



European Transport \ Trasporti Europei

Editorial Advisory Board

Editor-in-chief/Direttore responsabile:

Giacomo Borruso

University of Trieste, Italy.
President of ISTIEE.

*Managing Editor/Coordinatore Comitato di
Redazione:*

Romeo Danielis

University of Trieste, Italy.

Editorial Advisory board/Comitato Scientifico:

Aurelio Amodeo

University of Trieste, Italy.

Michel Bierlaire

Swiss Institute of Technology, Lausanne,
Switzerland.

Sergio Caracoglia

University of Trieste, Italy.

Roberto Camus

University of Trieste, Italy.

Marino de Luca

University of Naples Federico II, Italy.

André de Palma

Cergy-Pontoise University / Ecole Nationale des
Ponts et Chaussées, France.

Jadranka Jović

University of Belgrade, Serbia and Montenegro.

Enrico Musso

University of Genoa, Italy.

Esko Niskanen

STAResearch, Helsinki, Finland.

Stratos Papadimitriou

University of Piraeus, Greece.

Piet Rietveld

Free University, Amsterdam, The Netherlands.

Fabio Santorini

University of Trieste, Italy.

Bernhard Wieland

Technical University, Dresden.

Associate Editors/Comitato di Redazione:

Elena Maggi

University of Molise, Italy.

Edoardo Marcucci

University of Urbino, Italy.

Marco Mazzarino

IUAV, Venice, Italy.

Vittorio A. Torbianelli

University of Trieste, Italy.

European Transport \ Trasporti Europei
International Journal of Transport Economics, Engineering and Law
Rivista Internazionale di Economia, Ingegneria e Diritto dei Trasporti

ISSN 1825-3997

YEAR XII, NUMBER 35, April 2007

Publisher/Direzione, redazione e amministrazione

I.S.T.I.E.E.

Istituto per lo Studio dei Trasporti nell'Integrazione Economica Europea

Via Lazzaretto Vecchio, 13
34123 TRIESTE
Tel. +39.040.311464
Fax. +39.040.311465
Mail: istiee@units.it

www.istiee.org/te

Print/Stampa
ARTIGRAFICHERIVA SRL TRIESTE

Autorizzazione del Tribunale di Trieste, n. 915 del 31 ottobre 1995

Spedizione in A.O. 70% DC TS
Tassa Pagata/Taxe Perçue



YEAR XII, NUMBER 35, April 2007

Special issue

**Pan-European logistics and supply chain challenges:
setting the research agenda**

Guest editor: *Pietro Evangelista*

<i>Evangelista, P.</i>	Introduction	1
<i>McKinnon, A.</i>	Increasing fuel prices and market distortion in a domestic road haulage market: the case of the UK	5
<i>Woxenius, J.</i>	Intermodal freight transport network designs and their implication for transshipment technologies	27
<i>Browne, M.</i> <i>Woodburn, A.</i> <i>Allen, J.</i>	Evaluating the potential for urban consolidation centres	46
<i>O’Riordan, A.</i> <i>Sweeney, E.</i>	An investigation into outsourcing practice in Ireland: a new direction in logistics and supply chain management	64
<i>Evangelista, P.</i> <i>Kilpala, H.</i>	The perception on ICT use among small logistics service providers: a comparison between Northern and Southern Europe	81
<i>De Martino, M.</i> <i>Marasco, A.</i>	Approaches to supply chain integration: an exploratory study in the textile/clothing sector in the Campania Region	99



Introduction

Pietro Evangelista^{1*}

¹ *Institute for Service Industry Research (IRAT), National Research Council (CNR), Naples, Italy*

In the last decades the European Union (EU) faced many changes fuelled by a number of different factors such as the growth in globalisation, the rapid advances in technology and the increased regulatory freedom. In addition, the enlargement process of the EU to several Eastern countries creates further challenges. One of the most notable effects is the considerable expansion of supply chains into international locations. In this scenario, logistics and supply chain management plays an increasing important role in ensuring the competitiveness of the continent. In its Communication to the European Parliament entitled “Freight Transport Logistics in Europe - the key to sustainable mobility” (Brussels, 28.06.06 - COM (2006) 336) the European Commission acknowledges that “advanced quality solutions are needed for Europe to maintain and improve its logistics position in the world market” (p.10). This special issue includes a broad range of papers that witness the expanding scope and importance of logistics and supply chain management in today’s European business environment. The six papers forming this special issue discuss some relevant topics for the today European logistics and supply chain landscape. From the scientific point of view, the six papers provide an useful and up-to-date agenda for developing research in some of the most important areas of action of the EU freight future scenario. The six papers can be divided into two broad categories: i) transportation-focused papers and ii) supply chain-focused papers.

The first category contains two papers. The first paper, written by *Alan McKinnon*, deals with market distortions induced by the increasing of fuel price in the road haulage sector. The paper analyses the case of the UK market where foreign road hauliers increased their penetration and were able to gain a significant cost advantage over domestic companies buying fuel before entering the UK. This situation has been attributed to the high fuel tax level policy adopted by British government in recent years. Using a large amount of data and information drawn from several sources, the author discusses such hypothesis showing how the increased penetration of foreign companies is the result of a number of factors such as the growth of UK imports and differences in other haulage costs. In addition, he notes that the increasing level of fuel market price during a period when fuel tax remained almost stable reduced international variations in pump prices. This mitigate the cost advantage of foreign operators purchasing fuel outside the UK. He also proposes a review of possible ways of correcting the fuel duty anomaly at national and EU level. Finally, the work considers

* Corresponding author: Pietro Evangelista (p.evangelista@irat.cnr.it)

possible options for a road haulage company to recover fuel price increases from shippers. The author identifies four possible methods that offer a more practical solution in comparison with European Commission's proposal.

Johan Woxenius analyses the consistency between the choice of a certain type of transport network, the associated level of performance and the ability of current transshipment technologies to fulfil such level of performance. The analysis is limited to the rail part of an intermodal road-rail freight transport service. The author starts discussing six significantly different theoretical design of transport systems. This description is complemented by an analysis on how the choice of a specific transport network design affects the level of terminal performances. Such an analysis is conducted defining seven evaluation criteria that have been applied to the six different transport network designs. In the following step of the work, the author presents a classification of the existing transfer technologies taking into account their technical features. Also in this case, the seven evaluation criteria defined above are applied to the transfer technologies classification. An analytical matching of requirements set by transport network designs according to what different technologies can offer has been obtained. The exercise allows the author to define how well each class of technology matches the demands for each transport network design and for how many criteria the technology does not fully fulfil the demands. Finally, the results put in evidence that although there is a sufficient number of technologies on the market, some of these still need to prove their viability in technical and economic terms.

The second group of works focused on supply chain issues includes four papers. The first paper is written by *Michael Browne, Allan Woodburn* and *Julian Allen* and it deals with the evaluation of the Urban Consolidation Centres (UCCs) potential. UCCs may play a critical role in improving supply chain efficiency in terms of reducing traffic and environmental problems within urban areas especially in the European context where they gained a little success. Nevertheless, traditional literature in urban consolidation research generally shows a narrow focus with no clear and detailed methodology for the evaluation of UCCs. Several schemes have been developed, but these seem to be fairly appropriate and show a lack of clarity in identifying the precise boundaries of the parts of the supply chain analysed. Starting from this, the aim of the paper is to contribute to this stream of literature proposing a new evaluation framework that take into consideration two important elements such as the way in which this evaluation should be carried out and the conditions for UCCs successful implementation. To build up the scheme interviews have been undertaken with relevant actors. A number of key lessons emerges such as: the need for detailed analysis of the traffic flows into and away from the designated area to facilitate the measurement of benefits for potential users; the choice of the appropriate location types to allow the UCCs successful implementation and, finally, the important role that public authorities may play in encouraging the UCCs usage through regulatory and planning actions.

O'Riordan and *Sweeney* investigates outsourcing practice in Ireland. In order to survive in a more competitive business landscape, many companies focused their resources on core activities and outsourced significant parts of their operations. In the last decades, such phenomenon increased significantly involving many company's functions such as IT, personnel, logistics, finance and accounting, manufacturing and R&D. Outsourcing is an important concept in supply chain management also as a wide range of logistics and supply chain activities are often performed outside the company such as transportation, warehousing, inventory and order management, etc. Business

practice evidenced that the performance of outsourced logistics activities has a direct effect on the company competitive advantage in terms of cost and service level. The paper is basically theory testing. Its main aim is to test the current theory on outsourcing through both a field survey and a case study analysis conducted in the Irish context. The findings suggest that outsourcing is a critical area for companies in Ireland especially for multinationals companies that used the island to move their manufacturing operation. Nevertheless, the survey put in evidence that Ireland is now becoming an outsourcer itself as many Irish companies are outsourcing to lower cost countries. Manufacturing outsourcing is now the most popular function to be outsourced for both small and large companies. With reference to logistics activities outsourcing specifically, the empirical evidences shown that they receive a higher priority in comparison with other business functions within the company.

Evangelista and *Kilpala* analyse the impact of Information and Communication Technology (ICT) on small logistics service providers in two different EU geographical areas. ICT has triggered multiple waves of changes in the logistics service industry in recent years. New technology is reshaping the organisation and structure of the industry as ICT impacts significantly on logistics companies' operations. Within this process, while large logistics groups gained substantial benefits from technology usage, the nature of changes resulting from ICT usage in small logistics companies remains unclear. This is reflected by the existing gap in the literature where ICT in large logistics service companies has been widely investigated while there is a shortage of research in the field of small logistics service providers. This is particularly critical for the EU logistics service market that is populated by a large number of small logistics service companies. The paper tries to fill this void and it deals with the use and implementation of ICT in the logistics service sector. The focus is on information technology capability of small and medium-sized logistics service providers in Europe. The work compares two recent surveys conducted in Italy and Northern Europe. The results indicate that in both study regions, the majority of the logistics service providers are familiar with basic information technology (e.g. mobile phone, internet access, email) while the use of more sophisticated technologies (e.g. ERP, CRM) is relatively low. Small logistics service providers typically offer a limited range of value-adding services. ICT has the potential to enlarge the range of and improving the customisation of services provided. The survey results put in evidence that this can be reachable if these companies will overcome the barriers for ICT investment. Finally, the survey results allow to draw a future research agenda in this field.

Finally, *De Martino* and *Marasco* deals with another important issue supply chain management research: supply chain integration. Integration of different supply chain actors and processes is one of the most important goal in any SCM project considering that the more integrated, the better the performance of the supply chain. The paper considers supply chain logistics integration an important lever for the competitiveness of firms in the textile/clothing (T/C) industry, given its potential to enable cost reductions, shorter lead times and customer service enhancements. However, the T/C sector has been neglected in terms of supply chain management research in general and of logistics integration studies in particular. The paper contributes to fill this gap analysing supply chain integration practices in small textile/clothing (T/C) manufacturing companies in the Southern Italy. The paper explores the approaches to supply chain integration adopted by T/C companies in the Campania Region. The investigation has been based on number of case study. The results of the study suggest

that prevailing approach to supply chain integration is limited to functional boundaries within the firm regardless of the specific characteristics of the companies such as manufacturing specialisation (clothing or fabrics), type of production (fast fashion or planned seasonal) and critical success factors (cost or quality).



Increasing fuel prices and market distortion in a domestic road haulage market: the case of the United Kingdom

Alan C. McKinnon ^{1*}

¹ *Logistics Research Centre, Heriot-Watt University, Edinburgh*

Abstract

Differences in diesel fuel prices can significantly distort competition both between and within domestic road haulage markets. This is well illustrated by the case of the UK, where diesel fuel prices are by far the highest in the EU. The paper examines the effects of high and rising fuel prices on cabotage penetration in the UK road freight market and reviews a series of measures that have been proposed to 'level the playing field' between British and foreign hauliers. Within domestic haulage markets, carriers also vary in the extent to which they can recover fuel price increases from shippers. The paper reviews recent empirical evidence on this subject collected in the UK and outlines several methods of compensating hauliers for fuel price rises.

Keywords: Road haulage; Fuel prices; Taxation; Cabotage; UK.

Introduction

Within the European Union, fuel typically accounts for between a quarter and a third of the total costs of operating a truck. This makes economic conditions in the road haulage industry highly sensitive to the prevailing price of fuel, particularly during periods of rising fuel prices. If changes in fuel prices and the structure of vehicle operating costs were uniform across the continent, cross-border competition in the European road haulage industry would be largely unaffected by fuel price inflation. In reality, however, fuel prices have increased at varying rates in both absolute terms and relative to other haulage costs. Fuel price rises have also had a differential impact within national haulage markets, partly because of differences in the nature of distribution operations and vehicles used, but also because some hauliers are better able than others to recover fuel price increases from their clients.

* Corresponding author: Alan C. McKinnon (A.C.McKinnon@hw.ac.uk)

Increases in fuel prices have therefore had the effect of distorting the market for road haulage services both internationally and within individual countries. One country in which these distortions have been pronounced is the UK. For over twenty years, it has had both the highest fuel prices in Europe and the most liberal market for road haulage services. Its island status and relatively peripheral location within Europe has offered its domestic hauliers some protection from international competition, though in recent years foreign penetration of the British haulage market has sharply increased (Sciullo and Smihily, 2006). It is frequently argued, mainly by trade associations, that this influx of foreign hauliers is a direct consequence of Britain's high fuel duty policy. In the first part of this paper, we examine this proposition using data drawn from several sources. We also consider what can be done at both EU and national levels to moderate the effects of fuel price differences on cross-border competition in the road haulage industry.

The second part of the paper explores differences in the ability of trucking companies to recover fuel price increases from shippers and outlines several procedures that can be adopted to compensate carriers for fuel price rises over which they have no control.

International divergence of fuel duties and prices

In 1993 the duty on diesel fuel in the UK was 23% above the EU average. By 1999 it was 96% above this average (Road Haulage Association, 2000). The reason for this sharp divergence was the introduction by the British government in 1994 of a 'fuel duty escalator' policy. This policy, which was unique within Europe, was justified on the grounds that it would help Britain to meet its Kyoto target for CO₂ emissions. It initially increased fuel duty in real terms by 5% per annum and after 1997 by 6% per annum. The impact of this measure on haulage costs was mitigated in the early years by a decline in world oil prices. By 1998, however, an upward trend in oil prices coupled with the raising of the annual tax increment from 5 to 6% amplified its effect. Between May 1997 and September 2000, the diesel fuel price rose by around 30%, increasing fuel's share of the typical haulier's budget from a quarter to a third (McKinnon, 2001). The government abandoned the fuel duty escalator policy in 1999¹, the year before the 'fuel crisis' when road hauliers and farmers blockaded oil refineries and obstructed major roads in protest against high fuel prices (Lyons and Chatterjee, 2002).

Since 2000, the diesel fuel duty in the UK has declined slightly in real terms (Leicester, 2005), though still remains much higher than the levels in other EU member states (Figure 1) (European Commission, 2006a). At 0.89 Euro per litre, it is 75% higher than the EU average and 141% higher than in Latvia, the mainland EU member state that taxes fuel the least. The fact that the diesel fuel price is higher in the UK than any other EU country is entirely due to the higher level of duty and tax that the government imposes. In March 2006, the UK actually had the lowest pre-tax fuel price in the EU

¹ Although originally justified as an environmental measure the high fuel duty policy was latterly defended on the grounds that it provided additional public funds for schools and hospitals. The connection between high fuel prices and climate change therefore weakened. Britain is, nevertheless, in line to meet its Kyoto targets, mainly as a result of a large shift in electricity generation from coal to gas. It is difficult to measure the contribution that the fuel duty escalator made to the pursuit of the Kyoto targets. As discussed later in the paper, fuel efficiency in the road freight sector rose by a significant margin between 1994 and 1999, while the escalator policy was in force.

(Figure 1). At 0.48 Euro per litre, it was 6% below the EU25 average and 15% below the equivalent price in Italy of 0.56 Euro per litre.

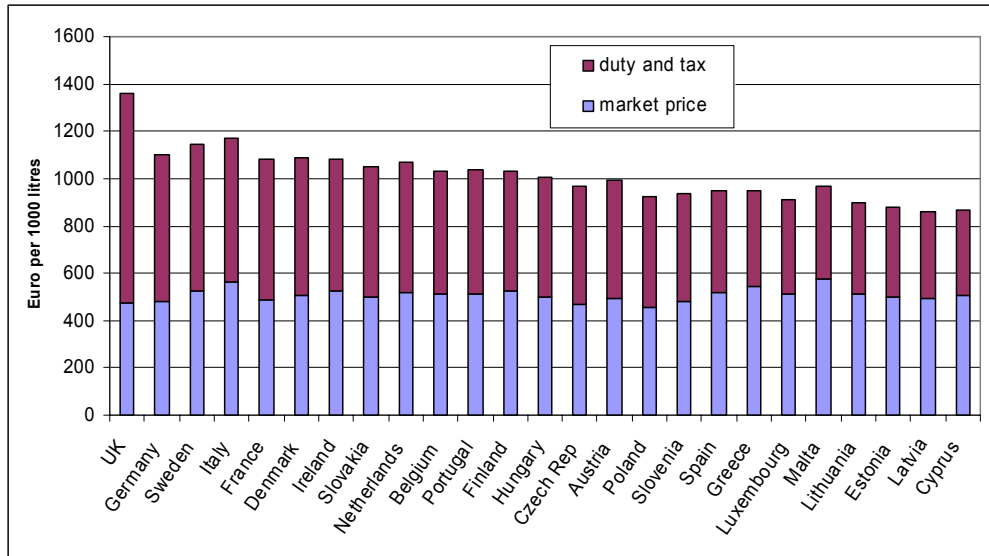


Figure 1: International Variations in Diesel Fuel Prices, Duty and Taxes: March 2006. Source: European Commission (2006).

Although there is currently a substantial difference in the diesel fuel price between the UK and other EU member states, it used to be much wider. In September 2000, at the time of the fuel protests, diesel fuel in the UK cost roughly 50% more than the EU average (the EU15 at that time) (McKinnon, 2001). By March 2006, the differential had narrowed to 24% (Figure 2). The gap in average fuel prices between the UK and its near neighbours in France, Belgium and the Netherlands also narrowed from 52% to 28% over this period (European Commission, 2006a). This recent trend has taken the gap in diesel fuel prices between the UK and the EU15 back to the level it was at in 1993, the year prior to the introduction of the UK government’s fuel duty escalator policy.

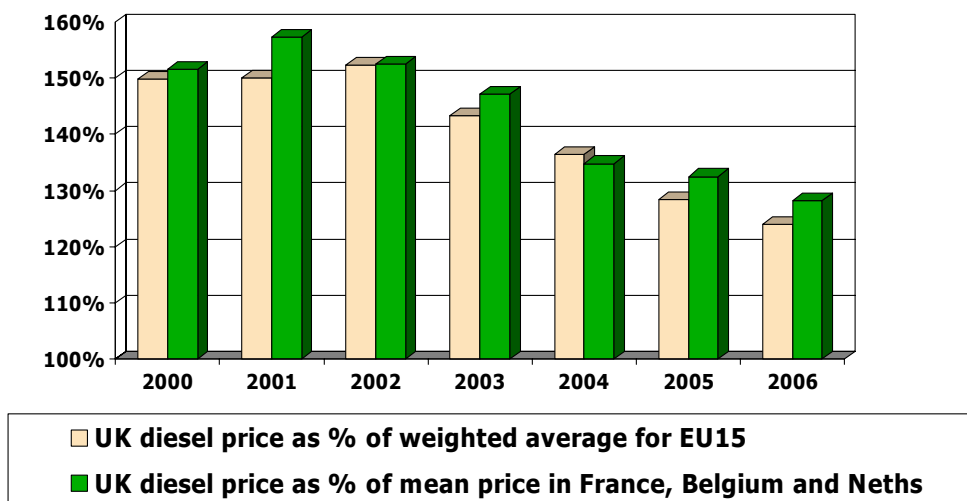


Figure 2: Narrowing of UK –EU Differential in Diesel Fuel Prices: 2000-2006 Source: European Commission (2006).

