

# Environmental sustainability

01

## A new priority for logistics managers

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### Introduction

Logistics is the term now widely used to describe the transport, storage and handling of products as they move from raw material source, through the production system to their final point of sale or consumption. Although its core activities have been fundamental to economic development and social well-being for millennia, it is only over the past 50 years that logistics has come to be regarded as a key determinant of business performance, a profession and a major field of academic study. During this period the dominant paradigm for those managing and studying logistics has been commercial. The prime, and in many cases sole, objective has been to organize logistics in a way that maximizes profitability. The calculation of profitability, however, has included only the economic costs that companies directly incur. The wider environmental and social costs, traditionally excluded from the balance sheet, have been largely ignored – until recently.

Over the past 10–15 years, against a background of increasing public and government concern for the environment, companies have come under mounting pressure to reduce the environmental impact of their logistics operations. This impact is diverse, in terms of the range of externalities and the distances over which their adverse effects are experienced. The distribution of goods impairs local air quality, generates noise and vibration, causes accidents and makes a significant contribution to global warming. The impact of logistics on climate change has attracted increasing attention in recent years, partly because tightening controls on pollution and road safety

improvements have alleviated the other environmental problems, but also because new scientific research has revealed that global warming presents a much greater and more immediate threat than previously thought.

It is estimated that freight transport accounts for roughly 8 per cent of energy-related CO<sub>2</sub> emissions worldwide (Kahn Ribeiro and Kobayashi, 2007). The inclusion of warehousing and materials handling is likely to add around 2–3 per cent to this total. The World Economic Forum and Accenture (2009) have estimated that logistical activity accounts for roughly 5.5 per cent of total global greenhouse gas (GHG) emissions (including all the GHGs and not simply CO<sub>2</sub>).<sup>2</sup> They suggest that ‘logistics buildings’ emit 9–10 per cent of the total, with the rest coming from freight transport. Trucks and vans are responsible for two-thirds of these transport GHG emissions. In the road transport sector, the amount of energy used to move freight is increasing at a faster rate than the energy consumed by cars and buses, and, in the European Union, may overtake it by the early 2020s (European Commission, 2003). If CO<sub>2</sub> emissions from shipping grow at their forecast rate while governments cut emissions from their national economies by an average of 50 per cent by the middle of the century in line with current targets, shipping alone could account for 15–30 per cent of total CO<sub>2</sub> emissions by 2050, even allowing for a 33–50 per cent improvement in its energy efficiency by then (Committee on Climate Change, 2008). It is hardly surprising, therefore, that governments and intergovernmental organizations are developing carbon abatement policies for the freight transport sector.

Making logistics ‘sustainable’ in the longer term will involve more than cutting carbon emissions. Despite recent improvements, the potential still exists to cut the other environmental costs of logistics by a significant margin. Furthermore, sustainability does not only have an environmental dimension. Sustainable development was originally portrayed as the reconciliation of environmental, economic and social objectives (Brundtland Commission, 1987). The expression ‘triple bottom line’ is often used in the business world to convey this notion of a three-way trade-off. The concept also underpins government strategies on sustainable distribution, such as that of the UK government (DETR, 1999a). In practice, however, many of the measures that reduce the environmental impact of logistics, the so-called ‘green-gold’ measures, also save money, avoiding the need to trade off economic costs against environmental benefits. While the main focus of this book is on ways of reducing the environmental effects of logistics, frequent reference is also made to their economic and social implications.

The issues discussed in this book are topical, important and currently engaging the attention of company managers and policy makers in many countries around the world. They are examined from both corporate and public policy perspectives. The book aims to provide a broad overview of technical, managerial, economic and policy aspects of green logistics, and as a result to improve understanding of the various problems that have to be overcome in assessing and addressing the environmental consequences of logistical activities. It contains case studies and examples of the types of

initiatives that can be taken at different levels, ranging from those within a single company to those that span an entire supply chain and possibly involve businesses in several countries. The book also explores the range of approaches and analytical tools available to academics and practitioners working in the field of green logistics.

