

Studies in Systems, Decision and Control 563

Aleksander Ślادkowski *Editor*


Using Artificial Intelligence to Solve Transportation Problems

 Springer

Studies in Systems, Decision and Control

Volume 563

Series Editor

Janusz Kacprzyk , Systems Research Institute, Polish Academy of Sciences,
Warsaw, Poland

Editorial Board

Dmitry A. Novikov, Institute of Control Sciences (Director), Russian Academy of
Sciences, Moscow, Russia

Peng Shi, School of Electrical and Mechanical Engineering, University of
Adelaide, Adelaide, SA, Australia

Jinde Cao, School of Mathematics, Southeast University, Nanjing, China

Marios Polycarpou, KIOS Research Center, University of Cyprus, Nicosia, Cyprus

Witold Pedrycz, Faculty of Engineering, University of Alberta, Alberta, Canada

Aleksander Śladkowski
Editor

Using Artificial Intelligence to Solve Transportation Problems

 Springer

Editor

Aleksander Śładkowski
Faculty of Transport and Aviation
Engineering
Silesian University of Technology
Katowice, Poland

ISSN 2198-4182

ISSN 2198-4190 (electronic)

Studies in Systems, Decision and Control

ISBN 978-3-031-69486-8

ISBN 978-3-031-69487-5 (eBook)

<https://doi.org/10.1007/978-3-031-69487-5>

© The Editor(s) (if applicable) and The Author(s), under exclusive license to Springer Nature Switzerland AG 2024

This work is subject to copyright. All rights are solely and exclusively licensed by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

If disposing of this product, please recycle the paper.

Contents

Key Artificial Intelligence and Digitalization Solutions Towards Vision Zero in Road Safety	1
Apostolos Ziakopoulos and George Yannis	
Usage of Specialized Intellectual and Artificial Intelligence Systems to Improve Railway Transport Technologies	27
Vladyslav Skalozub, Ihor Zhukovytskyi, Dmytro Bosyi, and Valerii Lakhno	
Numerical Assessment of the Railway Network Functioning	123
Wojciech Kamiński and Aleksander Sladkowski	
The Impact of Digitalization and Method of Container Transshipment on Intermodal Freight Transport	191
László Vida and Béla Illés	
Improvement of Freight Routes: Innovative Digital Solutions for Long-Term Planning in Kazakh Rail Transport	247
Madiyar Sultanbek, Nazdana Adilova, and Aleksander Sladkowski	
Systems for Planning and Operation of Electric Buses for Public Transport of Passengers in Cities	309
Velizara Pencheva, Asen Asenov, Ivan Georgiev, Aleksandar Georgiev, and Pavel Stoyanov	
Intelligent Logistics Mobile Robot Automatic Navigation Key Technology and Its Application	375
Xuelin Wang, Hao Chen, Kailan Gao, Huixin Wei, and Changlin Wang	

Supply Chain Challenges in Wartime: LLC “Raben Ukraine” Key Study 433
Antoniia Bieliatynska, Kristina Čižiūnienė, Iryna Klymenko,
and Jonas Matijošius

Machine Learning in Road Freight Transport Management 485
Artur Budzyński and Aleksander Sładkowski

Numerical Assessment of the Railway Network Functioning

Wojciech Kamiński and Aleksander Sladkowski

Abstract Before making a decision to invest in railway lines, many different analyzes are carried out. Issues related to the assessment and comparison of individual railway lines so far have been addressed many times. Previous research in this area has involved determining the factors that describe the analyzed railway line, influence the volume of transport on a specific line or define what parameters it should meet. Later, the weights of individual factors were determined. In previous studies, they were set using expert assessments, based on consultations with decision-making centers, or authors of research imposed them arbitrarily. This publication presents a new, numerical method for analyzing the efficiency of railway lines. This method will define quantitative socio-economic and infrastructural factors that affect the movement of passenger and freight trains. Then, the impact of individual factors affecting to train traffic on the railway lines selected for comparison will be determined. For this aim partial correlation coefficients will be used. Based on the obtained results, the weights of these factors will be determined entirely analytically. This action avoids the use of expert assessments. Using the obtained weights, it is possible to compare selected railway lines taking into account quantitative criteria. These lines can be located in any region of the world, but the obtained results will vary. After obtaining the weights analytically, it is possible to use modified multi-criteria analysis methods for comparison. Methods were used such as the zero unitarization method, the AHP method and the TOPSIS method. The use of this methods allows for comparison of railway lines in passenger and freight transport in a completely analytical way. Such assessments, with appropriate data, can be performed automatically.

Keywords Railway lines · Passenger transport · Freight transport · Correlation coefficient · Multi-criteria analysis TOPSIS method · AHP method · Logistics

W. Kamiński (✉) · A. Sladkowski

Faculty of Transport and Aviation Engineering, Silesian University of Technology, Krasińskiego 8, 40-019 Katowice, Poland

e-mail: wojciech.kaminski@polsl.pl

A. Sladkowski

e-mail: aleksander.sladkowski@polsl.pl