart of the Lesson (40 minutes)

The instructor presents electric vehicle charging (10 min).

Then, the instructor presents the smart charging concept (10 min).

The next section of the lesson is dedicated to the Utrecht case study of vehicle-to-grid charging. Initially, the class watches a video with certain interruptions and explanations by the instructor (10 min). Then, in groups, learners have to find solutions for various challenges related to smart charging and mobility in cities (10 min).

### Closure Activity (5 minutes)

A very short summary of hours 4, 5 and 6 of module 3: Selected learners will be asked to tell in a few sentences what they have learned during hours 4, 5 and 6. Other learners can participate. The instructor helps learners list and describe the topics.



## HOURS 7 & 8: Final Group Work Project

<b>Lesson Title:</b>	<b>Finale Group Work Project</b>
<b>Related Learning Outcomes:</b>	<p>Upon successful completion of this hour, learners will be able to:</p> <ul style="list-style-type: none"> <li>• Understand trends in challenges of current and future power grids</li> <li>• Identify and critically evaluate green energy initiatives related to transportation and mobility.</li> <li>• Compare and explain current and future trends in energy supply and consumption.</li> <li>• Identify and analyze the main challenges of future energy-related urban planning.</li> </ul>
<b>Duration of the Lesson:</b>	100
<b>Dominant Instructional Method:</b>	Group work, presentations, discussions
<b>Instructional Materials:</b>	The teaching notes are available on the project website.
<b>Prerequisite Learning:</b>	Attendance at the first lesson of module 3. No other prerequisite knowledge is needed.
<b>Discussion Questions:</b>	<ul style="list-style-type: none"> <li>• Are there restrictions for connecting to the grid (e.g., DSO permission to connect PV or charging station)?</li> <li>• What are the incentives for investments in smart grid incentives?</li> <li>• What is the possible business model of operation of SG technology?</li> </ul>
<b>Formative Assessment Activities:</b>	<ul style="list-style-type: none"> <li>• Participation in group work</li> <li>• Questioning</li> <li>• Active participation</li> </ul>

### IMPLEMENTATION OF THE LESSON PLAN



### **Beginning of the Lesson (10 minutes)**

In the initial part of the lesson, the instructor gives instructions for working in groups (10 min).

### **Heart of the Lesson (75 minutes)**

Learners in the groups work on their projects. The atmosphere is relaxed, learners can leave the classroom. The objective of the project is to deepen the learners' understanding of the concepts discussed in module 3 (power grid, RES, smart meters, EV, types of charging) through work on the project (40 min).

The groups present their projects (35 min).

### **Closure Activity (15 minutes)**

A short discussion about the topic of the module. Learners are encouraged to voice their opinions on topics discussed during the model and about the module itself (5 min).

Learners get an exam to test their post-lecture knowledge on the topic of the module (10 min).



Pre-post evaluation  
questions Module 3.d



## MODULE #4: GREEN VEHICLES AND GREEN PUBLIC TRANSPORTATION NETWORK DESIGN

### INSTRUCTOR INFORMATION

**Instructors:** Zafer Yılmaz, Gizem Çelik

**E-mails:** [zafer.yilmaz@tedu.edu.tr](mailto:zafer.yilmaz@tedu.edu.tr), [gizem.celik@tedu.edu.tr](mailto:gizem.celik@tedu.edu.tr)

**HOOR 1:** Review of the current public transportation means (Examples from European Cities)

<b>Lesson Title:</b>	<b>Review of the current public transportation means (Examples from European Cities)</b>
<b>Related Learning Outcomes:</b>	In this lesson, upon successful completion of this hour, learners will be able to: <ul style="list-style-type: none"><li>• Explain current public transportation technologies and identify public transportation in European cities.</li></ul>
<b>Duration of the Lesson:</b>	50
<b>Dominant Instructional Method:</b>	Lecture, discussion, questioning, brainstorming.
<b>Instructional Materials:</b>	The teaching notes and lecture presentations (PowerPoint slides) are available on the project website. In addition to teaching notes and lecture presentations, the following research are advised to gain knowledge about the concepts which will be introduced during the course. <ul style="list-style-type: none"><li>• Alkiviadis Tromaras, Efthymis Papadopoulos, Aggelos Aggelakakis, "The Future of the European Transport Sector: Identifying the Key Trends Regarding the Transport Concepts of the Future", INTERNATIONAL CONFERENCE ON TRAFFIC AND</li></ul>



	<p>TRANSPORT ENGINEERING - ICTTEAt: Belgrade, Serbia.</p> <ul style="list-style-type: none"> <li>• Doc. Ing. Marián Gogola, Doc. Mgr. Dana Sitanyiová, Ing. Ľubomír Černický, Ing. Milan Veterník, PhD., 2018, "NEW DEMAND PATTERNS FOR PUBLIC TRANSPORT DUE TO DEMOGRAPHIC CHANGE", Working Paper</li> <li>• ALEKSANDER JAGIEŁŁO, Agnieszka Wojtach, Aldona Łuczak, 2018, "REPORT BENCHMARKS FOR THE CURRENT PUBLIC TRANSPORT SYSTEMS", INNO BALTICA.</li> <li>• European Commission, Directorate-General Mobility and Transport, B-1049 Brussels, 2019, "Transport in the European Union Current Trends and Issues".</li> <li>• EU COMMISSION, STATISTICAL POCKETBOOK 2020, EU TRANSPORT in Figures.</li> </ul>
<b>Prerequisite Learning:</b>	<p>No prerequisite is required; however, learners are advised to read:</p> <ul style="list-style-type: none"> <li>• The teaching note which is available on the project website.</li> <li>• Supplementary materials given in the previous section.</li> </ul>
<b>Discussion Questions:</b>	<ul style="list-style-type: none"> <li>• What does the public transportation mean?</li> <li>• Which public transportation ways are used in the EU?</li> <li>• Do you know passenger transportation in the EU? Could you please give examples?</li> <li>• Can you guess private car and public transportation usage percentages in the EU?</li> <li>• Do you have any idea about public transportation in Ankara, Berlin, and Paris?</li> </ul>





<b>Formative Assessment Activities:</b>	<ul style="list-style-type: none"><li>• Mentimeter usage</li><li>• Questioning</li><li>• One-minute oral presentation</li></ul>
---	---



## IMPLEMENTATION OF THE LESSON PLAN

### Beginning of the Lesson (5 minutes)

The module and the instructors will be introduced first. The teaching objective and the learning outcomes of this hour will be explained. Next, learners will be asked a set of questions such as:

Q1: What are the basic goals of public transport operation?

Q2: Which one of the following is the most frequently used mode of public transport in Europe?

- a. buses and trolleybuses
- b. tram
- c. metro
- d. suburban rail

Q3: In 2018, total passenger transport activities in the EU-27 by any motorized means of transport are estimated to amount to 5916 billion km or on average around 13251 km per person. Please sort (from the highest to the lowest) the transport mode concerning its percentage in total passenger transport.

Passenger cars, powered two-wheelers, buses and coaches, railways, trams, and metros.

To capture learners' interest and motivation:

- The learners will be encouraged to ask questions.
- The learners will be asked to give information about public transportation in their cities.
- They will be asked to discuss the public transportation modes in the cities where they reside.

### Heart of the Lesson (35 minutes)

In addition to lecturing, other learner-centred instructional methods such as discussion, brainstorming, and questioning will be used in this hour for active student engagement

First, the instructor will teach the related information using the lecture presentation slides. The presentation (15 minutes) will include the following topics:



- Public transportation means
- Public transportation ways in the EU
- Passenger transportation in the EU
- Private car usage versus public transportation in the EU

Next, the following discussion and brainstorming are planned.

Discussion (6 minutes): Each topic will be discussed with the learners one by one respectively. A discussion question: Why do people use private cars rather than public transportation?

Brainstorming (3 minutes): How people can be encouraged to use public transportation means?

Next, the instructor will teach the related information using the lecture presentation slides. The presentation (5 minutes) will include the following topic:

- Public transportation in Ankara, Berlin, and Paris

Finally, the learners will be asked to talk about the following questioning topic:

Questioning (6 minutes): Can you question the public transportation in the city where you reside and tell us the pros and cons of public transportation in your city?

Detailed information about this hour will be available for the learners via the Lecture Notes document.

### **Closure Activity (10 minutes)**

At the end of this hour:

- The topic of this hour will be summarized by the instructor in 2-3 minutes.
- The instructor will ask a set of questions.
- Selected learners will be asked to tell in a minute what they have learned.
- “Mentimeter” will be used, and learners will be asked to write 3-5 words about what they think is important about this hour’s topic. The results will be shown on the screen.
- Learners will be asked to write one sentence about the most important concept that attracts their attention most.



## 

<b>Lesson Title:</b>	<b>Air pollution problems caused by the vehicles used in current public transportation</b>
<b>Related Learning Outcomes:</b>	<p>In this lesson, upon successful completion of this hour, learners will be able to:</p> <ul style="list-style-type: none"> <li>describe air pollution problems caused by the vehicles used in current public transportation.</li> </ul>
<b>Duration of the Lesson:</b>	50
<b>Dominant Instructional Method:</b>	Lecture, discussion, questioning, games.
<b>Instructional Materials:</b>	<p>The teaching notes and lecture presentations (PowerPoint slides) are available on the project website. In addition to teaching notes and lecture presentations, the following researches are advised to gain knowledge about the concepts which will be introduced during the course.</p> <ul style="list-style-type: none"> <li>Alkiviadis Tromaras, Efthymis Papadopoulos, Aggelos Aggelakakis, "The Future of the European Transport Sector: Identifying the Key Trends Regarding the Transport Concepts of the Future", INTERNATIONAL CONFERENCE ON TRAFFIC AND TRANSPORT ENGINEERING - ICTTEAt: Belgrade, Serbia.</li> <li>Doc. Ing. Marián Gogola, Doc. Mgr. Dana Sitanyiová, Ing. Ľubomír Černický, Ing. Milan Veterník, PhD., 2018, "NEW DEMAND PATTERNS FOR PUBLIC TRANSPORT DUE TO DEMOGRAPHIC CHANGE", Working Paper</li> <li>ALEKSANDER JAGIEŁŁO, Agnieszka Wojtach, Aldona Łuczak, 2018, "REPORT BENCHMARKS FOR THE</li> </ul>



	<p>CURRENT PUBLIC TRANSPORT SYSTEMS”, INNO BALTICA.</p> <ul style="list-style-type: none"> <li>• European Commission, Directorate-General Mobility and Transport, B-1049 Brussels, 2019, “Transport in the European Union Current Trends and Issues”.</li> <li>• EU COMMISSION, STATISTICAL POCKETBOOK 2020, EU TRANSPORT in Figures.</li> <li>• European Environment Agency. Transitions toward a More Sustainable Mobility System. EEA Report 34. TERM 2016: Transport Indicators Tracking Progress Toward Environmental Targets in Europe, 2016.</li> <li>• Ibarra-Rojas, O. J., F. Delgado, R. Giesen, and J. C. Munoz. Planning, Operation, and Control of Bus Transport Systems: A Literature Review. Transportation Research Part B: Methodological, Vol. 77, 2015, pp. 38–75.</li> </ul>
<b>Prerequisite Learning:</b>	<p>No prerequisite is required, however learners are advised to read:</p> <ul style="list-style-type: none"> <li>• The teaching note which is available on the project website.</li> <li>• Supplementary materials given in the previous section.</li> </ul>
<b>Discussion Questions:</b>	<ul style="list-style-type: none"> <li>• Are you aware of the air pollution caused by the vehicles used in current public transportation considering the vehicle types?</li> <li>• What is the air pollution amounts in EU countries (i.e. Ankara, Berlin and Paris)?</li> <li>• What is the fuel usage proportions with respect to different transport vehicles?</li> <li>• How the private cars of the learners contribute air pollution?</li> </ul>



<b>Formative Assessment Activities:</b>	<ul style="list-style-type: none"><li>• Mentimeter usage</li><li>• Questioning</li><li>• One-minute oral presentation</li></ul>
---	---



## IMPLEMENTATION OF THE LESSON PLAN

### Beginning of the Lesson (5 minutes)

The module and the instructors will be introduced first. The teaching objective and the learning outcome of this hour will be explained. Next, learners will be asked a set of questions:

Q1: CO<sub>2</sub> emissions and air pollution from all sectors are the major environmental concerns. Which one of the following sectors causes the highest CO<sub>2</sub> emissions in the EU in 2018?

- |                |                      |
|----------------|----------------------|
| a. residential | b. energy industries |
| c. transport   | d. industry          |

Q2: Because transportation emissions and exposure tend to be co-located in urban areas, transportation-attributable fractions (TAF) and associated air pollution deaths for urban areas in the EU are estimated. The urban areas with the highest number of transportation-attributable air pollution deaths are a combination of those with the largest populations and transportation emissions. Please sort (from highest to lowest) the following top 10 EU cities with the highest TAFs.

Berlin, Milan, Kyiv, London, Turin, Stuttgart, Haarlem, Cologne, Leeds, Rotterdam.

To capture learners' interest and motivation:

- The learners will be encouraged to ask questions.
- The learners will be asked to talk about if they are aware of the air pollution problems caused due to private car usage.

### Heart of the Lesson (35 minutes)

In addition to lecturing, other learner-centred instructional methods such as discussion and game playing will be used in this hour for active student engagement

First, the instructor will teach the related information using the lecture presentation slides. The presentation (22 minutes) will include the following topics:

- Air pollution caused by the vehicles used in current public transportation



- Air pollution in EU countries (i.e. Ankara, Berlin and Paris)
- Fuel Usage concerning different transport vehicles

Game Playing (8 minutes): A game will be played – Participants will be asked to write down;

- their daily private car usage
- their estimation of possible fuel consumption caused by their private cars
- their estimation of CO2 emissions caused by their private cars

Next, the excel file which includes fuel consumption and CO2 emissions concerning different vehicles will be shown on the screen and learners will be asked to calculate their real daily CO2 emissions caused by their private cars. They will be asked to compare what they have estimated and what is the reality.

Finally, the learner with the lowest CO2 emission will win the game and get a present from the instructor.

Discussion (5 minutes): Each topic will be discussed with the learners one by one respectively. A discussion question: How people can be encouraged to use public transportation means?

Detailed information about this hour will be available for the learners via the Lecture Notes document.

### **Closure Activity (10 minutes)**

At the end of this hour:

- The topic of this hour will be summarized by the instructor in 2-3 minutes.
- The instructor will ask a set of questions.
- Selected learners will be asked to tell in a minute what they have learned.
- “Mentimeter” will be used and learners will be asked to write 3-5 words about what they think is important about this hour’s topic. The results will be shown on the screen.
- Learners will be asked to write one sentence about the most important concept that attract their attention most.





### HOOR 3: Green public vehicles to be used in future smart cities

<b>Lesson Title:</b>	<b>Green public transportation vehicles to be used in future smart cities</b>
<b>Related Learning Outcomes:</b>	Upon successful completion of this hour, learners will be able to: <ul style="list-style-type: none"> <li>Describe green vehicles used in public road transportation especially based on fuel types.</li> </ul>
<b>Duration of the Lesson:</b>	50
<b>Dominant Instructional Method:</b>	Lecture, discussion, questioning
<b>Instructional Materials:</b>	The teaching notes and lecture presentations (PowerPoint slides) are available on the project website. In addition to teaching notes and lecture presentations, the following researches are advised to gain knowledge about the concepts which will be introduced during the course. <ul style="list-style-type: none"> <li>IEA, C. (2020). Global ev outlook 2020. URL: <a href="https://www.iea.org/reports/global-ev-outlook-2020">https://www.iea.org/reports/global-ev-outlook-2020</a>.</li> <li>European Commission, Directorate-General Mobility and Transport, B-1049 Brussels, 2019, "Transport in the European Union Current Trends and Issues".</li> </ul>
<b>Prerequisite Learning:</b>	No prerequisite is required, however learners are advised to read; <ul style="list-style-type: none"> <li>The teaching note which is available on the project website.</li> <li>Supplementary materials given in the previous section.</li> </ul>
<b>Discussion Questions:</b>	<ul style="list-style-type: none"> <li>Are you aware of green transportation vehicle or clean vehicle is a road motor vehicle that produces less harmful impacts to the environment than the equivalent conventional internal combustion engine vehicles that run on gasoline or diesel?</li> <li>What are the types of green vehicles?</li> <li>What is the current status of green public transportation vehicles in road transportation?</li> </ul>
<b>Formative Assessment Activities:</b>	<ul style="list-style-type: none"> <li>Questions</li> <li>Quiz</li> </ul>



## IMPLEMENTATION OF THE LESSON PLAN

### Beginning of the Lesson (5 minutes)

The teaching objective and the learning outcome of this hour will be explained. Next, learners will be asked a set of questions:

Q1: Increasing pollution caused by the transportation sector due to CO<sub>2</sub> emissions raises the importance of green vehicle use all around the world. What are the types of green vehicles used in Europe considering fuel types?

To capture learners' interest and motivation:

- The learners will be encouraged to ask questions.
- The learners will be asked to talk about if they are aware of green vehicles.

### Heart of the Lesson (35 minutes)

In addition to lecturing, other learner-centred instructional methods such as discussion and quizzes will be used in this hour for active student engagement.

First, the instructor will teach the related information using the lecture presentation slides. The presentation (20 minutes) will include the following topics:

- Green vehicles
- Current status of green public transportation vehicles
- Future projected green public transportation vehicles

Quiz (10 minutes): there is a short quiz which consists of matching questions about the number of buses used in public transportation in different EU countries by fuel type. The focus of this quiz is to increase the awareness of participants about fuel types used in public road transportation in EU countries.

Next, the figure which includes fuel types and EU countries will be shown on the screen and learners will be asked to analyze it. They will be asked to compare what they have estimated and what is the reality.

Finally, The learner with the highest grade will win the game and get a present from the instructor.

