

Table of Contents

Symbols and markings	5
1 Introduction to sustainable development of transport systems	6
1.1 The concept of transport system	6
1.2 Modelling transport systems.....	8
1.3 Issues in the development of transport systems.....	14
1.4 The origin of the sustainable development of transport systems	17
1.5 Modelling of sustainable transport system development (EMITRANSYS)	20
2 Simulation methods in the modelling of transport systems.....	23
2.1 The concept, types, and pros and cons of simulation	23
2.2 Constructing simulation models	28
2.3 Types of simulation tools.....	34
2.4 PTV VISUM simulation environment	35
3 A mathematical model of the sustainable development of TS	37
3.1 General assumptions	37
3.2 Formal notation of the model.....	40
3.3 Mirroring the transport system structure	41
3.4 Mirroring of means of transport	42
3.5 Characteristics of selected model elements	43
3.6 Mirroring the demand for carriage	47
3.7 Mirroring the organisation of traffic flow	48
4 Assessment of the sustainable development of the transport system.....	51
4.1 Assessment of the pro-ecological nature of the transport system.....	51
4.2 Assessment of the efficiency of TS in terms of environmental friendliness	53
4.3 Assessment criteria of sustainable development of TS	56
4.3.1 General remarks	56
4.3.2 Economic criteria	57
4.3.3 Technological criteria	58
4.3.4 Ecological criteria.....	60
4.3.5 The criteria for assessing the impact of sustainable TS on the environment	65
5 EMITRANSYS as a model of the sustainable development of TS	68
5.1 Assumptions for modelling sustainable TS on the macro scale	68
5.2 Modelling of passenger transport needs.....	71
5.2.1 Travel motivations.....	71
5.2.2 Parameters of sources and outlets of the traffic flow	71
5.2.3 Spatial distribution of the traffic flow	72
5.2.4 Modal division of transport tasks	73
5.3 Modelling of cargo transport needs	79
5.3.1 Demand segments.....	79
5.3.2 Estimation of the volume of transport needs	80
6 Implementation of the model using simulation tools	86

6.1 Data structure in the model	86
6.2 Data on the transport network	88
6.2.1 Road network	88
6.2.2 Railway network.....	92
6.2.3 Airline and inland waterway transport network	94
6.3 Data on the supply of transport services	96
6.4 Data on the demand for transport services.....	99
6.5 Representation of the means of transport	103
6.6 Data on the emissions of harmful exhaust compounds	104
7 Planning the sustainable development of TS using simulation tools – case studies	107
7.1 Simulation of traffic distribution within a transport network, with considerations for external costs.....	107
7.1.1 Introduction to the research	107
7.1.2 Definition of the research problem	109
7.1.3 The results of the simulation of traffic flow distribution over the transport network	112
7.2 Multivariate analysis of traffic distribution in the aspect of sustainable development TS (Emitransys model)	116
7.2.1 Introduction to the research	116
7.2.2 Variant distribution of traffic in the transport network using simulation tools	118
7.2.3 Simulation of pollution dispersion in the Emitransys model	122
7.3 Modelling the development of urban agglomeration transport system for cargo traffic	131
7.3.1 Introduction to research	131
7.3.2 The research on cargo traffic in the urban agglomeration	132
7.3.3 Modelling cargo traffic in the transport system of an urban agglomeration	135
8 References	141