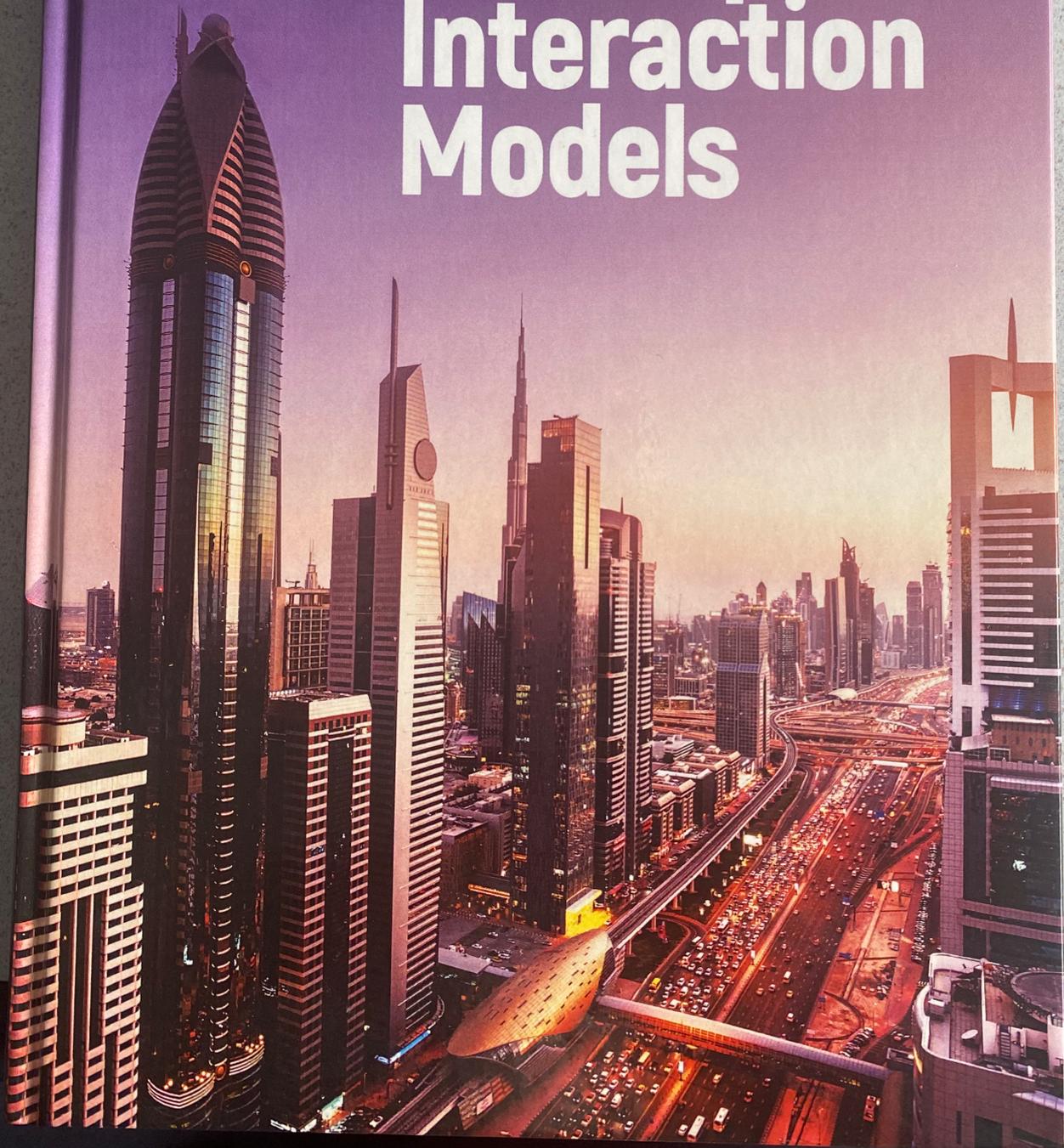


 CRC Press
Taylor & Francis Group

Rubén Cordera
Ángel Ibeas
Luigi dell'Olio
Borja Alonso

Land Use — Transport Interaction Models



CRC Press
Taylor & Francis Group
6000 Broken Sound Parkway NW, Suite 300
Boca Raton, FL 33487-2742

© 2018 by Taylor & Francis Group, LLC
CRC Press is an imprint of Taylor & Francis Group, an Informa business

No claim to original U.S. Government works

International Standard Book Number-13: 978-1-1380-3246-0 (Hardback)

This book contains information obtained from authentic and highly regarded sources. Reasonable efforts have been made to publish reliable data and information, but the author and publisher cannot assume responsibility for the validity of all materials or the consequences of their use. The authors and publishers have attempted to trace the copyright holders of all material reproduced in this publication and apologize to copyright holders if permission to publish in this form has not been obtained. If any copyright material has not been acknowledged please write and let us know so we may rectify in any future reprint.