Discussion (5 minutes): Each topic will be discussed with the learners one by one respectively. A discussion question: How people can be encouraged to use green vehicles?



Detailed information about this hour will be available for the learners via the Lecture Notes document.

### Closure Activity (10 minutes)

At the end of this hour;

- The topic of this hour will be summarized by the instructor in 2-3 minutes.
- The instructor will ask a set of questions.
- Selected learners will be asked to tell in a minute what they have learned.
- “Mentimeter” will be used and learners will be asked to write 3-5 words about what they think is important about this hour’s topic. The results will be shown on the screen.
- Learners will be asked to write one sentence about the most important concept that attracts their attention most.

	Petrol	Diesel	Battery electric	Plug-in hybrid	Hybrid electric	Natural gas	LPG	Other	Unknown
Austria	0.0 %	96.2 %	1.6 %	–	0.4 %	1.6 %	0.0 %	0.2 %	0.0 %
Belgium	0.7 %	92.8 %	0.3 %	0.0 %	5.5 %	0.1 %	0.0 %	0.0 %	0.5 %
Croatia	0.0 %	100.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %
Czech Republic	0.0 %	89.2 %	0.3 %	0.0 %	0.1 %	6.7 %	0.0 %	0.6 %	3.2 %
Denmark	0.4 %	96.7 %	1.0 %	0.3 %	0.0 %	1.7 %	–	0.0 %	0.0 %
Estonia	4.2 %	91.6 %	0.0 %	–	0.8 %	3.4 %	0.0 %	0.0 %	0.0 %
Finland	0.2 %	98.8 %	0.5 %	0.0 %	0.0 %	0.3 %	0.0 %	0.1 %	0.0 %
France	0.0 %	97.1 %	0.3 %	0.0 %	0.9 %	1.4 %	0.2 %	0.0 %	0.0 %
Germany	0.1 %	96.8 %	0.5 %	0.0 %	1.2 %	1.3 %	0.0 %	0.0 %	0.0 %
Greece	0.0 %	96.1 %	0.0 %	0.0 %	0.0 %	3.9 %	0.0 %	0.0 %	0.0 %
Hungary	0.3 %	97.5 %	0.1 %	–	0.5 %	1.3 %	0.2 %	0.0 %	–
Ireland	0.0 %	100.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %
Italy	0.4 %	93.8 %	0.5 %	–	0.1 %	4.7 %	0.3 %	0.0 %	0.0 %
Latvia	0.2 %	99.3 %	0.2 %	0.0 %	–	0.2 %	0.1 %	0.0 %	0.0 %
Lithuania	0.1 %	83.2 %	10.2 %	0.0 %	0.0 %	0.3 %	0.0 %	0.0 %	6.3 %
Luxembourg	0.1 %	86.8 %	5.0 %	0.0 %	5.3 %	2.8 %	0.0 %	0.0 %	0.0 %
Netherlands	0.1 %	84.7 %	7.6 %	0.0 %	1.3 %	6.0 %	0.0 %	0.1 %	0.2 %
Poland	3.4 %	79.7 %	0.3 %	0.0 %	0.3 %	0.7 %	0.6 %	0.1 %	14.9%*
Portugal	0.0 %	97.5 %	0.2 %	0.0 %	0.0 %	2.0 %	0.0 %	0.0 %	0.3 %
Romania	0.0 %	98.9 %	0.1 %	0.0 %	0.0 %	0.5 %	0.0 %	0.0 %	0.5 %
Slovakia	0.4 %	94.5 %	0.5 %	0.0 %	0.0 %	2.5 %	0.0 %	0.0 %	2.1 %
Slovenia	0.1 %	95.7 %	0.0 %	0.0 %	0.0 %	4.0 %	0.0 %	0.0 %	0.3 %
Spain	0.2 %	93.0 %	0.2 %	0.1 %	1.8 %	4.5 %	0.0 %	0.0 %	0.0 %
Sweden	0.2 %	78.5 %	1.8 %	0.0 %	1.0 %	17.6 %	0.0 %	0.8 %	0.0 %
EUROPEAN UNION	0.8 %	94.5 %	0.6 %	0.0 %	0.7 %	2.7 %	0.2 %	0.1 %	0.3 %

Source: <https://www.acea.auto/publication/report-vehicles-in-use-europe-january-2021/>



## **HOUR 4: Integration of green and intelligent public transportation vehicles into future public transportation technologies**

<b>Lesson Title:</b>	<b>Integration of green and intelligent public transportation vehicles into future public transportation technologies.</b>
<b>Related Learning Outcomes:</b>	<p>Upon successful completion of this hour, learners will be able to:</p> <ul style="list-style-type: none"> <li>describe intelligent transportation systems</li> <li>explain the integration of green and intelligent public transportation system for more sustainable transportation in future smart cities.</li> </ul>
<b>Duration of the Lesson:</b>	50
<b>Dominant Instructional Method:</b>	Lecture, discussion, questioning
<b>Instructional Materials:</b>	<p>The teaching notes and lecture presentations (PowerPoint slides) are available on the project website. In addition to teaching notes and lecture presentations, the following research is advised to gain knowledge about the concepts which will be introduced during the course.</p> <ul style="list-style-type: none"> <li>ERTICO – ITS Europe (editor). (2019). Intelligent Transport Systems (ITS) and SUMPs – making smarter integrated mobility plans and policies. Retrieved from: <a href="https://www.eltis.org/sites/default/files/the_role_of_intelligent_transport_systems_its_in_sumps.pdf">https://www.eltis.org/sites/default/files/the_role_of_intelligent_transport_systems_its_in_sumps.pdf</a>.</li> <li>United Nations, 2021, “Sustainable Transport, Sustainable Development”, Interagency Report for Second Global Sustainable Transport Conference, 59-68.</li> <li>SLOCAT. (2021). Transport action and voluntary national reviews 2021: Achieving the Sustainable Development Goals in times of change. 2021. Retrieved from <a href="https://slocat.net/wp-content/uploads/2021/10/SLOCAT-2021-VNR-Analysis_Final-Report.pdf">https://slocat.net/wp-content/uploads/2021/10/SLOCAT-2021-VNR-Analysis_Final-Report.pdf</a>.</li> </ul>
<b>Prerequisite Learning:</b>	<p>No prerequisite is required, however learners are advised to read;</p> <ul style="list-style-type: none"> <li>The teaching note which is available on the project website.</li> <li>Supplementary materials given in the previous section.</li> </ul>



<b>Discussion Questions:</b>	<ul style="list-style-type: none"><li>• Are you aware of intelligent public transportation system?</li><li>• What do you understand from the integration of green and intelligent public transportation system?</li><li>• Are you aware of SDG goals?</li></ul>
<b>Formative Assessment Activities:</b>	<ul style="list-style-type: none"><li>• Questioning</li><li>• Discussion</li></ul>

### IMPLEMENTATION OF THE LESSON PLAN

#### Beginning of the Lesson (5 minutes)

The teaching objective and the learning outcome of this hour will be explained. Next, learners will be asked a set of questions:

Q1: What are the advantages of intelligent systems in transportation?

Q1: At the scope of the 2030 Agenda for sustainable development by the United Nations, 17 Sustainable Development Goals (SDGs) are specified, and these are urgent calls for action by all countries. What are these SDG goals or what are the focused topics of these SDG goals?

To capture learners' interest and motivation:

- The learners will be encouraged to ask questions.
- The learners will be asked to talk about if they are aware of the intelligent public transportation system and SDG goals.

#### Heart of the Lesson (35 minutes)

In addition to lecturing, other learner-centred instructional methods such as discussion and quizzes will be used in this hour for active student engagement.

First, the instructor will teach the related information using the lecture presentation slides. The presentation (30 minutes) will include the following topics:

- Intelligent public transportation system
- The integration of green and intelligent public transportation system

Discussion (5 minutes): Each topic will be discussed with the learners one by one respectively. A discussion question: How people can be encouraged to use green vehicles?



Detailed information about this hour will be available for the learners via the Lecture Notes document.

### **Closure Activity (10 minutes)**

At the end of this hour;

- The topic of this hour will be summarized by the instructor in 2-3 minutes.
- The instructor will ask a set of questions.
- Selected learners will be asked to tell in a minute what they have learned.
- “Mentimeter” will be used, and learners will be asked to write 3-5 words about what they think is important about this hour’s topic. The results will be shown on the screen.
- Learners will be asked to write one sentence about the most important concept that attracts their attention most.



## **HOUR 5: Implementation of green public transportation vehicles into real transportation cases: Word Limit Game**

<b>Lesson Title:</b>	<b>Implementation of green public transportation vehicles into real transportation cases: Word Limit Game</b>
<b>Related Learning Outcomes:</b>	<p>In this lesson, learners will gain an understanding of</p> <ul style="list-style-type: none"> <li>• general concepts and technologies needed for operation optimisation in green public transportation, and</li> <li>• the challenges in integrating green public transportation.</li> </ul>
<b>Duration of the Lesson:</b>	50
<b>Dominant Instructional Method:</b>	Lecture, discussion, questioning, games.
<b>Instructional Materials:</b>	The teaching notes and lecture presentations (PowerPoint slides) are available on the project website.
<b>Prerequisite Learning:</b>	<p>No prerequisite is required, however, learners are advised to read;</p> <ul style="list-style-type: none"> <li>• The teaching note which is available on the project website.</li> <li>• Supplementary materials given in the previous section.</li> </ul>
<b>Discussion Questions:</b>	<p>Group conversation at the end of the game takes place to reflect on the experiences everyone had during the game. Some questions: Do the game that were created make sense? What did you learn from the session? How has it changed your mind on a green public transportation? How would it be different with a different audience?</p>
<b>Formative Assessment Activities:</b>	<ul style="list-style-type: none"> <li>• Mentimeter usage</li> <li>• Questioning</li> <li>• Five-minute oral presentation</li> </ul>

### **IMPLEMENTATION OF THE LESSON PLAN**

#### **Beginning of the Lesson (5 minutes)**





The teaching objective and the learning outcome of this hour will be explained. Next, the Word Limit game will be introduced to participants and the groups are specified for game. Learners are divided into 3 or 4 groups depending on the number of participants.

To capture learners' interest and motivation:

- The learners will be encouraged to ask questions.

### Heart of the Lesson (40 minutes)

First, a word limit game will be played. The lecturer (teacher) offers minimum of 20 words to each group and the number of the word depends on the number of participants in each group. These words are related to green transportation literature. The example words which can be seen in table 1 are preferred for the game.

**Table 1. Example words for the game**

Urban transportation	Sustainability	Electric vehicle	Energy	Bus	Electric vehicle
Public transportation	Mobility	Autonomous vehicle	Fuel consumption	Bike	Connected vehicles
Smart city	Micro-mobility	Shared service	Traffic congestion	E-scooter	Metro
Passenger	Green vehicle	Pedestrian	CO2 emission	Tram	Alternative Fuel

Then, the lecturer (teacher) prepare different questions about green public transportation. Three different questions are specified and asked in groups. All groups should be worked on the same questions. The questions are:

- 1) What are the basic elements of green public transportation in your cities?
- 2) What are the green public transportation problems in your city and what is your suggestions about these problems?
- 3) How can municipalities or private transportation companies pursue private car users to use green public transportation?



In the next 10 minutes, each group can discuss their answers and prepare their answers by using their defined words. Each group answered the same question by focusing on different points depending on the defined words.

Discussion (5 minutes): each group explains the question by using defined words and discuss answers with the answers of other groups. Detailed information of this hour will be available for the learners via the Lecture Notes document.

There is an in-class activity in this part of the lecture. First, the table which consists of information about GHG Emissions depending on the type of fuel and size of the engine is demonstrated to the learners and a brief explanation is conducted to facilitate learning. Then, learners will be asked how many kilometers they travel by vehicle on average per day. The first example will be done by the instructor through an excel sheet. There are different vehicle options and each option has a specific kilogram of CO<sub>2</sub> per kilometer. The total kilogram CO<sub>2</sub> for each type of vehicle depending on this kilometer data will be calculated automatically on an excel sheet.

Discussion (5 minutes): Each learner will give kilometer data taken per day and the result table will be renewed. The numbers will be analyzed and discussion based on these will be conducted with the participation of learners. The detailed information about this hour will be available for the learners via the Lecture Notes document.

### **Closure Activity (5 minutes)**

At the end of this hour:

- The topic of this hour will be summarized by the instructor in 1 minute.
- Group conversation at the end of the game takes place to reflect on the experiences everyone had during the game. Some questions: Do the game that was created make sense? What did you learn from the session? How has it changed your mind about a green public transportation? How would it be different with a different audience?
- Learners will be asked to write one sentence about the most important concept that attract their attention most.



## **HOUR 6: Using information systems, efficient transportation methods and tools (i.e., GIS) in public transportation network planning**

<b>Lesson Title:</b>	<b>Using information systems, efficient transportation methods and tools (i.e., GIS) in public transportation network planning.</b>
<b>Related Learning Outcomes:</b>	<p>In this lesson, learners will be able to:</p> <ul style="list-style-type: none"> <li>• Explain the purpose, way of functioning and advantages of information systems for green public transportation from both users' and providers' perspective</li> <li>• Recognize main technologies needed for green public transportation</li> </ul>
<b>Duration of the Lesson:</b>	50
<b>Dominant Instructional Method:</b>	<ul style="list-style-type: none"> <li>• Lecture</li> <li>• Discussions</li> <li>• Questioning</li> </ul>
<b>Instructional Materials:</b>	The teaching notes and lecture presentations (PowerPoint slides) are available on the project website.
<b>Prerequisite Learning:</b>	<p>No prerequisite is required, however learners are advised to read;</p> <ul style="list-style-type: none"> <li>• The teaching note which is available on the project website.</li> <li>• Supplementary materials given in the previous section.</li> </ul>
<b>Discussion Questions:</b>	<p>At the beginning of the lesson, the group will be asked several question: Are you familiar with information systems used by (smart) cities in public transportation? Can you name some of the technologies needed for green smart transportation to function? Questions will be repeated after each section as learners might be familiar with green public transportation IS</p>



	or technologies not knowing they are using them themselves.
<b>Formative Assessment Activities:</b>	The activity is not graded.

## IMPLEMENTATION OF THE LESSON PLAN

### Beginning of the Lesson (5 minutes)

In the beginning, the objective of this part of the module is given. The students are asked about their expectations and if there are familiar with information systems used by (smart) cities in public transportation. In addition, they are asked if they can name some of the technologies needed for green smart transportation to function. Afterwards, the content of the lesson is given.

To capture learners' interest and motivation:

- The learners will be encouraged to ask questions.

### Heart of the Lesson (40 minutes)

Discussion (5 minutes): The students are asked about their expectations and if there are familiar with information systems used by (smart) cities in public transportation. In addition, they are asked if they can name some of the technologies needed for green smart transportation to function.

Second, the Information system in public transportation will be introduced by the instructor.

- Data analysis and real-time management
- Fleet management system
- Passenger information system
- Real-time vehicle monitoring
- Autonomous vehicle public transportation system
- Geographic Information System (GIS) in public transportation

Detailed information of this hour will be available for the learners via the Lecture Notes document.

### Closure Activity (5 minutes)



At the end of this hour:

- The topic of this hour will be summarized by the instructor in 1 minute.
- Ask learners to comment on the green side of technologies and information systems presented and discussed.



## HOURS 7 & 8: Business Model CANVAS: Discussions on green public transportation alternatives in smart cities

<b>Lesson Title:</b>	<b>Business Model CANVAS: Discussions on green public transportation alternatives in smart cities</b>
<b>Related Learning Outcomes:</b>	In this lesson, learners will be able to: <ul style="list-style-type: none"> <li>• explain Business Canvas Model and Lean Canvas Model</li> <li>• prepare a Business Canvas Model for their new idea.</li> </ul>
<b>Duration of the Lesson:</b>	120
<b>Dominant Instructional Method:</b>	<ul style="list-style-type: none"> <li>• Lecture</li> <li>• Discussions</li> <li>• Brainstorming</li> <li>• Case study</li> </ul>
<b>Instructional Materials:</b>	The teaching notes and lecture presentations (PowerPoint slides) are available on the project website.
<b>Prerequisite Learning:</b>	No prerequisite is required, however learners are advised to read; <ul style="list-style-type: none"> <li>• The teaching note which is available on the project website.</li> <li>• Supplementary materials given in the previous section.</li> </ul>
<b>Discussion Questions:</b>	The learners will establish a group which consists of 3-4 learners and then prepare their own "Business Canvas Model in the scope of the next lesson "Preparing a Business Canvas Model for the new idea" (45 min). Then each group will review of its developed Business Model (30 min).
<b>Formative Assessment Activities:</b>	Oral presentation

### IMPLEMENTATION OF THE LESSON PLAN



### **Beginning of the Lesson (15 minutes)**

In the beginning, the objective of this part of the module is given.

Preparation (10 minutes): Depending on the number of course participants, the learners will establish a group which consists of 3-4 learners. Each group will prepare a business canvas model for an idea which is used for green public transportation. Before the brainstorming session, the given business model in the lecture note of this hour will be explained as an example for participants.

### **Heart of the Lesson (70 minutes)**

Brainstorming (10 minutes): Each group will brainstorm ideas related to improving green public transportation. Each group will select one idea to apply to the business canvas model. At the end of this session, the instructor will visit each group and advise them about the business ideas.

An empty business canvas model which can be seen in the lecture note of this hour will be given to each group. Preparing the business canvas model as a group will last 60 minutes. Groups will discuss their business ideas and examine different sides of their business ideas. The instructor will follow each group and take notes according to their improvements on the business canvas model.

Detailed information about this hour will be available for the learners via the Lecture Notes document.

### **Closure Activity (35 minutes)**

At the end of this hour:

- The topic of this hour will be summarized by the instructor in 1 minute.
- Each group will present a business canvas model and at the end of the presentation, each idea will be discussed by participants.
- At the end of the presentations, an online questionnaire will be sent to the participant and there is a surprise for the best business idea.