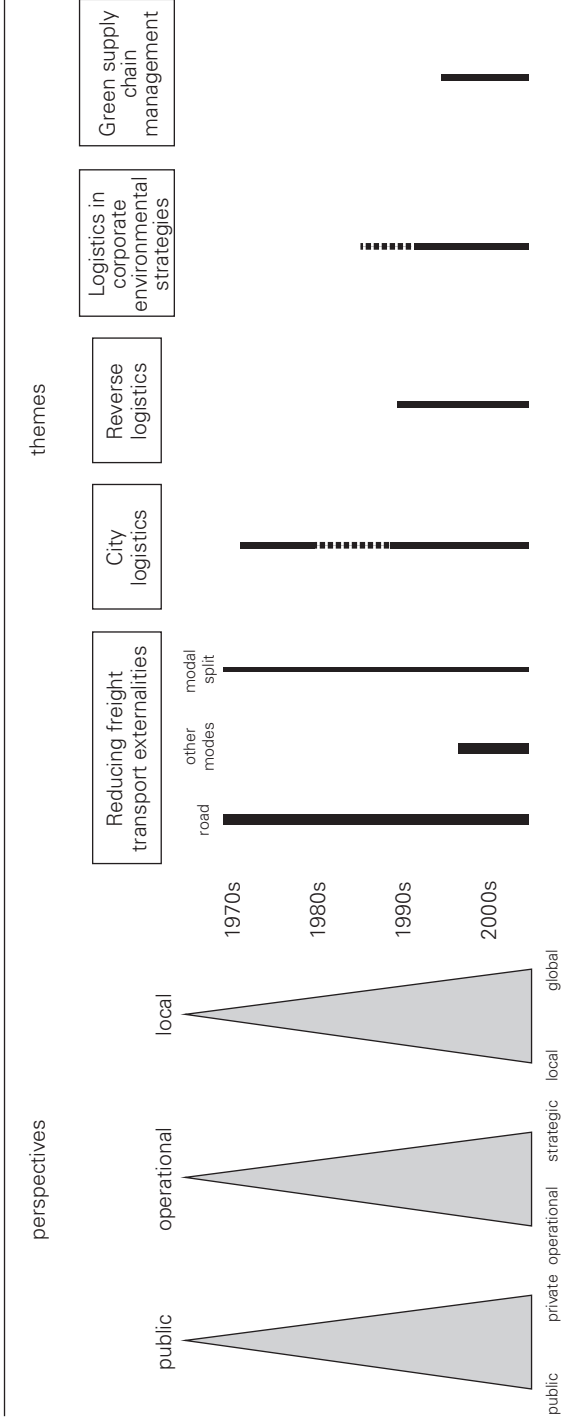
Green logistics is a relatively young but rapidly evolving subject. This is a good time to take stock, reflect on the work that has been done to date and assess the challenges ahead. The remainder of this chapter lays a foundation for the book by reviewing the development of the subject over the past 50 years. It also presents an analytical framework for the study of green logistics and concludes with a brief outline of the other 16 chapters.

## A brief history of green logistics research

It is difficult to decide when research on green logistics began. One possible starting point would be the publication of the first paper on an environmental theme in a mainstream logistics journal. This, however, would ignore a large body of earlier research on the environmental effects of freight transport undertaken before logistics gained recognition as a field of academic study. While concern was expressed about the damaging effects of freight transport in the 1950s, most of the substantive research on the subject dates from the mid-1960s. Murphy and Poist (1995: 16) assert that: ‘prior to the 1960s, there was relatively little concern regarding environmental degradation. For the most part, the environment’s ability to absorb wastes and to replace resources was perceived as being infinite.’ This review is therefore confined to the past 40 years, but it ‘casts its net wide’ to capture a broad assortment of relevant literature in journals, books and reports. In their review of 10 logistics, supply management and transport journals over the period 1995–2004, Aronsson and Huge-Brodin (2006) found that only 45 papers out of 2,026 (2.2 per cent) addressed environmental issues. When the publication horizons are extended by time and type of output, however, one uncovers a large, well-established and vibrant field of research.

