SECOND EDITION

THE GEOGRAPHY OF TRANSPORT SYSTEMS

ROUTLEDGE

JEAN-PAUL RODRIGUE, CLAUDE COMTOIS AND BRIAN SLACK

The Geography of Transport Systems

Second edition

Jean-Paul Rodrigue, Claude Comtois
and Brian Slack

Routledge
Taylor & Francis Group
LONDON AND NEW YORK

First edition published 2006
by Routledge

Second edition published 2009 by Routledge
2 Park Square, Milton Park, Abingdon, Oxon, OX14 4RN

Simultaneously published in the USA and Canada
by Routledge
270 Madison Avenue, New York, NY 10016

Routledge is an imprint of the Taylor & Francis Group, an informa business

Typeset in 8.75/10pt Times by Graphicraft Limited, Hong Kong

Printed and bound in Great Britain by CPI Antony Rowe, Chippenham, Wiltshire

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

Library of Congress Cataloging-in-Publication Data
Rodrigue, Jean-Paul, 1967–
The geography of transport systems/Jean-Paul Rodrigue, Claude Comtois, and Brian Slack. – 2nd ed.

p. cm.
Includes index.
1. Transportation geography. I. Comtois, Claude, 1954– II. Slack, Brian, 1939– III. Title.
HE323.R63 2009
388.01–dc22
2008040189

ISBN 10: 0-415-48323-9 (hbk)
ISBN 10: 0-415-48324-7 (pbk)
ISBN 10: 0-203-88415-9 (ebk)

ISBN 13: 978-0-415-48323-0 (hbk)
ISBN 13: 978-0-415-48324-7 (pbk)
ISBN 13: 978-0-203-88415-7 (ebk)

To Gordana, Suzanne and Mabel

Preface

The Geography of Transport Systems is now into its second edition. Substantial efforts have been made to build on the first edition's success by improving the content and its structure. Like the first edition, we have elected for a synthetic writing style, instead of a narrative, where the goal is to provide a structured framework to the reader. Great care has been made to avoid factual information, particularly in the usage of graphs related to statistical data, so that the textbook can retain its relevance in spite of continuous and often unforeseeable changes in the transport industry. A large quantity of statistical information is available on the companion website, which is constantly updated.

Transportation is concerned with mobility, particularly how this mobility is taking place in the context of a wide variety of conditions. Mobility is a geographical endeavor since it trades space for a cost. Technological and economic forces have changed this balance many times in the past, but in recent decades a growing amount of space has been made accessible at a similar cost. It is thus not surprising to realize that at the same time that technology permitted improvements in transport speed, capacity and efficiency, individuals and corporations have been able to take advantage of this improved mobility. A driving force of the global economy resides in the capacity of transport systems to ship large quantities of freight and to accommodate vast numbers of passengers. The world has become interconnected at several scales. This new geographical dimension transcends a more traditional perspective of transportation mainly focused on the city or the nation. At the beginning of the twenty-first century, the geography of transportation is thus fundamentally being redefined by global, regional and local issues.

Presenting these issues to students or the public remains a challenging task. This book has specifically been designed with this in mind. Its origins are rather unusual since it began in 1997 as an online initiative to provide material about transport geography and was simply titled "Transport Geography on the Web". The material was considerably revised and expanded over the years, often thanks to comments and queries we received, as the site gained a wider audience. It has already endured the decade-long test of being exposed to the scrutiny of a global audience including practitioners, policy makers, educators and, most importantly, students. For many years and as these words were written, the site ranked first in Google under the topic of transport geography, and other key terms such as intermodal transportation or transport modes, implying its popularity as a trusted source of information. Its contents are appearing in a growing number of transport-related curriculums, underlining the relevance of the material covered and that a demand was being fulfilled. The step of moving to a textbook was a natural one especially after receiving many requests in this direction.