## MODULE #5: INTERMODAL GREEN PUBLIC TRANSPORT PLANNING

### INSTRUCTOR INFORMATION

**Instructors:** Dorinela Costescu, Sergiu Olteanu

**E-mails:** [dorinela.costescu@upb.ro](mailto:dorinela.costescu@upb.ro), [sergiu.olteanu@upb.ro](mailto:sergiu.olteanu@upb.ro)

**HOUR 1:** Domains of the mobility system performance

<b>Lesson Title:</b>	<b>Domains of the mobility system performance</b>
<b>Related Learning Outcomes:</b>	By the end of this lesson, learners will be able to: <ul style="list-style-type: none"><li>• Discuss the necessity of developing all transport modes in an integrated manner.</li><li>• Explain the domains of sustainable mobility performance.</li></ul>
<b>Duration of the Lesson:</b>	60 min
<b>Dominant Instructional Method:</b>	<ul style="list-style-type: none"><li>• Lecture</li><li>• Video presentation</li><li>• Discussions</li></ul>
<b>Instructional Materials:</b>	<ul style="list-style-type: none"><li>• PowerPoint slides</li><li>• Videos</li><li>• Readings</li></ul>
<b>Prerequisite Learning:</b>	
<b>Discussion Questions:</b>	<ul style="list-style-type: none"><li>• What is the aim of this module?</li><li>• What are the components of a sustainable urban mobility strategy?</li><li>• What are the domains of the mobility system performance?</li></ul>
<b>Formative Assessment Activities:</b>	Classroom assessment techniques.

### IMPLEMENTATION OF THE LESSON PLAN



## Beginning of the Lesson (15 minutes)

This part introduces the instructors, the focus, and the module's structure.

Then, the objective of the first part of module 5 is stated. The students are asked to define sustainable development objectives and explain how these objectives are related to urban mobility systems. The students are asked to give examples of known (or possible) strategies and policy measures for achieving better sustainable urban mobility. Starting from the question "How might sustainable urban mobility be most effectively delivered?", the main topics of the lesson are outlined.

## Heart of the Lesson (40 minutes)

### 1. Review the principles of sustainable urban mobility (15 min)

A PowerPoint presentation is used to review the principles of sustainable urban mobility and explain the mobility system performance domains.

### 2. Discuss the particularities of different local transport systems (25 min)

Case study: A video<sup>1</sup> presenting innovative cycle and public space projects exemplifies the domains of the mobility system performances and emphasizes the pillars of sustainable urban mobility.

The students are asked to describe how the transport system works in their cities, providing answers to the following questions:

- What are the main means of travel? What are the main problems and opportunities?
- What are transport's positive and negative impacts on their city or neighbourhood? What measures could be applied to reduce the negative consequences?

After posting a response, each participant is asked to offer their views and opinions on the other participant's answer.

---

<sup>1</sup> E.g.: *Urban Transport Inspiration. The Netherlands.* <https://www.youtube.com/watch?v=kNHe5PFdcFA> or *4th SUMP Award (Utrecht) - DG MOVE.* <https://vimeo.com/260423639>



Then, the answers related to the problems and transport's positive and negative impacts are centralized (grey cells) and assigned to performance fields (public transport / urban mobility system / urban planning):

Examples		Public transport system	Urban mobility system	Urban planning
Main problems in the urban transport system	.			
Positive impacts of transport	.			
Negative impacts of transport	.			

The classification is analyzed, and the relationships among the domains of public transport performance are discussed.

#### Closure Activity (5 minutes)

- Revise the objectives of the module.
- Ask learners to explain why "Develop all transport modes in an integrated manner" is defined as a SUMP principle.
- Review the domains of the mobility system performance.



## HOUR 2: The role of the intermodal public transport

<b>Lesson Title:</b>	<b>The role of the intermodal public transport</b>
<b>Related Learning Outcomes:</b>	By the end of this lesson, learners will be able to: <ul style="list-style-type: none"> <li>• Define the intermodal public transport for passenger mobility services.</li> <li>• Discuss the role of intermodal public transport.</li> </ul>
<b>Duration of the Lesson:</b>	60 min
<b>Dominant Instructional Method:</b>	<ul style="list-style-type: none"> <li>• Lecture</li> <li>• Video presentation</li> <li>• Case study analysis</li> <li>• Discussions</li> </ul>
<b>Instructional Materials:</b>	<ul style="list-style-type: none"> <li>• PowerPoint slides</li> <li>• Videos</li> <li>• Readings</li> </ul>
<b>Prerequisite Learning:</b>	---
<b>Discussion Questions:</b>	<ul style="list-style-type: none"> <li>• What does intermodal transport mean?</li> <li>• What are the functions of urban public transport?</li> <li>• What is the role of intermodal transport?</li> </ul>
<b>Formative Assessment Activities:</b>	Classroom assessment techniques.

### IMPLEMENTATION OF THE LESSON PLAN

#### Beginning of the Lesson (5 minutes)

Based on the SUMP principle "Develop all transport modes in an integrated manner", discussed in the previous lesson, this part introduces the objectives of the lecture. Starting from the question "What is the role of intermodal transport?", firstly, it is necessary to understand the definition of intermodal public transport and the difference relative to multimodal transport. Then, it is essential to understand the functions of public transport



and how intermodal transport can enhance the efficacy and efficiency of the public transport system in an integrated urban mobility system.

### Heart of the Lesson (50 minutes)

#### 1. Explain the definition of intermodal public transport (10 min)

A PowerPoint presentation is used to explain the terms "door-to-door mobility", "multimodal transport" and "intermodal transport".

The students are asked to give examples of intermodal services (at different geographic scales). Then, the definitions for multimodality, intermodality, and door-to-door mobility at the urban level are clarified.

#### 2. Explain the functions of intermodal transport in sustainable mobility solutions (15 min)

A PowerPoint presentation is used to explain the role of intermodal public transport in achieving sustainable development goals. Firstly, the main functions of public transport are discussed. Then, it is discussed how intermodal transport can enhance the efficacy of public transport and the overall performance of the mobility system. The role of intermodal public transport is examined. It is demonstrated how the benefits of intermodal public transport are associated with sustainable development pillars.

#### 3. Discuss and compare the options for multimodal and intermodal transport (25 min)

A video<sup>2</sup> is used to exemplify different multimodal options. It also presents what measures are applied to increase the share of public transport or active travel and to support a reduction in car usage.

#### *Individual activity:*

1. The students are asked to specify which modes of travel were illustrated in the video.
2. Then, the students are asked to exemplify multimodality and intermodality for a certain example of a trip (defined by Origin-Destination, purpose - work or work-related or study or pick up and bring people or shopping or health or recreational/social activities, distance, usual frequency), providing answers to the following questions:

---

<sup>2</sup> E.g.:

Greater Manchester, winner of the 7th SUMP Award. <https://www.youtube.com/watch?v=hmv0vNq6B-Q&t=13s> or

Greater Manchester, finalist of the 7th SUMP Award. <https://www.youtube.com/watch?v=BkgfMaEjICs> or  
Greater Manchester 2040: The Way Ahead. <https://www.youtube.com/watch?v=cl6fiVWFNTY>



- What are the travel options for the chosen trip? What modes of transport and/or mobility services can be used?
- What are the main user benefits and inconveniences of each travel option?

*Group activity:*

3. Based on each purpose of the given trip examples, the participants are grouped. The answers are centralized and analyzed.

	<i>Trip purpose *</i>			<i>Characteristics</i>	
	Eg.1	Eg.2	....		
Frequency				<i>Frequency range</i>	
Distance				<i>Distance range</i>	
Modal variants	.			<i>Advantages</i>	<i>Inconveniences</i>
	.				
	.				
Intermodal variants	.			<i>Advantages</i>	<i>Inconveniences</i>
	.				

\* For a specific travel purpose - *work* or *study* or ... etc., the answers (Eg.1, Eg.2, ...) are centralized in a table (grey cells) to be characterized (in the cells with green text).

- a) If no intermodal variants exist for some examples:
  - the participants are asked to argue the state (if possible, based on previously presented concepts - domains of the mobility system performances, and functions of public transport).
- b) If intermodal variants exist:
  - the participants are asked to demonstrate how intermodal transport contributes to sustainable mobility, respective to sustainable growth (based on the presented concepts - functions and role of intermodal public transport).

(The video and the discussion ensure the link to the concepts presented in the following part.)

### Closure Activity (5 minutes)

- Revise the objectives of the lesson.



- 
- Ask learners to explain what intermodal public transport means and the difference relative to multimodal transport.
  - Review the functions of intermodal transport in sustainable mobility solutions.





### HOUR 3: The Key Components of the Intermodal Urban Mobility System

<b>Lesson Title:</b>	<b>The key components of the intermodal urban mobility system</b>
<b>Related Learning Outcomes:</b>	By the end of this lesson, learners will be able to; <ul style="list-style-type: none"> <li>• Identify the key components of the intermodal urban mobility system.</li> <li>• Discuss the levels of integration for intermodal urban mobility development.</li> </ul>
<b>Duration of the Lesson:</b>	60 min
<b>Dominant Instructional Method:</b>	<ul style="list-style-type: none"> <li>• Lecture</li> <li>• Video presentation</li> <li>• Case study analysis</li> <li>• Discussions</li> </ul>
<b>Instructional Materials:</b>	<ul style="list-style-type: none"> <li>• PowerPoint slides</li> <li>• Videos</li> <li>• Readings</li> </ul>
<b>Prerequisite Learning:</b>	---
<b>Discussion Questions:</b>	<ul style="list-style-type: none"> <li>• What are the key components of the intermodal urban mobility system?</li> <li>• What are the integration levels required to develop an intermodal mobility system?</li> </ul>
<b>Formative Assessment Activities:</b>	<ul style="list-style-type: none"> <li>• Classroom assessment techniques.</li> </ul>

#### IMPLEMENTATION OF THE LESSON PLAN

##### Beginning of the Lesson (5 minutes)

Travel demands, and subsequently the value of intermodal planning, can be evaluated from different perspectives. This part introduces the lesson's objectives based on the intermodal public transport examples discussed in the previous lesson. It is emphasized



the essentiality of understanding the mobility service characteristics; and the necessity of figuring out the key components of intermodal public transport systems.

Cities must develop intermodal urban mobility systems by extending their public transport offering and adapting it from "delivering transport" to "delivering solutions". To achieve this goal, five general levels are involved in intermodal integration.

### Heart of the Lesson (50 minutes)

#### 1. Discuss the key components of the intermodal mobility system (20 min)

A PowerPoint presentation is used to explain the key components of the intermodal mobility system. The service characteristics are discussed.

An exercise based on a video<sup>3</sup> is used to identify the key components of an intermodal mobility system (see Appendix 1).

#### 2. Explain levels of integration for intermodal urban mobility development (10 min)

A PowerPoint presentation is used to describe the levels of integration for intermodal urban mobility development. Firstly, the main categories of public and private stakeholders are specified. Then, the critical task of an "integrated mobility platform operator" is discussed, responsible for planning, booking, payment and billing. The main levels of integration for intermodal urban mobility development are explained.

#### 3. Discuss the levels of integration for intermodal urban mobility development (20 min)

- a) Best practices for the development of integrated urban mobility are exemplified. Implemented solutions of levels of integration are discussed (case of Hong Kong, London, and Stockholm).
- b) The students are asked to identify what levels of integration have been already implemented in their city (see Appendix 2). Next, for the trip example given in the previous lesson, the students are asked to specify if the mentioned advantages of the travel variants are due to implemented integration levels; to explain what levels of integration could diminish the mentioned inconveniences for each modal and intermodal option.

### Closure Activity (5 minutes)

<sup>3</sup> *The future of mobility: Ben's Journey* : <https://www.youtube.com/watch?v=uDEEgMBRW2s>



- Review the objectives of the lesson.
- Review the key components of the intermodal mobility system.
- Ask learners to define the main levels of integration for intermodal urban mobility development.

## Appendix 1

### Exercise 1: Key components of the intermodal mobility system

The video "*The future of mobility: Ben's Journey*" presents a scenario for integrated mobility services. Watch the video and analyse how the mobility offering:

- Combines different modes of transportation
- Ensures a set of personalised travel options (including travel on demand)
- Provides additional services next to core mobility services.

Select the elements and service characteristics exemplified in the video.

<b>Public mobility infrastructure</b>	Public collective transport	<input type="checkbox"/> Rail – regional, suburban, metro, light rail (LRT), tram <input type="checkbox"/> Road – regional buses, urban buses, trolleybuses, bus rapid transit (BRT) <input type="checkbox"/> Ferries, special transport
	Public individual transport/ mobility	<input type="checkbox"/> Car & scooter & bike sharing <input type="checkbox"/> Car & bike rental <input type="checkbox"/> Taxi & transport on demand <input type="checkbox"/> Others .....
	Parking infrastructure	<input type="checkbox"/> Park-and-ride facilities <input type="checkbox"/> Bike-and-ride facilities <input type="checkbox"/> Parking lots and bike garages <input type="checkbox"/> Others .....



<b>Service characteristics</b>	Quality	<input type="checkbox"/> Network coverage, accessibility, operating hours <input type="checkbox"/> Punctuality, reliability, frequency <input type="checkbox"/> Sufficient capacity on-peak hours
	Safety and security	<input type="checkbox"/> Safety performances, security, and perception of security <input type="checkbox"/> Emergency medical and police services
	Convenience	<input type="checkbox"/> Real-time information, planning, booking and payment <input type="checkbox"/> Comfort, speed, congestion freeness
	Sustainability	<input type="checkbox"/> Energy efficiency and alternative engines <input type="checkbox"/> Air quality and noise neutrality, climate neutrality
	Affordability	<input type="checkbox"/> Financial attractiveness for users, meeting social and distributional objectives <input type="checkbox"/> Cost efficiency for operators
	Others?	.....
Additional value-added services next to core mobility services	.....	.....
	.....	.....

## Appendix 2

<b>Exercise 2: Levels of integration for intermodal urban mobility development</b>	
<ul style="list-style-type: none"> <li>What levels of integration have been already implemented in their city?</li> </ul>	
<i>Select the levels that you consider that have been partially or fully implemented.</i>	<i>For each selected level, give an example of a measure/measures implemented to achieve mobility integration.</i>



<input type="checkbox"/> <b>Physical integration</b> - is associated with a complex scheme of intermodal facilities ensuring easy access to modal interchanges; the design of pedestrian ways facilitating modal transfers and minimising distances for access to stops.	
<input type="checkbox"/> <b>Transport network integration</b> – modal service networks (bus, tram, metro, etc.) should be an integrated network that is complementary in relation to their modal characteristics. Metro and tram services should be designed to ensure high-capacity corridors and rapid services.	
<input type="checkbox"/> <b>Fare integration</b> - involves developing a common fare collection system for all modes through a single shared payment media.	
<input type="checkbox"/> <b>Information integration</b> – complete and easy-to-use information and guidance system are critical for encouraging intermodal travel. Signage at metro and bus stations should be designed to deliver passengers' information effectively. Intelligent Transport Systems (ITS) have an essential role in transport integration in general and information integration.	
<input type="checkbox"/> <b>Institutional or administrative integration</b> - consists of developing only one institutional scheme to plan, coordinate, manage and control a set of transport networks (e.g., a common metropolitan entity).	



### Exercise 3: Levels of integration for intermodal urban mobility development

- Examine how the mentioned advantages and inconveniences of the travel variants are related to different levels of integration.

• <i>Example of travel (given in the previous lesson)</i>			
Trip purpose			
Frequency			
Distance			
Modal variants	.	Advantages	Inconveniences
	.		
	.		
Intermodal variants	.	Advantages	Inconveniences
	.		

	Advantages	Inconveniences
<i>Levels partially or fully implemented</i>	<i>Assign the mentioned advantages to levels of integration; explain how the level of integration contributes to the mentioned advantage.</i>	<i>Assign the mentioned inconveniences to levels of integration; explain how the level of integration could diminish the inconvenience.</i>
<input type="checkbox"/> Physical integration		
<input type="checkbox"/> Transport network integration		
<input type="checkbox"/> Information integration		
<input type="checkbox"/> Information integration		
<input type="checkbox"/> Institutional or administrative integration		
	<i>If some mentioned advantages aren't assigned to any levels of integration:</i> <ul style="list-style-type: none"> <li><i>explain why they aren't related to the integration of mobility services.</i></li> </ul>	<i>If some mentioned inconveniences aren't assigned to any levels of integration:</i> <ul style="list-style-type: none"> <li><i>explain why they aren't related to the integration of mobility services.</i></li> </ul>



---

	...	...
--	-----	-----





## HOUR 4: Particularities of the Intermodal Public Transport (1)

<b>Lesson Title:</b>	<b>Particularities of the intermodal public transport (1)</b>
<b>Related Learning Outcomes:</b>	By the end of this lesson, learners will be able to; <ul style="list-style-type: none"> <li>• Discuss the relationships between urban structure and public transport efficiency.</li> <li>• Explain the characteristics that differentiate the transport modes.</li> </ul>
<b>Duration of the Lesson:</b>	60 min
<b>Dominant Instructional Method:</b>	<ul style="list-style-type: none"> <li>• Lecture</li> <li>• Video presentation</li> <li>• Case study analysis</li> <li>• Discussions</li> </ul>
<b>Instructional Materials:</b>	<ul style="list-style-type: none"> <li>• PowerPoint slides</li> <li>• Videos</li> <li>• Readings</li> </ul>
<b>Prerequisite Learning:</b>	---
<b>Discussion Questions:</b>	<ul style="list-style-type: none"> <li>• What transport modes do we need to integrate into local contexts to help achieve sustainable travel behaviours?</li> <li>• What are the main characteristics that differentiate the transport modes?</li> </ul>
<b>Formative Assessment Activities:</b>	<ul style="list-style-type: none"> <li>• Classroom assessment techniques.</li> </ul>

### IMPLEMENTATION OF THE LESSON PLAN

#### Beginning of the Lesson (5 minutes)

A comprehensive understanding of mode characteristics and performance under different circumstances is essential for the selection of optimal modes in intermodal public transport system development. This part introduces the lesson's objectives based on the



intermodal public transport benefits discussed in the second lesson. It is emphasized the essentiality of understanding the modal characteristics.