The difference in fuel prices between the UK and the rest of the EU has shrunk because increases in diesel fuel prices over the past six years have been mainly attributable to increases in the pre-tax price of fuel. As the main inflationary pressure has been exerted by the world price of oil, those countries with relatively low rates of fuel duty have experienced the largest increase in pump prices. Between January 2004 and March 2006, a period over which the market price of oil doubled from \$34 to almost \$70 a barrel, the average diesel price rose by 49% in Greece as opposed to 23% in the UK (Figure 3). Because of the buffering effect of high fuel duties, the UK experienced the lowest percentage increase in fuel prices over this period, significantly below the average 36% increase across the EU15. One of the few consolations of having fuel duty set at a relatively high level is that it reduces the sensitivity of pump prices to variations in the market price of oil.

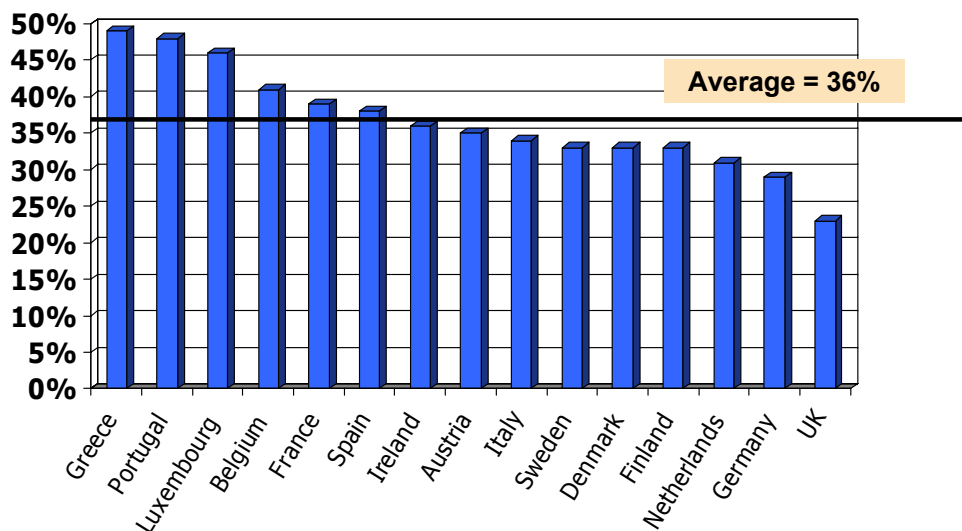


Figure 3: % Increase in Diesel Fuel Prices between Jan 2004 and March 2006
Source: European Commission (2006).

Foreign penetration of the UK road haulage market

Prior to 1991, foreign-registered hauliers were prohibited from undertaking domestic haulage work in any EU country. This practice, known as ‘cabotage’, was legalized during the 1990s. Increasing numbers of cabotage permits were issued each year until 1998 when cabotage was fully liberalized. Prior to the liberalisation of cabotage during the 1990s, the differences in fuel duty between the UK and other EU member states irritated British hauliers but had little direct effect on the domestic road haulage market. Since the complete liberalisation of cabotage in 1998, there has been a sharp increase in the amount of domestic haulage work undertaken in the UK by foreign carriers. The extent of this increase is uncertain, however, because of disparities between the two sets of cabotage statistics available. The level of cabotage in a country is measured by the ‘cabotage penetration rate’. This is defined as ‘the proportion of a country’s domestic market (national transport plus cabotage) taken by cabotage’ (Schiullo and Smihily,

2005). Table 1 shows the cabotage penetration rates estimated by Eurostat and the UK government between 1997 and 2004 using different survey methodologies. The latter estimates are substantially lower, but still show a steep increase in cabotage between 2000 and 2003. The Eurostat figures are based on a larger sample of operators and more consistent sampling frame. On the basis of these figures, it is estimated that the amount of freight movement on cabotage journeys within the UK increased from 79 million tonne-kms in 1997, the year preceding full liberalization of cabotage, to 1.86 billion tonne-kms in 2004.

Table 1. Estimates of road cabotage penetration rates for the UK: % of domestic road tonne-kms.

	Eurostat	UK government
1997	0.05	-
1999	0.48	-
2000	0.87	0.06
2001	0.86	-
2002	0.96	-
2003	1.05	0.4
2004	1.20	-

Sources: Allen (2001), Oberhausen (2003), Sciuillo and Smihily (2005), Sciuillo and Smihily (2006), Department of the Environment, Transport and the Regions (2000) and Department for Transport (2003a).

Almost all of this freight movement will have been powered by fuel purchased outside the country. Foreign operators invariably fill their fuel tanks before entering the UK. This gives them a significant cost advantage over UK-registered hauliers. In March 2006, diesel fuel could be purchased, respectively, 20% and 24% cheaper in France and Belgium than in the UK (European Commission, 2006a). Other things being equal, this would have given the typical French or Belgium haulier a 5-6% cost advantage over their British counterpart. On a full tank of fuel, typically holding 1500 litres in the case of a 40 tonne articulated lorry, they could exploit this advantage over a distance of around 3000 kms. As the average length of haul for UK domestic freight movements by articulated trucks with gross weights in excess of 33 tonnes is only 125 kms, a substantial number of cabotage journeys can be undertaken on a single tank of cheaper fuel purchased outside the UK.

There is some disagreement over the resulting distortion of the UK domestic road haulage market. The Eurostat estimate of the level of cabotage in the UK in 2004 suggests that only around 1.2% of domestic road tonne-kms were carried in foreign-registered vehicles (in line with the EU average) (Sciuillo and Smihily, 2006). This figure expresses cabotage penetration as a percentage of total road tonne-kms in lorries with a gross weight of over 3.5 tonnes. This definition includes local deliveries by smaller rigid vehicles, a market in which foreign carriers seldom compete. As the vast majority of foreign trucks are articulated vehicles with a gross weight of 40 tonnes, it is more realistic to measure cabotage with respect to this heavier end of the haulage market. Confining the measure to tonne-kms carried in articulated vehicles with gross weights of 33 tonnes or more, increases the cabotage penetration rate by just under 50%, but this still represented only around 1.7% of domestic tonne-kms in 2004. The main

trade associations argue that the relevant haulage market should be more tightly defined in terms of vehicle type, length of haul and geographical area. The Road Haulage Association, for example, claims that cabotage penetration of the general haulage sector comprising 75,000 trucks of 38 tonnes or more ‘could be as high as 25 per cent’ (Local Government and Transport Committee, 2006). Such a high level of penetration is only likely to occur in particular geographical areas or routes.

By combining data from the Foreign Vehicle Survey (FVS) and the Continuing Survey Road Goods Transport (CSRGT) for 2003 it is possible to conduct a geographical analysis of foreign penetration of the British road haulage market (Department for Transport, 2003 and 2004a). The available data from the FVS combines cabotage journeys with the UK legs of cross-border trips and transit movements between Ireland and the European mainland. It is not possible, therefore, to calculate cabotage penetration rates on a geographically disaggregated basis. Tables 2 and 3 measure the foreign penetration of inter-regional and intra-regional haulage markets expressed, respectively, in tonnes and tonne-kms². They reveal wide geographical variations in the extent to which foreign operators have penetrated the UK haulage market. This market penetration is greatest on inter-regional routes to and from the South East of England and East England, regions in which the main roll-on roll-off ferry ports are located. Relatively high penetration rates were also recorded on routes to and from Wales through which most of the Irish transit traffic passes. Overall 6 (7%) of the inter-regional links had penetration rates between 5 and 9.9%, 8 (9%) between 10 and 19.9% and 7 (8%) over 20%. This suggests that foreign competition is having a significant impact on the road haulage market in particular parts of the country.

Table 2: Percentage of Road Tonnes-lifted Carried by Foreign-Registered Hauliers on Intra- and Inter-regional Routes in the UK.

	North East	North West	Yorks/Humb	East Midlands	West Midlands	East of England	South East	South West	Wales	Scotland
North East	0.0%	0.1%	0.3%	0.1%	0.5%	9.1%	12.3%	-	-	0.9%
North West	0.3%	0.2%	1.9%	0.9%	1.2%	4.1%	19.7%	2.8%	2.1%	0.7%
Yorks Humber	0.9%	1.5%	0.3%	0.2%	0.5%	5.9%	16.0%	0.1%	3.6%	3.0%
East Midlands	1.4%	1.0%	0.7%	0.1%	0.6%	1.8%	3.2%	0.1%	4.5%	0.7%
West Midlands	0.6%	2.9%	2.5%	1.4%	0.2%	3.4%	9.6%	0.9%	3.4%	0.7%
East of England	6.3%	2.5%	2.7%	3.1%	4.1%	1.0%	2.6%	1.5%	7.1%	4.2%
South East	17.4%	33.6%	30.9%	16.5%	25.9%	11.9%	3.7%	7.2%	44.2%	21.7%
South West	-	0.6%	0.3%	0.3%	2.4%	1.9%	3.0%	0.2%	1.2%	-
Wales	-	1.4%	9.0%	4.4%	2.5%	5.9%	25.1%	0.2%	0.1%	-
Scotland	0.4%	1.5%	2.9%	0.0%	2.2%	-	38.6%	-	-	0.1%

Source: Department for Transport (2003 and 2004).

² The Burns Inquiry, commissioned by the two main trade bodies (FTA and RHA), conducted a similar analysis using the same data to assess ‘foreign vehicle activity as a % of goods moved by road in Great Britain’. It is not clear what unit of measurement was used for vehicle activity. Although the results are broadly similar to those in Tables 2 and 3, there are significant disparities.

Table3: Percentage of Road Tonnes-kms Carried by Foreign-Registered Hauliers on Intra- and Inter-regional Routes in the UK

	North East	North West	Yorks/Humber	East Midlands	West Midlands	East of England	South East	South West	Wales	Scotland
North East	0.0%	0.1%	0.8%	0.0%	0.6%	10.2%	21.6%	0.0%	6.8%	1.0%
North West	0.3%	0.4%	2.3%	0.8%	1.6%	5.7%	25.6%	2.7%	2.6%	1.0%
Yorks Humber	1.4%	2.6%	0.5%	0.2%	0.6%	8.2%	20.9%	0.1%	4.2%	4.2%
East Midlands	1.7%	1.3%	0.9%	0.2%	0.9%	3.5%	5.9%	0.0%	6.9%	0.8%
West Midlands	0.9%	3.2%	3.5%	1.5%	0.2%	4.5%	16.7%	1.6%	6.8%	0.7%
East of England	10.9%	3.3%	4.4%	5.0%	6.0%	1.6%	5.9%	2.9%	17.1%	10.9%
South East	33.7%	51.9%	46.0%	33.9%	46.3%	24.3%	10.6%	16.2%	-	36.1%
South West	0.0%	0.7%	0.2%	0.4%	4.1%	2.0%	6.2%	0.4%	3.6%	1.2%
Wales	8.7%	2.3%	8.6%	7.6%	4.0%	13.6%	45.0%	0.5%	0.2%	2.4%
Scotland	0.4%	2.2%	4.2%	0.0%	2.0%	4.5%	68.7%	0.4%	4.1%	0.4%

Source: Department for Transport (2003 and 2004).

Foreign hauliers not only exert market influence by capturing traffic from domestic operators. Their presence in the market can also depress haulage rates on particular routes, squeezing the profit margins of domestic hauliers. 26% of hauliers responding to a survey conducted by the Burns Inquiry (2005) partly attributed worsening ‘terms and conditions’ to the ‘effects of foreign competition’ though they tended to be ‘localised and sector-specific’ (p.34-5). The financial position of hauliers operating on routes and in areas most affected by foreign competition is, therefore, likely to have been adversely affected by the differential fuel costs of British and foreign operators.

This is a problem largely confined to domestic carriers. International road hauliers are able to buy all or most of their fuel in other countries at the same prices as foreign carriers. An analysis commissioned by European Conference of Ministers of Transport (2000) revealed that, despite national differences in the taxes paid by hauliers (fuel duty, vehicle excise duty and road tolls) the total amount of tax paid on international journeys varied little between hauliers registered in different countries.

While travelling in other countries, British hauliers can engage in cabotage operations, partly offsetting cabotage penetration in the UK domestic haulage market. British hauliers, however, accounted for only 1.4% of all road cabotage in the EU in 2004. This compares with the 12.9% of total EU cabotage activity performed in the UK (Sciullo and Smihily, 2006). A country’s overall road cabotage position can be measured by expressing cabotage tonne-kms handled by its registered hauliers in other countries as a ratio of the total tonne-kms carried by foreign operators in its domestic market (Figure 4). In 2004, the UK’s position was the weakest in the EU with its hauliers carrying only 10.9 tonne-kms on a cabotage basis elsewhere for every 100 tonne-kms of cabotage in its home market.

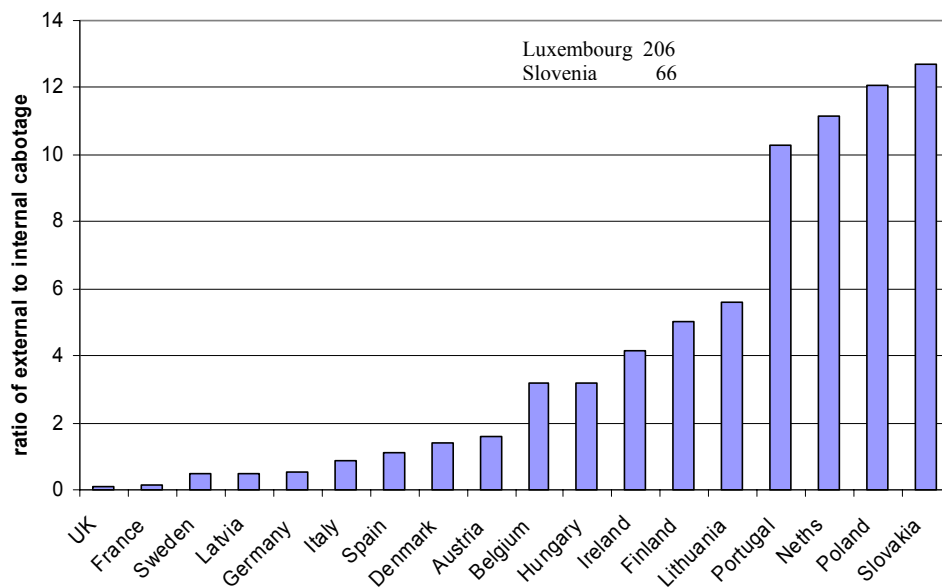


Figure 4: Ratio of External Cabotage by Country's Hauliers to Internal Cabotage Undertaken by Foreign-registered Hauliers within the Country (based on tonne-kms).
Source: Sciallo and Smihily (2006).

Reasons for the increase in foreign haulage activity in the UK

The sharp increase in foreign haulage activity in the UK cannot be attributed solely to the difference in fuel duties between the UK and other EU member states. It is one of a number of factors that have promoted this trend. Two other factors are also likely to have been important:

1. Growth of imports into the UK: The overall degree of import penetration into the UK has risen sharply since 1997. Companies exporting by road to the UK tend to use hauliers registered in their home countries to transport their goods. This partly explains the influx of foreign-registered trucks into the UK. This trend is reinforced by differences in freight rates. Over the past decade, imports of goods from other EU countries have increased much faster than exports (Figure 5). The traffic imbalance is reflected in freight rates charged for haulage movements to and from the UK. As the dominant flow is inbound and hauliers find it difficult to find return loads from the UK, rates for import consignments are significantly higher than those for exports. Foreign carriers that can charge relatively high tariffs on journeys into the UK can offer low backhaul rates on return journeys to the European mainland. British international hauliers find it very difficult to compete with these low outbound rates. This helps to explain why the proportion of British registered lorries travelling between the UK and mainland Europe has dropped sharply over the past decade (Figure 6) and why British hauliers account for such a small proportion of cabotage in other countries.

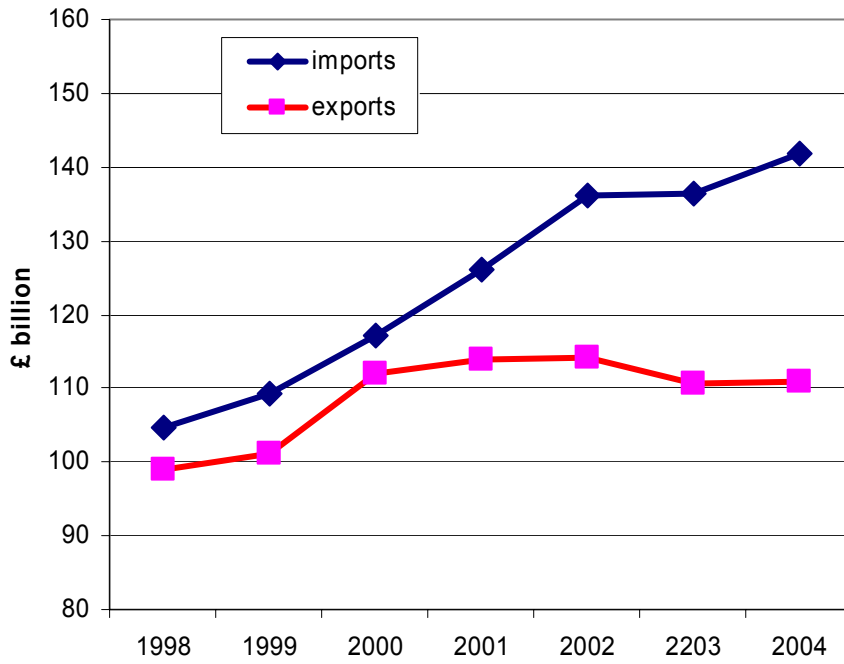


Figure 5: Value of UK Imports and Exports to / from the European Union.
Source: Office of National Statistics (2006).