What we now call ‘green logistics’ represents the convergence of several strands of research that began at different times over the past 40 years. Figure 1.1 groups these strands under five headings: reducing freight transport externalities, city logistics, reverse logistics, corporate environmental strategies towards logistics, and green supply chain management. This extends the threefold classification of green logistics research adopted by Abukhader and Jonsson (2004), which comprises environmental assessment, reverse logistics and green supply chains. Figure 1.1 also proposes a tentative chronology for research activity on these topics and depicts three more general trends that have, since the 1960s, altered the context and priorities of the research. These are shown as wedges to reflect a broadening perspective:

**FIGURE 1.1** Evolving perspectives and themes in green logistics



- 1 Public-to-private:** much of the early research was driven by a public policy agenda as newly emergent environmental pressure groups began to lobby for government intervention to mitigate the damaging effects of freight movement and public agencies sought to improve their understanding of the problem and find means of addressing it. Through time, this public sector interest in the subject has been complemented by a growth in private sector involvement in green logistics research as businesses have begun to formulate environmental strategies both at a corporate level and more specifically for logistics.
- 2 Operational-to-strategic:** a second general trend has been a broadening of the corporate commitment to green logistics, from the adoption of a few minor operational changes to the embedding of environmental principles in strategic planning.
- 3 Local-to-global:** in the 1960s and 70s the main focus was on the local environmental impact of air pollution, noise, vibration, accidents and visual intrusion. No reference was made to the global atmospheric effects of logistical activity. Indeed in the 1970s some climate models predicted that the planet was entering a new ice age! The transcontinental spread of acid rain (from sulphur emissions) and depletion of the ozone layer (caused mainly by chlorofluorocarbons) during the 1980s demonstrated that logistics and other activities could have a more geographically extensive impact on the environment. With climate change now the dominant environmental issue of the age, the impact of logistics on global atmospheric conditions has become a major focus of research.

The context within which research on green logistics has been undertaken has also been evolving in other ways. Over the past 40 years, logistics has developed as an academic discipline, extending its original focus on the out-bound movement of finished products (physical distribution) to companies' entire transport, storage and handling systems (integrated logistics) and then to the interaction with businesses upstream and downstream (supply chain management). This has extended the scope of green logistics research in terms of the functions, processes and relationships investigated (McKinnon, 2003). Other major contextual trends include the growth of environmental awareness, the proliferation of environmental regulations, and the development of national and international standards for environmental reporting and management that many companies now adopt as part of their corporate social responsibility (CSR) programmes. Partly as a result of these trends, the volume of statistics available to green logistics researchers has greatly expanded and companies have become more willing to support studies in this field.

In reviewing the development of green logistics as a field of study, one detects international differences in research priorities. Although a survey by Murphy and Poist (2003) of samples of US and 'non-US' companies found

strong similarities in the environmental perceptions and practices of logistics management, research efforts have tended to be skewed towards topics of national interest. In the UK, for example, much of the early research on green logistics was a response to a public dislike of heavy lorries. In Germany, research on reverse logistics was stimulated by the introduction of radical packaging-waste legislation in the early 1990s. Until recently, reverse logistics attracted much more attention from US researchers than other aspects of green logistics, with much of the corporate interest in the subject related to its impact on costs and profitability rather than on the environment.

### ***Reducing freight transport externalities***

Much of the early research on the environmental impact of logistics was motivated by the growth of lorry traffic at a time when lorries were much noisier and more polluting than today. Numerous studies were conducted in the 1970s to assess the nature and scale of these effects, many of them in the UK. Their focus was on the local environmental impact of lorries. Reports published by environmental pressure groups catalogued the environmental damage they were causing and demanded government action to contain the 'lorry menace'. Campaigners were particularly alarmed by official forecasts that freight traffic volumes would continue to grow steeply for the foreseeable future. In the UK, the government responded by setting up an inquiry to examine the effects of lorries on the environment and explore ways of minimizing them (Pettit, 1973). This led to the formation of the Lorries and the Environment Committee, an organization which between 1974 and 1979 published several reports on ways of rationalizing the movement of freight by road. The UK government, nevertheless, felt it necessary to commission a much wider investigation of 'lorries, people and the environment'. The report of this inquiry (Armitage, 1980) provided a useful review of lorry-related externalities, the causes of road freight growth and the options for mitigating its environmental effects. It was preoccupied, however, with local planning and regulatory issues, and antagonized environmental groups at the time by recommending an increase in the maximum gross lorry weight from 32 to 44 tonnes. At an international level, the OECD (1982) also published a report on the effects of heavy trucks on the environment and explored ways in which they might be reduced.