### Heart of the Lesson (50 minutes)

#### 1. Discuss the relationships between urban structure and public transport efficiency (10 min)

A PowerPoint presentation is used to explain the relationships between urban structure and public transport efficiency. It is emphasized that (i) urban features critically determine the roles of public transport and private mobility, and (ii) a great variety of modes is needed to improve the mobility system in medium-sized and large cities.

#### 2. Explain the characteristics of public transport modes (20 min)

A PowerPoint presentation is used to describe the levels of integration for intermodal urban mobility development. Firstly, the main categories of public and private stakeholders are specified. Then, the critical task of an "integrated mobility platform operator" is discussed, responsible for planning, booking, payment and billing. The main levels of integration for intermodal urban mobility development are explained.

#### 3. Discuss the characteristics of urban travel modes (20 min)

- c) A video<sup>4</sup> is used to exemplify the appropriateness of different modal solutions in a specific urban context. (Sustainable mobility services accessible to all, active and shared travel options, interconnected city travels).
- d) The participants are asked to examine the characteristics of travel modes given as options in the previous discussion (see Appendix).

### Closure Activity (5 minutes)

---

<sup>4</sup> Greater Grenoble Mobility Authority, winner of the 9th Award for Sustainable Urban Mobility Planning : <https://www.youtube.com/watch?v=llpgkca1AX0>



- Review the relationships between urban structure and public transport efficiency.
- Review the main categories of public transport modes.
- Ask learners why is important to understand the characteristics of public transport modes.

## Appendix 1

### Exercise: Characteristics of different transport modes

For the selection of optimal modes, a comprehensive understanding of modal characteristics and performance under different circumstances is essential. Tables 1 & 2 present a classification of mobility services by type of usage and classification of public transport modes by main characteristics.

*Examine the characteristics of the mobility and transport modes given as options in the previous discussion:*

- *From the previous example of travel, select at least three transport modes and compare them based on the presented service and mode characteristics.*
- *Describe similarities and dissimilarities between transport modes given as variants of travel (modal variants or modes included in the intermodal variants).*

• <i>Example of travel (discussed in the previous lesson)</i>			
Trip purpose			
Frequency			
Distance			
Modal variants	.	<i>Advantages</i>	<i>Inconveniences</i>
Intermodal variants	.	<i>Advantages</i>	<i>Inconveniences</i>

<i>Transport modes</i>	<i>Similarities</i>	<i>Dissimilarities</i>
1. ....		
2. ....		
3. ....		



*Based on identified similarities and dissimilarities, discuss the potential relationships of competition or complementarities between the analysed transport modes.*

...



**Table 1. Classification of mobility services by type of usage (Vuchic, 2007)**

Usage type characteristics	Private		For-hire		Public or common carrier
Common designation	Private		Paratransit		Transit
Service availability	Owner		Individuals, groups		Public
Service supplier	User		Carrier		Carrier
Route determination	User (flexible)		User (carrier)		Carrier (fixed)
Time-schedule determination	User (flexible)		User (carrier)		Carrier (fixed)
Cost-price	User absorbs		Fixed rate		Fixed fare
Carrier type	Individual		Individual/Group		Group
Modes	Walking Bicycle Motorcycle Automobile	Carpools Vanpools	Rental car Car sharing Taxi	Dial-a-ride Charter bus	Street transit (bus, trolleybus, streetcar) Semi-rapid transit (bus rapid transit, light rail transit) Rapid transit (rail and rubber-tired metros, regional rail) Specialized modes
Optimum (but not exclusive) domain of operation/Area density	Low-medium	Origin: low Destination: high	Any		High-medium
Route	Dispersed	Radial	Dispersed		Concentrated (radial), ubiquitous
Time	Off-peak	Peak-only	All times		Peak, daily hours
Trip purposes	Recreation, shopping, business, other	Work	Business Special services		Work, school



**Table 2: Classification of public transport modes by main characteristics (Vuchic, 2007)**

Determinant factors	Categories/types	Basic characteristics	Modes
Separation from other traffic Support Guidance Propulsion • Motor/engine • Traction Control	C B A  Road; driver-steered Rubber-tired: guided, semiguided Rail	Right-of-way category  Technology	Shuttle bus Regular bus Express bus Trolleybus Streetcar/tramway  Bus rapid transit Light rail transit  Automated guided transit Monorails Rail rapid transit/metro Regional rail  Cable car Cog railway Aerial tramway Ferryboat Hydrofoil
Line length Type of operation Trips served	Short-haul City Regional  Local Accelerated Express	Type of service	Street transit  Semirapid transit  Rapid transit  Specialized transit



## HOUR 5: Particularities of the Intermodal Public Transport (2)

<b>Lesson Title:</b>	<b>Particularities of the intermodal public transport (2)</b>
<b>Related Learning Outcomes:</b>	By the end of this lesson, learners will be able to; <ul style="list-style-type: none"><li>• Discuss the operating characteristics of different transport modes.</li><li>• Demonstrate the advantages of feeder services in an urban intermodal network.</li></ul>
<b>Duration of the Lesson:</b>	60 min
<b>Dominant Instructional Method:</b>	<ul style="list-style-type: none"><li>• Lecture</li><li>• Case study analysis</li><li>• Discussions</li></ul>
<b>Instructional Materials:</b>	<ul style="list-style-type: none"><li>• PowerPoint slides</li><li>• Readings</li></ul>
<b>Prerequisite Learning:</b>	---
<b>Discussion Questions:</b>	<ul style="list-style-type: none"><li>• Why do we need to integrate more transport modes into local contexts to achieve sustainable mobility?</li><li>• What are the advantages of trunk-and-feeder intermodal services?</li></ul>
<b>Formative Assessment Activities:</b>	<ul style="list-style-type: none"><li>• Classroom assessment techniques.</li></ul>

### IMPLEMENTATION OF THE LESSON PLAN

#### Beginning of the Lesson (5 minutes)

Starting from the statement that "improving the efficacy and efficiency of public transport can be achieved by using several modes of transport", this part introduces the lesson's





objectives. It is emphasized that the most appropriate modes must be identified in each context in terms of operating characteristics.

### Heart of the Lesson (50 minutes)

#### **1. Discuss the operating characteristics of different transport modes (5 min)**

A PowerPoint presentation is used to explain what operating characteristics are applied to assess the domain of application of each transport mode. The possible intervals of the technical and operational characteristics of the transport modes are presented and discussed.

#### **2. Explain the complementarities of transport services (10 min)**

A PowerPoint presentation is used to explain the circumstances in which intermodal services should be analysed as sustainable travel options. The particularities of direct and feeder services are presented. The advantages of trunk-and-feeder intermodal services are described.

#### **3. Illustrate the planning of an intermodal urban transport network (10 min)**

A case study is used to illustrate the design of bus lines in an area where a metro line is implemented. The steps followed in the development of the trunk-and-feeder intermodal network are presented. The benefits of the feeder services in an intermodal network are demonstrated. The challenges in trunk-and-feeder intermodal services are discussed.

#### **4. Investigate the potential of the development of intermodal services in terms of capacity (25 min)**

- e) The participants are asked (1) to calculate the line capacity for a service included in the previous travel examples; (2) to evaluate if the service should be a trunk service in an intermodal network (see Appendix).
- f) The results of all participants are centralised, compared, and discussed.



### Closure Activity (5 minutes)

- Review the operating characteristics used to estimate the optimal application domains of the transport modes
- Ask learners to specify the advantages of feeder services in an urban intermodal network.



## Appendix

### Exercise: Application domains of the transport modes

The trunk-and-feeder intermodal services enhance the overall efficiency of the public transport system. Table 1 presents the technical, operational, and system characteristics of urban transport modes.

*From the previous example of travel, select the transport mode that you consider having the highest capacity (in spaces/hour).*

- *Identify the public transport line (for the given example)*
- *calculate the line capacity*
- *evaluate if the service should be a trunk service in an intermodal network (in terms of efficient use of existing line capacity)*

• <i>Example of travel (discussed in the previous lesson)</i>			
Trip purpose			
Frequency			
Distance			
Modal variants	.	<i>Advantages</i>	<i>Inconveniences</i>
	.		
	.		
Intermodal variants	.	<i>Advantages</i>	<i>Inconveniences</i>
	.		



	<b>Transport mode</b>	<b>....</b>
<i>Input data *</i>	<i>Line (name/number/code)</i>	<i>...</i>
	<i>Transit unit capacity (spaces/TU)</i>	
	<i>Frequency (TU/hour)</i>	
<i>Computed value</i>	<i>Line capacity (spaces/hour)</i>	
<i>Additional input data</i>	<i>Urban population density (inhbts./sq.km)</i>	<i>...</i>
<i>Based on the</i> <ul style="list-style-type: none"> <li><i>transport mode characteristics,</i></li> <li><i>particular line characteristics (including line capacity), and</i></li> <li><i>urban population size,</i></li> </ul> <i>evaluate if the service should be a trunk service in an intermodal network (in terms of efficient use of existing line capacity).</i>		

\* The input data are obtained from the public information provided by the transport operator. If the data are not available, values presented in Table 1 can be used for computation.



**Table 1. Technical, operational, and system characteristics of urban transport modes (Vuchic, 2005)**

Generic Class		Private		Street Transit		Semirapid Transit		Rapid Transit	
Characteristics	Mode Unit	Auto on Street	Auto on Freeway	RB	SCR	BRT	LRT	RRT	RGR
Vehicle capacity	sps/veh	4 – 6	1,2 – 2,0 usable	40 -120	100 – 250	40 – 150	110 -250	140 – 280	140 – 210
Vehicles/TU	veh/TU	1	1	1	1 – 3	1	1 – 4	1 – 10	1 – 10
TU capacity	sps/TU	4 – 6, total	1,2 – 2,0	40 – 120	100 – 500	40 – 150	100 – 750	140 – 2400	140 – 2000
Max. technical speed	Km/h	40 – 80	80 – 120	40 – 80	60 – 70	70 – 90	60 – 100	80 – 100	80 – 130
Max. Frequency	TU/h	600 – 800	1500 – 2000	60 – 180	60 – 120	60 – 300	40 – 60	20 – 40	10 – 30
Line capacity	sps/h	720 – 1050	1800 – 2600	2400 – 8000	4000 – 15000	4000 – 8000 –20,000	6000 – 20,000	10,000 – 70,000	8000 – 60,000
Normal operating speed	Km/h	20 – 50	60 – 90	15 – 25	12 – 20	20 – 40	20 – 45	25 – 60	40 – 80
Operating speed at capacity	Km/h	10 – 30	20 – 60	8 – 15	8 – 13	15 – 40	15 – 40	24 – 55	38 – 75
Productive capacity	10 <sup>3</sup> sp-km/h	10 – 25	50 – 120	25 – 90	35 – 150	75 – 200 – 600	120 – 600	700 – 1800	800 – 4000
Lane with (one-way)	m	3,00 – 3,65	6,65 – 3,75	3,00 – 3,65	3,00 – 3,35	3,65 – 3,75	3,40 – 3,60	3,70 – 4,30	4,00 – 4,75
Vehicle control	–	Man./vis.	Man./vis.	Man./vis.	Man./vis.	Man./vis.	Man./vis.-sig.	Man.-auto./sig.	Man.-auto./sig.
Reliability	–	Low – med.	Low – high	Low – med	Low – med	High	High	Very high	Very high
Safety	–	Low	Low – med	Med	Med	High	High	Very high	Very high



Station spacing	m	–	–	200 – 500	300 – 500	500 - 800	500 – 1000	500 – 2000	1200 – 4500
Investment cost per pair of lanes	Mill. Euro/k m	10 <sup>6</sup> \$/k m	20,0 – 100,0	0,5 – 6,0	5,0 – 10,0	5,0 – 40,0	10,0 – 50,0	40,0 – 100,0	50,0 – 120,0
<i>Abbreviations:</i> sps - spaces; veh – vehicles; TU – transit unit; RB – regular bus; SCR – streetcar; BRT – bus rapid transit; LRT – light rail transit; RRT – rail rapid transit; RGR – regional rail.									



## HOOR 6: Design of the Intermodal Public Transport Network (1)

<b>Lesson Title:</b>	<b>Design of the intermodal public transport network (1)</b>
<b>Related Learning Outcomes:</b>	By the end of this lesson, learners will be able to; <ul style="list-style-type: none"><li>• Discuss the characteristics of the infrastructure and service networks.</li><li>• Examine the hierarchical level of infrastructure and service networks.</li></ul>
<b>Duration of the Lesson:</b>	60 min
<b>Dominant Instructional Method:</b>	<ul style="list-style-type: none"><li>• Lecture</li><li>• Discussions</li></ul>
<b>Instructional Materials:</b>	<ul style="list-style-type: none"><li>• PowerPoint slides</li><li>• Readings</li></ul>
<b>Prerequisite Learning:</b>	---
<b>Discussion Questions:</b>	<ul style="list-style-type: none"><li>• What are the objectives followed in the design of the intermodal networks?</li><li>• How can multilevel transport networks enhance the performance of public transport systems?</li></ul>
<b>Formative Assessment Activities:</b>	<ul style="list-style-type: none"><li>• Classroom assessment techniques.</li></ul>

### IMPLEMENTATION OF THE LESSON PLAN

#### Beginning of the Lesson (10 minutes)

Based on the previous discussion regarding the necessity of the correlation of different transport modes for sustainably satisfying travel needs, this part introduces the general aspects of the intermodal network design problem.

#### Heart of the Lesson (45 minutes)





### **1. Describe the characteristics of the infrastructure and service networks (5 min)**

A PowerPoint presentation is used to introduce what components are used to characterize the infrastructure and service networks to assess the performance of satisfying different categories of mobility demands. The differences in the characterization of the mobility supply for individual trips and public transport offers are emphasized.

### **2. Explain the objectives defined in network design problems (10 min)**

A PowerPoint presentation is used to explain the advantages of network configurations with flow concentration, specific for intermodal networks. The antagonism between the economic optimum and social equity of different network configurations is argued. The guiding principles followed in optimizing the network structures are discussed.

### **3. Illustrate the hierarchical structure of the infrastructure networks (5 min)**

A PowerPoint presentation is used to describe the hierarchical structure of the infrastructure network developed according to the territorial functions (international, national, regional, local). The role of intermodal connections in the hierarchical structure is emphasized.

### **4. Examine the hierarchical level of infrastructure and service networks (20 min)**

- g) The participants are asked to identify different levels of infrastructure and service networks and how different hierarchical network levels are linked (see Appendix).
- h) The examples of all participants are centralized, compared and discussed.

### **5. Explain the role of network accessibility (5 min)**

A PowerPoint presentation is used to explain the role of accessibility in overall mobility system performances and land use. It is explained how the solutions for enhanced accessibility have led to multilevel urban public transport networks based on the hierarchy in spatial structure.

### **Closure Activity (5 minutes)**

- Review the objectives in network design problems.
- Ask learners to indicate the characteristics of networks that correspond to the economic optimum, respective to the optimum of social equity.
- Ask learners to explain the advantages of network configurations specific to intermodal systems.



## Appendix

### Exercise: Examine the hierarchical structure of infrastructure and service networks

	<ul style="list-style-type: none"> <li>Specify categories of infrastructures and services that can be accessed in your city or from its neighbourhood.</li> </ul>	<ul style="list-style-type: none"> <li>Indicate services at different levels that are linked. Specify if the identified links are included in intermodal networks</li> </ul>
<p><i>Hierarchical</i></p> <p>I – international:</p> <p>Level</p> <p>N – national, interzonal:</p> <p>Level</p> <p>R – regional, zonal:</p> <p>Level</p> <p>L – local</p> <p>Level</p>		
	<ul style="list-style-type: none"> <li>Identify what services (existing or potential) at the local level could be organized in an intermodal system.</li> </ul>	



## HOOR 7: Design of the Intermodal Public Transport Network (2)

<b>Lesson Title:</b>	<b>Design of the intermodal public transport network (2)</b>
<b>Related Learning Outcomes:</b>	By the end of this lesson, learners will be able to; <ul style="list-style-type: none"> <li>• Explain the methods used in the assessment of the spatial accessibility.</li> <li>• Examine measures to increase the spatial accessibility to public transport.</li> </ul>
<b>Duration of the Lesson:</b>	60 min
<b>Dominant Instructional Method:</b>	<ul style="list-style-type: none"> <li>• Lecture</li> <li>• Case study analysis</li> <li>• Video presentation</li> <li>• Discussions</li> </ul>
<b>Instructional Materials:</b>	<ul style="list-style-type: none"> <li>• PowerPoint slides</li> <li>• Videos</li> <li>• Readings</li> </ul>
<b>Prerequisite Learning:</b>	---
<b>Discussion Questions:</b>	<ul style="list-style-type: none"> <li>• How can the spatial accessibility of service networks be assessed?</li> <li>• What measures can enhance spatial accessibility?</li> </ul>
<b>Formative Assessment Activities:</b>	<ul style="list-style-type: none"> <li>• Classroom assessment techniques.</li> </ul>

### IMPLEMENTATION OF THE LESSON PLAN

#### Beginning of the Lesson (5 minutes)

This part introduces the lesson's objectives based on the role of network accessibility discussed in the previous lesson. The case studies for accessibility assessment are outlined.



## Heart of the Lesson (50 minutes)

### 1. Explain the criteria used in the exemplification of the spatial accessibility assessment (5 min)

A PowerPoint presentation is used to emphasize the importance of accessibility assessment in planning sustainable mobility solutions. It is explained that different criteria can be used in accessibility assessment. It is clarified that service coverage area and spatial accessibility at the network level are used in the presented case studies.