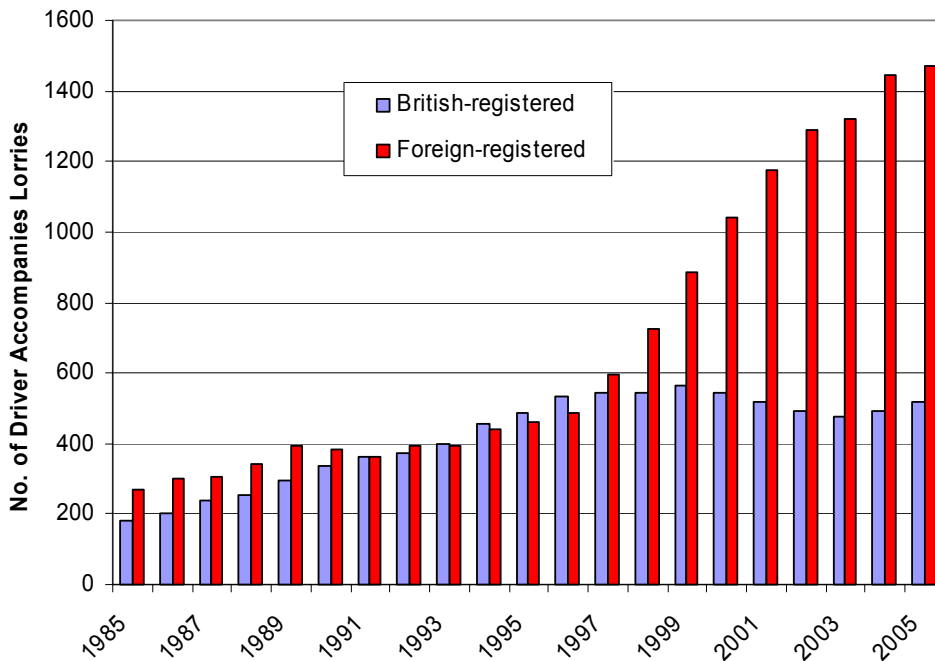


Figure 6: Numbers of British- and Foreign-registered Lorries Travelling between UK and Mainland Europe.
Source: Department for Transport (2006a).

2. *Widening international differences in other haulage costs:* The Burns Inquiry compiled comparative data on the costs of operating a 40 tonne 5-axle truck in six European countries. This indicated that operating costs were, respectively, 4%, 8%, 21%, 37% and 69% higher in the UK than in Germany, Belgium, the Czech Republic, Hungary and Bulgaria (Figure 7). Differences in fuel prices accounted for, respectively, 139%, 110%, 49%, 30% and 31% of the variations in total vehicle operating costs. In Germany and Belgium, lower fuel prices were more than offset by higher labour costs, while in the three Eastern European states, the cost differential with the UK was even greater for drivers than for fuel.

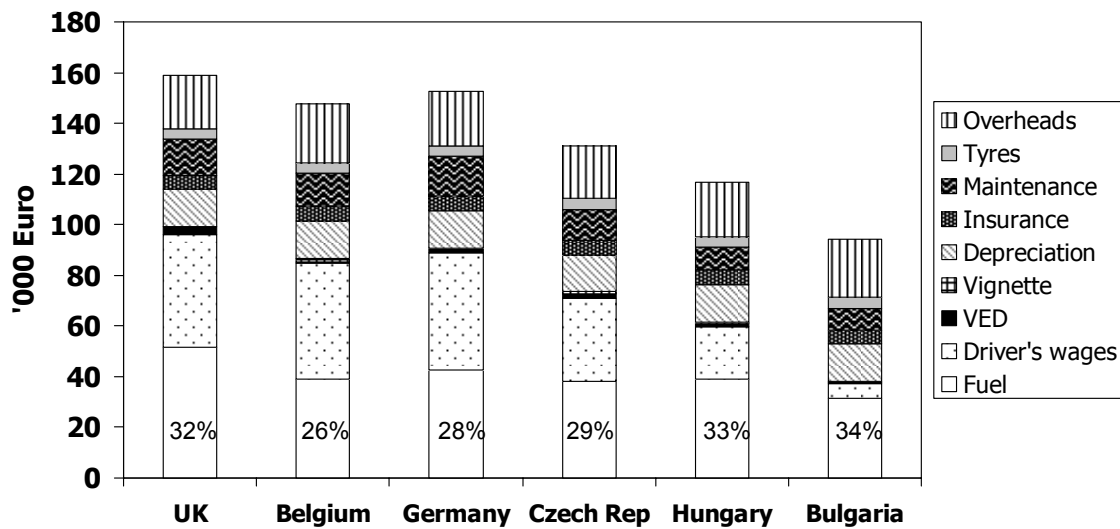


Figure 7: Structure of Truck Operating Costs in Six European Countries: annual expenditure. Source: Burns Inquiry (2005).

Foreign operators can substantially undercut the labour costs paid by British-registered hauliers, particularly by employing Eastern European drivers. According to the Burns Inquiry, driver costs in Hungary and Bulgaria were, respectively, 45% and 27% of those in the UK. As operators need only comply with minimum wage regulations in the country in which the driver is employed, foreign trucks can be driven on UK roads by drivers employed at these low wage rates. This labour cost advantage is reinforced by the failure of many foreign carriers to fully observe the Road Transport Directive while operating in the UK. This Directive restricts working hours in the road haulage industry (Department for Transport, 2005a). While operating in the UK, foreign drivers are covered by Britain's RTD regulations. It is very difficult, however, for the UK enforcement authority, VOSA, to check compliance as company records relating to working time are held at the foreign operator's base outside the UK. This situation is further aggravated by the fact that many of the EU member states in which foreign operators are based have so far failed to implement the RTD (Local Government and Transport Committee, 2006).

Wider economic issues

In assessing the net effect of foreign penetration of the British road haulage market, it is necessary to look beyond the interests of the domestic haulage industry. Many users of freight transport services have benefited from the arrival of foreign carriers offering lower rates. They have either benefited directly by employing their services or indirectly from the downward pressure on the general level of rates exerted by greater foreign competition in the market. No attempt has yet been made to quantify these benefits to shippers.

In evidence to a Scottish Parliamentary inquiry into freight transport, the representative of the Freight Transport Association, which represents mainly users of transport, claimed that he 'did not think that the vast majority of his members regard the arrival of foreign operators as a good thing. They would rather deal with domestic operators with which they can build up long-term relationships that are founded on trust between parties'. The final report by the Parliament's Local Government and Transport Committee (2006), nevertheless, disputed this claim, arguing that:

'If Scottish businesses wish to remain loyal to the indigenous road haulage industry and cultivate longer term relationships with local hauliers they can do so. If this were the prevailing view across Scottish industry, very little use would be made of foreign operators and the issue of cabotage penetration would not arise. The fact that the Committee's attention has been drawn to the issue and it has been highlighted as a problem, suggests that some Scottish firms aim to minimise their transport costs regardless of the haulier used. This is perfectly reasonable behaviour.'

The intensification of competition in the UK haulage market is likely to have had the effect of improving the efficiency of domestic operations, as well as squeezing the hauliers' profit margins. It may also have contributed to the increased rate of bankruptcies and insolvencies in the transport / communication sector between 1998 and 2004 (Burns Inquiry, 2005). Many of the less competitive operators will have been forced to leave the industry. This would be in keeping with the government's objective of 'modernising the UK road haulage' (HM Treasury, 2000)

On the negative side, the British government loses large amounts of potential revenue that it could earn from foreign hauliers if they bought their fuel in the UK. We estimate that if foreign operators bought all the fuel required for their UK operations within the UK the government would gain around £200million more each year in fuel duty.

There is legitimate concern too that, as foreign hauliers pay neither fuel duty nor vehicle excise duty in the UK, they contribute nothing to the construction, maintenance and policing of the UK road network nor do they cover any of the environmental costs they impose while travelling in the UK. Recent research undertaken by NERA (2005) for the Freight Transport Association has valued the environmental, accident-related and road track costs imposed in the UK by foreign trucks at £236 million per annum.

Possible ways of correcting the fuel duty anomaly

As noted earlier, steep increases in the market price of fuel during a period of relatively stable duties has had the effect of narrowing differentials in pump prices. The gap between fuel tax levels in the UK and those of other EU countries remain wide, however. It has been argued, therefore, that government initiatives are required to reduce or possibly close this gap. These initiatives could be introduced at an EU level or internally within the UK.

EU initiative

In its 2001 Transport Policy White Paper, the European Commission (2001) proposed 'harmonisation of fuel taxation for commercial users, particularly in road transport'. It published a draft directive in 2002 to standardise excise duty for the commercial use of diesel in goods vehicles of over 16 tonnes gross weight by 2010 for the EU15 and 2012 for the new accession states. Countries would have been allowed initially to vary their level of duty around a 'central rate' of 350 Euros per 1000 litres of fuel. The 'fluctuation band' around the central value would narrow, however, with convergence on the harmonized rate by 2010 for the EU15. Annual indexation of the central rate would raise it to 410 Euros by 2010.

The two main aims of this proposal were to:

1. remove market distortions in the European road haulage industry and level the competitive 'playing field', at least as far as fuel purchases were concerned.
2. recover a higher proportion of the environmental costs imposed by road freight transport.

The Commission is, after all, committed to applying the 'polluter pays' principle in the transport sector³ (European Commission, 2001). Harmonising fuel duty at 410 Euro per 1000 litres would have increased the tax burden on hauliers in most EU15 countries and raised the total tax revenue from road freight operations across the continent. It would, however, have had the opposite effect in the UK, where, at the time the draft directive was published, fuel duty was already 80% higher. Harmonising on the 410 Euro central value would have cost the UK Exchequer around £2bn in lost revenue (House of Lords Select Committee on the European Union, 2003). It is hardly surprising therefore that the UK government strongly opposed the 2002 draft directive. At an EU level it was rejected by the European Parliament in November 2003. Undeterred by this earlier rejection, the European Commission has recently launched a new round of consultation on the issue of fuel tax harmonisation. It has identified three options:

³ For consistency the same principle should be applied to all sectors, though in recent years much of the debate about the internalization of environmental costs has focused on the transport sector.

Option A: No further intervention at an EU level, with individual states retaining freedom to set the level of fuel duty.

Option B: Gradual harmonisation on a single EU fuel duty. It is proposed that this single duty level should be 400 Euro per 1000 litres of diesel fuel and universally adopted by 2018.

Option C: Gradual convergence on a narrow range of fuel duty rates delimited by EU-wide maximum and minimum values. This range would be progressively reduced to 100 Euro by 2010.

It remains to be seen if this new EU initiative will command greater support today than the previous attempt to harmonise fuel duties across the continent.

UK initiatives

UK fuel duties deviate much further from the EU mean than those of other countries and this deviation appears to have a greater impact on the competitive position of road hauliers in Britain than in other parts of the EU. It can be argued, therefore, that the UK presents a special case which requires country-specific initiatives. The Burns Inquiry (2005) identified a total of fifteen options (or ‘potential solutions’) which the British government could adopt to correct the fuel duty anomaly or at least ease its effects on the UK road haulage industry. These were assessed, on a subjective basis, against a set of eight criteria⁴. None of the options satisfied more than six of the eight criteria, with most of them unlikely to gain ‘political acceptability’. The options can be grouped into three categories:

1. Reduce diesel fuel duty for all users
2. Reduce the fuel duty paid by road hauliers
3. Increase the fuel duty paid by foreign hauliers operating in the UK

1. Reduce diesel fuel duty for all users:

This would be a relatively simple fiscal measure, but one which would sharply reduce government tax revenue and conflict with its energy conservation and sustainable distribution goals (Department of the Environment, Transport and the Regions, 1999). Every 1 pence reduction in fuel duty would cut government tax revenue by £200 million (Burns Inquiry, 2005). Bringing the UK diesel fuel duty down to the EU average would require a 25 pence per litre reduction and represent a loss of £5.2 billion per annum in

⁴ These criteria were: (i) extent to which the scheme corrected the fuel duty anomaly (ii) ease of operation (iii) cost to government (iv) extent to which it made foreign carriers pay the true costs of operating on UK roads (v) acceptability to fuel suppliers (vi) speed of implementation (vii) ability to decouple truck taxation from that of cars (viii) political acceptability.

tax revenue. This would require a major restructuring of government finances. There is no evidence that the government is seriously contemplating this option.

2. Reduce fuel duty paid by road hauliers:

This option would involve decoupling the diesel fuel taxes paid by different road users. Road hauliers could then pay less fuel duty than diesel car users. This decoupling could be achieved in several ways:

(i) differentiation of diesel fuel used in trucks: this could be done by placing a coloured dye in the fuel, as already happens in the case of ‘red’ diesel used, for example, in farm vehicles and refrigeration units. Currently red diesel carries a very low rate of duty (only 6.4 p per litre). As the reduced level of fuel duty for hauliers would be substantially higher than this, a different colour dye would have to be added (blue has been proposed). This option was suggested by the government in a consultation exercise in 2001 and commanded little support (HM Treasury, 2001). The current system of red diesel is widely infringed and the creation of another category of coloured fuel would further complicate the enforcement process.

(ii) introduction of a rebating system: trade associations have argued that British road hauliers deserve an Essential User Rebate on fuel duty to compensate them for the fact that foreign carriers can avoid paying this duty (Road Haulage Association, 2000). Such a ‘fuel duty rebate’ scheme has operated successfully for many years for buses in the UK. Several methods could be used to rebate a proportion of the fuel duty paid by hauliers. For example, hauliers could provide receipts to confirm fuel purchases or by using special fuel cards they could have the rebate deducted automatically from the price at the refuelling point.

(iii) transfer a proportion of the fuel duty onto VAT: as road hauliers, unlike most diesel car users, are VAT-registered they would be able to reclaim the VAT, effectively gaining a fuel duty rebate. The Burns Inquiry investigated this option, however, and found that it would infringe current EU rules on VAT.

This option would also cut government tax revenues, though by a smaller amount than the first option (£2 billion per annum as opposed to £5.2 billion). The government would be unlikely to countenance such a loss of revenue. It has, nevertheless, been argued by the Centre for Business Research (quoted in Burns Inquiry, 2005) that this loss would be largely offset by additional tax revenues raised mainly from three sources:

- increase in the share of domestic and international road haulage undertaken by British-registered hauliers paying taxes to the UK government
- UK hauliers, particularly those engaged on international operations and foreign carriers, switching the purchase of their fuel from other countries (including Eire) to the UK and thus paying UK duty
- additional employment created in the UK as a result of the new tax policy

Several of the assumptions underpinning this analysis are rather tenuous. For example, it is assumed that aligning UK fuel duty with the EU mean would virtually eliminate cabotage. The government also disputes the claim that rebating fuel duty for hauliers in this way would be self-financing.

3. Increase the taxes / charges paid by foreign hauliers

Rather than levelling fuel duty for UK hauliers down to the EU mean, this option would impose British levels of fuel duty on foreign carriers operating in the UK. To comply with EU rules, this could only be done in a way that did not discriminate against foreign operators and / or present a barrier to trade. Two proposals considered by the Burns Inquiry would clearly fail this test. These are the suggestions all trucks must enter the UK with an empty fuel tank and / or leave the country with a full tank of fuel.

The other means of achieving this option would entail the introduction of some form of road user charging for trucks. Truck tolling schemes have been introduced in Switzerland, Germany and Austria, partly to ensure that foreign-registered vehicles are adequately charged for their use of road infrastructure (McKinnon, 2006a). In its 2001 consultation exercise the UK government sought views on the adoption of either a distance- or time-based system of road user charging in the UK (HM Treasury, 2001). The distance-based charging option received much more support than a time-based scheme employing vignettes (or 'Britdisks') (HM Treasury, 2002a). The UK government then embarked on the development of a Lorry Road User Charging (LRUC) scheme, which would have charged all lorries with a gross weight of over 3.5 tonnes a per-kilometre toll for using the UK road network. Hauliers, registered either in the UK or other countries, would have been able to reclaim a proportion of their fuel duty to offset against the road user charge. The government assured the British road haulage industry that its overall tax burden would not increase as a result of LRUC, at least in its early stages (HM Treasury, 2002b; HM Treasury, 2003). The fuel duty rebate system would ensure fiscal neutrality for UK operators. Foreign hauliers, on the other hand, would have to pay charges on an equivalent basis to their British counterparts for their use of UK road infrastructure.

The government's plans for LRUC were criticised for being over-specified, too expensive and poorly aligned with its declared policy objectives (House of Commons Transport Committee, 2005; McKinnon, 2006b). Although portrayed essentially as a means of 'levelling the playing field' between British and foreign operators, LRUC would also have had the capability to vary charges by road type, geographical area and time of day (HM Customs and Excise, 2004). An alternative, much simpler and cheaper system of road user charging for trucks has been proposed, which would rely on tachograph readings rather than vehicle tracking to measure the distance travelled by lorries on UK roads (McKinnon, 2006b).

The government decided to abandon its plans for LRUC in July 2005, arguing that it would be more sensible to develop road user charging for trucks within the context of a more general programme of road pricing for all categories of vehicle. According to government reports, general road pricing is unlikely to be introduced before 2015 at the earliest (Department for Transport, 2004b). Representatives of the UK haulage industry have argued that the fuel duty anomaly needs to be corrected before then (Wright,

2006). A simpler, low technology scheme, involving distance measurement and fuel duty rebating, could be implemented on an interim basis until general road pricing is technically feasible and politically acceptable (McKinnon, 2006b). A joint government-industry committee is currently re-examining the whole issue of fuel duty differentials, foreign competition and cabotage.

Little progress has therefore been made towards correcting the fuel duty anomaly. As noted earlier, however, the upward trend in the market price of fuel, combined with stable duty levels, is gradually narrowing the gap between the UK and average EU diesel prices.

The remainder of the paper considers the opportunities for addressing another issue which has been seriously concerning the British road haulage industry. This is the difficulty of recovering fuel price increases from shippers, particularly during periods of high fuel price inflation.

Recovery of fuel price increases from shippers

Across the EU15, diesel fuel prices rose by an average 36% between January 2004 and March 2006 (European Commission, 2006a). In the UK, they rose by an average of 23%, inflating average vehicle operating costs by roughly 6% (European Commission, 2006a; Phillips, 2006). In an ideal world, these increases would be passed down the supply chain and ultimately borne by the final consumer. It is possible to make a rough estimate of the inflationary effect of such an eventuality. According to a quinquennial survey undertaken for the European Logistics Association (A.T.Kearney, 2004), in 2003 the logistics costs of European businesses averaged 6.1% of sales revenue and transport accounted for 43% of these costs. If one assumes that fuel constitutes on average 27% of truck operating costs, the 36% increase in diesel fuel prices between January 2004 and March 2006 would have added only around 25.5 cents to a 100 Euro shopping bill. If averaged over the typical family shopping budget such an increase would be barely noticed.

The suggestion that fuel price increases should ripple down the supply chain, in much the way that VAT is added, may seem far-fetched. It was, however, another formal proposal in the Transport White Paper of the European Commission (2001). The Commission indicated that it would propose 'legislation allowing harmonisation of certain clauses in contracts in order to protect carriers from consignors and enable them to revise their tariffs in the event of a sharp rise in fuel prices' (p.16). In other words, it would become a legal requirement to build clauses into haulage contracts giving carriers the right to reclaim fuel price increases. It is difficult to see how such legislation could be enforced in an industry as intensely competitive as road haulage. Nor would this proposed legislation offer much support for the large section of the haulage industry relying mainly on spot-hire rather than longer term contracts.

A survey conducted by Aleszewicz (2005) found that a sample of 29 hauliers managed to recover an average of only 27% of the fuel price increase over the previous year. Underlying this average, however, was a wide variation in the % of the price increase recovered. Twelve of the 29 claimed to have recovered less than 5%, while

nine were compensated for 50% or more of the fuel price increase. Only around a quarter of the companies responding (27%) indicated that shippers with whom they had contracts automatically compensated them if the fuel price rose above an agreed margin. Three out of four claimed that compensation for fuel price increases ‘always or usually’ involved negotiation.