Like the first edition, the textbook is articulated along two core approaches to transport geography, one conceptual and the other methodological. The conceptual parts present what we think are some of the most relevant issues explaining contemporary

transport geography. In addition to the more conventional topics related to transport modes and terminals, as well as urban transportation, the book also substantially focuses on emerging issues such as globalization, supply chain management, energy and the environment. Many of these issues have been superficially covered, if at all, in the past, but their importance cannot be underestimated in a transport geography that involves an increasingly integrated world.

The methodological parts address how transportation information is used to assist transport operators allocate their resources (investments, vehicles) or to influence public policy. This includes a wide array of methods ranging from qualitative to quantitative. Since transport is a field of application, the use of methodologies is particularly relevant as they relate to real world issues. The merging between methodologies and information technologies has led to many new opportunities, notably with the emergence of transportation geographic information systems (GIS-T). It has become a very active field of investigation and application.

In an effort to illustrate the applied dimension of transport geography, the second edition also contains a number of case studies selected for their relevance and their potential appeal to a wide international audience. The first one deals with a perspective about how transportation geography can be taught and how it can fit into a variety of academic curriculums. Others, each in their own way, illustrate how transportation and geography merge into the consideration of real world problems.

It is our hope that the reader will have a better understanding of the nature, function, importance and challenges of contemporary transportation systems. The online companion site will insure that this book will not be a static endeavor and will be revised and updated as changes take place in this fascinating field which is transport geography.

New York, August 2008

Contents

Plates

Figures

Tables

1 Transportation and geography

Movements of people, goods and information have always been fundamental components of human societies. Contemporary economic processes have been accompanied by a significant increase in mobility and higher levels of accessibility. Although this trend can be traced back to the industrial revolution, it significantly accelerated in the second half of the twentieth century as trade was liberalized, economic blocs emerged and the comparative advantages of global labor and resources were used more efficiently. However, these conditions are interdependent with the capacity to manage, support and expand movements of passengers and freight as well as their underlying information flows. Societies have become increasingly dependent on their transport systems to support a wide variety of activities ranging, among others, from commuting, supplying energy needs, to distributing parts between factories. Developing transport systems has been a continuous challenge to satisfy mobility needs, to support economic development and to participate in the global economy.

Concept 1 – What is transport geography?

The purpose of transportation

> The ideal transport mode would be instantaneous, free, have an unlimited capacity and always be available. It would render space obsolete. This is obviously not the case. Space is a constraint for the construction of transport networks. Transportation appears to be an economic activity different from the others. It trades space with time and thus money.
>
> (translated from Merlin, 1992)

As the above quotation underlines, the unique purpose of transportation is to overcome space, which is shaped by a variety of human and physical constraints such as distance, time, administrative divisions and topography. Jointly, they confer a friction to any movement, commonly known as the friction of distance. However, these constraints and the friction they create can only be partially circumscribed. The extent to which this is done has a cost that varies greatly according to factors such as the distance involved and the nature of what is being transported. There would be no transportation without geography and there would be no geography without transportation. The goal of transportation is thus to transform the geographical attributes of freight, people or information, from an origin to a destination, conferring them an added value in the process. The convenience at which this can be done – transportability – varies considerably.

Transportability. Refers to the ease of movement of passengers, freight or information. It is related to transport costs as well as to the attributes of what is

being transported (fragility, perishability, price). Political factors can also influence transportability such as laws, regulations, borders and tariffs. When transportability is high, activities are less constrained by distance.

The specific purpose of transportation is to fulfill a demand for mobility, since transportation can only exists if it moves people, freight and information around. Otherwise it has no purpose. This is because transportation is dominantly the outcome of a derived demand (Figure 1.1).