### 2. Describe the method of evaluation of network coverage indicators (5 min)

A PowerPoint presentation is used to describe input data and the procedures applied to assess network coverage indicators. The method is exemplified in the case of the public transport network in Bucharest. And the results are discussed.

### 3. Describe the evaluation of spatial accessibility at the network level (10 min)

A PowerPoint presentation is used to describe the method applied to assess spatial accessibility at the network level. The results obtained for the metro and tram networks from Bucharest are discussed. The results interpretation in the intermodal network design problem is clarified.

### 4. Examine how individual services can enhance the accessibility to urban public transport (7 min)

- i) A video<sup>5</sup> is used to exemplify how individual services can enhance the accessibility to public transport lines.
- j) The participants are asked to explain how accessibility is modified through the integration of cycling into the public transport system.

### 5. Discuss how intermodal terminals can enhance the accessibility to urban public transport (8 min)

---

<sup>5</sup> Integrating cycling into the public transport system in Brno: <https://www.youtube.com/watch?v=gwc0rg-0tYM>



A PowerPoint presentation and a video are used to exemplify the functions and components of an intermodal terminal developed to link the zonal and urban networks and to enhance the accessibility to urban rapid public transport.

#### **6. Examine the service coverage area for an important network node (15 min)**

The participants are asked to select a major node of the public transport network in their city and to use Google map tools to assess and analyze the service coverage area of the node. Then, the participants are asked to examine what mobility/transport services could be used to extend the coverage area.

#### **Closure Activity (5 minutes)**

- Review the advantages of intermodal networks in increasing public transport accessibility.



## HOOR 8: Measures to Increase the Attractiveness of Intermodal Urban Mobility

<b>Lesson Title:</b>	<b>Measures to increase the attractiveness of intermodal urban mobility</b>
<b>Related Learning Outcomes:</b>	By the end of this lesson, learners will be able to: <ul style="list-style-type: none"><li>• Explain the functions of the intermodal hubs.</li><li>• Examine the stakeholders involved in the design and operation of intermodal hubs.</li></ul>
<b>Duration of the Lesson:</b>	60 min
<b>Dominant Instructional Method:</b>	<ul style="list-style-type: none"><li>• Lecture</li><li>• Case study analysis</li><li>• Discussions</li></ul>
<b>Instructional Materials:</b>	<ul style="list-style-type: none"><li>• PowerPoint slides</li><li>• Videos</li><li>• Readings</li></ul>
<b>Prerequisite Learning:</b>	---
<b>Discussion Questions:</b>	<ul style="list-style-type: none"><li>• What functions must fulfil the intermodal hubs in order to reduce the disutility introduced by intermodal transfers?</li></ul>
<b>Formative Assessment Activities:</b>	<ul style="list-style-type: none"><li>• Classroom assessment techniques.</li></ul>

### IMPLEMENTATION OF THE LESSON PLAN

#### Beginning of the Lesson (10 minutes)

Starting from the levels of integration discussed in the previous topics and the characteristics of physical integration, the disadvantages related to the disutility of intermodal transfers are emphasized. This part introduces the necessity of identifying the main functions of the intermodal hubs and presents the lesson's objectives.



## Heart of the Lesson (40 minutes)

### 1. Discuss the functions of the intermodal hubs (10 min)

A PowerPoint presentation is used to explain the disutility introduced by intermodal transfers and the role of intermodal hubs in diminishing it. The definition of intermodal hubs is presented, and the functions of intermodal hubs are described.

The video "*So what is a Mobility Hub? - Future Transport Zone*"<sup>6</sup> is used to exemplify and discuss the functions of mobility hubs.

### 2. Explain the characteristics of the intermodal hubs (10 min)

A PowerPoint presentation is used to explain the factors that influence the efficiency of intermodal hubs. The classification of intermodal hubs is introduced. The video "*Lyon Part-Dieu*"<sup>7</sup> is used to discuss the main principles applied in designing a complex intermodal terminal, including transport, urban and service functions.

### 3. Describe the category of stakeholders involved in the management of the intermodal hubs (10 min)

A PowerPoint presentation is used to illustrate the heterogeneity of components implied in the structure of different types of intermodal hubs. The diversity of decision-makers involved in the design and management of intermodal hubs is described. The variety of responsibilities, the controversial objective and the competitive relationships between different stakeholders are emphasized.

### 4. Investigate the characteristics of a particular intermodal hub (10 min)

- k) For a particular intermodal hub, the participants are asked to identify the main characteristics and the main categories of stakeholders involved (see Appendix).
- l) The results of all participants are centralized, compared and discussed.

---

<sup>6</sup> [https://www.youtube.com/watch?v=Ga9D7CFhh\\_g](https://www.youtube.com/watch?v=Ga9D7CFhh_g)

<sup>7</sup> [https://www.youtube.com/watch?v=5t1hNz3p\\_qI](https://www.youtube.com/watch?v=5t1hNz3p_qI)





### Closure Activity (10 minutes)

- Review the functions of intermodal hubs
- Review the topics covered by the module "Intermodal Green Public Transport Planning"
- Ask participants which topic has been considered the most significant/interesting.



## Appendix

### Exercise: Characteristics of an intermodal hub

Select an intermodal terminal with which you are familiar (or have used) and identify the main particularities and categories of involved stakeholders.

<i>Terminal name</i>		
<i>Location</i>		
<i>Terminal type</i>	<input type="checkbox"/> For long-distance trips (interzonal) <input type="checkbox"/> For short-distance trips (outskirts and the city centers) <input type="checkbox"/> Park-and-ride <input type="checkbox"/> Urban facilities (urban trips)	
<i>Modal infrastructure</i>	<i>List the connected modal infrastructure separated by hierarchical level</i>	<i>Identify stakeholders involved in management of infrastructure and transport operation</i>



<i>Additional functions</i>		
<i>For the identified stakeholders, examine the type of relationships between them (cooperation, competition)</i>		



## MODULE #6: INFORMATION SYSTEMS AND TECHNOLOGIES FOR GREEN PUBLIC TRANSPORTATION

### INSTRUCTOR INFORMATION

Instructor: Silvia Golem

E-mail: [silvia.golem@efst.hr](mailto:silvia.golem@efst.hr)

### HOUR 1: The future of cities and smart mobility

<b>Lesson Title:</b>	<b>The future of cities and smart mobility</b>
<b>Related Learning Outcomes:</b>	In this lesson, learners will be able to: <ul style="list-style-type: none"><li>• Discuss general concepts related to the smart city paradigm and smart urban mobility.</li><li>• Recognize the challenges and opportunities of the pedestrian-oriented city concept.</li></ul>
<b>Duration of the Lesson:</b>	60
<b>Dominant Instructional Method:</b>	<ul style="list-style-type: none"><li>• Lecture</li><li>• Video presentations</li><li>• Discussions</li></ul>
<b>Instructional Materials:</b>	<ul style="list-style-type: none"><li>• PowerPoint slides</li><li>• Videos</li><li>• Readings</li></ul>
<b>Prerequisite Learning:</b>	-
<b>Discussion Questions:</b>	How important is distance in our everyday lives? Are your choices based on distance/proximity considerations? Are you more productive when you work close to your peers? Why? What are the main advantages/disadvantages of living in cities?



	Thoughts on car-oriented urban development vs pedestrian-oriented urban development? What are the main everyday travel purposes of a modern citizen? What modalities of urban mobility do you typically use?
<b>Formative Assessment Activities:</b>	No formative assessment activity

## IMPLEMENTATION OF THE LESSON PLAN

### Beginning of the Lesson (15 minutes)

At the beginning of the lesson, the main objectives of this part of the module are communicated. The learners are introduced to the learning outcomes of this part of the module and to the structure of the lesson. The learners are engaged and motivated to actively discuss the concept of the future of cities and modern urban life in the context of smart mobility.

### Heart of the Lesson (30 minutes)

The concept of cities and their development over time is introduced. The main driving forces of urban development are explained. The emphasis is placed on the concept of smart cities and smart mobility. The changes in the urban development paradigm and the importance of pedestrian-oriented strategies are discussed, followed by case studies.

### Closure Activity (15 minutes)

At the end of the lesson, the main concepts are reviewed and summarized. The learners are invited to offer their insights, personal experiences and comments regarding the covered topics.



## HOURS: 2 & 3 & 4: Information Systems and Technologies for Green Public Transportation

<b>Lesson Title:</b>	<b>Information Systems and Technologies for Green Public Transportation</b>
<b>Related Learning Outcomes:</b>	<p>In this lesson, learners will be able to:</p> <ul style="list-style-type: none"><li>• Explain the purpose, way of functioning and advantages of information systems (IS) for green public transportation from both users' and providers' perspectives.</li><li>• Recognize the main technologies needed for green public transportation.</li><li>• Explain how data generated from ISs can be used for decision-making.</li></ul>
<b>Duration of the Lesson:</b>	180 minutes
<b>Dominant Instructional Method:</b>	<ul style="list-style-type: none"><li>• Lecture</li><li>• Discussions</li></ul>
<b>Instructional Materials:</b>	<ul style="list-style-type: none"><li>• PowerPoint slides</li><li>• Book chapter</li></ul>
<b>Prerequisite Learning:</b>	-
<b>Discussion Questions:</b>	<p>At the beginning of the lesson, the group will be asked several questions: Are you familiar with information systems used by (smart) cities in public transportation? Can you name some of the technologies needed for green smart transportation to function? Questions will be repeated after each section as learners might be familiar with green public transportation IS or technologies not knowing they are using them themselves.</p>



<b>Formative Assessment Activities:</b>	The activity is not graded.
---	-----------------------------

## IMPLEMENTATION OF THE LESSON PLAN

### Beginning of the Lesson (10 minutes)

In the beginning, the objective of this part of the module is given. The students are asked about their expectations and if there are familiar with information systems used by (smart) cities in public transportation. In addition, they are asked if they can name some of the technologies needed for green smart transportation to function. Afterwards, the content of the lesson is given.

### Heart of the Lesson (95 minutes)

A PowerPoint presentation is used to highlight underlying technologies for the smart mobility sector (attached to this module).

#### 1. UNDERLYING TECHNOLOGIES FOR SMART MOBILITY SECTOR (20 min)

- Machine to Machine (M2M) concept
- Internet of Things (IoT)
- Intelligent Transport System (ITS)

#### 2. CLASSIFICATION OF MODERN INFORMATION SYSTEMS IN PUBLIC TRANSPORT IN SMART CITIES (50 min)

Presentation of modern information systems by listing its definitions, ways of functioning and advantages:

- Billing and ticketing systems
- Information collection systems
- Vehicle maintenance systems
- Passenger information systems





- Traffic safety systems
- Automatic vehicle control systems
- Vehicle sharing systems

### **PUBLIC TRANSPORT IN CITIES – CASE STUDIES FROM EUROPE (20 min)**

Presentation of case studies from Rome, Paris, London and Split.

### **3. DATA AS INPUT FOR DECISION-MAKING (75 min)**

- Smart city job profiles
- Smart city data
- Case study – Split parking – model building in Rapid Miner
- Visualizing data - Tableau

### **Closure Activity (15 minutes)**

- Review the key concepts learned.
- Ask learners to comment on the green side of technologies and information systems presented and discussed.



## HOURS: 5 & 6: Foresight in Planning Smart City Services in the Mobility Segment: Scenario Exploration System

<b>Lesson Title:</b>	<b>Foresight in planning smart city services in the mobility segment: Scenario Exploration System</b>
<b>Related Learning Outcomes:</b>	In this lesson, learners will be able to: <ul style="list-style-type: none"><li>• discuss general concepts and technologies needed for operation, optimization, and decision support in green public transportation, and</li><li>• elaborate on the challenges in integrating data generated by various stakeholders in green public transportation.</li></ul>
<b>Duration of the Lesson:</b>	120
<b>Dominant Instructional Method:</b>	Scenario exploration i.e., serious game with role playing; moderated group work.
<b>Instructional Materials:</b>	<ul style="list-style-type: none"><li>• Scenario Exploration System (SES): FUTURE OF MOBILITY scenario game - includes board, different cards representing megatrends, uncertainty and actions, tokens in 5 different colors, cube/die (instructions, board and cards attached, and the complete package is also available from <a href="https://knowledge4policy.ec.europa.eu/foresight/future-mobility-ses-edition_en">https://knowledge4policy.ec.europa.eu/foresight/future-mobility-ses-edition_en</a>)</li><li>• Participant's record sheets and the Score sheet.</li></ul>
<b>Prerequisite Learning:</b>	This lesson should follow the lessons related to the role and functions of underlying IoT and AI technologies and the examples of dashboards and information systems across various green public transportation modes. A general understanding of these topics would be a prerequisite for participation in the role-playing activity.



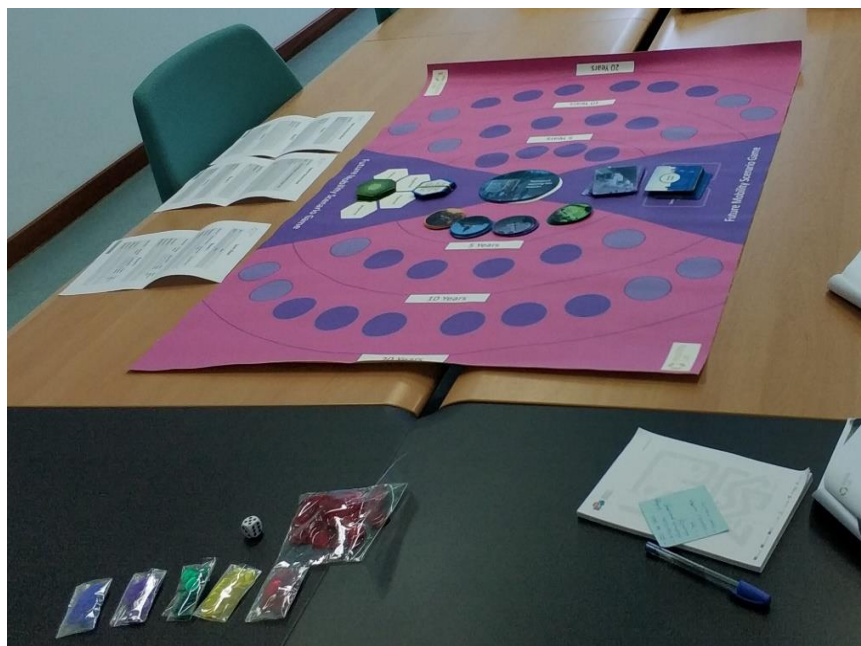
<b>Discussion Questions:</b>	Group conversation at the end of the game takes place to reflect on the experiences everyone had during the game. Some questions: Do the stories that were created make sense? What did you learn from the session? How has it changed your mind on a specific issue? How would it be different with a different audience? Who should play this game if we were to do it again? Does it make you feel confident about the future?
<b>Formative Assessment Activities:</b>	Oral presentation (based on the reflection and questions described above) is graded. It assesses the demonstrated ability of a participant to propose a solution using given tools for optimizing and managing green public transportation services for citizens in the urban surrounding in the future (5, 10, 20 years). Record sheets collected from students are used to support the assessment.

## IMPLEMENTATION OF THE LESSON PLAN

### Preparation

Depending on the number of course's participants, a single or two SES games should be prepared before class. Each game should have a minimum of 5 participants and up to 15 as a maximum.

For example, in case there are 10 participants (students), the alternatives are: a) organizing 2 tables for 2 SES games that will be played separately but simultaneously in the same classroom, or b) organizing a larger table for a single SES game where 5 roles are distributed between pairs (total of 10 participants).



### Beginning of the Lesson (40 minutes)

#### Introduction (20 min)

- Introduce participants to the foresight gaming system (SES) in general, stating that European Commission's Joint Research Centre developed the tool.
- Explain that the scenario's purpose is to engage different stakeholders in systematic future thinking on a specific topic with a long-term perspective to explore alternative futures.
- Present the SES Future of mobility and its general rules (possible scenarios, player roles, procedure, scoring).

#### Beginning of the game (20 mins)

- Scenario master (teacher) offers four possible scenarios to be played, and participants choose one. The possibilities are:
  - 1) Autonomy Drives All,



- 2) Climate measures get tough,
  - 3) Transport moving the masses and
  - 4) Innovation is our business model.
- The details of the scenario are written in scenario details cards.
- The teacher can choose the scenario instead of students, having in mind learning outcomes.
- After choosing the scenario, participants decide on their roles: National Government, Local Government, Business, or a Non-Governmental Organisation (NGO). A fifth participant plays the role of the Public Voice analyzing the actions of the participants, giving feedback and scoring the actions of the four scenario explorers (i.e. participants – students, entrepreneurs...). The teacher introduces them to the record and score sheets, and tokens.
- The appropriate number of action cards and resource tokens are handed out to the participants.

### Heart of the Lesson (60 minutes)

#### Round 1, 2 and 3

- At the beginning of the session, the start year is set (e.g., current year or 2025, etc.). If the current year is set as a starting point, Round 1 represents the near future, i.e. what will happen in five years; Round 2 represents what will happen in ten years and Round 3 twenty years. If some year in the future is set as a starting point, Round 1 represents what happened up to that point; Round 2 is what happened in ten years from today and Round 3 in twenty years. The teacher can set the year or let the participants choose.
- The teacher gives participants a few minutes to choose a role and explain their choice to others and the long-term vision (where their organization will be in 20 years?). The business should have a clear business plan, location, size, market, and suppliers. The NGO must specify its scope, objective, and membership details. The national government must specify its government department; the local government must be the city government or similar authority responsible for local transport. The Public Voice chooses its profile (socio-economic positioning, political opinion, aspirations, etc.) and perspective/philosophy.
- At the beginning of each round, corresponding detailed scenario cards are shown by the teacher explaining what will happen or have happened in 5 or 10 years. All participants



except the Public Voice pick two Real Life cards that they keep secret, and the Uncertainty card is shown.