A larger survey conducted several months later for the Burns Inquiry (2005, p.36) found that around 60% of UK hauliers were ‘able to substantially recover fuel costs’ in 2005. The ability to gain compensation for fuel price rises depended on the size of the operator, however. Only 50% of hauliers with five or fewer vehicles managed to ‘substantially recover fuel costs’, while for operators with 26 or more vehicles the corresponding percentage was almost 80% (Table 4). Between 2000 and 2005, differences in the extent to which the three size classes of haulier were able to recover fuel price increases markedly widened. This will have strengthened the market position and profitability of the larger operators, particularly as this deviation coincided with sharp increases in fuel prices.

Table 4: Percentage of hauliers able to ‘substantially recover’ fuel price rises from shippers.

	1-5 trucks	6-25 trucks	>26 trucks
2000	43	40	43
2001	39	43	48
2002	35	45	50
2003	34	48	58
2004	45	50	85
2005	53	77	79

Source: Burns Inquiry (2005)

The differing experiences of hauliers of varying size can be partly explained by the greater reliance of larger operators on contracts containing ‘fuel clauses’. Many logistics companies have open-book contracts which allow them to reclaim fuel price increases. The vast majority of hauliers, however, are small and lack this type of contractual relationship. For example, according to unpublished data from the Traffic Commissioner, the average road freight operator in the Scotland runs only four vehicles, while 79% of them have five or fewer vehicles.

Improvement in fuel efficiency

Fuel price increases give operators an incentive to improve the energy efficiency of their operations, particularly when they cannot be recouped in full by rate increases. A commonly held view among shippers is that hauliers should not be compensated in full for fuel price rises as this would remove the incentive to improve fuel efficiency. By raising the energy efficiency of their transport operations, hauliers are not only able to offer more competitive rates. They can also reduce their exposure to future fuel price increases.

Between 1990 and 2005, average fuel efficiency across the entire UK truck fleet increased by roughly 10.5%. Most of this increase occurred over two time periods, 1994-1998 and 2004-5 (Figure 8). These were periods of high fuel price inflation. The first coincided with the first four years of the government's fuel duty escalator policy. In 2004-5, the surge in fuel prices occurred as a result of the increase in the world price of oil. The close correlation between fuel efficiency and fuel price trends suggests that demand for fuel from the haulage industry is price-sensitive and that companies respond to sharp fuel price increases by running their vehicles more fuel efficiently, especially larger and heavier articulated lorries.

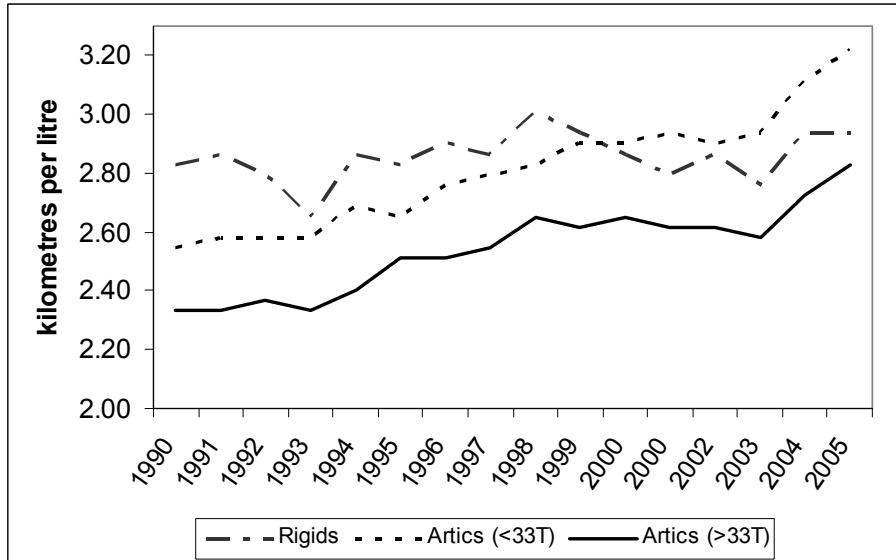


Figure 8: Average Fuel Efficiency of Different Classes of Truck in the UK. Source: Department for Transport (2006b).

Fuel efficiency gains, however, cannot possibly offset price rises of the magnitude experienced over the past two years. Where hauliers are unable to recover fuel price increases in higher rates or achieve offsetting improvements in fuel efficiency, they have to absorb at least a proportion of the higher fuel costs within their profit margins. As average profit margins in the British road haulage industry are only around 3%, most hauliers can ill-afford to do this (Plimsoll, 2005).

As it is predicted that fuel prices are likely to remain volatile and follow a longer-term upward trend, some method needs to be found to compensate hauliers for these inflationary pressures on one of the main inputs into their business.

Methods of compensating hauliers for fuel price rises

Road haulage is typically a buyer's market. It is a sector characterised by over-supply of capacity and intense competition. This can make it easy for shippers to refuse to compensate hauliers for fuel price increases, particularly in the spot-hire, general

haulage market. If one haulier insists on getting a higher rate to cover higher fuel costs, another can usually be found that will undercut this rate. Where haulage work is undertaken on a contractual basis, however, it can be advantageous for a shipper to incorporate a fuel price clause into the contract. Where oil prices are relatively high, as at present, shippers risk accepting rates based on high fuel prices that may drop during the period of the contract. Also, during periods of rapidly increasing fuel prices, failure to compensate hauliers can risk driving them into bankruptcy and disrupting the transport operation. The Burns Inquiry (2005), for example, found that hauliers were able to recover a much higher proportion of fuel price increases during periods of high fuel price inflation (2004 – 2005) than over periods when fuel price rises were more modest (2001-2003) (Table 4).

An ideal method of compensating hauliers for fuel price increases would adhere to four principles:

- Visibility – both parties should have open access to fuel price and use data
- Equity - opportunistic behaviour by one party should be discouraged
- Symmetry – as fuel prices can go down as well as up, adjustments should operate in both directions.
- Sustainability – the arrangement should survive periods of high price volatility

Four methods have been proposed (Aleszewicz , 2005)

1. The shipper buys the fuel for the carrier. Safeguards must be put in place, however, to ensure that carriers do not abuse this situation. This can be done by giving them fuel efficiency targets.
There are a few instances of this happening in practice, though it is relatively uncommon. When companies outsource their transport operations, they prefer to entrust fuel purchasing to their carriers.
2. The shipper and carrier agree an open-book contract establishing full transparency of fuel consumption, expenditure and price levels. The contract sets out the fuel price compensation rules, preferably incorporating fuel efficiency targets. This tends only to work, however, in the case of dedicated contracts where shippers have the exclusive use of vehicle assets. It is more difficult to apply to groupage / network services where several shippers' traffic is consolidated in the same vehicle.
3. The shipper tries independently to determine an adequate level of fuel price compensation. To do this, he requires information about changes in the fuel price and the % of the contract value which is spent on fuel. The first figure should be quite easy to find. This latter, however, is much harder to estimate. Annual surveys of road haulage costs, such as those compiled in the UK by *Motor Transport*, DFF and the Freight Transport Association, give an indication of the proportion of total costs allocated to fuel, but their estimates vary. The haulage work undertaken for a particular shipper can also differ significantly from the industry averages used in these published cost tables. In the case of cross-border operations, the situation is even more complicated as the % of

operating costs spent on fuel and fuel price increases vary from country to country, as discussed earlier.

4. At the time of tendering the carrier specifies the percentage of the contract value to be spent on fuel and agrees with the shipper that fuel price increases, above a certain margin, will automatically trigger additional payments in proportion to the declared expenditure on fuel. This allows the shipper to take the fuel cost % into account during the tendering process. The main problem with this method is that many carriers would have difficulty estimating the fuel cost component in a tender, particularly for a complex mix of loads and routes. Aleszewicz (2005) found that almost a third of hauliers seldom or never disaggregated fuel costs by shipper and journey. Many hauliers might also be reluctant to accept the risk involved in fixing the fuel costs incorporated within a contract at the time of tendering.

Conclusion

In its mid-term review of its 2001 Transport White Paper, the European Commission (2006) acknowledges that ‘the predominance of small companies and the impact on competition of considerable differences in fuel tax levels between Member States are important factors that will influence future development’ (p.9). Despite the Commission’s earlier efforts to narrow variations in fuel duty across the EU, they remain quite wide, with the British duty level 24% above the mean for the EU15. The development of the British road haulage industry over the past decade illustrates what can happen when a government unilaterally imposes a high fuel duty policy within a liberalised international freight market. This policy has undoubtedly contributed to the sharp increase in the level of cabotage in the UK since 1998, when this practice was fully deregulated within the EU15. Foreign-registered hauliers buying all their fuel before entering the UK gain a significant cost advantage over domestic hauliers and avoid contributing to the cost of building, maintaining and policing the country’s road infrastructure. This fuel cost advantage, however, is only one of several factors that have reinforced the growth of cabotage. It is also important to put cabotage into perspective. By 2004, cabotage had captured only around 1.2% of domestic road tonne-kms in the UK, in line with the EU25 average. Spatial analysis of cabotage penetration in the UK nevertheless reveals that its impact on the domestic haulage market is much greater, in some cases twenty times greater, on particular inter-regional routes.

Increases in the market price of fuel during a period when fuel duties have remained reasonably stable are narrowing international variations in pump prices. This is reducing the relative cost advantage that foreign operators gain from ‘fuelling-up’ outside the UK. It is, however, exacerbating another problem for British, and other European, hauliers – that of recovering fuel price increases from shippers. The extent to which they are able to recover these price increases and protect their margins varies with the size of carrier, the nature of the business and industrial sector. The steep rise in the oil price over the past two years has strengthened the need for more fair and consistent

methods of compensating hauliers for higher fuel costs. This paper has identified four possible methods. While none of them are ideal, they at least put the issue of fuel cost recovery on a more formal basis and offer a more practical solution to the problem than the European Commission's proposal that legislation be used for this purpose.

References:

- Aleszewicz, W. (2005) *Compensation for Fuel Price Movements in Road Freight Transport*, MSc dissertation, School of Management and Languages, Heriot-Watt University, Edinburgh.
- Allen, J. (2001) *Road Freight Cabotage 1990-1997*, Statistics in Focus: Transport – Theme 7 – 4/2001, Eurostat, Luxembourg.
- A. T. Kearney Ltd. (2004) *Insight to Impact: Results of the Fourth Quinquennial Survey of European Logistics*, European Logistics Association, Brussels.
- Burns Inquiry (2005) *The Burns Report*, Freight Transport Association / Road Haulage Association, Weybridge.
- Department of the Environment, Transport and the Regions (1999) *Sustainable Distribution: A Strategy*. London.
- Department for Transport (2003a) *Survey of Foreign Vehicle Activity in GB – 2003*, Department for Transport, London.
- Department for Transport (2004a) *Transport of Goods by Road in Great Britain*, Department for Transport, London.
- Department for Transport (2004b) *Feasibility of Road Pricing in the UK: Report*. London.
- Department for Transport (2005) *Road Transport (Working Time) Guidance*, Department for Transport, London.
- Department for Transport (2006a) *Road Goods Vehicles Travelling to Mainland Europe: Q1 2006*, Department for Transport, London.
- Department for Transport (2006b) *Road Freight Statistics 2005*, Department for Transport, London.
- European Commission (2001) *Transport Policy for 2010: Time to Decide*, European Commission, Brussels.
- European Commission (2006) *Oil Bulletin*. Available online at: http://ec.europa.eu/energy/oil/bulletin/2005_en.htm
- European Commission (2006) *Keeping Europe Moving – Sustainable Mobility for our Continent: Mid-term Review of the European Commission's 2001 Transport White Paper*, European Commission, Brussels.
- European Conference of Ministers of Transport (2000) *Efficient Transport Taxes and Charges*, ECMT, Paris.
- European Conference of Ministers of Transport (2003) *Reforming Transport Taxes*, ECMT, Paris
- HM Customs and Excise (2004) *LRUC: Procurement Prospectus*. London.
- HM Treasury (2000) *Pre-budget Report: November 2000*. London
- HM Treasury (2001) *Modernising the Taxation of the Haulage Industry: Consultation Document*. London.
- HM Treasury (2002a) *Modernising the Taxation of the Road Haulage Industry: Progress Report 1*. London.
- HM Treasury (2002b) *2002 Budget Statement*. London.
- HM Treasury (2003) *Modernising the Taxation of the Road Haulage Industry: Progress Report 2*. London.
- House of Commons Transport Committee (2005) *Road Pricing: The Next Steps. Volume 1*. (HC 218-1) The Stationery Office, London.
- House of Lords Select Committee on the European Union (2003) *The Taxation of Fuel in the European Union*, 24th Report for Session 2002-3, London.
- Leicester, A. (2005) *Fuel Taxation*, Briefing note 55, Institute of Fiscal Studies, London.
- Local Government and Transport Committee (2006), *Freight Transport in Scotland*, Scottish Parliament, Edinburgh.
- Lyons, G. and Chatterjee, K. (eds) *Transport Lessons from the Fuel Tax Protests of 2000*, Ashgate, Aldershot.
- McKinnon, A. C. (2001) "Haulier than thou" *Public Service Review*, autumn, pp. 22-25.

- McKinnon, A. C. (2006a) "A review of truck tolling schemes and assessment of their possible impact on logistics systems" *International Journal of Logistics: Research and Applications*, 9, 3, pp. 191-205.
- McKinnon, A. C. (2006b) "Government plans for lorry road user charging in the UK: a critique and an alternative" *Transport Policy*, 13, 3, pp.204 -216.
- NERA (2005) *Costs Imposed by Foreign-registered Trucks on Britain's Roads*, NERA, London.
- Oberhausen, J. (2003) *Road Freight Cabotage 1999-2001*. Transport Theme 7, Eurostat, Luxembourg.
- Office of National Statistics (2005) *Annual Abstract of Statistics*. Palgrave-Macmillan, London.
- Phillips, J. (2006) "Putting profit in the firing line" *Motor Transport*, 1st June, 2006, pp.19-21.
- Plimsoll (2005) *Road Haulage: the Plimsoll Portfolio Analysis*, Plimsoll Publishing, Stockton-on-Tees.
- Road Haulage Association (2000) *Fair Play on Fuel 2000*, Road Haulage Association, Weybridge.
- Sciullo, C. and Smihily, M. (2005) *Trends in Road Freight Transport up to 2003*, Statistics in Focus: Transport 7/2005, Eurostat, Luxembourg.
- Sciullo, C. and Smihily, M. (2006) *Road Freight Cabotage 1999-2004: Cabotage and Transport with Non-EU Countries*, Statistics in Focus: Transport 8/2006, Eurostat, Luxembourg.
- Wright, R. (2006) "Road pricing: hauliers want level playing field" *Financial Times*, April 24th 2006



Alternative transport network designs and their implications for intermodal transshipment technologies

Johan Woxenius^{1*}

¹ Division of Logistics and Transportation, Chalmers University of Technology, Göteborg, Sweden
and
Department of Systems and Software Engineering, Blekinge Institute of Technology, Karlshamn, Sweden

Abstract

Six principles for operation of the rail part of intermodal rail freight transport systems are described: direct link, corridor, hub-and-spoke, connected hubs, static routes, and dynamic routes. The first part is a theoretical discussion of the characteristics of the transport network designs. The theory is then applied to intermodal freight transport by analysing how each transport network design affects the need for terminal performance. The discussion includes a classification of existing transfer technologies and an analysis of how well developed technologies meet the demands. It is concluded that there is a sufficient supply of technologies, but some need to be taken further than the current blueprint phase and prove their viability in technical and economic terms.

Keywords: Corridor; Hub-and-spoke; Intermodal transport; Terminal; Transshipment technology.

1. Introduction

Policy-makers strongly believe in intermodal road-rail freight transport (IRRF) for solving a multitude of problems related to all-road freight transport. Promoting rail freight is thus an integrated part of transport policy in Europe (European Commission, 2001 and 2006) and Japan (Saito *et al.*, 2004), and it has prospects to make its way also into U.S. transport policy (Brown and Hatch, 2002). The stimulating measures are needed, but there is still a significant challenge for intermodal operators to compete with all-road transport, defined by Konings and Kreutzberger (2001) and Trip and Bontekoning (2002) as the need for a quality leap. Danielis *et al.* (2005) also call for significant improvements.

One area allowing for improvements is the choice of how to operate the transport network. This decision is influenced by the geography, supply of infrastructure, character of the transport demand, and, not least significantly, competition with other traffic modes. Although Cardebring *et al.* (2000) found a wide range of production

* Corresponding author: Johan Woxenius (johwox@chalmers.se)

arrangements in a survey of European intermodal operators, there is evidence for claiming that IRRFT is conventionally produced.

The dominating production paradigm is night-leaps directly between large-scale transshipment terminals using gantry cranes and reach stackers (Bärthel and Woxenius, 2004). Starting with Germany in the 1980s and the Netherlands in the 1990s, European railways have gradually abandoned the wagonload production profile for direct trains (Rutten, 1995 and Wenger, 2001). According to Woxenius and Bärthel (2006), the trend of abandoning true networks for even more direct trains continues. Even CNC, with a long history of operating a hub-and-spoke system with Paris as hub, now focuses on shuttle trains (i.e., trains with a fixed number of wagons operated between two terminals) to and from ports under the new company name, Naviland (Naviland, 2006). The Swedish intermodal market was one of the last to face the transition as CargoNet changed its timetable to include only shuttle trains from January 2006 (CargoNet, 2005). Also, North America has seen a geographical concentration to fewer terminals (Slack, 1990 and Newman and Yano, 2000b).

Reasons for the operational conservatism can be sought in an inferior innovativeness by European railways (see, e.g., Loizides and Tsionas, 2002) and by the fact that freight trains are generally leaving way for passenger trains during the daytime (Racunica and Wynter, 2005). It is acknowledged, however, that it is actually truly demanding to operate complex IRRFT systems (Danielis and Marcucci, 2006). Direct trains offer simple and cost-efficient operations and a very good service on axes with large flows over long distances. The dominance of direct trains, however, implies that major parts of the freight transport market are left to all-road. If IRRFT is to play a major role in transforming the European transport system in a sustainable direction, it also has to work up the markets of relatively short distances or small flows (see, e.g., Bärthel and Woxenius, 2004, Bontekoning, 2006, and Macharis and Verbeke, 2002).

The conservative attitude of IRRFT operators is also disappointing for researchers addressing operational aspects of intermodal transport, who believe that IRRFT can compete for less-than-train flows as well as over shorter distances. There is a substantial supply of published research on alternative transport operation principles as well as wagon and transshipment technologies (for an overview, see Bontekoning *et al.*, 2003). Inventors have also made significant efforts to develop technologies facilitating more advanced traffic operations, but very few of these efforts have been commercially implemented. There are examples of both research and development initiatives that combine transport operation principles and new hardware (e.g., Bärthel and Woxenius, 2004, Bontekoning, 2006, Bontekoning and Priemus, 2004, Bukold, 1996, Kreutzberger, 1999a and b, 2004, Meinert *et al.*, 1998, Trip and Bontekoning, 2002, Woxenius, 1998a and b), but there is a tendency to treat these issues separately.

As an example, Bukold (1994 and 1996) identifies a flexibility gap between traditional production models for IRRFT. Shuttle and direct trains benefit from economies of scale but are subject to certain capacity risks, while old production models based on consolidation by marshalling single wagons or shunting wagon groups do not depend on a stable demand but are too expensive to operate. Bukold argues that new flexible corridor and hub-and-spoke production models can achieve economies of scale at much lower-capacity risk levels.

