Transport Science and Technology

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Emerald Group Publishing Limited
Howard House, Wagon Lane, Bingley BD16 1WA, UK

First edition 2007

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

ISBN: 978-0-08-046754-2

Awarded in recognition of Emerald's production department's adherence to quality systems and processes when preparing scholarly journals for print

INVESTOR IN PEOPLE

PREFACE

Transportation evolved in the past 30 years as a self standing field of research and education. This book and the conference from which we extracted a sample of presented papers showcase this unique nature of transportation practice and research. The conference Transportation Science and Technology Congress (TRANSTEC) ATHENS 2004 was held in September 1-5, 2004, at the landmark Athens Hilton Hotel, following the Athens 2004 Olympic Games. Dedicated to the truly Olympic achievements of our transportation profession, this book illustrates creativity and innovation in science and technology.

TRANSTEC's objectives were to assemble a wide range of case studies, motivate collaborations among professionals that do not usually meet in other venues, identify themes and methods that are shared by different specialties, and gather specialists to celebrate the science and technology excellence creating a unique forum for exchange of ideas across the entire spectrum of the transportation industry. There were 85 presentations and workshops from 24 countries and 150 attendees.

There are five groups of chapters in this book that start with a selection of review contributions describing the state of the art in simulation, capacity and traffic operations, soft computing for modeling and simulation, and innovations in transportation materials research. This is followed by a section dedicated to the host country illustrating the context within which the Olympic Games were planned and delivered, the solutions to transportation problems and impressive technologies employed leading to the most successful Olympic Games. The remaining three sections take us to an exciting trip around the world showcasing first the importance of human-centered designs in the section on "systemic and systematic approaches to human performance and behavior." Then, as a reflection of today's information era a group of chapters shows the pioneering science and technology role of transport systems in the section on "information systems, communication, management, and control." The final section offers a rich set of complex solutions on "logistics, supply chains, and intermodal systems" and includes contributions from maritime transportation.

There is no doubt the TRANSTEC success is due to the persons that worked hard to make it a reality. First of all, the impeccable conference organization characterized by a uniquely Hellenic hospitality and warmth is due to the *ALVIA DMC* and the creative genius of Nassos Stevenson. Inspirational guidance and support also came from Konstantinos Zekkos of *"DROMOS" Consulting Ltd* who also ensured the attendance of many of our local colleagues. The warm welcome and insights about the transportation and tourism relationship of the Deputy Minister of Tourism Anastasios Liaskos set the stage for a memorable experience.

As always a successful meeting is due to its scientific committees. TRANSTEC was fortunate to have Chandra Bhat (University of Texas), Lily Elefteriadou (University of Florida), George A. Giannopoulos (Aristotle University of Thessaloniki), Dimitrios G. Goulias (University of Maryland), Loukas Kalisperis (The Pennsylvania State

University), Assad Khattak (University of North Carolina), Ryuichi Kitamura (Kyoto University), Hani S. Mahmassani (University of Maryland), John M. Mason, Jr. (The Pennsylvania State University), Mirko Novak (Czech Technical University of Prague), Ram M. Pendyala (Arizona State University), Konstantinos M. Zekkos ("DROMOS" Consulting Ltd), and Athanassios K. Ziliakopoulos (University of Thessaly).

Many thanks to all new and old friends that made TRANSTEC and this book possible.

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The conference participants at the Athens Hilton conference site overlooking the Acropolis

CHAPTER 1

Introduction to science, technology, and transport systems

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INTRODUCTION

The need to provide for safe, reliable, and efficient movement of people and goods is held as the core mission of transportation systems and services. In pursuing this mission, one can identify at least five influential themes that are embedded in the creation and operation of transportation systems. These themes are: a) behaviour, b) design, c) performance, d) technology, and e) chance.

Behaviour is of paramount importance from two perspectives: the travellers and the operators. It includes our everyday behaviour but it is also based on our values, perceptions, intentions, attitudes, and the exchange of material and nonmaterial entities. In-depth understanding of this human nature is essential to the planning, design, and operational analysis of transportation systems. In fact, transportation specialties are interested in these aspects and research on this is extremely active, accelerating in pace during the past few years, and aiming not only to understand but to also predict human behavior. The second theme, *design*, contains the traditional component of engineering system design that is now at a very mature state. There is also another component that is emerging as an exciting new field, which is a human centered design of systems and services and incorporates ideas from field studies and disciplines that are not traditionally associated with typical transportation studies. *Performance*, the third theme, is of paramount importance again from two perspectives: the human performance, particularly in human machine interaction, and the system and its components' performance. This area spans a wide spectrum from the materials used to build the systems to the operations of an entire system itself. Unavoidably *technology* provides the tools used to make the systems and services work with prominent place taken today by information and telecommunication technologies. This is particularly present in this book because of the important role technology played in the recent years but also because this is the area where we see galloping advances. *Chance* is a theme that is becoming increasingly prominent in the science and engineering of transportation systems and services and it is

increasingly used to account for our inability to control all the factors impacting our systems. We also realize that we do not have sufficient knowledge about the world surrounding us and therefore our inventions need to take this into account. Most important, however, chance is also used to account for the rich nature and unpredictability of human behavior in the interactions with other humans, the anthropogenic world, and nature itself.