- All participants roll the die (not the Public Voice), and the highest score plays first, the others in an order descending according to their roll of the die (6 goes first, then 5 etc.). Participants get 3 min to define what **action** they want to take (based on given Action cards). They write on their record sheet what their action is and how many tokens they use to support it. They then have 2 min to place their Action Card and corresponding RTs on the board and give a verbal explanation for the action.
- Public Voice explains its opinion on each action, and its overall perspective on the situation and distributes Future Impact Tokens. Then, Real Life cards may be used (not required!). Some can be used earlier (see specific instructions on the cards).
- Scores are calculated by the teacher after all Real-Life cards have been used, and she/he records the scores on the Record sheet.
- The explorers that have used a Real-Life card pick a new one, so they hold two at the start of every round.
- **Round 2** begins by revealing a new Uncertainty that will affect this round. The previous one is placed at the bottom of the pile. The teacher describes briefly what happened in Round 1, and then reveals and builds a story based on the 10-year Scenario Detail cards. All explorers roll the die, following the same logic as in the previous round. They then repeat the same process for defining their action, recording it, and deploying their resource tokens. They then have to explain their action as per Round 1. The news is that the explorers who want to collaborate invite others to do so when it is their turn. The invited explorers who accept to collaborate put Resource Tokens on the corresponding action(s). The turn is now on Public Voice which explains its opinion on each action, its overall perspective on the situation and distributes Future Impact Tokens. If there is an interest, Real-Life cards are used. Scores are calculated and recorded in the attached sheets and Real-Life cards replenished if used in this round.
- **Round 3** starts again with revealing new Uncertainty for this round, and the teacher describes what happened in the previous round following the revealing of new 20-year Scenario cards. The same procedure follows rolling the die by explorers, taking and recording actions, scoring by Public Voice, using Real Life cards and calculating the final scores.





## Closure Activity (20 minutes)

### Wrap up

- The teacher summarizes the events that happened over the three rounds and sums the scores of all explorers. Collective assessment is made if the explorers achieved their objectives and if these events could bring us to a sustainable future. Challenges faced by participants are discussed as well.
- There does not have to be necessarily a winner in each scenario game – this is the teacher's decision.
- Group conversation at the end of the game takes place to reflect on the experiences everyone had during the game. Some questions: Do the stories that were created make sense? What did you learn from the session? How has it changed your mind on a specific issue? How would it be different with a different audience? Who should play this game if we were to do it again? Does it make you feel more or less confident about the future?
- Record sheets can be collected and analysed further later.





## HOURS 7 & 8: Developing a relevant classification or prediction decision support model

<b>Lesson Title:</b>	<b>Developing a relevant classification or prediction decision support model</b>
<b>Related Learning Outcomes:</b>	In this lesson, learners will be able to: <ul style="list-style-type: none"><li>• Understand how decision support model is developed</li><li>• Explain the purpose and way of functioning of intelligent path selection</li><li>• Work on resolving the travelling salesman problem successfully</li></ul>
<b>Duration of the Lesson:</b>	120
<b>Dominant Instructional Method:</b>	<ul style="list-style-type: none"><li>• Demonstrating, hands on activities</li></ul>
<b>Instructional Materials:</b>	<ul style="list-style-type: none"><li>• Pdf instructions</li></ul>
<b>Prerequisite Learning:</b>	-
<b>Discussion Questions:</b>	At the beginning of the lesson, the group will be asked several questions: Have you ever used any transportation application? Which one(s)? What is your experience?
<b>Formative Assessment Activities:</b>	The activity is graded in form of case analysis.

### IMPLEMENTATION OF THE LESSON PLAN

#### Beginning of the Lesson (10 minutes)

At the beginning of the lesson, the objective of this part of the module is given. The students are asked about their expectations and if they used any application related to



(smart) transportation. Have they used it in their own country or/and in other countries, as well? In addition, they are asked how they plan their trip when in a foreign country. Afterwards, the content of the lesson is given.

### Heart of the Lesson (95 minutes)

Pdf materials are used to introduce the application and related working materials. Lectures are done in info labs containing computers for each student as activities are demonstrated and done using computers (Windows needed).

The following topics and case analyses are to be discussed/done:

- Algorithms for intelligent path selection for interventions on territory – introduction
- Demonstration of application - Interactive map part
- Case analysis using Istanbul example (with instructor)
- Demonstration of application – File analysis part
- Case analysis using demo example (with instructor)
- Case analysis – to be done in pairs (grading activity)
- Demonstration of application – Maintenance part
- Case analysis with instructor
- Case analysis – to be done in pairs (grading activity)

### Closure Activity (15 minutes)

- Review of the key concepts learned.
- Ask learners to comment on the data driven decisions that they made.



## MODULE #7: ECONOMICS OF GREEN PUBLIC TRANSPORTATION SYSTEMS

### INSTRUCTOR INFORMATION

Instructors: İbrahim Ünalmiş, Öykü Yücel

E-mails: [ibrahim.unalmis@tedu.edu.tr](mailto:ibrahim.unalmis@tedu.edu.tr), [oyku.yucel@tedu.edu.tr](mailto:oyku.yucel@tedu.edu.tr)

### HOURL 1: Review of Demand, Utility and Relative Prices in Green Public Transportation

<b>Lesson Title:</b>	<b>Review of demand, utility, and relative prices in green public transportation</b>
<b>Related Learning Outcomes:</b>	In this lesson, upon successful completion of this hour, learners will be able to: <ul style="list-style-type: none"><li>• Explain basics of demand and utility of green public transportation.</li><li>• Explain how relative prices can be used to promote green public transportation.</li></ul>
<b>Duration of the Lesson:</b>	50
<b>Dominant Instructional Method:</b>	Lecture, discussion, brainstorming
<b>Instructional Materials:</b>	The teaching notes are available on the project website. In addition to teaching notes, the following chapters from Economics by R. Glenn Hubbard and Anthony P. O'Brien are advised to gain knowledge about the concepts which will be introduced during the course. <ul style="list-style-type: none"><li>• Chapter 3: Where Prices Come From: The Interaction of Demand and Supply.</li></ul>



	<ul style="list-style-type: none"> <li>Chapter 6: Elasticity: The Responsiveness of Demand and Supply.</li> <li>Chapter 10: Consumer Choice and Behavioral Economics.</li> </ul> <p>Other resources:</p> <ul style="list-style-type: none"> <li>Todd Litman, 2004, "Transit Price Elasticities and Cross-Elasticities", Journal of Public Transportation, 7(2), 37-58.</li> <li>Vivid Economics for the Coalition for Urban Transitions, 2019, "Climate Emergency, Urban Opportunity Report", 60-81.</li> </ul>
<b>Prerequisite Learning:</b>	<p>No prerequisite is required, however learners are advised to read;</p> <ul style="list-style-type: none"> <li>The teaching note which is available on the project website.</li> <li>Supplementary materials given in the previous section.</li> </ul>
<b>Discussion Questions:</b>	<ul style="list-style-type: none"> <li>Do you currently use green public transportation, if yes what is your main motivation?</li> <li>Which economic variables can impact your and society's choice of using green public transportation?</li> <li>How can we use current or expected future prices to promote green public transportation?</li> <li>Do you always make rational choices? Can you give one irrational choice you've made regarding environment?</li> </ul>
<b>Formative Assessment Activities:</b>	<ul style="list-style-type: none"> <li>Questioning</li> <li>Submitting one minute paper stating what main findings learners remember about this lecture and asking them to explain what they are interested in most / why.</li> </ul>



## IMPLEMENTATION OF THE LESSON PLAN

### Beginning of the Lesson (5 minutes)

The module and the instructors will be introduced first. The teaching objective and the learning outcome of this hour will be explained. Next, learners will be asked a set of discussion questions which are available in the previous section.

### Heart of the Lesson (40 minutes)

First, the instructor will teach the related information using the lecture presentation slides. The presentation will include the following topics:

- The demand curve, variables that shift market demand for public transportation
- Demand price elasticities and use of relative prices in promoting green public transportation.
- Utility concept and principle of diminishing marginal utility.
- Social influences on decision making.

Detailed information about this hour will be available for the learners via the Lecture Notes document. The topics will be discussed with the learners one by one respectively. The instructor will ask a couple of questions for each topic. The learners will be encouraged to ask questions.

One In-class exercise will be given. In-class exercise will be given after explaining demand price elasticities and the use of relative prices in promoting green public transportation subject. It will take 5 minutes to complete and 5 minutes to discuss the results with the class. It would measure learners' understanding of how to calculate and interpret consumer and producer surplus after subsidy. Details of this exercise can be found in the learning note.



### Closure Activity (5 minutes)

At the end of this hour;

- The topic of this hour will be summarized by the instructor in 2-3 minutes.
- The instructor will ask a set of questions and classroom discussion will be facilitated.
- Learners will submit one minute paper stating the main finding they remember from the lecture and what they are interested in most.



## HOOR 2: Review of Supply, Externalities and Cost Benefit Analysis of Green Public Transportation

<b>Lesson Title:</b>	<b>Review of supply, externalities, and cost benefit analysis of green public transportation</b>
<b>Related Learning Outcomes:</b>	<p>In this lesson, upon successful completion of this hour, learners will be able to:</p> <ul style="list-style-type: none"><li>• Explain basics of supply side and price elasticity of supply of green public transportation.</li><li>• Explain how externalities and cost / benefit advantage can be used to promote green public transportation.</li></ul>
<b>Duration of the Lesson:</b>	50
<b>Dominant Instructional Method:</b>	Lecture, discussion, brainstorming, in-class activity
<b>Instructional Materials:</b>	<p>The teaching notes are available on the project website. In addition to teaching notes, the following chapters from Economics by R. Glenn Hubbard and Anthony P. O'Brien are advised to gain knowledge about the concepts which will be introduced during the course.</p> <ul style="list-style-type: none"><li>• Chapter 3: Where Prices Come From: The Interaction of Demand and Supply.</li><li>• Chapter 5: Externalities, Environmental Policy, and Public Goods.</li></ul> <p>Other resources:</p> <ul style="list-style-type: none"><li>• Todd Litman, 2021, "Evaluating Public Transit Benefits and Costs: Best Practices Guidebook", Victoria Transport Policy Institute.</li><li>• Vassilios Profillidis et.al, 2014, "Environmental Effects and Externalities from the Transport Sector and Sustainable Transportation Planning –</li></ul>





	A Review”, International Journal of Energy Economics and Policy, 4(4), 647-661.
<b>Prerequisite Learning:</b>	No prerequisite is required, however, learners are advised to read; <ul style="list-style-type: none"><li>• The teaching note which is available on the project website.</li><li>• Supplementary materials given in the previous section.</li></ul>
<b>Discussion Questions:</b>	<ul style="list-style-type: none"><li>• In your daily life what is the main benefit and cost of using green public transportation?</li><li>• When you are using green public transportation, is there a benefit or cost that affects society who are not directly involved in the production or consumption? Can you give an example?</li></ul>
<b>Formative Assessment Activities:</b>	<ul style="list-style-type: none"><li>• Questioning</li><li>• Two in-class activities to measure learners’ understanding of how to calculate and interpret equilibrium market price and computing total cost, average cost, and marginal cost.</li></ul>

## IMPLEMENTATION OF THE LESSON PLAN

### Beginning of the Lesson (5 minutes)

The module will be introduced firstly. The teaching objective and the learning outcome of this hour will be explained. Next, learners will be asked a set of discussion questions which are available in the previous section.

### Heart of the Lesson (40 minutes)

First, the instructor will teach the related information using the lecture presentation slides. The presentation will include the following topics:

- Supply curve, variables that shift market supply for public transportation.
- Supply price elasticities and externalities.



- Social cost / Private cost & Social benefit / Private benefit concepts.
- Economic cost and benefit analysis of using and promoting green public transportation.

The detailed information about this hour will be available for the learners via the Lecture Notes document. The topics will be discussed with the learners one by one respectively. The instructor will ask a couple of questions for each topic. The learners will be encouraged to ask questions.

Two in-class exercises will be given. The first-in-class exercise will be given after explaining the supply curve and variables that shift market demand for public transportation, it will take 5 minutes to complete and discuss the results with the class. It would measure learners' understanding of how to calculate and interpret equilibrium market price. The second in-class exercise will be given after introducing average cost, total cost, and marginal cost concepts. It will take 5 minutes to complete and discuss the results with class. It would require computing total cost, average cost, and marginal cost and measuring learners' understanding of economies of scale. Details of these exercises can be found in the learning note.

### **Closure Activity (5 minutes)**

At the end of this hour;

- The topic of this hour will be summarized by the instructor. Learners will be encouraged to join and ask questions by asking them what main findings they remember about this lecture.



## HOOR 3: Review of Fiscal Policies and Subsidies to Promote Green Public Transportation

<b>Lesson Title:</b>	<b>Review of fiscal policies and subsidies to promote green public transportation.</b>
<b>Related Learning Outcomes:</b>	<p>In this lesson, upon successful completion of this hour, learners will be able to:</p> <ul style="list-style-type: none"> <li>• Explain how main fiscal policies and subsidies can be used to promote green public transportation.</li> <li>• Explain how awareness raising campaigns and R&amp;D activities from governments and municipalities can be used to promote green public transportation.</li> </ul>
<b>Duration of the Lesson:</b>	50
<b>Dominant Instructional Method:</b>	Lecture, discussion, brainstorming, case study
<b>Instructional Materials:</b>	<p>The teaching notes are available on the project website. In addition to teaching notes, the following chapter from Economics by R. Glenn Hubbard and Anthony P. O'Brien is advised to gain knowledge about the concepts which will be introduced during the course.</p> <ul style="list-style-type: none"> <li>• Chapter 27: Fiscal Policy.</li> </ul> <p>Other resources:</p> <ul style="list-style-type: none"> <li>• United Nations, 2021, "Sustainable Transport, Sustainable Development", Interagency Report for Second Global Sustainable Transport Conference, 59-68.</li> <li>• Dorina Pojani et.al, 2015, "Sustainable Urban Transport in the Developing World: Beyond Megacities", Sustainability, 7, 7784-7805.</li> </ul>



	<ul style="list-style-type: none"><li>Govinda R. Timilsina et.al, 2008, “Fiscal Policy Instruments for Reducing Congestion and Atmospheric Emissions in the Transport Sector: A Review”, The World Bank Policy Research Working Paper 4652.</li></ul>
<b>Prerequisite Learning:</b>	<p>No prerequisite is required, however learners are advised to read;</p> <ul style="list-style-type: none"><li>The teaching note which is available on the project website.</li><li>Supplementary materials given in the previous section.</li></ul>
<b>Discussion Questions:</b>	<ul style="list-style-type: none"><li>Can increasing taxes on fossil fuel-based automobiles increase use of green public transportation?</li><li>Do you think decreasing fare prices to promote green public transportation may backfire?</li></ul>
<b>Formative Assessment Activities:</b>	<ul style="list-style-type: none"><li>Questioning</li><li>Case study discussion</li></ul>

## IMPLEMENTATION OF THE LESSON PLAN

### Beginning of the Lesson (5 minutes)

The module will be introduced first. The teaching objective and the learning outcome of this hour will be explained. A case study handout will be distributed. Lesson will start with the discussion questions listed above to facilitate interest.

### Heart of the Lesson (40 minutes)

First, the instructor will teach the related information using the lecture presentation slides. The presentation will include the following topics:

- Fiscal policy concept, main policies used to promote public transportation.



- Main subsidies are used to enhance green public transportation and possible disadvantages.
- Use of awareness-raising campaigns and R&D activities from governments and municipalities.

Detailed information about this hour will be available for the learners via the Lecture Notes document. The topics will be discussed with the learners one by one respectively. Learners will be encouraged to ask questions and participate with the help of discussion questions.

One case study will be given after the three topics listed above are completed. It will evaluate the advantages and disadvantages of using fare price subsidies to promote green public transportation. Case studies may be conducted in groups of two or three learners. It will take 10 minutes to complete, and results will be shared by group members and discussed in 5 minutes. Details of these exercises can be found in the learning note.

#### **Closure Activity (5 minutes)**

At the end of this hour;

- The topic of this hour and the main findings of the case study will be summarized by the instructor.



## HOUR 4: Review of New and Alternative Ways to Finance Green Public Transport Technologies

<b>Lesson Title:</b>	<b>Review of new and alternative ways to finance green public transport technologies</b>
<b>Related Learning Outcomes:</b>	<p>In this lesson, upon successful completion of this hour, learners will be able to:</p> <ul style="list-style-type: none"> <li>• Explain latest financing alternatives such as green bonds, social impact investing and crowdfunding.</li> <li>• Explain how different financing alternatives can be used to finance green public transport projects, main advantages and disadvantages.</li> </ul>
<b>Duration of the Lesson:</b>	50
<b>Dominant Instructional Method:</b>	Lecture, discussion, brainstorming, in-class activity
<b>Instructional Materials:</b>	<p>The teaching notes are available on the project website. In addition to teaching notes, the following study by World Bank is advised to gain knowledge about the concepts which will be introduced during the course.</p> <ul style="list-style-type: none"> <li>• World Bank Group, 2016, "Sustainable Urban Transport Financing from the Sidewalk to the Subway: Capital, Operations, and Maintenance Financing.</li> </ul> <p>Other resources:</p> <ul style="list-style-type: none"> <li>• Amundi Asset Management &amp; International Finance Corporation, 2021, "Emerging Market Green Bonds Report 2020.</li> <li>• European Parliament's Committee on Employment and Social Affairs, 2020, "Social Impact Investment: Best Practices and</li> </ul>



	<p>Recommendations for the Next Generation Report.</p> <ul style="list-style-type: none"><li>• Hong et.al, 2019, "Crowdfunding Public Projects: Collaborative Governance for Achieving Citizen Co-funding of Public Goods", Government Information Quarterly, 36, 145-153.</li></ul>
<b>Prerequisite Learning:</b>	<p>No prerequisite is required, however, learners are advised to read;</p> <ul style="list-style-type: none"><li>• The teaching note which is available on the project website.</li><li>• Supplementary materials given in the previous section.</li></ul>
<b>Discussion Question:</b>	<ul style="list-style-type: none"><li>• Would you like to invest in a project that aims to convert your city's public transportation into a more environmentally friendly system? If yes, what could be the possible ways for investment?</li></ul>
<b>Formative Assessment Activities:</b>	<ul style="list-style-type: none"><li>• In-class activity</li><li>• Written report</li></ul>

## IMPLEMENTATION OF THE LESSON PLAN

### Beginning of the Lesson (5 minutes)

The module will be introduced first. The teaching objective and the learning outcome of this hour will be explained. Written report instruction handouts will be distributed. The lesson will start with the discussion question listed above to facilitate brainstorming.