The purpose of this article is to define options for operating the rail part of an intermodal road-rail freight transport service, deduce how each option affects the

transshipment terminals, and, finally, analyse whether the current supply of transshipment technologies meets these demands.

The discussion circles around six significantly different theoretical designs of transport systems: *direct link*, *corridor*, *hub-and-spoke*, *connected hubs*, *static routes*, and *dynamic routes*. The transport network designs are first presented in a general freight transport setting. The focus is then narrowed to IRRFT by defining how each network design affects the need for transshipment terminal performance. The discussion includes a categorisation of existing intermodal transfer technologies and how these fulfil the performance needs.

2. Transport network designs

From the perspective of the shipper—the ultimate user of freight transport services—and at the abstraction level of material flows, consignments are generally seen to move directly from origin to destination. In reality, however, the directness of transport services depends on the economic and practical viability of consolidation, defined by Bookbinder and Higginson (2002, p. 305) as “an active effort to more efficiently utilize transportation resources.” The phenomenon is also referred to as bundling, simply defined by Macharis *et al.* (2002, p. 1) as “collection of goods to fill a transport unit.” Also, mode-specific terms denote the consolidation activities, primarily in rail freight with shunting and marshalling or the terms classification, grouping, and blocking (Assad, 1980), more frequently used in the USA. The decision whether to consolidate depends on a number of parameters:

- Consignment size – the closer to the full capacity of a transport means, the more direct.
- Transport distance – the shorter, the more direct.
- Transport time demand – the more specific, the more direct.
- Product characteristics – the more specific, the more direct.
- Availability of other goods along the route – the lesser the availability, the more direct.

If consolidating flows is decided on, it is generally done in a systematic way: that is, according to a transport network design. Each design possesses inherent qualities and matches different preconditions in terms of geography, demography, supply of infrastructure and character of the transport demand. The choice of network design is also affected by when correct information about the actual demand is captured (Tjokroamidjojo *et al.*, 2006): i.e., if there is support for centralised decision-making as investigated by Newman and Yano (2000a).

Figure 1 takes the perspective of a transport system operator and presents six alternative transport network designs. A fixed example with ten nodes illustrates the different links used for a transport assignment from the origin (O) to the destination (D). The theory is based on the assumption that a sufficient supply of infrastructure enables direct links between all terminals in the network and that all terminals are capable of serving as origins and destinations as well as transfer points. The network operator can decide whether to operate the links and nodes itself or use services provided by other operators.

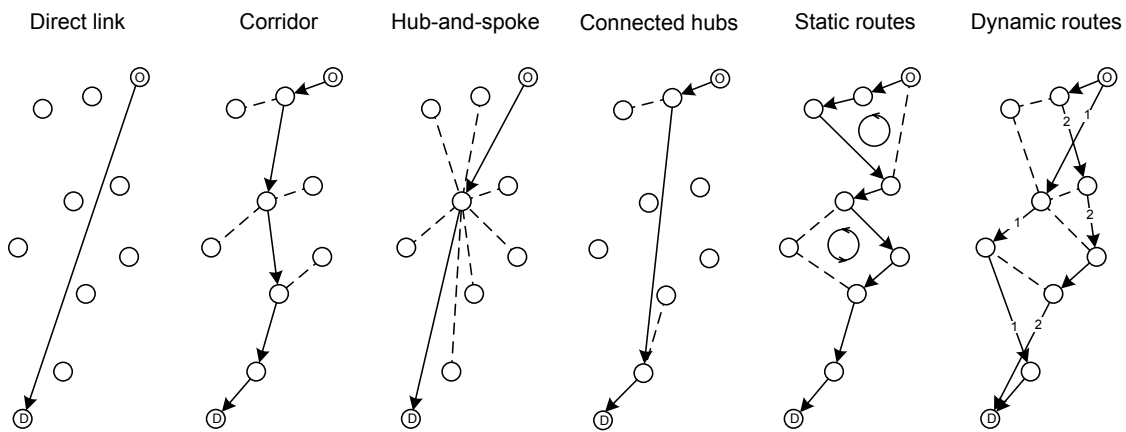


Figure 1: Six options for transport from origin (O) to destination (D) in a network of ten nodes. Dotted lines show related links in the network designs. In “Dynamic routes” two alternative routes are shown. In all other designs the routing is predefined.

In the *direct link* alternative, transport is obviously direct from O to D, and there is no coordination with transport between other O-D pairs. Also, no other nodes are involved.

The transport *corridor* is a design based on using a high-density flow along an artery and short capillary services to nodes off the corridor. The nodes are thus hierarchically ordered, here denoted corridor and satellite nodes, respectively. In this example O is a satellite node, and D is a corridor node.

In the *hub-and-spoke* layout, one node is designated the hub, and all consignments call this node for transfer, even for consignments between adjacent origins and destinations. Terminals are then either hub terminals or spoke terminals. While the operations follow simple principles, the challenge is to coordinate a large number of interdependent transport services.

The *connected hubs* design is another hierarchical layout in which local flows are collected at hubs that in turn are connected to hubs in other regions. It can thus be described as a direct link with regional consolidation. Also here terminals are either of the hub type or the spoke type.

When using the *static routes* design, the transport operator designates a number of links to use on a regular basis. In contrast to the hub-and-spoke layout, several nodes are used as transfer points along the route. Usually only a part of the load is transferred, and the rest stays on the transport means to the next node. The term exchange terminal is here used if only parts of the unit loads are exchanged; terminals with full exchange between trains are referred to as gateways. In Figure 1 O is on a one-way loop, connected by a feeder link to a two-way loop, which in turn is connected to D through another node.

The maximum flexibility is offered by the *dynamic routes* design. Links are designated depending on actual demand, and the network operator can choose many different routes between O and D. Transport services are planned by rules of thumb or optimisation methods. In an extreme form, routes can be changed during transportation.

Transport networks can be of a complex design using several basic designs. Hence, the layout principles are not mutually exclusive. The example of domestic hub-and-spoke systems in combination with other domestic systems making up a connected hubs system has already been mentioned. If the hubs themselves are significant sources and sinks, users of a direct link are then combined with users of a connected hubs design.

Hence, users and operators can perceive networks differently. A forwarder or agent might perceive most freight services as static routes, while the transport operators define their services as any of the other designs except dynamic routes.

It is also conceivable to combine direct links with a hub-and-spoke system. Liu *et al.* (2003) estimate the potential savings in total distance to be 10%, compared to operating according to one of the designs. Also, a system for very large flows can be improved by superposing the direct link, since the freight volume rarely match a discrete number of full transport means between all origins and destinations. If the surplus volume is small, it can be forwarded in a consolidation design.

3. Functional requirements on transshipment terminals

The choice of transport network design affects the level of performance that must be met by the terminals and in turn the choice of transshipment technology. The requirements on the terminals and the transshipment technology for each of the six transport principles described above are analysed in this section.

The analysis here is limited to rail transport and the dots and circles in Figure 1 represent transshipment terminals. Pre- and post-haulage by road is then performed outside the analysed system. Using this demarcation, a shipper or a forwarder with a full unit load is the system's customer. The requirements on terminals are kept more narrowly on technical performance than done by Wiegmans *et al.* (2003-2004) and the economic performance evaluation that Nijkamp *et al.* (2002) like to see, is only briefly included. If nothing else is stated, the rail services analysed are produced overnight, which, according to Trip and Kreutzberger (2002), corresponds to distances between 250 and 750 kms between 20.00 and 04.00. For the larger nations in Europe this implies domestic transport, although Woxenius *et al.* (2004) suggest technologies allowing up to 1250 kms to be covered, however using twelve night hours.

The advantages of direct trains were elaborated in the introduction, as was the need for alternative transport network designs if IRRFT is to compete for O-D pairs characterised by small volumes or short distances. A *short distance* is regarded here as shorter than the 500 kms often mentioned for Europe (Rutten, 1998, van Klink and van den Berg, 1998, and Woxenius, 1998a) and Japan (Saito, 2004) and the 500 miles (appr. 800 kms) mentioned for the USA (Gellman, 1994 and Newman and Yano, 2000b). A *small volume* refers to a volume that is less than economically viable for direct trains. This is admittedly a blunt measure, since economically viable direct trains range from a double-stack train with 100 wagons (Rodrigue, 2007) and a capacity of several hundred TEUs in the USA to a Swedish small-scale shuttle train operated with 20 wagons and a 40 TEU capacity. Nevertheless, for the rest of the article it is assumed that there is a real need for alternative network designs.

The analysis is implicitly based upon seven analytical questions about the performance and operation of the IRRFT system:

- What are the capacity and cost requirements? I.e., should the terminals be high-capacity facilities able to handle several unit loads simultaneously, or are low-cost, low-capacity terminals preferred?

- Is the reliability of the transfer function crucial? I.e. what are the consequences of a technical break-down?
- For how long are trains disposable for transshipment? I.e., can unit loads be transferred during a short stop or throughout the day?
- Can unit loads be transferred directly between road and rail vehicles, or is an intermediate storage area required?
- Must any unit load in the train be accessible, or can they be handled sequentially?
- Are there restrictions in the choice between operating with fixed train sets, shunting of groups of wagons, or marshalling of individual wagons? I.e., are rail wagons or the unit loads transferred between trains along the route?
- Is the network to be technologically open to all unit loads, or is it restricted to one or a few types?

These questions correspond to the evaluation criteria to be used in the analyses and they build the structure of the running text about each transport network principle below.

In a *direct link* design the terminals are either the origin or the destination of trains. Although all unit loads in the train are transhipped, the goods volume handled at the terminals is comparatively limited, thus reducing the capacity requirements on the terminals. The transfer time requirements depend on how long the trains are available for handling. If they stay at the terminal throughout the day, as is currently customary in Europe, this becomes a non-critical parameter. Nevertheless, due to the customers' timing preferences, the terminals are mainly busy in the early morning and the early evening. During those hours rather rapid transshipment is needed and the applied technology must be rather reliable. The same applies when the train set is used as a shuttle with a tight time table or if it is used for additional short day-leaps as presented by Bärthel and Woxenius (2004). A direct links design requires large flows to fill the trains, and the services are thus often technically open to a wide array of unit loads. This includes the heavy and somewhat awkwardly handled semi-trailers with significant effect for dimensioning of terminals and wagons. These require large and comparatively complicated terminals, and the costs must be distributed between large numbers of annual transshipments. Transshipment is often direct between trains and trucks, and the storage needs are thus moderate, but it requires direct accessibility to any unit load. The load plan is important if some customers are promised late hand-in and early pick-up of unit loads at the terminals, when those unit loads should be kept together for efficient operations.

In a system based on the *corridor* design, each train passes several terminals en route, and the transfer times must be kept at a minimum in order not to prolong the total transport time. On the other hand, only a limited number of unit loads is transferred at each terminal, and, hence, these must be economically feasible to operate on a small scale. Reliability of an individual terminal is not crucial since it only affects the unit loads to be transhipped at the terminal. The limited distance between terminals also facilitates trucking of unit loads to adjacent terminals in case of break-down. Since the rail transport service can be between any two terminals along the corridor, each unit load must be accessible for transshipment individually. Since trains are disposable at each terminal only for a limited period of time, storage space for unit loads must be provided, and road vehicles and rail wagons should be able to call terminals independently. Demands for transshipment ability of all types of unit loads might lead to conflicts with the requirement of fast transfer and low fixed costs. Hence, corridor

services are preferably limited to a rather homogenous set of unit loads, often implying that semi-trailers and 40-foot containers are not accepted.

The chief characteristic of the *hub-and-spoke* design is that all unit loads pass through the hub terminal, and it must thus handle an extensive throughput. It is, therefore, of paramount importance that the hub terminal has a large capacity. It also has to be extremely reliable since the whole system is affected if the hub terminal breaks down. The design implies comparatively large detours, and for covering a large area overnight the hub terminal must offer short train stops. Hub terminals can be based on marshalling of wagons or on transhipping unit loads between trains, as is thoroughly investigated by Bontekoning (2006). They are often only designed for rail-rail transshipment, implying that they are actually not intermodal terminals. The load plan and exchange technology must offer accessibility to any unit load, and if all trains combined at the hub are not accessible simultaneously, there is a great need for intermediate storage. Semi-trailers imply no problem if wagons are marshalled but their height and weight complicate the transshipment technology significantly compared to ISO-containers and swap bodies that can be transferred horizontally. The spoke terminals face requirements similar to those of direct link terminals, but they can employ simpler and cheaper technologies if semi-trailers are excluded. The hub-and-spoke design implies long detours and time is consumed in the hub terminal, implying that time requirements are a little higher on the spoke terminals.

Since fewer trains are connected through the hubs in the *connected hubs* design than in a hub-and-spoke design, the capacity requirements are more modest. Two hub operations consume time, but the detours are less significant than for hub-and-spoke so time requirements are rather equal for the spoke terminals. If unit loads are only exchanged between a few trains, groups of wagons can be shunted at terminals, requiring that a strict load plan be followed at the spoke terminals but it facilitates a technically open system accepting a wide variety of unit load types.

In the *static routes* design the train sets traffic routes, along which exchanges between trains are performed on several occasions. The transshipment capacity required is limited, since only a few unit loads are handled at each terminal, except for the gateway terminals. The need for reliability corresponds to the number of unit loads that are handled. Static routes are often used for international transport or when time demands are modest. Short exchange times at gateway terminals are, therefore, a crucial requirement only if a short total transport time is particularly demanded. In order to make this design feasible, it is therefore necessary to restrict the accepted types of unit loads or to use a handling technology that can accommodate all types of unit loads and access them individually. The function of being a gateway terminal between network modules can be combined with that of being an origin or destination of direct link trains. Trains operated in a static route design would then use the terminals during mid-day and through the night and direct link trains during early morning and early evening.

Also, the *dynamic routes* design implies several exchanges between trains. The terminal requirements are similar to static routes, but as operations change between each transport cycle, there is a greater need for operational flexibility. Shunting is then generally difficult, since the complex combination of train services might not allow wagon groups to be formed and kept together. Nevertheless, due to the rigidity of train timetables and limited access to slack track capacity, this is currently no real option for intermodal transport. With future information systems and enhanced availability of tracks, however, dynamic timetables are foreseen for freight trains.

The requirements related to the transport network designs highly depend on the actual context, e.g., in terms of distances, the shippers' time requirements and the competing transport services. Nevertheless, an attempt at a quantitative assessment is presented in Table 1, referring to a general European situation. The scoring in this and the following tables is, admittedly, subjective in its nature, but based upon knowledge acquired during many years of research in the field.

Table 1: Requirements for the terminal function related to transport network design.

<i>Network design</i>	<i>Terminal type</i>							
		<i>High terminal capacity</i>	<i>Rapid transshipment</i>	<i>Low fixed terminal costs</i>	<i>Technical reliability</i>	<i>Detachability road and rail vehicles</i>	<i>Accessibility to any unit load in the train</i>	<i>Types of unit loads accepted</i>
Direct link	End terminal	3	3	1	3	2	2	3
Corridor	End terminal	2	3	3	3	3	2	2
	Intermediate terminal	1	4	4	2	4	5	2
Hub-and-spoke	Hub terminal	5	5	1	5	n.a.	5	2
	Spoke terminal	2	2	3	2	2	2	2
Connected hubs	Hub terminal	3	4	2	5	n.a.	2	4
	Spoke terminal	2	2	3	2	2	2	2
Static routes	Exchange terminal	2	2	3	3	n.a.	4	4
	Gateway	4	4	1	5	n.a.	4	2
Dynamic routes	Exchange terminal	3	3	3	3	n.a.	5	3

The higher the score, the higher the demand, n.a.=not applicable.

The next section is devoted to transshipment technologies and their ability to fulfil the demands of the different transport network options.

4. Supply of transshipment technologies

The rendering in this section departs from the technical features of transshipment technologies and attempts at classifying them into generic families, rather than mentioning brand names of individual technologies. The empirical base for this presentation is an extensive investigation (Woxenius, 1997 and 1998b¹), and reference is only given here to sources not mentioned in those publications. That investigation used brochures, fax enquiries, site visits, interviews and literature to collect information about the technologies. The reports include detailed technical descriptions, pictures and information about the development projects around the technologies.

¹ Both reports are available for free download at: www.mot.chalmers.se/staff/johwox.

Despite the large number of transshipment technologies developed over the last 40 years, intermodal terminals still look the same throughout the world. The term *conventional large-scale transshipment* is used for denoting terminals with a gantry crane overreaching railway tracks and lorry driving lanes complemented with reach-stackers, i.e., large counter-balanced trucks. Terminals are dimensioned for the semi-trailer and thus comparatively large, complicated and costly. The reach-stackers require a hardened surface, adding to investment costs. Any unit load is accessible for direct transfer between train and truck, but terminals often include a storage area. Redundant resources make the transshipment quick and reliable; the effect of a breakdown of a single transfer unit is a temporarily reduced transfer capacity of the terminals rather than total stand still. The technology is also used for train to train transshipment (Martinez *et al.*, 2004).

Marshalling and shunting yards² are examples of *conventional train to train transfer*, that offer large capacity and, at least for shunting, a fairly fast transfer, as investigated by Bontekoning (2006).

Several innovative technologies have been developed for increasing the capacity of train to train transshipment (Alicke, 2002; Nijkamp *et al.*, 2002; Rodrigue, 2007; Rotter, 2004). Most *new-generation large-scale transfer* technologies aim for a high degree of automation, implying significant investment costs. Some technologies reduce complexity by limiting the types of unit loads handled and by using dedicated rail wagons, while others use more incremental improvements of conventional large-scale technologies adapted for several types of unit loads.

Small-scale vertical transshipment technologies implement many of the principles used in conventional transshipment technologies, as they grip the unit loads from above and the transshipment equipment carries the full weight. The complexities range from using standard fork-lift trucks, such as those commercially operated in Japan (Saito *et al.*, 2004) and tested in Sweden (Bärthel and Woxenius, 2004), to fully automated integrated terminals, erected as a prototype in Switzerland (Tuchschnid, 2006). Some technologies limit the range of unit loads accommodated. The Japanese system is designed only for ten foot containers, which is unsuitable for transport of palletized goods (Saito *et al.*, 2004).

Small-scale horizontal transshipment means that only a small vertical lift is needed to accomplish such work as lifting a container or swap body above the container locks in order to make folding the support legs possible. The transshipment equipment itself is often not dimensioned to carry the full weight of the unit loads, and only a small force is needed to tranship them horizontally. Besides the possibility of slimmer dimensioning, the big advantage of horizontal transshipment is transshipping under the overhead contact line. However, this feature is also offered by some vertical transshipment technologies. Nevertheless, this often comes with the drawback of technical complexity, and some technologies depend on the simultaneous presence of rail and road vehicles at the terminals. The ideas of horizontal transshipment are not new – milk containers were transhipped horizontally between flat wagons and lorries in the United Kingdom already in the 1930's.