What takes place in one sector has impacts on another; demand for a good or service in one sector is derived from another. For instance, a consumer buying a good in a store will likely trigger the replacement of this product, which will generate demands for activities such as manufacturing, resource extraction and, of course, transport. What is different about transport is that it cannot exist alone and a movement cannot be stored. An unsold product can remain on the shelf of a store until a customer buys it (often with discount incentives), but an unsold seat on a flight or unused cargo capacity in the same flight remain unsold and cannot be brought back as additional capacity later. In this case an opportunity has been missed since the amount of transport being offered has exceeded the demand for it. The derived demand of transportation is often very difficult to reconcile with an equivalent supply and actually transport companies would prefer to have some additional capacity to accommodate unforeseen demand (often at much higher prices). There are two major types of derived transport demand:

Direct derived demand. Refers to movements that are directly the outcome of economic activities, without which they would not take place. For instance, work-related activities commonly involve commuting between the place of residence and the workplace. There is a supply of work in one location (residence) and a demand of labor in another (workplace), transportation (commuting) being directly derived from this relationship. For freight transportation, all the components of a supply chain

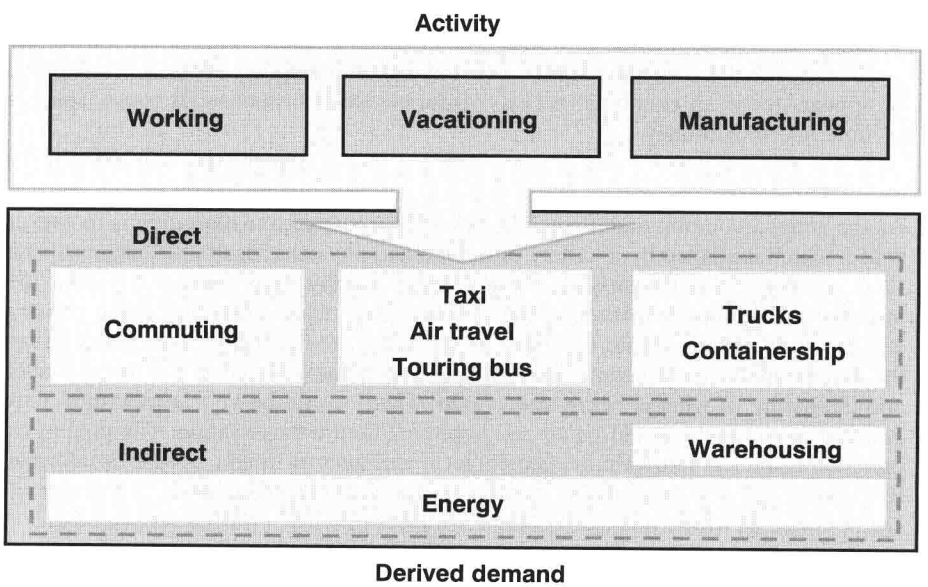

Figure 1.1 Transportation as a derived demand

require movements of raw materials, parts and finished products on modes such as trucks, rail or containerships. Thus, transportation is directly the outcome of the functions of production and consumption.

Indirect derived demand. Considers movements created by the requirements of other movements. The most obvious example is energy where fuel consumption from transportation activities must be supplied by an energy production system requiring movements from zones of extraction, to refineries and storage facilities and, finally, to places of consumption. Warehousing can also be labeled as an indirect derived demand since it is a "non movement" of a freight element. Warehousing exists because it is virtually impossible to move commodities instantly from where they are produced to where they are consumed.

Distance, a core attribute of transportation, can be represented in a variety of ways, ranging from a simple Euclidean distance – a straight line between two locations – to what can be called logistical distance; a complete set of tasks required to be done so that distance can be overcome (Figure 1.2).

- **Euclidean distance**. A simple function of a straight line between two locations where distance is expressed in geographical units such as kilometers. Commonly used to provide an approximation of distance, but almost never has a practical use.
- **Transport distance**. A more complex representation where a set of activities related to circulation, such as loading, unloading and transhipment, are considered. Additional elements such as costs and time are also part of the transport distance. On Figure 1.2, the transport distance between locations A and B includes pickup, travel by mode 1, transhipment, travel by mode 2 and finally, delivery. The same applies to the circulation of people, although the involved activities will be different. For instance, someone using air travel between two locations will require going to an airport, may transit through an intermediate airport and will finally need to reach his/her destination from the terminal airport. Transport distance is jointly expressed in geographical units, in cost and in time.
- **Logistical distance**. A complex representation that encompasses all the tasks required so that a movement between two locations can take place. Logistical distance