### Heart of the Lesson (40 minutes)

First, the instructor will teach the related information using the lecture presentation slides. The presentation will include the following topics:

- New and alternative ways of financing options for green public transportation projects,
- Green bond investments,





- Crowdfunding and social impact investing
- The role of international institutions, grants, and partnerships.

Detailed information about this hour will be available for the learners via the Lecture Notes document. The topics will be discussed with the learners one by one respectively. Learners will be encouraged to ask questions and participate with the help of discussion questions.

One in-class activity will be given after the three topics listed above are completed. It will evaluate the understanding of the main differences, advantages and disadvantages of green bonds and social impact bond financing options. In-class activity may be conducted in groups of two learners or individually. It will take a maximum of 10 minutes to complete and discuss. Details of the in-class activity can be found in the learning note.

### Closure Activity (5 minutes)

At the end of this hour;

- The topic of this hour and the main findings of the in-class activity will be summarized by the instructor.
- Written report instructions will be reviewed and explained. A written report will be about comparing alternative ways of fiscal policies and fund-raising options for green public transport facilitating projects. Details of the written report can be found below.

### GUIDELINES FOR THE FORMAL WRITTEN REPORT

Topic: "Please compare and contrast alternative ways of fiscal policies and fund-raising options for green public transport facilitating projects and discuss the most applicable option and policy for your country. Don't forget to include advantages, disadvantages, opportunities, and risks in your analysis".

Please use a 12-point font, have 1.5-line space, include page numbers, and do not exceed 1500 words.

Grading will be based on the following criteria;

#### 1. Focus and Content

Does the paper have a clear central idea? Are the concepts explained clearly?



I.e., What are alternative fiscal policies, what are different fund-raising options, and why do they matter for promoting green public transportation?

## 2. Development

Is the subject accurately and logically developed? Are the arguments appropriate?

I.e., Why do you think the fiscal policy and fund-raising option you suggest is most applicable? Are there any already existing examples you can give? What are the advantages, disadvantages, opportunities, and risks related to your suggestions? What are your supportive arguments?

## 3. Organization

The report must be presented. Use sections, subsections, and paragraphs to guide the reader through the reasoning of your report. Use words, tables, diagrams, and graphs precisely and effectively. Please, cite appropriate references.

Please use the following format.

### TITLE

Give the title with the author's name(s)

### ABSTRACT

Give a short synopsis of the report.

### INTRODUCTION

Explain the alternative fiscal policies and fund-raising options for green public transport facilitating projects.

### DISCUSSION

Discuss the most applicable fund-raising option and policy for your country. Don't forget to include advantages, disadvantages, opportunities, and risks in your analysis.

### CONCLUSION

Give a brief wrap-up of your analysis.

### REFERENCES

Please cite all your references.



## MODULE #8: ENTREPRENEURSHIP OPPORTUNITIES CONSIDERING SMART CITY PUBLIC TRANSPORTATION

### INSTRUCTOR INFORMATION

**Instructor:** Seda Damla Yucel

**E-mail:** [seda.yucel@tedu.edu.tr](mailto:seda.yucel@tedu.edu.tr)

### HOUR 1: Introduction of Intellectual Property Rights (IPR)

<b>Lesson Title:</b>	<b>Introduction of Intellectual Property Rights (IPR)</b>
<b>Related Learning Outcomes:</b>	This will be a discussion-based course and by the end of the lesson, learners will be able: <ul style="list-style-type: none"><li>• to compare all forms of IPR</li><li>• to distinguish patents from other types of IPR</li></ul>
<b>Duration of the Lesson:</b>	60
<b>Dominant Instructional Method:</b>	Lecture, discussion, brainstorming
<b>Instructional Materials:</b>	The teaching notes are available on the project website. In addition to teaching notes, the following research are advised to gain knowledge about the concepts which will be introduced during the course. <ul style="list-style-type: none"><li>• <a href="https://www.wipo.int/about-ip/en/">https://www.wipo.int/about-ip/en/</a></li><li>• WIPO; Intellectual Property Handbook: Policy, Law, and Use</li><li>• WIPO; What is Intellectual Property?</li></ul>
<b>Prerequisite Learning:</b>	No prerequisite is required
<b>Discussion Questions:</b>	Before starting to explain the definitions of IPR the learners will answer the following questions:



	<ul style="list-style-type: none"><li>• Q1: What do you know about patents, copyrights, industrial designs, or trademarks?</li><li>• Q2: Why would people want to protect their inventions, ideas, or innovations?</li></ul>
<b>Formative Assessment Activities:</b>	<ul style="list-style-type: none"><li>• Questioning</li><li>• Fill in the blanks word game</li><li>• Selecting 2 Cards</li></ul>

## IMPLEMENTATION OF THE LESSON PLAN

### Beginning of the Lesson (10 minutes)

The module owner will provide general information about herself, the project, and the module content. Before starting to explain the definitions of IPR, the learners will answer the following questions:

- Q1: What do you know about patents, copyrights, industrial designs, or trademarks?
- Q2: Why would people want to protect their inventions, ideas, or innovations?

### Heart of the Lesson (40 minutes)

The module owner will provide detailed information about the following subjects:

- Introduction of IPR and its types
- What is intellectual property?
- General information about;
  - Patent/Utility Model
  - Trademark
  - Industrial Design
  - Geographical Signs



- Layout - Designs of Integrated Circuits
- Brief about;
  - Trade secret
  - Copyrights

### Closure Activity (10 minutes)

At the end of the lesson, the learners will fill in the blanks with suitable words.

- \_\_\_\_\_ is an intangible form of property which provides limited duration and intangible rights which can be sold (assignment-transfer), licensed (renting), etc.
- \_\_\_\_\_ is granted for the invention of any new and useful process, the machine, manufacture or composition of matter, or any new useful improvement thereof.
- \_\_\_\_\_ are much cheaper to obtain and the requirements for grantee are usually less stringent and the term is shorter than patent.
- Patentability Requirements are \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_.
- \_\_\_\_\_ is a word, phrase, symbol, design, or combination of words, phrases, symbols, or designs which provides that it is capable of distinguishing the goods and services of one undertaking from the goods and services of other undertakings.
- \_\_\_\_\_ just protect the appearance of a product; its technical and functional properties are protected by \_\_\_\_\_ if they meet the requirements for protection.

At the end of this hour;

- the learners will fill in the blanks with suitable words.
- Then, they will select two cards and will give at least 2 examples suitable for the IPR written on the card.
- finally, selected learners will talk about the difference between the two types of IPR and provide an example for each type related to green transportation.



## HOOR 2: Entrepreneurship Ecosystem and the Relationship Between IPR and Entrepreneurship

<b>Lesson Title:</b>	<b>Entrepreneurship Ecosystem and the Relationship Between IPR and Entrepreneurship</b>
<b>Related Learning Outcomes:</b>	At the end of the lesson, learners will be able to: <ul style="list-style-type: none"> <li>• compare different forms of entrepreneurship</li> <li>• evaluate their own potential to become entrepreneurs</li> <li>• analyze the position of the IPR in the entrepreneurial ecosystem</li> </ul>
<b>Duration of the Lesson:</b>	60
<b>Dominant Instructional Method:</b>	Lecture, discussion, brainstorming.
<b>Instructional Materials:</b>	The teaching notes are available on the project website. In addition to teaching notes, the following research are advised to gain knowledge about the concepts which will be introduced during the course. <ul style="list-style-type: none"> <li>• Ignacio De Leon, Jose Fernandez Donoso (2017); Innovation, Startups and Intellectual Property Management</li> <li>• Gerald B. Halt Jr., John C. Donch, Jr., Amber R. Stiles, Robert Fesnak (2017); Intellectual Property and Financing Strategies for Technology Startup</li> <li>• Gerald B. Halt Jr., John C. Donch, Jr., Amber R. Stiles, Robert Fesnak (2014); Intellectual Property in Consumer Electronics, Software and Technology Startups</li> </ul>
<b>Prerequisite Learning:</b>	No prerequisite is required.
<b>Discussion Questions:</b>	At the end of the lesson, the learners will;



	<ul style="list-style-type: none"><li>• discuss the common characteristics of a successful entrepreneur</li><li>• discuss the common reasons for entrepreneurial failure</li><li>• explain the advantages and disadvantages of IP for entrepreneurs</li><li>• discuss the differences between trade secrets and patents. Provide a known example for trade secret and patent.</li></ul>
<b>Formative Assessment Activities:</b>	<ul style="list-style-type: none"><li>• Questioning</li><li>• Discussing</li></ul>

## IMPLEMENTATION OF THE LESSON PLAN

### Beginning of the Lesson (5 minutes)

Before starting the learners will share their ideas and opinions about entrepreneurship and the relationship between IPR and entrepreneurship.

### Heart of the Lesson (40 minutes)

The module owner will provide detailed information about the following subjects:

- Definitions
- Entrepreneurial Ecosystem
  - Building an Ecosystem for Entrepreneurship
  - Entrepreneurs in the Entrepreneurial Ecosystem
- The Role of IPR in the Entrepreneurial Ecosystem
  - Intellectual Property Rights (IPR) and IP Management
  - Entrepreneurs and IP Management





### Closure Activity (15 minutes)

At the end of this hour the learners will;

- discuss the common characteristics of a successful entrepreneur
- discuss the common reasons for entrepreneurial failure
- explain the advantages and disadvantages of IP for entrepreneurs
- discuss the differences between trade secrets and patents. Provide a known example of a trade secret and patent.



### HOOR 3: IP & Technology Commercialization Instruments

<b>Lesson Title:</b>	<b>IP &amp; Technology Commercialization Instruments</b>
<b>Related Learning Outcomes:</b>	At the end of the lesson, learners will be able to: <ul style="list-style-type: none"><li>• compare different types of new businesses</li><li>• evaluate the alternative commercialization models of IPR.</li></ul>
<b>Duration of the Lesson:</b>	60
<b>Dominant Instructional Method:</b>	Lecture, discussion, brainstorming.
<b>Instructional Materials:</b>	<p>The teaching notes are available on the project website. In addition to teaching notes, the following research is advised to gain knowledge about the concepts which will be introduced during the course.</p> <ul style="list-style-type: none"><li>• Ignacio De Leon, Jose Fernandez Donoso (2017); Innovation, Startups, and Intellectual Property Management.</li><li>• Gerald B. Halt Jr., John C. Donch, Jr., Amber R. Stiles, Robert Fesnak (2014); Intellectual Property in Consumer Electronics, Software and Technology Startups.</li><li>• The European IPR Helpdesk; Your Guide to IP Commercialisation.</li><li>• The European IPR Helpdesk; Your Guide to IP and Contracts.</li><li>• World Intellectual Property Organization, Module 11: IP Valuation.</li><li>• International Chamber of Commerce (ICC); Handbook on Valuation of Intellectual Property Assets.</li></ul>
<b>Prerequisite Learning:</b>	No prerequisite is required



<b>Discussion Questions:</b>	<p>Before starting, the learners will;</p> <ul style="list-style-type: none"><li>• share their ideas and opinions about commercialization instruments of IPR.</li></ul> <p>At the end of the lesson, the learners will;</p> <ul style="list-style-type: none"><li>• examine the different commercialization methods of IP</li><li>• discuss the different valuation approaches.</li><li>• explain the advantages and disadvantages of each valuation approach.</li></ul> <p>The learners will express their opinion about the following subject with their reasons:</p> <ul style="list-style-type: none"><li>• If they have an IP asset, which methods of monetizing IP will they prefer and why?</li></ul>
<b>Formative Assessment Activities:</b>	<ul style="list-style-type: none"><li>• Questioning, discussing</li></ul>

## IMPLEMENTATION OF THE LESSON PLAN

### Beginning of the Lesson (5 minutes)

Before starting, the learners will share their ideas and opinions about the commercialization instruments of IPR.

### Heart of the Lesson (40 minutes)

The module owner will provide detailed information about the following subjects

- Definitions
- The Main Definitions of Start-ups, Spin-Offs, and Spin-Outs
- Commercialization Instruments for IPR
- Licensing IP as a Commercialization Method



### Closure Activity (15 minutes)

At the end of the lesson, the learners will;

- examine the different commercialization methods of IP
- discuss the different valuation approaches
- explain the advantages and disadvantages of each valuation approach

The learners will express their opinion about the following subject with their reasons:

- If they have an IP asset, which methods of monetizing IP will they prefer and why?



## HOOR 4: Patent Search by Using Free Tools

<b>Lesson Title:</b>	<b>Patent Search by Using Free Tools</b>
<b>Related Learning Outcomes:</b>	At the end of the lesson, learners will be able to: <ul style="list-style-type: none"> <li>• use different free tools to search for patents.</li> <li>• Compare different patent applications with their idea.</li> <li>• evaluate the alternative inventors/start-ups/SMEs/companies that are interested in green transportation, smart cities, etc.</li> </ul>
<b>Duration of the Lesson:</b>	30
<b>Dominant Instructional Method:</b>	Lecture, discussion, brainstorming, web pages
<b>Instructional Materials:</b>	The teaching notes are available on the project website. In addition to teaching notes, the following web pages are advised to gain knowledge about the concepts which will be introduced during the course. <ul style="list-style-type: none"> <li>• European Patent Office <a href="https://worldwide.espacenet.com/?locale=en_EP">https://worldwide.espacenet.com/?locale=en_EP</a></li> <li>• Google Patent <a href="https://patents.google.com/">https://patents.google.com/</a></li> <li>• WIPO - Search International and National Patent Collections <a href="https://patentscope.wipo.int/search/en/search.jsf">https://patentscope.wipo.int/search/en/search.jsf</a></li> <li>•</li> </ul>
<b>Prerequisite Learning:</b>	No prerequisite is required.
<b>Discussion Questions:</b>	At the end of the lesson, the learners will actualize the following activities: <p>Step 1: Think of three items that are used for transportation. What kind of benefits do they provide?</p> <p>Step 2: Make a list of the problems you encounter or know about transportation.</p>



	<p>Step 3: Make a list of ideas/solutions including details that focus especially on green transportation for smart cities and write the keywords.</p> <p>Step 4: Search for patents by using your keywords through free patent search tools.</p>
<b>Formative Assessment Activities:</b>	<ul style="list-style-type: none"><li>• Questioning</li><li>• Discussing</li></ul>

## IMPLEMENTATION OF THE LESSON PLAN

### Beginning of the Lesson

Before starting, the module owner provides a brief information about the content.

### Heart of the Lesson (20 minutes)

The module owner will provide detailed information about free patent search tools.

### Closure Activity (25 minutes)

At the end of the lesson, the learners will actualize the following activities:

Step 1: Think of three items that are used for transportation. What kind of benefits do they provide?

Step 2: Make a list of the problems you encounter or know about transportation

Step 3: Make a list of ideas/solutions including details that focus on especially green transportation for smart cities and write the keywords.

Step 4: Search patents by using your keywords through free patent search tools



## HOOR 5: Introduction to Canvas Models and Preparing a Business Canvas Model for New Ideas

<b>Lesson Title:</b>	<b>Introduction to Canvas Models and Preparing a Business Canvas Model for New Ideas</b>
<b>Related Learning Outcomes:</b>	At the end of the lesson, learners will be able to: <ul style="list-style-type: none"><li>• compare Business Canvas Model and Lean Canvas Model.</li><li>• prepare a Business Canvas Model for their new idea.</li></ul>
<b>Duration of the Lesson:</b>	125
<b>Dominant Instructional Method:</b>	Lecture, discussion, project-based learning, brainstorming
<b>Instructional Materials:</b>	The teaching notes are available on the project website. In addition to teaching notes, the following webpages are advised to gain knowledge about the concepts which will be introduced during the course. <ul style="list-style-type: none"><li>• Isaac Jeffries; Building A Strong Business Model; A guide for startups, social enterprises and boards who want to change the world.</li></ul>
<b>Prerequisite Learning:</b>	No prerequisite is required.
<b>Discussion Questions:</b>	The learners will establish a group which consists of 3-4 learners and then prepare their own “Business Canvas Model in the scope of the next lesson “Preparing a Business Canvas Model for the new idea” (45 min). Then, each group will review its developed Business Model (30 min).
<b>Formative Assessment Activities:</b>	<ul style="list-style-type: none"><li>• Project</li><li>• Oral presentation</li></ul>





## IMPLEMENTATION OF THE LESSON PLAN

### Beginning of the Lesson

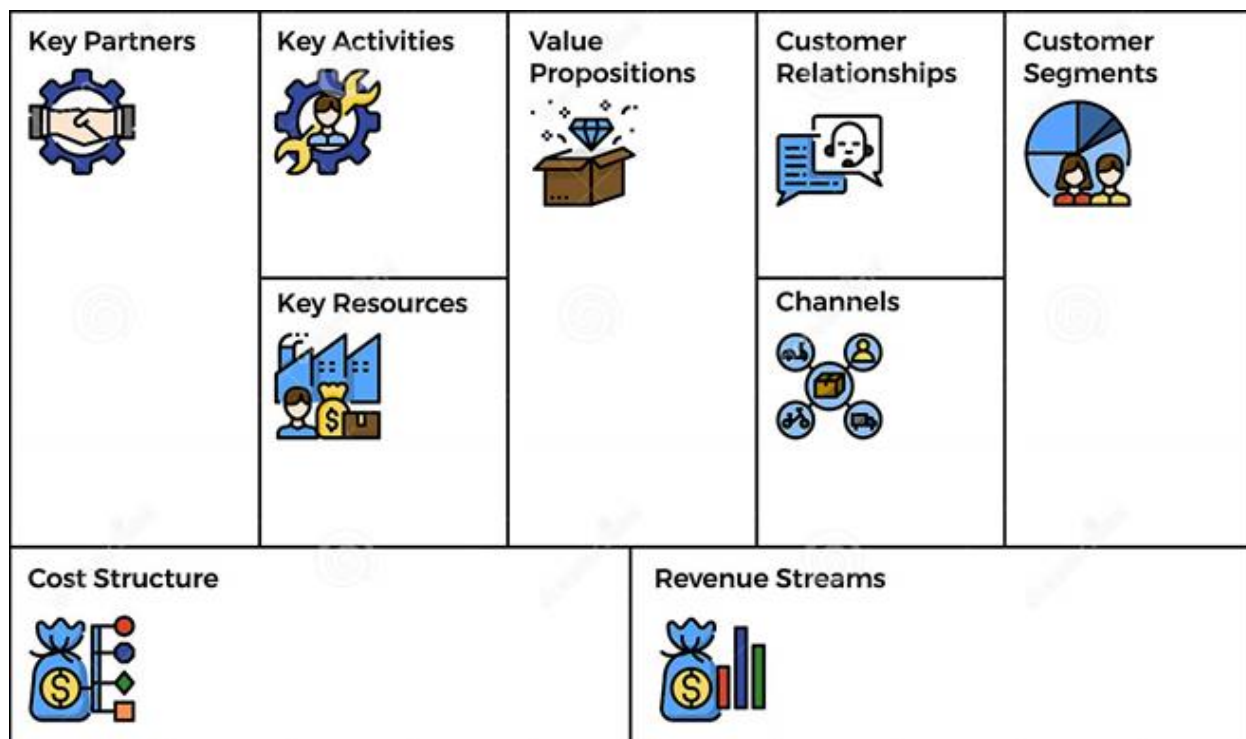
Before starting, the module owner provides a brief information about the content.