The *lorry to ground and rail wagons* group of technologies primarily facilitates transshipment of containers between a road vehicle and the ground. Some systems aim for the big market of picking up and distributing ISO-containers around ports, while

² A marshalling yard uses a hill and gravity for sorting individual wagons, whereas a shunting yard forms trains from groups of wagons by use of a locomotive.

others use purpose-built containers to transport scrap iron and building site refuse. Technologies hoisting containers along a tilting frame, or levering them over the end of the lorry, have not proven to be practical for pure inland transportation of general cargo, due to insufficiently secured loads inside the unit. As a bonus, however, they generally allow for horizontal transshipment between lorries and rail wagons fitted with turntables. This technology has also been used for smaller unit loads, utilizing the maximum allowed width on rails as well as on roads. Another set of technologies fold out hydraulic jibs from the side of the road vehicle and lift the container after fastening it with a spreader or a set of chains. These pieces of equipment are usually referred to as self-loading trailers or side-loaders, and are used for transporting a container to the ground, onto another container, lorry or, as is of particular interest to this study, a rail wagon. All technologies handle ISO-containers but at least two brands are designed for also lifting swap bodies.

The principle used when a lorry lifts a swap body from the ground has inspired some rail wagon manufacturers. The results are *self-loading rail wagons*, designed for running underneath and lifting swap bodies standing on their support legs, which are first placed in a row over the tracks by lorry drivers. The rail wagons are unique, but they do not interfere with the use of any conventional system employing vertical handling. One brand is designed as independent wagons which are also suitable for conventional wagonload systems, while others are intended for use in fixed, short-coupled wagon groups or shuttle trains. The swap bodies have to be carefully sequenced according to the order in which they were unloaded, but the actual transshipment is very quick. This principle is also commercially used for moving very large special containers for paper, weighing up to 90 tons, and cassettes for steel transport.

In original *bimodal systems*, semi-trailers are permanently equipped with wheels for both road and rail use. In more recent bimodal systems, reinforced semi-trailers are fitted onto railway bogies by lorry drivers. There are no real rail wagons involved; instead, two semi-trailers are mounted directly onto opposite ends of a 2-axle bogie. The solution saves tare weight, although the reinforced semi-trailers weigh approximately one ton more than standard semi-trailers. In addition, the distance between two adjacent semi-trailers is reduced to about 30 centimetres, with positive effects on train carrying capacity and aerodynamics. The system has limited transfer capacity, and the total transfer time is long, since they are loaded sequentially. Trains cannot be shunted or marshalled, since two semi-trailers share the same bogie.

Many IRRFT designers have been inspired by the roll-on-roll-off (RoRo) principles used in short sea shipping, and have developed wagons for *RoRo-transshipment of road vehicles*. In the USA, with a very generous rail loading gauge, rolling vehicles onto a set of bridged rail wagons over a ramp has long been the dominating intermodal principle, and terminals are still often referred to as “ramps”, since a ramp at wagon height was usually the only tool needed (deBoer, 1992). Rolling highways, where full lorries are driven onto trains, were introduced in Europe in the 1960's. The main purpose for these is to overcome a natural or legislative obstacle and is predominantly used for trans-Alpine crossings. Wagons that can swing out the loading platform for individual loading have also been presented. Common for wagons used in Europe is the complex and costly design of accommodating full lorries within the loading gauge. Semi-trailers can be transhipped independently, but ISO-containers and swap-bodies require a lorry or chassis as an interface to the wagon.

The scoring in Table 2 attempts to summarize the short presentations of the technology categories above. The difference from Table 1 is that Table 2 rates the fulfilment of the requirements rather than demands. The scoring is admittedly subjective but strongly based on the empirical work in the mentioned investigation (Woxenius, 1997 and 1998b). The rendering here must be kept rather short, thus the assessment weigh in some assumptions and facts not mentioned here. One example is that capacity for some of the technologies is easily scaled up by adding handling equipment, but the scoring in Table 2 is based on the capacity for normally fitted terminals. There is also a variety within each class of technologies and the grading reflects the general capabilities of the technologies.

Table 2: Scoring of how well each transshipment technology class fulfils the functional requirements.

<i>Transshipment technology class</i>	<i>Variant</i>	<i>High terminal capacity</i>	<i>Rapid transshipment</i>	<i>Low fixed terminal costs</i>	<i>Technical reliability</i>	<i>Detachability of road and rail vehicles</i>	<i>Accessibility to any unit load in the train</i>	<i>Types of unit loads accepted</i>
Gantry cranes and reach-stackers		4	4	2	4	4	4	5
Conventional train to train transfer	Shunting	5	4	4	5	n.a.	2	5
	Marshalling	4	3	3	4	n.a.	5	5
New-generation large-scale transfer		5	5	1	4	n.a.	5	3
Small-scale vertical transshipment	Direct	2	3	5	4	1	5	2
	Indirect	2	4	5	4	5	5	3
Small-scale horizontal transshipment	Direct	2	3	5	3	1	5	2
	Indirect	2	4	5	3	5	5	3
Lorry to ground and rail wagons		1	1	5	4	1	4	2
Self-loading rail wagons		3	5	4	3	5	1	1
Bimodal systems		1	1	4	3	3	1	1
RoRo-transshipment	Rolling highway	4	5	4	4	1	1	4
	Swinging platform	4	5	4	4	1	5	4

The higher the score, the higher the fulfilment of requirements n.a.=not applicable.

5. Matching the demand and supply of transshipment technologies

The scoring in Table 1 and 2 provides the basis for an analytical matching of requirements set by transport network designs according to what different technologies can offer. The matching, however, is not a mathematical exercise with an undisputable result that is valid in all contexts. Hence, this analysis is an attempt to generally evaluate if the supply of technologies allows prospective intermodal operators to choose from the current supply, or if new technologies must be developed. It is not intended as a recommendation for which technology is best suited for a certain task; the issue is simply too contextual for that.

The table in the appendix combines the grading in Table 1 and Table 2. It then appears how well each class of technology matches the demands for each transport network design and for how many criteria the technology does not fully fulfil the demands. The information in the appendix is condensed into Table 3, which show how many of the requirements that are violated for each transfer technology. Some features are not negotiable, and if they are not fulfilled, the technology is marked as disqualified. Frequency of non-fulfilment is, admittedly, a blunt measure. Nevertheless, since the scoring of technologies is highly contextual, further analysis requires specification of the case at hand, which in turn opens up for more detailed methodology. For example, Woxenius (1997 and 1998a) uses a weight-criterion analysis method to rank technologies for small-scale IRRFT and Fowkes *et al.* (1991) use a stated preference methodology for the UK market for intermodal technologies.

Table 3: Matching of functional requirement and available transfer technologies.

	<i>Gantry cranes and reach-stackers</i>	<i>Conventional train to train transfer, shunting</i>	<i>Conventional train to train transfer, marshalling</i>	<i>New-generation large-scale transfer</i>	<i>Small-scale vertical transshipment, direct</i>	<i>Small-scale vertical transshipment, indirect</i>	<i>Small-scale horizontal transshipment, direct</i>	<i>Small-scale horizontal transshipment, indirect</i>	<i>Lorry to ground and rail wagons</i>	<i>Self-loading rail wagons</i>	<i>Bimodal systems</i>	<i>RoRo-transshipment, rolling highway</i>	<i>RoRo-transshipment, swinging platform</i>
Direct link	0	-	-	-	-	-	-	-	-	2	4	2	1
Corridor, end terminal	1	-	-	-	-	-	-	-	2	-	-	-	-
Corridor, intermediate terminal	-	-	-	-	2	0	2	0	-	-	-	-	-
Hub-and-spoke, hub terminal	4	2	2	1	-	-	-	-	-	-	-	-	-
Hub-and-spoke, spoke terminal	1	-	-	-	1	0	1	0	-	2	-	-	-
Connected hubs, hub terminal	1	0	2	3	-	-	-	-	-	-	-	-	-
Connected hubs, spoke terminal	1	-	-	-	1	0	1	0	-	2	-	-	-
Static routes, exchange terminal	1	-	0	2	-	-	-	-	-	-	-	-	0
Static routes, gateway	1	1	2	1	-	-	-	-	-	-	-	-	-
Dynamic routes, exchange terminal	2	1	0	2	-	1	-	1	-	-	-	-	0

Numbers refer to the frequency of non-fulfilled demands; - =disqualified.

Conventional large-scale transshipment and RoRo-transshipment fulfil all demands of a *direct links* design. The latter, however, repeatedly moves costly and heavy road vehicles, and somewhat violates the basic principle of intermodality. Bimodal systems and self-loading rail wagons are primarily intended for direct links, but are limited in the unit load scope, and as such, are only suitable for specialized applications kept under one management.

Both vertical and horizontal small-scale technologies fulfil the demands set by a *corridor* design, although indirect transshipment is preferable for efficient operation. Also, lorry to ground or rail wagon techniques are conceivable, but the direct transshipment can imply certain operational handicaps. RoRo-transshipment, with swinging platforms, fulfils most demands, but shares the tare weight disadvantages with rolling highway. The end terminals can be served by the above technologies, but can also be served by conventional terminals, if the volumes of different services are added.

The hub terminal is obviously critical for a *hub-and-spoke* design. In competition for shorter distances, the new-generation large-scale technologies best match the demands, although conventional marshalling is conceivable. Spoke terminals are less critical and gantry cranes and reach-stackers are effective, but cost is a concern if there are many terminals in the system not used along with other services.

New-generation technologies can also be used for the hub terminals in a *connected hubs* design, but fewer combinations of trains allow for shunting, lower volume for conventional terminals and indirect small-scale technologies. The demand and fulfilment of spoke terminals correspond roughly to that of the hub-and-spoke design.

The exchange terminals in *static routes* are like hub terminals in connected hubs, but shunting is excluded. The gateways resemble hub terminals in the hub-and-spoke design. The analysis for *allocated routes* generally corresponds to that for static routes.

Since at least one technology fulfils all demands, or all but one demand, for each terminal function, it can be stated that there is a good match between demand and supply of terminal technologies.

6. Conclusions and implications

Some of the developed transfer technologies are purposely and consciously developed addressing certain terminal functions required for operating different transport network designs, while others are proposed by inventors on a “solves-all-problems” basis. Other developers seem to not have a clear idea about which network the technology would best fit. Still, this study shows that most proposed technical solutions can find an application, although lorry to ground or rail wagon, bimodal systems and the rolling highway are only found suitable for narrowly focused services.

The direct link, corridor, hub-and-spoke and connected hubs network operation principles are commonly applied in transport systems and exhaustively researched in scientific literature, although denoted differently by authors. The static and dynamic routes, however, are addressed less often and might attract further attention from *researchers*.

A signal to *manufacturers and inventors* is that a wide variety of transshipment technologies have already been developed. Admittedly, new and refined technologies can prosper, but they can also build on earlier efforts and experiences, rather than trying to break through untilled soil.

Most of the scoring in this study is based on what inventors and manufacturers promise in terms of technical capabilities; many technologies are never commercially tested or even become a prototype. The technical challenge of moving big boxes is insuperable; hence, inventors and manufacturers are given the benefit of the doubt that they can deliver the offered technical capabilities. The same does not apply to costs of

investments and operations, since they depend highly on the number of sold systems and the context in which the technologies are implemented. Here, most manufacturers still have to prove themselves in real operation and in their ability to find a sufficient number of customers. Suspicion is not easily diverted from some inventors that the business concept is rather to attract public development funds than really working up a market. One suggestion to *agencies funding research* is to prioritize the funding of analyses investigating why the developed systems are generally not implemented before they fund further technology development.

The implication for *the transport industry* is that the relatively positive evaluation of the supply of transshipment technologies can encourage intermodal operators to develop and implement new ways of operating the rail part of their services. Although gantry cranes and reach-stackers scored very well, there are realistic alternatives. European freight rail transport is hampered by insufficient interoperability in border-crossing traffic and in some cases even domestically. Technical compatibility between intermodal systems should then focus on the exchanged resources in terms of unit loads and in some cases rail wagons. Compatibility is not crucial for the transshipment technologies that might be well-adapted to the special requirements given by the used network principle.

A message to *transport policy-makers* is that efficient operation of some of the transport network designs requires track access during daytime hours, and that the dedicated freight network, as described by the European Commission (2001) and analyzed by Reynaud and Jiang (2001), is badly needed. Since significant time and funds will be needed, giving higher priority to freight on existing tracks is an intermediate means that can be implemented without significant delay. Applying non-direct transport layouts also facilitates execution of efficient transport when direct infrastructure is lacking. Hence, there are tradeoffs between heavy initial investments, higher operational costs, environmental degradation when building infrastructures (van der Heijden, 2006), and operating transport systems. A less strict division between public and private funding might then be economically sound. For example, subsidizing more expensive low-built rail wagons would save significant costs that would be incurred by extending the UK loading gauge (The Piggyback Consortium, 1994).

Until recent years, the markets for intermodal transportation in Europe have been predominately national, resulting in short transport distances and limited market sizes. This has led to the employment of standardized systems, or systems for all types of unit loads, since a large portion of the available market has to be covered by a single system. The current trend is working towards a true intra-European transport market. This will foster specialized systems targeting only a market niche. We may foresee a period of "trial and error" for a number of new solutions before one or more technologies reach the developmental stage where they can seriously challenge the existing production paradigm of gantry cranes and reach-stackers.

References

- Alicke, K. (2002) "Modeling and optimization of the intermodal terminal Mega Hub." *OR Spectrum*, 24, 1, pp. 1-17.
- Assad, A. A. (1980) "Models for rail transportation." *Transportation Research A*, 14, 3, pp. 205-220.
- Bärthel, F. and Woxenius, J. (2004) "Developing intermodal transport for small flows over short distances." *Transportation Planning and Technology* 27, 5, pp. 403-424.
- Bontekoning, Y. (2006) Hub exchange operations in intermodal hub-and-spoke networks, *Ph.D. thesis*, Delft University of Technology, Delft.
- Bontekoning, Y. and Priemus, H. (2004) "Breakthrough innovations in intermodal freight transport." *Transportation Planning and Technology*, 27, 5, pp. 335-345.
- Bontekoning, Y. M., Macharis, C. and Trip, J. J. (2003) "Is a new applied transportation research field emerging? – A review of intermodal rail-truck freight transport literature." *Transportation Research Part A: Policy and Practice*, 38/1:1-34.
- Bookbinder, J. H. and Higginson, J. K. (2002) "Probabilistic modeling of freight consolidation by private carriage." *Transportation Research Part E: Logistics and Transportation Review*, 38, 5, pp. 305-318.
- Brown, T. A. and Hatch, A. B. (2002) The value of rail intermodal to the US economy, www.aar.org/pubcommon/documents/govt/brown.pdf, visited 2006-07-02.
- Bukold, S. (1994) "New Production models for combined transport", *WCRR '94 - Proceedings of the World Congress on Railway Research*, Paris, 14-16 November, pp. 133-138.
- Bukold, S. (1996) Kombiniertes Verkehr Schiene/Strasse in Europa – Eine vergleichende Studie zur Transformation von Gütertransportsystemen, *Ph.D. Thesis*, Technischen Universität Hamburg-Harburg, Peter Lang Verlag, Frankfurt am Main. In German.
- Cardebring, P. W., Fiedler, R., Reynaud, C. and Weaver, P. (2000) *Summary report of the IQ project*, TFK, Hamburg.
- CargoNet (2005) "Färre långtradare på vägarna (Fewer trucks on the road)", Press release 2005-12-13. In Swedish.
- Danielis, R. and Marcucci, E. (2006) "Attribute cut-offs in freight service selection." *In Press, Transportation Research Part E: Logistics and Transportation Review*.
- Danielis, R., Marcucci, E. and Rotaris, L. (2005) "Logistics managers' stated preferences for freight service attributes." *Transportation Research Part E: Logistics and Transportation Review*, 14, 3, pp. 201-215.
- DeBoer, D. J. (1992) *Piggyback and Containers – A History of Rail Intermodal on America's Steel Highway*, Golden West Books, San Marino, Ca.
- European Commission (2001) *White paper. European Transport Policy for 2010: time to decide*, Office for official publications of the European Communities, Luxembourg.
- European Commission (2006) *Keep Europe moving - Sustainable mobility for our continent*, Mid-term review of the European Commission's 2001 Transport White Paper, Office for official publications of the European Communities, Luxembourg.
- Fowkes, A. S., Nash, C. A. and Tweddle, G. (1991) "Investigating the market for inter-modal freight technologies." *Transportation Research A*, 25, 4, pp. 161-172.
- Gellman, A. J. (1994) "An Assessment of Intermodal Transport in North America", *Swedish Transport Research Conference*, Linköping, 12-13 January.
- Klink, H. A. and van den Berg, G. (1998) "Gateways and Intermodalism." *Journal of Transport Geography*, 6, 1 pp. 1-9.
- Konings, J. and Kreutzberger, E. (2001) *Towards a Quality Leap in Intermodal Freight Transport, Theoretical Notions and Practical Perspectives in Europe*, TRAIL Research School, The Netherlands: Delft University Press.
- Kreutzberger, E. (1999a) *Innovative networks and new-generation terminals for intermodal transport*, the 5th Trail PhD Congress, TRAIL Research School, Delft.
- Kreutzberger, E. (1999b) *Promising innovative intermodal networks with new-generation terminals*, Termet, Deliverable 7, TU Delft, Delft.
- Kreutzberger, E. (2004) "The shipper's perspective on distance and time and the operator (intermodal goods transport) response." *European Transport*, 25-26, pp. 99-113.
- Liu, J., Li, C-L. and Chan, C-Y. (2003) "Mixed truck delivery systems with both hub-and-spoke and direct shipment." *Transportation Research Part E: Logistics and Transportation Review*, 39, 4, pp. 325-339.

