RECENT DEVELOPMENTS IN TRANSPORT MODELLING: LESSONS FOR THE FREIGHT SECTOR

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INVESTOR IN PEOPLE

In Memory of Prof. Marvin L. Manheim

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Chapter 1

Recent Developments in Transport Modelling: What We Can Learn for the Freight Sector

Moshe Ben-Akiva, Hilde Meersman and Eddy Van de Voorde

The ongoing economic globalization and increasing need for flexibility in modern enterprises have turned freight transport into a major public policy and corporate domain. The field of freight transportation research has reflected this evolution, and is quite justifiably attracting increasing attention.

Transport growth is a *sine qua non* for sustained economic growth, yet this relationship is not without problems. External effects such as air pollution, congestion, accidents and damage to infrastructure generate considerable social costs.

Transportation is not just the product of social and economic activity. It also generates such activity. Since production and consumption of goods and services are usually physically separated, the distance between the two needs to be bridged by means of at least one mode of transportation.

Similarly, relocating production from high-cost to low-cost countries can only be achieved through better, cheaper and more extensive transportation services. Hence, transportation has become one of the driving forces of economic growth. But an unrestrained expansion of passenger and freight transport will create substantial negative externalities. Consequently, if the relevant policies remain unchanged, the social costs of mobility may exceed the benefits.

The European Commission has shown awareness of this danger and the urgent need for solutions in the design of EU transport policy. However, implementing and, as the case may be, adjusting this transport policy is not a straightforward proposition. Continuous monitoring and effective insights are required to afford decision-makers the ability to successfully design and pursue transport policies, while responding adequately to new challenges. Despite the prolific research on passenger transport in the 1970s and 1980s, the rise of economic globalization during the 1990s caused researchers and policymakers to shift their primary focus to freight transport.

Recent Developments in Transport Modelling

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As the late Prof. Marvin L. Manheim emphasized in quite a few of his publications and in the opening address he delivered at the 8th World Conference on Transport Research (Antwerp, 1998), effective and sound resolutions for such issues require a new and broader transport analysis. The present book endeavours to elaborate on this notion and to push the frontiers of freight transport modelling forward. It is comprised of contributions by researchers specializing in transport economics and freight modelling. It provides valuable information for researchers and students, as well as transport decision-makers in both government and industry.

To capture the complexity of freight transport systems, researchers have proposed a wide array of models. De Jong, Van de Riet, and Kroes (2004) define these models as one or more mathematical–empirical relations designed to describe and explain the behaviour of a transport system. Ultimately, by taking into account that any transport system is subject to exogenous shocks and/or policy measures, these models can provide insight into possible future evolutions in freight transport.

Freight models must also represent special characteristics of transport markets (Small & Winston, 1999, p. 11 ff.), most importantly the interactions within or involving the transport system. Ideally, a whole range of important factors such as localization, trade issues, destinations, infrastructure, shipment and parcel size, timing and frequency of shipment, quality of service, transportation mode, routing, costing and inventory holdings, as well as possible interactions with passenger transport, need to be entered into the equation. To complicate matters further, due attention must be given to the dynamic nature of transport systems. Some decisions need to be taken consecutively and require harmonization in order to optimize the transport and logistics chain. Others are to be taken simultaneously and may involve a high degree of interaction. Finally, freight transport models must allow for a considerable time lag between a decision and its implementation.

Thus far, the many different freight transport models that have been put forward tend to deal with specific topics and are usually designed to only accommodate a limited number of interactions. The main constraint on the development of more elaborate freight transport models is the limited availability of data, especially at the firm level.

The modelling of freight transport demand has evolved from a non-structural, aggregate engineering approach conventionally used for traffic management and routing decisions, to a structural, disaggregate approach. The aggregate models use global data on shippers and shipments to identify general relations resulting from underlying behavioural assumptions. The more sophisticated models use flexible functional forms and test such traditional restrictions as homogeneity, economies of scale and separability.

With the advent of faster computers, new empirical methods and availability of firm-level data, transport modellers have turned their focus to more behavioural disaggregate analyses.

In the literature, we find numerous examples of both aggregate and disaggregate freight transport modelling. Tavasszy (2006) provides an extensive overview on the state of the art in freight modelling with special focus on European applications. Three important fields are identified: the modelling of the relationship between transportation and economic activity, logistic decision-making and processes, and the linking of traffic flows and networks.

Small and Winston (1999, p. 13) quite rightly point out that 'economists have primarily, though not exclusively, focused on mode choice'. Over the past decade, transport researchers have clearly broken with this tradition, as evidenced in this book. It introduces a broad range of research efforts in the field of freight transport modelling.

The book consists of three parts. The first part includes articles focusing on Prof. Marvin Manheim's contribution to transport research with particular reference to the field of logistics and freight transport. The second part includes articles discussing recent developments in freight transport modelling. Considering that these models can provide important and explicit input for public debate, the third part includes contributions that explore the relationship between freight modelling and policy-making. Let us now briefly summarize the papers included in this volume.

Mary Beth Watson-Manheim describes Marvin Manheim's contribution to the field of transport research. She traces the evolution of his ideas by briefly examining samples of major works from the 1960s to the 1990s in chronological order. She highlights a number of recurring topics and characteristics such as: his interest in the relationship between theory development and practical implementation, consistency in focus on process rather than outcome with due attention to understanding change and process adaptation, his tendency to think broadly, deeply and creatively about complex problems, and the foresight of his ideas. Marvin Manheim never stopped trying to model the changes he envisioned across multiple disciplines and problem settings. He was a creative researcher, an integrator and a visionary.

Mary Beth Watson-Manheim's analysis is echoed in Marvin Manheim's opening address delivered at the eighth World Conference on Transport Research in Antwerp (1998), which he aptly entitled 'The next challenge in transportation research: Enhancing the application of the mind'. In it, he identifies several critical issues in transportation research. One of these issues, i.e. the need to increase individual and collaborative effectiveness, is explored in depth. Marvin Manheim emphasizes the need for research in cognition and action, i.e. research that examines how people think and act, while aiming to develop aids for thinking and acting that result in significant improvements in people's behaviours and performance. We consider this text as Marvin Manheim's legacy to the World Conference on Transport Research Society (WCTRS), of which he was a co-founder and the first chair.

Part two of the book consists of contributions on 'recent developments in transport modelling'. Hilde Meersman and Eddy Van de Voorde discuss the relationship between economic activity and freight transport. In the interpretation of empirical findings regarding the impact of various explanatory factors as well as the relationship between freight traffic and economic activity, the following important question arises: Can the existing infrastructure cope with forecast growth? After all, any loss of time due to bottlenecks, coupled with either a temporary or a structural capacity shortage, will affect costs negatively. Changes in costs can impact the behaviour of the various actors involved in respect of such logistic variables as speed, the number of routes to be served, the number of nodes to be called at ports and terminals, the frequency of scheduling, the means to be deployed and whether or not to make use of hubs. To gain a better understanding of the changing relationship