All five themes interact and influence each other very often in ways that we need to understand and they are all reflected in each chapter of this book. As the chapters in this book show, interaction among these themes is a process that spans the wide spectrum of transport science and technology. The process itself is unique to transportation and in addition to transferring methods from other disciplines to engineering system design (interdisciplinary approach), it is also emerging as a scientific and technological field with its own principles, methods, and techniques much like medicine. This book is a small contribution to this emerging transdisciplinary nature of transport science and technology.

BOOK ORGANIZATION

Instead of offering a comprehensive review of transport science and technology we selected a sample of a few interesting aspects that demonstrate the synergy of the five themes discussed above. Selection of the chapters was from the more than 80 presentations given at the Transport Science and Technology Congress (TRANSTEC) in Athens in September, 2004. Emphasis is given to a balanced representation of the five themes above but also representation from the different schools of thought around the world and the variety of specific missions in transportation research and practice.

This book is divided into five sections. We start with a state-of-the-art section in which there are four overview chapters on selected aspects. The second chapter by Lily Elefteriadou on "Highway capacity analysis in the U.S: state of the art and future directions" offers an informative review of the most popular manual/handbook for traffic operators and the determination of highway capacity. Then, Aruna Sivakumar and Chandra Bhat in the third chapter give us another state of the art review of emerging simulation methods that are increasingly employed by many transportation planning models and they are very useful for other applications as well. The fourth chapter by Ondrej Pribyl is a summary of a training workshop at TRANSTEC and shows how techniques of soft computing developed in other fields found their home in traffic operations and transportation planning. This section closes with a chapter by Dimitrios Goulias illustrating technological and methodological advances in materials research. One common thread among all chapters is the extensive use of probability and statistics that by now is no longer an innovation but a tool of the transportation trade.

In the second section of the book and reflecting the TRANSTEC venue and the excitement of the Athens Olympics we dedicate the chapters to the Hellenic transportation systems. The first chapter by George Giannopoulos offers a comprehensive review of transportation in Greece within the broader context of the European Union. In the second chapter we find the

blueprint of planning for the Athens 2004 Olympic games written by John Frantzeskakis. Undoubtedly the phenomenal success and exemplary organization of these Olympics is partially to be attributed to blueprints of this type. Liza Panagiotopoulou in Chapter 8 describes a typical example of advanced technology at the service of transportation management and operations, which is the "eye in sky" employed and tested during the Athens Olympics. This section concludes with another major technology application in the Northern Greek provinces along the ancient Egnatia Odos that is today a high speed freeway. Konstantinos Koutsoukos and Lefteris Koutras provide a complete description of the technical and institutional issues and the solutions and technologies employed.

Human nature is examined in depth within the third section of the book on human performance and behaviour. The section starts with Mirko Novak's overview on attention decreases setting the stage for potential solutions to one of the most severe problems of transportation today (i.e., the large amount of fatalities and injuries travellers suffer every year worldwide). Then, in Chapter 11 Tomas Brandesky reviews some key ideas of creative human reasoning and offers a proposal for microsopic simulation to mimic human reasoning. Chapter 12 is the third contribution of the Czech Technical University in this section in which Zdeněk Votruba, Mirko Novák, and Jaroslav Veselý argue convincingly that uncertainty should be taken into account in the design of man-machine interfaces to study reliability. The other chapters in this section switch gear to the study of behaviour. Chapter 13 is a unique contribution in which Goran Vuk and Tine Lund Jensen demonstrate differences between model predictions and observed changes using a before-after methodology for the newly completed Copenhagen Metro. In the same spirit of developing new methods Pat Burnett in Chapter 14 argues that qualitative research methods have a place in the toolbox of planners and engineers and should be given a more careful consideration. In Chapter 15 Tor Vorraa shows how one commercial software represents toll systems and how the software can be used to produce impact scenarios. This section ends with a chapter written by Natalija Jolić and Zvonko Kavran on simulation modeling for transportation, land use and development decisions in which decision making and behaviour are integrated to form a comprehensive planning process.

In the fourth section of this book nine chapters are dedicated to information systems, communication, management, and control. First, we find three papers that illustrate the complex relationship among time use, technology ownership, telecommunications, and travel behaviour. The first paper by Kuniaki Sasaki, Kazuo Nishii, Ryuichi Kitamura, and Katsunao Kondo, offers new evidence on the intra-household relationship between telecommunication, activity participation, and travel using survey data. Kim and Goulias in the following two papers analyze the determinants of telecommunication technology ownership in Chapter 18 and then in Chapter 19 show that mode choice is influenced by telecommunications technologies in complex ways. Studying information technology and its impact on transportation systems also requires examining the behaviour of other agents such as commercial operators. In Chapter 20 Vladimir Momčilović, Vladimir Papić, Olivera Medar and Aleksandar Manojlović demonstrate how a decision support system can change the behavior of commercial operators to achieve lower energy consumption and fuel emissions. In the second portion of this section a group of chapters is dedicated to information systems in the context of traffic operations and control. Hartwig Hetzheim and Wolfram Tuchscheerer describe applications of mathematical methods to video camera image processing for traffic