- Loizides, J. and Tsonas, E. G. (2002) "Productivity Growth in European Railways: a new Approach." *Transportation Research Part A: Policy and Practice*, 36, 10, 633-644.
- Macharis, C. and Verbeke, A. (2002) "Location Analysis for Belgian Intermodal Terminals: a Tool for Achieving Sustainable Intermodal Transport in Belgium." In: Notteboom, T. (Ed.) *Current Issues in Port Logistics and Intermodality*, Garant, Antwerp.
- Macharis, C., Vereecken, L. and Verbeke, A. (2002) "The possibilities of bundling in Belgium", *Congress Freight Transport Automation and Multimodality*, 23-24 May, Delft.
- Martinez, F. M., Gutierrez, I. G., Oliveira, A. O. and Bedia, L. M. A. (2004) "Gantry crane operations to transfer containers between trains: a simulation study of a Spanish terminal." *Transportation Planning and Technology*, 27, 4, pp. 261-284.
- Meinert, T. S., Youngblood, A. D., Taylor, G. D., and Taha, H. A. (1998) *Simulation of railway component in intermodal transport*, Mack-Blackwell Transportation Center, University of Arkansas, Fayetteville, Final Report.
- Naviland (2006) Naviland Cargo Network, www.cnc-transport.com, accessed at 2006-09-03.
- Newman, A. M. and Yano, C. A. (2000a) "Centralized and decentralized train scheduling for intermodal operations." *IEE Transactions*, 32, 8, pp. 743-754.
- Newman, A. M. and Yano, C. A. (2000b) "Scheduling Direct and Indirect Trains and Containers in an Intermodal Setting." *Transportation Science*, 34, 3, pp. 256-270.
- Nijkamp, P., Masurel, E. and Bergering, C. (2002) "Economic Feasibility of New Generation Terminals." *European Transport*, 22, pp. 3-6.
- Racunica, I. and Wynter, L. (2005) "Optimal location of intermodal freight hubs." *Transportation Research Part B: Methodological*, 39, 5, pp. 453-477.
- Reynaud, C. and Jiang, F. (2001) "The concept of dedicated 'Trans-European Network' for freight, a strategical rail network", *World Conference on Transport Research*, 2001, 23-27 July, Seoul.
- Rodrigue, J-P. (2007) "The Thruport Concept and Transmodal Rail Freight Distribution in North America." Submitted for publication to *Journal of Transport Geography*.
- Rotter, H. (2004) "New operating concepts for intermodal transport: the mega hub in Hanover/Lehrte in Germany", *Transportation Planning and Technology*, 27, 5, pp. 347-365.
- Rutten, B. C. M. (1995) On Medium Distance Intermodal Rail Transport, *Ph.D. thesis*, Delft University of Technology, Delft.
- Rutten, B. C. M. (1998) "The design of a terminal network for intermodal transport", *Transport Logistics*, 1, 4, pp. 279-298.
- Saito, M., Yano, Y. and Hayashi, K. (2004) "Potential for modal shift in business strategies of Japanese shippers", *10th World Conference on Transport Research*, Istanbul, 4-8 July. Published in "Revised CD/Selected proceedings".
- Slack, B. (1990) "Intermodal transportation in North America and the development of inland load centres." *Professional Geographer*, 42, 1, pp. 72-83.
- The Piggyback Consortium (1994) *The feasibility of a piggyback network for the British Isles*, MDS Transmodal and Servant Transport Consultants, investigation sponsored by the European Commission DGVII under the PACT (Pilot Actions for Combined Transport) programme.
- Tjokroamidjojo, D., Kutanoglu, E. and Taylor, D. G. (2006) "Quantifying the value of advance load information in truckload trucking." *Transportation Research Part E: Logistics and Transportation Review*, 42, 4, pp. 340-357.
- Trip, J. and Kreutzberger, E. (2002) *Complex Bundling Networks and New-Generation Terminals: a synthesis*, TRAIL Reports in Transportation Planning R02/01, Delft University Press, Delft.
- Trip, J. and Bontekoning, Y. (2002) "Integration of small freight flows in the intermodal transport system." *Journal of Transport Geography* 10, 3, pp. 221-229.
- Tuchs Schmid (2006) *NETHS - Neuweiler Tuchs Schmid Horizontal-System*, www.tuchs Schmid.ch/kombiverkehr/neths.html, accessed 2006-09-22.
- van der Heijden, H-A. (2006) "Multi-level Environmentalism and the European Union: The Case of Trans-European Transport Networks." *International Journal of Urban and Regional Research*, 30, 1, pp. 23-37.
- Wenger, H. (2001) *UIRR 30 Jahre – Geschichte der UIRR und des Kombinierten Güterverkehrs Schiene-Strasse in Europa 1970-2000*, UIRR, Brussels. In German.
- Wiegman, B., Rietveld, P. and Nijkamp, P. (2003-2004) "Quality of terminal services." *European Transport/Trasporti Europei*, 25/26:61-80.
- Woxenius, J. (1997) *Inventory of Transshipment Technologies in Intermodal Transport*, International Road Transport Union (IRU), Geneva.

- Woxenius, J. (1998a) Development of Small-scale Intermodal Freight Transportation in a Systems Context, *Ph.D. thesis*, Chalmers University of Technology, Göteborg. available for download at www.mot.chalmers.se/staff/johwox.
- Woxenius, J. (1998b) Intermodal Transshipment Technologies – An Overview, *Detached appendix to the Ph.D. thesis above*, Chalmers University of Technology, Göteborg. available for download at www.mot.chalmers.se/staff/johwox.
- Woxenius, J. and Bärthel, F. (2006) Intermodal Road-Rail Transport in the European Union, Forthcoming in: Konings, R., H. Priemus & P. Nijkamp (eds.), *The Future of Intermodal Freight Transport, Concepts, Design and Implementation*, Edward Elgar Publishing, Cheltenham, UK.
- Woxenius, J., Andersson, E., Bärthel, F., Troche, G., Sommar, R. Trouvè, J. (2004) “A Swedish intermodal transport service based on line-trains serving freight forwarders”, *Selected proceedings of the 10th World Conference on Transport Research*, Istanbul, 4-8 July.

Appendix: Matching terminal types with relevant transfer technologies.

	<i>High terminal capacity</i>	<i>Rapid transshipment</i>	<i>Low fixed terminal costs</i>	<i>Technical reliability</i>	<i>Detachability road and rail vehicles</i>	<i>Accessibility to any unit load in the train</i>	<i>Types of unit loads accepted</i>	<i>Number of non-fulfilled demands</i>
<i>Direct link, end terminal</i>	3	3	1	3	2	2	3	
Gantry cranes and reach-stackers	4	4	2	4	4	4	5	0
RoRo-transshipment, swinging platform	4	5	4	4	<u>1</u>	5	4	1
Self-loading rail wagons	3	5	4	3	5	<u>1</u>	<u>1</u>	2
RoRo-transshipment, rolling highway	4	5	4	4	<u>1</u>	<u>1</u>	4	2
Bimodal systems	<u>1</u>	<u>1</u>	4	3	3	<u>1</u>	<u>1</u>	4
<i>Corridor, end terminal</i>	2	3	3	3	3	2	2	
Gantry cranes and reach-stackers	4	4	<u>2</u>	4	4	4	5	1
Lorry to ground and rail wagons	<u>1</u>	<u>1</u>	5	4	<u>1</u>	4	2	3
<i>Corridor, intermediate terminal</i>	1	4	4	2	4	5	2	
Small-scale vertical transshipment, indirect	2	4	4	4	5	5	3	0
Small-scale horizontal transshipment, indirect	2	4	4	3	5	5	3	0
Small-scale vertical transshipment, direct	2	<u>3</u>	5	4	<u>1</u>	5	2	2
Small-scale horizontal transshipment, direct	2	<u>3</u>	5	3	<u>1</u>	5	2	2
<i>Hub-and-spoke, hub terminal</i>	5	5	1	5	2	5	2	
New-generation large-scale transfer	5	5	1	<u>4</u>	n.a.	5	3	1
Conventional train-train transfer, marshalling	<u>4</u>	3	3	<u>4</u>	n.a.	5	5	2
Conventional train-train transfer, shunting	5	<u>4</u>	4	5	n.a.	<u>2</u>	5	2
Gantry cranes and reach-stackers	<u>4</u>	<u>4</u>	2	<u>4</u>	4	<u>4</u>	5	4
<i>Hub-and-spoke, spoke terminal</i>	2	2	3	2	2	2	2	
Small-scale vertical transshipment, indirect	2	2	5	4	5	5	3	0
Small-scale horizontal transshipment, indirect	2	2	5	3	5	5	3	0
Gantry cranes and reach-stackers	4	4	<u>2</u>	4	4	4	5	1
Small-scale vertical transshipment, direct	2	2	5	4	<u>1</u>	5	2	1
Small-scale horizontal transshipment, direct	2	2	5	3	<u>1</u>	5	2	1
Self-loading rail wagons	3	5	4	3	5	<u>1</u>	<u>1</u>	2
<i>Connected hubs, hub terminal</i>	3	4	2	5	n.a.	2	4	
Conventional train-train transfer, shunting	5	4	4	5	n.a.	2	5	0
Gantry cranes and reach-stackers	4	4	2	<u>4</u>	4	4	5	1
Conventional train-train transfer, marshalling	4	<u>3</u>	3	<u>4</u>	n.a.	5	5	2
New-generation large-scale transfer	5	5	<u>1</u>	4	n.a.	4	<u>3</u>	3

<i>Connected hubs, spoke terminal</i>	2	2	3	2	2	2	2	
Small-scale vertical transshipment, indirect	2	2	5	4	5	5	3	0
Small-scale horizontal transshipment, indirect	2	2	5	3	5	5	3	0
Gantry cranes and reach-stackers	4	4	<u>2</u>	4	4	4	5	1
Small-scale vertical transshipment, direct	2	2	5	4	<u>1</u>	5	2	1
Small-scale horizontal transshipment, direct	2	2	5	3	<u>1</u>	5	2	1
Self-loading rail wagons	3	5	4	3	5	<u>1</u>	<u>1</u>	2
<i>Static routes, exchange terminal</i>	2	2	3	3	n.a.	4	4	
Conventional train-train transfer, marshalling	4	3	3	4	n.a.	5	5	0
RoRo-transshipment, swinging platform	4	5	4	4	1	5	4	0
Gantry cranes and reach-stackers	4	4	<u>2</u>	4	4	4	5	1
New-generation large-scale transfer	5	5	<u>1</u>	4	n.a.	4	<u>3</u>	2
<i>Static routes, gateway</i>	4	4	1	5	n.a.	4	2	
Gantry cranes and reach-stackers	4	4	2	<u>4</u>	4	4	5	1
Conventional train-train transfer, shunting	5	4	4	5	n.a.	<u>2</u>	5	1
New-generation large-scale transfer	5	5	1	<u>4</u>	n.a.	4	3	1
Conventional train-train transfer, marshalling	4	<u>3</u>	3	<u>4</u>	n.a.	5	5	2
<i>Dynamic routes, exchange terminal</i>	3	3	3	3	n.a.	5	3	
Conventional train-train transfer, marshalling	4	3	3	4	n.a.	5	5	0
RoRo-transshipment, swinging platform	4	5	4	4	1	5	4	0
Conventional train-train transfer, shunting	5	4	4	5	n.a.	<u>2</u>	5	1
Small-scale vertical transshipment, indirect	<u>2</u>	2	5	4	5	5	3	1
Small-scale horizontal transshipment, indirect	<u>2</u>	2	5	3	5	5	3	1
New-generation large-scale transfer	5	5	<u>1</u>	4	n.a.	<u>4</u>	3	2
Gantry cranes and reach-stackers	4	4	<u>2</u>	4	4	<u>4</u>	5	2

Scores: The higher the score, the better the demand/fulfilment, n.a.=not applicable. Fulfilment scores below the requirements are underscored.



Evaluating the potential for urban consolidation centres

Michael Browne^{1*}, Allan Woodburn¹, Julian Allen¹

¹ Transport Studies Group, University of Westminster, London

Abstract

This paper focuses upon the potential for Urban Consolidation Centres (UCCs) to alleviate local environmental and traffic problems within urban areas. An international literature review was undertaken, interviews were held with a range of relevant parties, and an evaluation framework was developed. In previous work a narrow focus has typically been adopted and no examples of thorough scheme evaluation were found. A particular concern discussed in the paper is the identification and subsequent allocation of the costs and benefits of implementing and operating a UCC. Lessons learned from existing and attempted UCCs are then presented, and a number of themes and location types that point to successful implementation are identified. The likelihood of a UCC being successful depends considerably upon the legal and planning frameworks in the locality or country involved.

Keywords: Freight consolidation; Urban transport; Transport policy; Freight scheme evaluation.

Introduction

This paper summarises key elements of the findings of a research project on Urban Consolidation Centres (UCCs) funded by the Department for Transport (DfT) and carried out by the University of Westminster (2005). The project essentially consisted of a scoping study that aimed to identify the potential for the development of UCCs that have as their principal objective the alleviation of local environmental and traffic concerns in urban areas. It was also concerned with the wider business and supply chain issues associated with the use of such centres.

Broadly speaking the key purpose of UCCs is the avoidance of the need for goods vehicles to deliver part loads into urban areas (be that a city centre, an entire town or a specific site such as a shopping centre). This objective can be achieved by providing facilities in or close to the urban area whereby deliveries (retail, office, residential or construction) can be consolidated for subsequent delivery into the target area in an appropriate vehicle with a high level of load utilisation. A range of other value-added

* Corresponding author: Michael Browne (m.browne@westminster.ac.uk)

logistics and retail services can also be provided at the UCC. Much of the older literature on transshipment centres (and similar public sector driven initiatives) can be said to focus on “the traditional break-bulk form of transshipment being implemented at an urban level on a communal, shared-user basis”, with much attention devoted to the use of small vehicles for the urban distribution (see for example McKinnon, 1998a and 1998b; Battilana and Hawthorne, 1976; GLC London Freight Conference, 1975; Lorries and the Environment Committee, 1976; Nathaniel Litchfield and Partners, 1976). In contrast, much of the literature since the late-1990s talks of UCCs, which are generally seen to be more flexible and involve break-bulk, transshipment and groupage, often with a focus on maximising vehicle loads, thereby avoiding the need for vehicles to deliver part loads into urban centres, and with a far greater role for the private sector (see for example Department for Transport, 2002; Dunning, 1997; Exel, 2004; Hesse, 2004; Institut für Seeverkehrswirtschaft und Logistik, 2005; Köhler. and Groke, 2003).

This paper addresses two key questions:

- How should the impacts of UCCs be evaluated?
- In what circumstances are UCCs likely to succeed and what are the main barriers to successful implementation?

UCCs have been subject to much discussion and the occasional trial, but to date there has been a lack of evidence-based information upon which potential operators, be they logistics providers or local authorities, can base decisions as to the viability of such initiatives. A review of the literature found that no clear and detailed methodology has been developed for, or applied to, the evaluation of UCCs: a number of schemes have been evaluated to some extent, but these evaluations have tended to be fairly ad hoc and generally have been limited in scope. This paper presents a framework by which the range of UCC types can be appraised, through the identification of a clear and consistent method of evaluation. First of all, the key elements of the evaluation process are discussed. This is followed by a section highlighting the importance of ensuring that the distribution of the costs and benefits associated with UCCs are taken into account. The paper concludes with an analysis of the lessons learned from existing and attempted UCC schemes.

Study approach

The study consisted of three main elements. First, a comprehensive literature review was conducted. This covered academic journals, public sector documents and industry publications from the United Kingdom and elsewhere. Specific consolidation centre research, trials and schemes that have been referred to in the literature were also identified and an attempt made to record consistent data relating to each of them. The review provided an important input to the evaluation task. The majority of the literature came from France, Germany, Netherlands, Sweden, the United Kingdom and Japan, and a more detailed discussion can be found in the full project report (University of Westminster, 2005). It was clear from the literature review that evaluating UCCs is far from straightforward, though a number of important measures were identified. In

previous work, in each of the countries where UCC evaluation has taken place, a narrow focus has typically been adopted and no examples of thorough scheme evaluation were found.

Second, interviews were held with a range of relevant parties, selected from: freight transport and logistics operators (both those currently involved in different types of consolidation schemes and those not), receivers and shippers of goods in urban areas, local government/policy makers with transport responsibilities. Issues addressed during the interviews with the sample of respondents included their views about the appropriateness of different types of consolidation systems with respect to factors such as product types, supply chain organisation, type of receiver, geography/location of delivery point, suitable types of vehicle, appropriate traffic regulations / restrictions, and localities suitable for UCCs. Respondents' views were sought on the likely effects of consolidation schemes on: supply chain operations (including efficiency and security), supply chain costs, transport intensity, and environmental impacts.

Finally, an evaluation framework was developed. This sought to review the evaluation approach applied in urban consolidation research described in the literature, together with consideration of how this evaluation work should ideally be carried out, as well as to indicate the conditions in which UCCs are likely to be most effective. This element forms the focus of this paper, and pulls together the key findings from the first two elements.

Key elements of the evaluation framework

The objectives of a specific consolidation centre may have an important bearing on how to evaluate the success of the UCC. The objectives could vary in the following ways:

- They could be based on economic efficiency or environmental/social factors (or both)
- They could be based on achieving supply chain-wide improvements or improvements in a localised geographical area (or both)
- They could aim to bring about greater consolidation of goods destined for the urban area or to tranship these goods onto smaller, lighter, cleaner goods vehicles for final delivery (or both)

Given the potentially differing objectives, it may well be the case that there is no single approach that can adequately evaluate all of the potential UCC types and applications. However, the framework identified in this paper attempts to be comprehensive so as to allow the evaluation of a scheme against multiple objectives. In practice, schemes with a more specific objective may not require all of the framework elements that have been proposed.

It was evident from the review of the literature that the evaluation of a UCC is far from straightforward. In this section, the most important aspects that should be part of any such evaluation are set out. Ten different measures were identified that have typically been used in previous evaluations:

- changes in the number of vehicle trips
- changes in the number of vehicle kilometres
- changes in the number of vehicles
- changes in travel time
- goods delivered per delivery point
- vehicle load factor
- changes in parking time and frequency
- changes in total fuel consumed
- changes in vehicle emissions
- changes in operating costs

While each of these measures may be important, dependent upon the UCCs objectives, they in themselves are not sufficiently tightly defined to be able to provide a meaningful evaluation. In previous evaluations, there appears to have been both a lack of consistency in comparing the “before” and “after” situations and a lack of clarity in identifying the precise boundaries of the parts of the supply chain being analysed. Many results have been presented in a relatively abstract way, with little quantification of the overall changes caused by a UCC across an urban area and/or along a supply chain. In order to achieve a more comprehensive evaluation of a UCC development it is desirable to identify and measure both broad indicators such as the impact on upstream logistics activities as well as the more specific indicators such as detailed changes in vehicle operations (see Table 1).

It is evident that the ease of data collection will vary significantly between the different indicators. Some are fairly localised in their impacts and are relatively easy to obtain data for, while others are significantly greater in scope and are more problematic from a data collection perspective as a consequence. Some general comments about the evaluation of these measures have arisen from the analysis of the previous literature and the discussions with relevant parties. These include:

- Deciding upon the boundaries of the evaluation process – this should ideally be as far-ranging as possible, considering the impacts on all supply chain activities affected by the UCC, but may practically be limited by the resources and timescale available. Previous analyses of the impacts of UCCs have tended to focus only on the very specific changes in goods movements as a result of new distribution patterns between the UCC and the final delivery point(s), while ignoring any wider changes.
- The importance of collecting “before” data - as with any evaluation of this kind, it is important to clearly establish the base situation (i.e. prior to the introduction of the UCC) so that the impacts of the consolidation centre can be measured.
- Standardisation of data collection between the “before” and “after” phases, to allow meaningful evaluation to be carried out.
- Undertaking the evaluation in as controlled an environment as possible, though this often is not practical. However, it is difficult to isolate and establish the impacts of a UCC if it is introduced at the same time as other measures such as vehicle access restrictions or changes in the nature of retailing activity. In reality, UCCs are perhaps more likely to succeed when introduced as part of a package of measures, so there may be a conflict between the desire to maximise

the benefits and the need to evaluate thoroughly the specific impacts of the UCC.

Table 1: Variables and Indicators to be Included in a Comprehensive UCC Evaluation.