### Heart of the Lesson (30 minutes)

The module owner will provide detailed information about Business Canvas Model and Lean Canvas Model.

### Closure Activity (25 minutes)

The learners will establish a group which consists of 3-4 learners and then prepare their own “Business Canvas Model in the scope of the next lesson “Preparing a Business Canvas Model for the new idea” (45 min). Then, each group will review of its developed Business Model (30 min).



## HOUR 6: Preparing a Simple Business Plan by Using the Prepared Canvas Model

<b>Lesson Title:</b>	<b>Preparing a Simple Business Plan by Using the Prepared Canvas Model</b>
<b>Related Learning Outcomes:</b>	At the end of the lesson, learners will be able to: <ul style="list-style-type: none"> <li>prepare a Business Plan by utilizing Business Canvas Model for their idea</li> </ul>
<b>Duration of the Lesson:</b>	45
<b>Dominant Instructional Method:</b>	Lecture, discussion, project-based learning, brainstorming
<b>Instructional Materials:</b>	The teaching notes are available on the project website.
<b>Prerequisite Learning:</b>	No prerequisite is required.



<b>Discussion Questions:</b>	The learners will establish a group which consists of 3-4 learners and then prepare their own “Business Plan” in the scope of the next lesson “Preparing a Business Plan for the new idea” (45 min). Then all groups will discuss their developed Business Plan (30 min).
<b>Formative Assessment Activities:</b>	<ul style="list-style-type: none"><li>• Project</li><li>• Oral presentation</li></ul>

## IMPLEMENTATION OF THE LESSON PLAN

### Beginning of the Lesson

Before starting, the module owner provides a brief information about the content.

### Heart of the Lesson (30 minutes)

The module owner will provide detailed information about Business Plan.

### Closure Activity (25 minutes)

The learners will establish a group which consists of 3-4 learners and then prepare their own “Business Plan” in the scope of the next lesson “Preparing a Business Plan for the new idea” (45 min). Then, all groups will discuss their developed Business Plan (30 min).



## SAMPLE BUSINESS PLAN

(<https://www.jotform.com/222235255382957>)



### Section 1 - The Company

#### Short Description of the Company

#### The Objectives of the Company

#### The Vision and Mission of the Company

### Section 2 - Product/Service

#### What Products/Services the Company Offer

#### What Needs/Problems the Product/Service Addresses

#### The Features and Benefits (Customer Viewpoint) of the Product/Service

#### How the Product/Service is Different From Others in the Market

### Section 3 - The Target Customers

#### Define the Target Customers and Which Channels will be preferred to Reach Them



What research have you conducted to understand your customers, competitors?

Surveys & questionnaires  
Interviews  
Market testing  
Met with suppliers  
Social media research  
Family and friends

What research have you conducted to understand your customers, competitors?

Management Structure and Functions of the Company

The Distribution of the Operational Responsibilities

## Section 5 - The Sales and Marketing Plans

How do you or will you promote your business?

Website (information only)  
Advertising (online)  
Search engine marketing  
Retail outlets  
Referrals  
Events and exhibitions

Website (for e-commerce)  
Advertising (print, radio, TV)  
Social media  
Telesales  
Leaflets  
PR

Pricing Strategy

## Section 4 - The Market and Competition

Define the Target Market in Terms of Size, Demographics, Structure, Growth Prospects, Trends

## Section 6 - The Operational Plans

Where does or will your business operate from?

Competitors

	Name	Location	Website	Average Prices	Strengths	Weaknesses
Competitor 1						
Competitor 2						
Competitor 3						



## HOURS 7 & 8: Providing Practical Guide about Project Management and Preparing a Simple Project Proposal for a Developed Idea

<b>Lesson Title:</b>	<b>Providing a Practical Guide about Project Management and Preparing a Simple Project Proposal for a Developed Idea</b>
<b>Related Learning Outcomes:</b>	At the end of the lesson, learners will be able to: <ul style="list-style-type: none"><li>• create a simple Project proposal in written form which will be based on the new idea.</li></ul>
<b>Duration of the Lesson:</b>	30
<b>Dominant Instructional Method:</b>	Lecture, discussion, project-based Learning, brainstorming
<b>Instructional Materials:</b>	The teaching notes are available on the project website.
<b>Prerequisite Learning:</b>	No prerequisite is required.
<b>Discussion Questions:</b>	The learners will establish a group which consists of 3-4 learners and then fill up the following Simple Project Proposal for the new idea (45 min). Then all groups will discuss their written proposal document (30 min).
<b>Formative Assessment Activities:</b>	<ul style="list-style-type: none"><li>• Project</li><li>• Oral presentation</li></ul>

### IMPLEMENTATION OF THE LESSON PLAN

#### Beginning of the Lesson

Before starting, the module owner provides a brief information about the content.

#### Heart of the Lesson (30 minutes)

The module owner will provide detailed information about Project Management Lifecycle and especially focus on how they can prepare a project proposal.



### Closure Activity (25 minutes)

The learners will establish a group which consists of 3-4 learners and then fill up the following Simple Project Proposal for the new idea (45 min). Then, all groups will discuss their written proposal document (30 min).

#### SAMPLE PROJECT PROPOSAL TEMPLATE

<b>Title of the Project</b>	
<b>Abstract</b>	
<b>Keywords</b>	
<b>Rationale/Background/Introduction</b> (Please explain why this idea needs/what are the existing problems)	
<b>Research Methodology</b>	
<b>Objectives of the Project</b>	
<b>Expected outcomes and benefits of the project</b>	





<b>Potential Risks</b>	
<b>Schedule and Milestones of the Project</b>	



## APPENDIX – Curriculum Vitae – Authors and Collaborators

### TED University (TEDU)

#### **Zafer Yilmaz**

is an assistant professor of the Business Administration Department at TED University, Turkey. He received his Ph.D. degree from the Turkish Military Academy Defense Sciences Institute, Department of Supply and Logistics Management.

Before joining TED University, he was a post-doctoral researcher at McGill University for 1.5 years. His research interests center on Operations Management, Management Science, Supply Chain Management, Inventory Management, and Network Analysis. His current researches focuses on Sustainable Transportation Planning, Hazardous Materials Transportation, and Disaster Logistics. He is currently a leading researcher at the "EUGPUT" project.



#### **Ibrahim Unalmis**

has a BSc degree on "Economics" from the Middle East Technical University, Turkey. He has received a master degree from the Birmingham University, UK on "Money, Banking and Finance". His PhD degree is on Macroeconomics. Specifically, he has worked on modelling oil demand and determination of oil price. He has publications at IMF Economic Review, Energy Economics, Economic Modelling, and Finance Research Letters. Dr. Unalmis has joined to the TED University in 2018 as an Associate Professor of Finance and Chair of Business Administration Department. Currently, he is Associate Dean of the Faculty of Economics and Administrative Sciences.





## Seda Damla Yucel

is an expert at Directorate of Research, Technology and Innovation at TEDU in Turkey. She received her MSc degree in Intellectual Property, Technology Policy and Innovation Management from Ankara University, Turkey. Her expert

areas are development and management projects for national/international funding programs, technology evaluation and valuation, supporting and mentoring for entrepreneurs, faculty members and students about Intellectual Property Rights and access to funding, development university-industry collaboration. She had various experience at international areas such as Internship at National Institutes of Health (NIH) OTT and also Visiting Scholar at Max Planck Institute for Innovation and Competition.



## Sibel Akin-Sabuncu

is an assistant professor of Curriculum and Instruction at the Faculty of Education at TED University, Turkey. She obtained her Ph.D. degree in Curriculum and Instruction Program at Middle East Technical University. She was a visiting scholar at Teachers

College, Columbia University during her doctoral studies, and is currently also a post-doctoral researcher at Teachers College, Columbia University. Her research focuses on curriculum design and evaluation, teaching and teacher education for social justice and educational equity. Her recent research project has been granted Global Education Research Award in 2021.







## Pelin Irgin

is an assistant professor of English Language Education at TED University in Turkey. She received her PhD degree in English Language Teaching at Hacettepe University, Turkey and completed her doctorate thesis research at University of Reading, UK. Her research interests are language learning and cognition, EFL listening comprehension, listening strategies instruction. She teaches undergraduate and graduate courses in linguistics, language acquisition, and language assessment. She has published in various refereed journals and presented papers at conferences. She is currently serving on the editorial boards of international publications.



## Oyku Yucel

graduated from Bilkent University, Faculty of Business Administration with a BS degree in Management. Upon completing her thesis on application of Capital Asset Pricing Model and Fama-French 3-Factor Model, she received her MS degree from Ankara University Faculty of Political Science, Business Administration Department. She continues her PhD studies at Ankara University Faculty of Political Science, Business Administration Department. She is working in TED University as a research and teaching assistant mainly in accounting and finance courses. Her research interests are capital asset pricing, electricity market pricing and renewable energy sources.





## Gizem Celik

was born in 1994. She completed her high school education in Mugla Anatolian High School in 2012. In 2018, she graduated from Middle East Technical University, Department of Business Administration. In 2021, she received her MS degree from İstanbul Technical University, Business Administration Department. She continues to her PhD studies in Business Administration Graduate Program at Hacettepe University, Turkey. She has been working as a research assistant at TED University since February 2019.



## Middle East Technical University (METU)

### Yesim Capa Aydin

is an associate professor in the Department of Educational Sciences and director of the Center for Advancing Learning and Teaching (ODTÜ ÖGEM) in Middle East Technical University, Turkey. She received her doctorate in quantitative research, measurement, and evaluation in education from The Ohio State University. She has been involved in 29 research projects and published more than 30 scientific articles. Her research interests include assessment and feedback in higher education, faculty development, performance evaluation, and assessment of psychological constructs.





## University of Split

### **Maja Ćukušić**

is an associate professor at FEBT's Department of Business Informatics in Croatia. Before employment at the University of Split, she worked for three years in a Dutch company and was involved in the design and implementation of complex ICT solutions for domestic and foreign markets. She is the manager of the project financed by Croatian Science Foundation (User-oriented process (re)design and information systems modelling – a case of smart city services) and the key expert for e-learning in the SEA-EU European University Alliance. In her teaching (courses OLAP systems, ERP systems, E-business), she covers studies on different business intelligence technologies, visualization tools (open data), and smart devices etc.



### **Ivana Ninčević Pašalić**

is a research and teaching assistant at FEBT's Department of Business Informatics, and a PhD candidate at the University of Split in Croatia. She teaches lab classes for the courses Multidimensional Information Systems and Management of Her previous working positions include being Internal Auditor for a US based international organization and Operations Manager at a Croatian private company. She is also a member of the research team of MIS4SC project. Within the framework of the project, her research is focused on G2C and C2G interactions in smart cities, with a special focus on citizen engagement via different information and communication technologies.







## Silvia Golem

graduated from Faculty of Economics, Business and Tourism Split, University of Split in Croatia. She obtained her MSc and PhD diploma in Economics at Staffordshire University, Stoke-on-Trent (UK). At the present time, she is employed as an associate professor at Faculty of Economics, Business and Tourism Split, University of Split where she teaches different courses: Methodology of Economic Research, Urban Economics, Spatial Economics and Macroeconomic Planning. She actively participates in scientific projects mainly related to urban and public economics. Her field of interest, within which she publishes scientific papers, includes public economics, econometrics, urban economics, and smart cities.



## Lana Ugrčić

Ugrčić is managing Center for Service-Learning and Student Business Incubator at Faculty of Economics, Business and Tourism in Split, Croatia. She is experienced in working with startups and scale-ups. She ran more than 5 startup batches in the incubator. She is an organizer of entrepreneurial events with the aim to connect startups; matches them with investors, serial entrepreneurs who can act as mentors, and business advisers to help them grow and manage European entrepreneurship projects. She has a proven track record of being awarded, implementing and managing EU funded projects.







## University Politehnica of Bucharest (UPB)

### Dorinela Costescu

is an associated professor at the Faculty of Transports, Polytechnic University of Bucharest in Romania. She coordinated the academic programmes in the Domain of Transport Engineering as Head of Transport, traffic and logistic Department between 2017 and 2020. Her teaching covers Transport Systems, Public Transport, Supply Chain Management. She was actively involved in several research projects related to intermodal transport and city logistics. In the period 2012 – 2016, she coordinated a multidisciplinary research project on urban road safety. Since 2017 her main interests have focused on sustainable technologies for urban transportation.



### Sergiu Olteanu

graduated Transports Faculty within POLITEHNICA University of Bucharest, Romania in 2011. Since 2013 he is a staff member of the Transports, Traffic and Logistics Department and since 2017 he is PhD in Transport Engineering scientific field. Before becoming a teacher, for two years, he has been part of the transport industry, working for a romanian private railway operator. Simultaneously, he graduated from the Transport Management master program, organized within the Transports Faculty. His research interests are Intermodal transport, Computerized modeling and simulation of the transport systems.





## University of Ljubljana (UL)

### **Aleš Groznik**

is a full professor at the Department of Business Informatics and Logistics at the School of Economics and Business, University of Ljubljana in Slovenia. His research interest is in the areas of long range planning of IT and logistics. His research area also covers studies on supply chain management, e-business and information technology management in ever changing business environments. He published over 150 papers in international journals and conferences, amongst them in Supply Chain Management Journal, Journal of Enterprise Information Management and Government Information Quarterly Journal.



### **Bor Krizmanič**

is a teaching assistant at the Department of Business Informatics and Logistics at the School of Economics and Business, University of Ljubljana in Slovenia. Prior to his employment at the University of Ljubljana, he worked in a large accounting firm in the area of information systems auditing and consulting in the implementation and maintenance of IT solutions. His area of interest includes research in technology adoption and digital transformation. He is currently pursuing a PhD in Information Management.





## Anton Manfreda

is an assistant professor at the Department of Business Informatics and Logistics at the School of Economics and Business, University of Ljubljana in Slovenia. His research interest is in the areas of business-IS relationship, various aspects of digital transformation, technology adoption and business process management. His work has appeared in International Journal of Information Management, Information Technology & People Journal, Journal of Enterprise Information Management and other international and national journals. He has also been a consultant for business process change on several projects in the public and private sector.



## Kristina Nagode

is a young researcher and teaching assistant at the Department of Business Informatics at the School of Economics and Business, University of Ljubljana in Slovenia since October 2021. She graduated from the Faculty of Tourism Studies, University of Primorska, Slovenia, with a master thesis on the effects of sustainability on customer satisfaction in hotel organizations based on big data analysis. Her area of interest is primarily related to smart cities and digitalization.







## Luka Tomat

is an assistant professor at the Department of Business Informatics and Logistics at the School of Economics and Business, University of Ljubljana in Slovenia, where he teaches several information management related courses on graduate and after-graduate level. In his research, he focuses on digital transformation, smart cities, information management, optimization, electronic business, business process management, big data analytics, IT in tourism and IT in healthcare. He also participates at several commercial projects.



## Atomic Intelligence

### Tomislav Križan

is a CEO & AI Evangelist at Atomic Intelligence Tomislav plays with data for a long time in every possible and impossible way. First Big Data project was on account-tickets in a bookkeeping service (low tech approach). Where the most see just numbers and letters, he finds a purpose and information. For a while now he is playing on a field of AI/DL/ML models for business purposes, with the last couple of years having a spotlight on text analytics, NLP (unstructured datasets) and applying ML models where they were not used before.





Energy Usage and Green Public Transportation in  
Future Smart Cities: An Innovative Teaching Program  
for Students, Stakeholders and Entrepreneurs  
n° 2020-1-TR01-KA203-094242



Co-funded by the  
Erasmus+ Programme  
of the European Union



<http://eugput.com>



<https://www.instagram.com/eugputproject>



<https://tr.linkedin.com/in/eugput-project-41762a211>



<https://mobile.twitter.com/eugputproject>