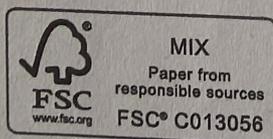
Except as permitted under U.S. Copyright Law, no part of this book may be reprinted, reproduced, transmitted, or utilized in any form by any electronic, mechanical, or other means, now known or hereafter invented, including photocopying, microfilming, and recording, or in any information storage or retrieval system, without written permission from the publishers.

For permission to photocopy or use material electronically from this work, please access www.copyright.com (<http://www.copyright.com/>) or contact the Copyright Clearance Center, Inc. (CCC), 222 Rosewood Drive, Danvers, MA 01923, 978-750-8400. CCC is a not-for-profit organization that provides licenses and registration for a variety of users. For organizations that have been granted a photocopy license by the CCC, a separate system of payment has been arranged.

Trademark Notice: Product or corporate names may be trademarks or registered trademarks, and are used only for identification and explanation without intent to infringe.

Visit the Taylor & Francis Web site at
<http://www.taylorandfrancis.com>

and the CRC Press Web site at
<http://www.crcpress.com>



Printed and bound in Great Britain by
TJ International Ltd, Padstow, Cornwall

Contents

Acknowledgements	vii
Editors	ix
Contributors	xi
Introduction.....	xiii

SECTION I State of the Art in Land Use–Transport Interaction Modelling

Chapter 1 A Brief History of Land Use–Transport Interaction Models	3
<i>Rubén Cordera, Ángel Ibeas, Luigi dell’Olio and Borja Alonso</i>	
Chapter 2 A Classification of Land Use–Transport Interaction Models.....	11
<i>Rubén Cordera and Ángel Ibeas</i>	

SECTION II The Theoretical Basis of Land Use–Transport Interaction Models

Chapter 3 The Nexus between Transport and Land Use: Accessibility	25
<i>Hugo González, Rubén Cordera and Ángel Ibeas</i>	
Chapter 4 Microeconomic Theory of the Interaction between Transport and Land Use.....	37
<i>Rubén Cordera, Ángel Ibeas and Borja Alonso</i>	
Chapter 5 Spatial Interaction Models	55
<i>Gonzalo Antolín, Rubén Cordera and Borja Alonso</i>	
Chapter 6 Random Utility Theory and Land Use–Transport Interaction Models.....	69
<i>Luigi dell’Olio, Rubén Cordera and Ángel Ibeas</i>	

- Chapter 7** Optimisation and Land Use–Transport Interaction Models..... 87
Sara Ezquerro and Borja Alonso

SECTION III Steps for Building an Operational Land Use–Transport Interaction Model

- Chapter 8** Definition of the Model's Purpose, the Study Area and the
 Input Data..... 103
Rubén Cordera, Ángel Ibeas and Luigi dell'Olio
- Chapter 9** Models for Simulating the Location of Population and Activities... 119
Eneko Echaniz, Rubén Cordera and Luigi dell'Olio
- Chapter 10** Models for Simulating the Impact of Accessibility on Real
 Estate Prices 139
Rubén Cordera, Ángel Ibeas and Luigi dell'Olio
- Chapter 11** Models for Simulating the Transport System..... 155
Borja Alonso, Rubén Cordera and Ángel Ibeas

SECTION IV Land Use–Transport Interaction Models Considering Spatial Dependence

- Chapter 12** Spatial Dependence in LUTI Models..... 179
Rubén Cordera and Luigi dell'Olio
- Chapter 13** Practical Application of a Land Use–Transport
 Interaction Model 199
Juan Benavente, Alvaro Landeras, Rubén Cordera and Ángel Ibeas
- Index**..... 215

Acknowledgements

The authors of this book, who are part of the Transport Systems Research Group (Grupo de Investigación de Sistemas de Transporte [GIST]) based at the University of Cantabria, Cantabria, Spain, acknowledge all the members of the group who have directly or indirectly contributed towards its creation. We also thank Professor Pierluigi Coppola of the University of Rome Tor Vergata, Rome, Italy for his inestimable help in obtaining the results on which this research was based and to Chris Tyas, geographer, for his contributions in the review and translation of this book. The active collaboration of Santander City Council, Cantabria, Spain, provided the information required to study the territorial realities used in this research. Finally, we thank the Spanish Ministry of the Economy and Competitiveness and the European Commission for their financial support that made this book a reality, through the following projects: (1) INTERLAND (E 21/08), (2) TRANSPACE (TRA2012-37659), (3) PARK-INFO (TRA2013-48116-R) and (4) SETA: A ubiquitous data and service ecosystem for better metropolitan mobility.