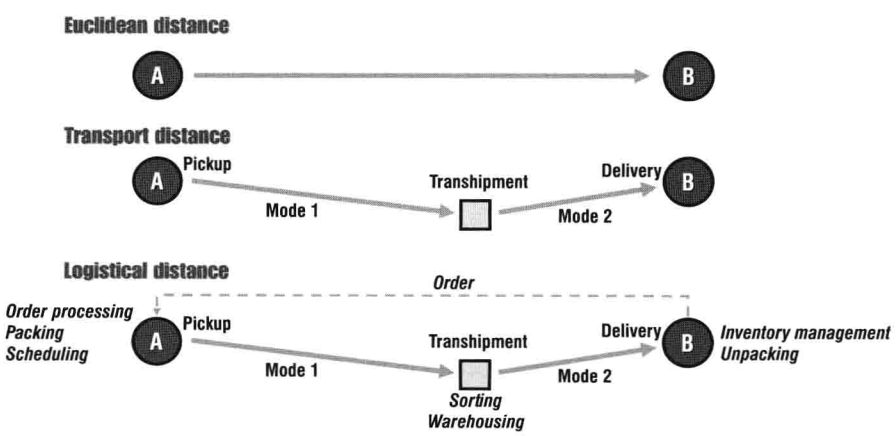

Figure 1.2 Different representations of distance

thus includes flows, but also a set of activities necessary for the management of these flows. For freight movements, among the most significant tasks are order processing, packing, sorting and inventory management. Geographical distance units are less relevant in its assessment, but the factors of costs and time are very significant. Time not only involves the delay related to management and circulation, but also how it is used to service the transport demand, namely the scheduling of pickups and deliveries. On Figure 1.2, the logistical distance between locations A and B includes an order from B, which is processed, packed and scheduled to be picked up. At the intermediate transhipment location, sorting and warehousing are performed, and finally, at the destination the delivery will be unpacked and used. For the transportation of passengers, logistical distance also concerns a specific array of tasks. Taking again an air travel example, a ticket would first need to be purchased, commonly several weeks in advance. Other common time and cost tasks concern packing, checking in, security checks, boarding and disembarking, picking up luggage and, finally, unpacking. Thus, a three-hour flight can in reality be a movement planned several weeks in advance and its full realization can take twice as much time if all the related logistical activities are considered.

Any movement must thus consider its geographical setting which in turn is linked to spatial flows and their patterns. Urbanization, multinational corporations, the globalization of trade and the international division of labor are all forces shaping and taking advantage of transportation at different, but often related, scales.

Consequently, the fundamental purpose of transport is geographic in nature, because it facilitates movements between different locations. Transport thus plays a role in the structure and organization of space and territories, which may vary according to the level of development. In the nineteenth century, the purpose of the emerging modern forms of transportation, mainly railways and maritime shipping, was to expand coverage, and create and consolidate national markets. In the twentieth century, the objective shifted to selecting itineraries, prioritizing transport modes, increasing the capacity of existing networks and responding to mobility needs and this at a scale that was increasingly global. In the twenty-first century, transportation must cope with a globally oriented economic system in a timely and cost effective way, but also with several local problems such as congestion and capacity constraints.

The importance of transportation

Transport represents one of the most important human activities worldwide. It is an indispensable component of the economy and plays a major role in spatial relations between locations. Transport creates valuable links between regions and economic activities, between people and the rest of the world. Transport is a multidimensional activity whose importance is:

- **Historical**. Transport modes have played several different historical roles in the rise of civilizations (Egypt, Rome and China), in the development of societies (creation of social structures) and also in national defense (Roman Empire, American road network).
- **Social**. Transport modes facilitate access to healthcare, welfare and cultural or artistic events, thus performing a social service. They shape social interactions by favoring or inhibiting the mobility of people. Transportation thus supports and may even shape social structures.