Advances in vehicle technology and tightening regulations on emission levels gradually reduced transport externalities per vehicle-km. It was recognized, however, that much of the environmental improvement being achieved at the individual vehicle level was being eroded by the underlying growth in road freight traffic (Adams, 1981; Whitelegg, 1995). Reducing the environmental burden imposed by freight transport would, therefore, entail much more than improved fuel efficiency and lower exhaust emissions. More radical measures to contain the growth of road freight traffic would be required. This might be difficult to achieve, however, without jeopardizing

future economic growth. Bennathan, Fraser and Thompson (1992: 7) had established, for a sample of 17 developed countries, that 'the partial elasticity of ton-kilometres by road with respect to GDP [was] about unity (1.02)'. This meant that road freight traffic was growing almost exactly in line with the economy.

Individual sectors of the economy, however, were experiencing rates of freight traffic growth well above the average and faster than the rate at which output was growing. Paxton (1994) showed how wider sourcing of food products was increasing the demand for freight transport or what she called 'food miles'. Around the same time, Böge (1994) conducted a much-publicized study in Germany of the amount of road transport generated by the production and distribution of a pot of strawberry yoghurt. By mapping the supply chains of all the ingredients and components contained in this product she was able to demonstrate that for every pot of yoghurt sold in a German supermarket, a truck had to travel nine metres. She went on to assess the environmental impact of all the related freight transport, using this case study to illustrate how the logistical requirements of even a fairly cheap basic product could be responsible for significant amounts of pollution and noise.

These and other studies highlighted the need for more research on the process of road freight traffic growth and the extent to which it could be influenced by public policy interventions. This need was addressed by a plethora of studies conducted in several countries during the 1990s. These studies examined, to varying degrees, three methods of decoupling economic growth from road freight traffic levels: reducing the transport intensity of the economy (generally defined as the ratio of road tonne-kms to GDP), altering the freight modal split (to displace freight on to alternative modes) and improving vehicle utilization (to reduce the ratio of vehicle-kms to tonne-kms). Table 1.1 lists some of the major freight-rationalization studies undertaken during the 1990s and shows which of the three decoupling options they considered.

Much of this research adopted a broader logistical perspective, acknowledging that the restructuring of companies' logistical systems was one of the main drivers of freight traffic growth. Research by McKinnon and Woodburn (1996), McKinnon (1998) and Cooper, Black and Peters (1998) identified a series of logistics and supply chain trends responsible for freight traffic growth. The nature of the relationship between these trends and freight traffic growth in different countries and sectors was subsequently investigated by two European Commission-funded projects called REDEFINE and SULOGRTRA. As discussed in Chapter 17, there was much interest among public policy makers around the late 1990s/early 2000s in the potential for decoupling freight traffic growth from general economic growth (European Commission, 2001). Ironically, over the previous decade the link had been broken in Europe, with freight tonne-kms growing at a faster rate than the EU economy as a whole. The policy aim, however, was to decouple these variables in the opposite direction. Evidence of this 'positive' form of decoupling

**TABLE 1.1** Freight transport rationalization studies conducted during the 1990s

Author/ organization	Study area	Date	Modal split	Transport intensity	Vehicle utilization
Hey <i>et al</i> EURES/Greenpeace	Europe	1992	*	*	*
Peeters/Werkgroep 2000	Netherlands	1993	*		*
DIW/ifeu/IVA/HACON	Germany	1994	*		*
Royal Commission on Environmental Pollution	UK	1994	*	*	*
Plowden and Buchan/Civic Trust	UK	1995	*	*	*
Bleijenberg/CE	Europe	1996	*	*	*
Holman/T&E	Europe	1996	*	*	*
Pastowski/Wupperthal Institute	Germany	1997		*	
Schipper <i>et al</i> / International Energy Agency	OECD	1997	*	*	*

had begun to emerge in some countries, such as the UK and Finland, stimulating research into the reasons for it occurring (Tapio, 2005; McKinnon, 2007). If the underlying growth in freight movement were to slacken, it would be easier for governments to make logistics more environmentally sustainable (DETR, 1999a). The main goal, however, should be to decouple economic growth from freight-related externalities rather than the growth in traffic volumes. This involves manipulating a series of key logistical parameters each of which is amenable to public policy initiatives. In the section below on 'A model for green logistics research', we present an analytical framework built around these key parameters, which has its heritage in the earlier studies outlined above and can serve as a model for the greening of logistics.



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