Contributors

Gonzalo Antolin
University of Cantabria
Cantabria, Spain

Juan Benavente
University of Cantabria
Cantabria, Spain

Eneko Echániz
University of Cantabria
Cantabria, Spain

Sara Ezquerro
University of Cantabria
Cantabria, Spain

Hugo González
University of Cantabria
Cantabria, Spain

Alvaro Landeras
University of Cantabria
Cantabria, Spain

13 Practical Application of a Land Use–Transport Interaction Model

*Juan Benavente, Alvaro Landeras,
Rubén Cordera and Ángel Ibeas*

CONTENTS

13.1	The Structure of the LUTI Model	200
13.2	Connection and Equilibrium between Land Use and Transport Models	202
13.3	Implementing a Land Use–Transport Interaction Model.....	203
13.3.1	Calibration of the Joined-Up Model without Considering Spatial Dependency between the Observations	204
13.3.2	Using a Land Use–Transport Interaction Model to Simulate the Introduction of a New Policy: Charge for Accessing the Urban Centre	207
13.4	Calibration of a Land Use–Transport Interaction Model Considering Spatial Dependence.....	210
13.5	Conclusions	212
	References.....	212

This chapter will describe the application of the sub-models described in the book to calibrate a combined land use and transport interaction model. The steps taken to define the goals of the model, outline the study area and collect the data that are required as the input information for the sub-models were summarised in Chapter 8. The examples were presented in Chapters 9 through 11 showing how to estimate models for the location of population and economic activities, as well as real estate pricing and mobility simulation models (trip generation, trip distribution, modal choice and assignment). This chapter will explain how to interrelate these sub-models and how to perform a joined-up calibration of the entire land use–transport interaction (LUTI) system. The model was programmed using Python 2.7, a free code language compatible with a variety of transport modelling software, including the Visum® model, which was used in this case (PTV 2014). The resulting LUTI model has been applied to a real case in order to simulate the effects of introducing a specific transport policy. A LUTI model that considers spatial dependence in the data will also be calibrated and its fit will be compared with that of the standard model. The aim of

- Duthie, J., K. Kockelman, V. Valsaraj, and B. Zhou. 2007. Applications of integrated models of land use and transport: A comparison of ITLUP and URBANSIM land use models. *54th Annual North American Meetings of the Regional Science Association International*, Savannah, GA.
- Eliasson, J. 2009. A cost–benefit analysis of the Stockholm congestion charging system. *Transportation Research Part A: Policy and Practice* 43 (4): 468–480. doi:10.1016/j.tra.2008.11.014.
- Lutz, M. 2013. *Learning Python*. Sebastopol, CA: O'Reilly Media.
- Manheim, M. L. 1979. *Fundamentals of Transportation Systems Analysis; Volume 1: Basic Concepts*. Cambridge, MA: MIT Press.
- PTV AG. 2014. *VISUM 14 User Manual*. Karlsruhe, Germany: PTV Group.
- Santos, G., and B. Shaffer. 2004. Preliminary results of the London congestion charging scheme. *Public Works Management & Policy* 9 (2): 164–181. doi:10.1177/1087724x04268569.

Rubén Cordera
Ángel Ibeas
Luigi dell'Olio
Borja Alonso

Land Use —Transport Interaction Models

Transport and the spatial location of population and activities have been important themes of study in engineering, social sciences and urban and regional planning for many decades. However, an integrated approach to the modelling of transport and land use has been rarely made, and common practice has been to model both phenomena independently.

This book presents an introduction to the modelling of land use and transport interaction (LUTI), with a theoretical basis and a presentation of the broad state of the art. It also sets out the steps for building an operational LUTI model to provide a concrete application. The authors bring extensive experience in this cross-disciplinary field, primarily for an academic audience and for professionals seeking a thorough introduction.

Features

- A unique guide to LUTI modelling
- Primarily for an academic readership, but also useful for advanced planners
- Sets out a workable model, TRANSPACE

Dr. Rubén Cordera is a Researcher in Transport and Land Use interaction in the Transportation Systems Research Group at the University of Cantabria, from where he earned his Ph.D. His research focuses on LUTI models, transport planning and spatial econometric models applied to transport and land use.

Dr. Ángel Ibeas is a Professor of Transport Planning and director of The Transport Systems Research Group at the University of Cantabria, from where he earned his Ph.D. His research focuses on logistics, transit operation, travel behaviour and intelligent transportation systems.

Dr. Luigi dell'Olio is a Professor of Transport Planning and Head of the Transportation Demand Modelling Division of the Transport Systems Research Group at the University of Cantabria. He earned his Ph.D. from the University of Burgos (Spain) and his master of engineering at the Technical University of Bari (Italy). His research focuses on transit operations and planning, travel behaviour and Land Use and Transport Interaction models.

Dr. Borja Alonso is an Assistant Professor of Transport Planning at University of Cantabria, from he earned his PhD. He belongs to the Transport Systems Research Group since 2007 and his research focuses on transit operations and planning, transport modelling and traffic engineering.

 **CRC Press**
Taylor & Francis Group

URBAN & TRANSPORT PLANNING

6000 Broken Sound Parkway, NW
Suite 300, Boca Raton, FL 33487
270 Madison Avenue
New York, NY 10016
2 Park Square, Milton Park
Abingdon, Oxon OX14 4RN, UK

K30717

ISBN: 978-1-138-03246-0