<i>Broad Indicators</i>	<i>Narrow Indicators</i>
<p>1) Logistics and supply chain changes</p> <p>Potential to improve efficiency at receiving premises due to fewer, more reliable deliveries Potential to improve efficiency/sales at receiving premises due to stockholding & value added services at UCC On-time delivery (punctuality) Change in order cycle time (i.e. time between despatch and receipt) Effect of greater reliability on stockholding strategy Change in total handling costs for goods passing through UCC Change in total freight transport costs for goods passing through UCC</p> <p>2) Social/environmental impact of UCC vehicle activity</p> <p><u>Fossil fuel consumption</u> Fuel consumption in urban area compared with previous consumption to make same deliveries Fuel consumption outside urban area compared with previous consumption to make same deliveries All Fossil fuel consumption by goods vehicles in urban area (i.e. in order to consider overall impact of change)</p> <p><u>Emissions</u> Emissions in urban area compared with previous emissions to make same deliveries Emissions outside urban area compared with previous emissions to make same deliveries All emissions by goods vehicles in urban area (i.e. in order to consider overall impact of change)</p> <p><u>Congestion</u> Contribution of UCC-related goods vehicle trips to traffic congestion inside urban area Contribution of UCC-related goods vehicle trips to traffic congestion outside urban area Existing or potential use of non-road modes for delivery to UCC</p>	<p>3) Goods vehicle activity</p> <p><u>Vehicle kms</u> Kms run in urban area compared with previous vehicle km to make same deliveries Kms run outside urban area compared with previous vehicle km to make same deliveries All goods vehicle km in urban area (i.e. in order to consider overall impact of change)</p> <p><u>Vehicle trips</u> Trips in urban area compared with previous vehicle trips to make same deliveries Trips outside urban area compared with previous vehicle trips to make same deliveries All goods vehicle trips in urban area (i.e. in order to consider overall impact of change)</p> <p><u>Vehicle load factor</u> Vehicle weight and volume utilisation for deliveries from UCC Vehicle weight and volume utilisation for supplies into UCC</p> <p>4) Loading/unloading activity</p> <p><u>Space utilisation</u> Utilisation of unloading space in urban area compared with previous demand to make same deliveries Total utilisation of unloading space in urban area by all goods vehicles</p> <p><u>Time</u> Duration of total time spent unloading in urban area compared with previous duration to make same deliveries Duration of total time spent unloading in urban area by all goods vehicles</p>

With the wide range of variables to be measured, there are clearly many ways in which UCCs can potentially be evaluated, with no one single method appropriate to all circumstances. In this section, the evaluation methodology previously developed by Nemoto (1997) has been adapted to show how different UCC models can be evaluated using common principles. Two different models are discussed here to highlight the differences – the first (see Figure 1) shows the effects of a UCC model based on switching from poorly loaded vehicles making direct deliveries to the use of better loaded vehicles for goods movements from the UCC to customers (shown as receivers). By way of contrast, the second model (shown in Figure 2) demonstrates a fairly typical transshipment-type of operation, where large goods vehicles making direct deliveries to customers are replaced by smaller vehicles operating out of a UCC.

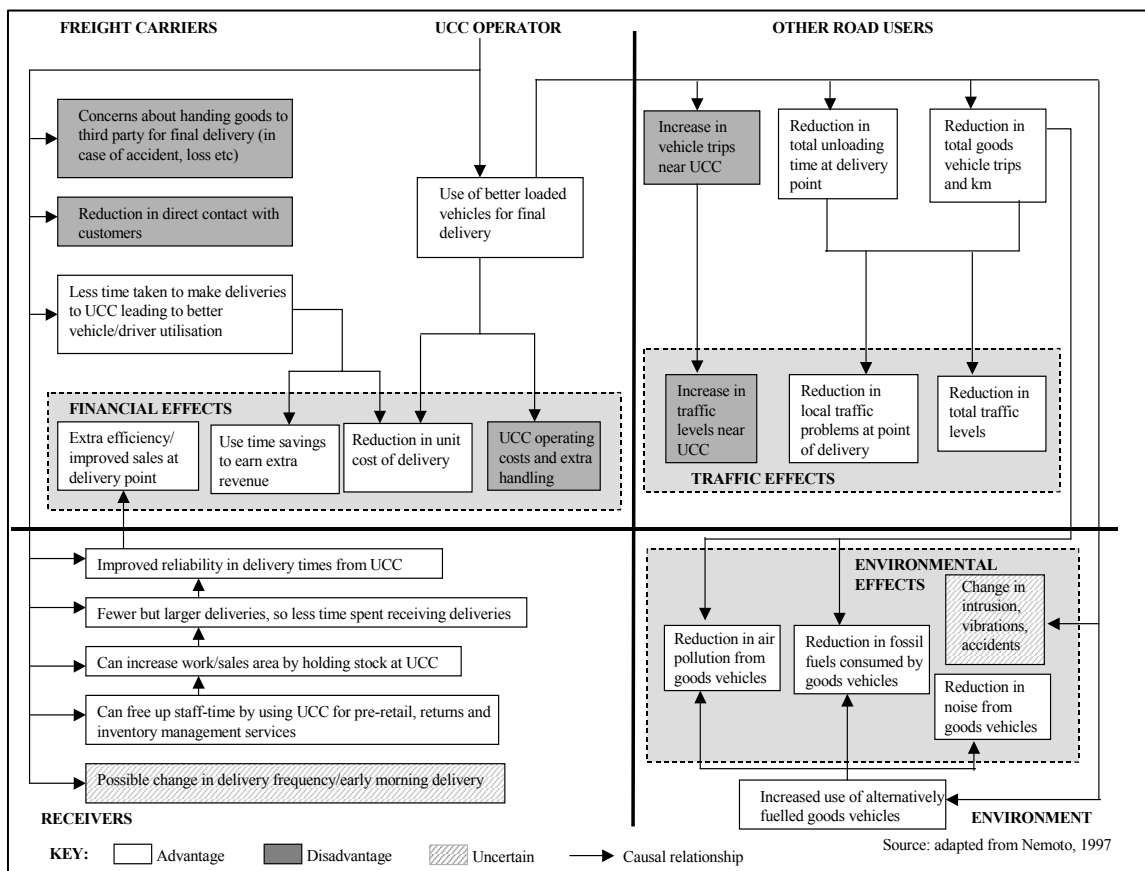


Figure 1: Model 1 - Poorly Loaded Vehicles on Direct Deliveries Replaced by Better Loaded Vehicles from UCC.

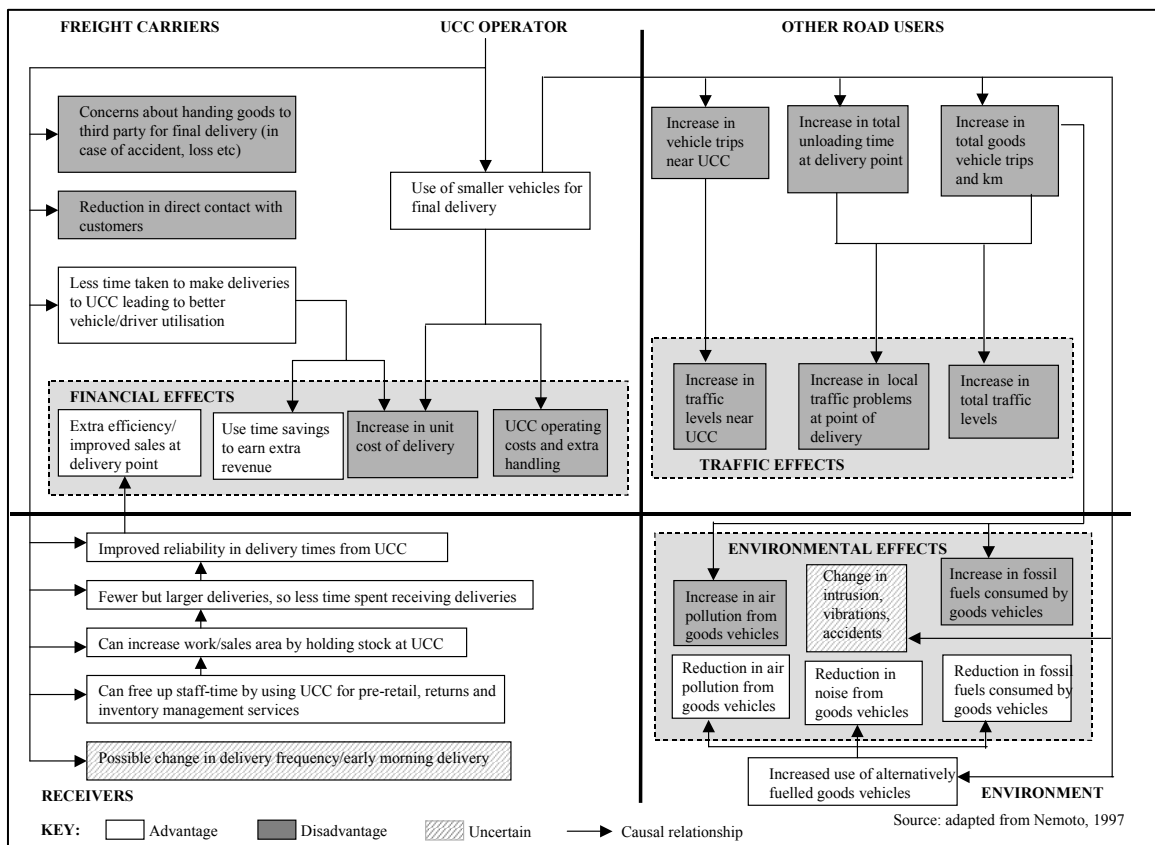


Figure 2: Model 2 - Large Goods Vehicles on Direct Deliveries Replaced by Smaller Vehicles from UCC.

Figures 1 and 2 show the main effects of UCCs on the key “parties” involved, these being the UCC operator, freight carriers, receivers, other road users and the environment. Comparison of the two diagrams reveals that the effects can be quite different depending on the nature of the UCC. Superficially at least, it seems that the use of better loaded vehicles (which may also be larger than in the pre-UCC period) shown in Figure 1 performs better in terms of the balance of advantages and disadvantages than does the transshipment of goods into smaller vehicles as shown in Figure 2. Of course, it is not simply the absolute number of advantages and disadvantages that is important, but the relative extent of each and the overall performance that results. However, the comparison does lend weight to the more recent developments in UCCs, where the emphasis has shifted away from the traditional transshipment model whereby goods are transferred into smaller vehicles for local delivery towards the use of better loaded vehicles to achieve higher levels of utilisation and efficiency. Further developmental work is required to enhance these models and to identify which is better or, indeed, whether a different variant would yield better results.

Previous UCC scheme evaluation

One of the best existing examples of UCC evaluation is that for Tenjin in Japan (Nemoto, 1997). In common with some of the other more comprehensive evaluations, the Tenjin example is relatively thorough in terms of its analysis of the direct transport impacts but does not fully consider the wider effects discussed earlier. The evaluation identified changes in:

- the number of trucks doing the same work
- delivery vehicle parking time in service roads in the city centre
- total traffic along the trunk road to the city centre
- total NO_x emissions in Tenjin, though measured only in one location
- total fuel consumption in Tenjin

This is more comprehensive than many other attempts at evaluating UCCs in that it does try to put the scale of change attributed to the UCC into some perspective with the latter three bullet points. However, Tenjin is just one area within the city of Fukuoka so the analysis is still relatively restricted in scope. Nemoto (1997) acknowledged the problems of data collection and availability, which meant that the overall net social benefit could not be calculated. In addition, though, there is no explicit consideration of the financial effects, the winners and losers amongst the parties involved, or any significant assessment of either the upstream supply chain changes or the impacts within the businesses served by the UCC. There is understandably a tendency to focus on the localised traffic impacts (and associated environmental factors) since these are easier to measure and the changes can be more easily attributed to the introduction of the UCC. In terms of reporting successes, the more localised the scale of analysis then the more positive the outcome tends to be. This is the case in Tenjin, where a large reduction was found in the number of trucks doing the same work (61%) and a noticeable decrease in delivery vehicle parking time in service roads (6.8%). By contrast decreases in the other measures, which take a broader geographical perspective, were only a fraction of one per cent.

It seems apparent from this discussion that there are many challenges involved in conducting a thorough evaluation of the impacts of a UCC. Even in the better examples from the literature, such as Tenjin, there are large gaps in the implementation of the evaluation methodology that mean that it is extremely difficult to thoroughly evaluate the effects of the introduction of a UCC.

Allocation of costs and benefits

Even when the various impacts of UCCs have been quantified (as much as is possible), a critical element in determining the viability of a UCC scheme is the way in which the costs and benefits can be allocated between the parties involved. In theory the quantification should be a relatively simple process, subject to agreement on the costs and benefits to be measured. By contrast, the degree of difficulty in allocating the costs and benefits is largely dependent upon the nature of the centre, and in particular the number and range of parties affected (e.g. numbers of transport providers, suppliers,

receivers). Further work is required, particularly in terms of identifying the wider impacts of a centre rather than just very specific changes for the particular flows using the UCC.

From both the published literature and the project interviews it is clear that the degree of success of a UCC depends critically upon the extent to which the costs and benefits are shared equitably. A three stage process can be applied, as follows:

1. quantification and allocation of costs
2. quantification and allocation of benefits
3. identification of mismatches between costs and benefits for those parties involved in the UCC

Figure 3 demonstrates a simplified cost-benefit analysis of a scheme such as a UCC, with costs and benefits accruing to both the private and public sectors. Dependent upon the specific scheme, the costs and benefits will be distributed differently. Indeed, it is by no means certain that the costs will outweigh the benefits, so “over benefits” may accrue instead of “over costs”.

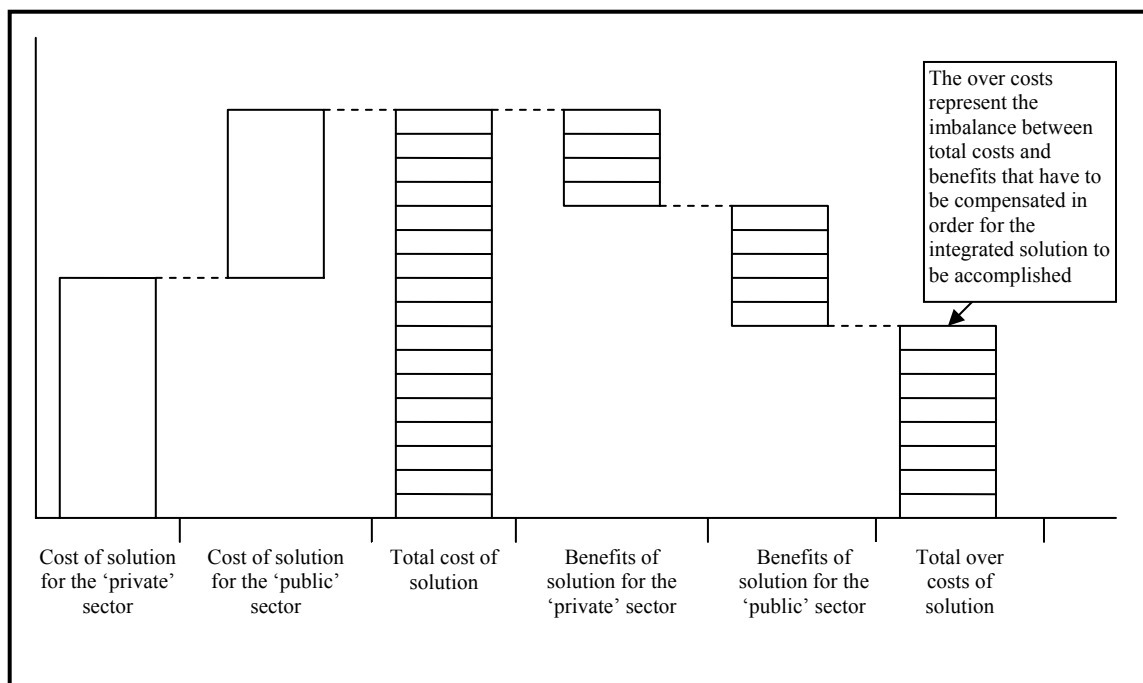


Figure 3: Example of cost-benefit analysis for a UCC scheme.
Source: City Ports (2005).

A primary challenge is the ability to quantify all the costs and benefits so that this analysis can take place in a thorough manner. It is almost inevitable that for any UCC scheme there will be winners and losers, thus making the allocation of the costs and benefits a key issue. This was an issue identified particularly in a number of the project interviews, where the difficulties of considering the full impacts of a particular scheme were highlighted, since parties involved are generally only concerned about the costs and benefits that directly affect themselves. Considerable differences have been identified during the course of the study in terms of the ease of quantification and

allocation of costs and benefits. In general terms, the monetary costs of establishing and running a UCC and the distribution operation from the centre to the customers are easily quantified and allocated. However, as Table 2 illustrates, there may be “costs” that can accrue to the parties involved (depending on the operational arrangements of the UCC) that are less easy to express in monetary terms. The table is only indicative, but is based upon the project interviews and literature review and shows the wider range and complexity of “costs” and benefits that may apply to the different parties involved.

Table 2: Illustration of the Distribution of Potential “Benefits” and “Costs” of a UCC Amongst Involved Parties (existence and extent of costs and benefits will depend on the operational arrangements of the UCC).

	<i>COSTS</i>	<i>BENEFITS</i>
Supplier	<ul style="list-style-type: none"> • Not a single “door-to-door” operation 	<ul style="list-style-type: none"> • Less time spent making deliveries in cities, leading to reduced operating costs • Potential to use time savings to generate additional revenue
Transport provider	<ul style="list-style-type: none"> • Security • Loss of control over timed deliveries/responsibility • Perceived increase in damage through extra handling • Additional handling/delivery charges – could be passed to supplier as “surcharge” 	<ul style="list-style-type: none"> • Routes involving UCCs allow more deliveries per day • Opportunity for night deliveries • Helps counter WTD driver shortage • Greater efficiency as no time spent slow running in town/parking problems etc. • Less slow running = improved fuel usage
Receivers	<ul style="list-style-type: none"> • Additional stage when chasing missing/late deliveries 	<ul style="list-style-type: none"> • Improved delivery reliability • Fewer deliveries/less staff disruption • Ability to call-off orders in parts • Clients able to collect purchases from UCC • Less storage/more selling space • Off-site value-added activities • Improved retailing (street) environment • Continuous waste removal/recycling • Clients avoid travelling to store to collect orders – collect at UCC
Local Authority	<ul style="list-style-type: none"> • Cost of policing freight movements 	<ul style="list-style-type: none"> • Potential licensing revenue • Fewer delivery vehicles in zone, leading to cleaner air, less congestion, pedestrian benefits and improved traffic flow • Potential for alternative fuel vehicles
UCC operator	<ul style="list-style-type: none"> • Multitude of IT & paperwork systems to handle <u>but</u> not if UCC is considered final delivery point and operator has own system to cover the “last mile” • Timed deliveries – how to service • Responsibility for identifying losses/damages at intake stage 	<ul style="list-style-type: none"> • Profit-making business
Developer (new retail sites only)	<ul style="list-style-type: none"> • Cost of establishing UCC if condition of planning consent 	<ul style="list-style-type: none"> • A revenue stream, either if managed in-house or additional charge on rent • More rentable space as result of centralised receipt point and less “in-store” storage space • Single UCC makes whole site more attractive with fewer freight vehicle movements

The evidence suggests that the benefits are more difficult to quantify and allocate than the costs, and this has probably been a factor inhibiting the development of UCCs in the past. It is clear that many of the positive aspects identified in Table 2 are very difficult to quantify, certainly in monetary terms. Further work is required to clarify the nature and quantification of benefits, but it is possible that agreement could be reached amongst the parties involved in setting up and benefiting from a UCC as to how benefits should be valued. As an example, it may be possible to set up some form of emissions trading scheme, whereby an agreed sum of money is allocated to the reduction of emissions of key pollutants, similar to the trading schemes being developed for international CO₂ emissions. Hypothecated revenue from transport schemes (e.g. congestion charging) could be used to fund these benefits on a transparent basis, such as per kg of pollutant avoided.

This discussion relating to the allocation of the costs and benefits associated with UCCs suggests that it is critical to ensure that the issue is thoroughly examined prior to trying to establish a scheme, otherwise there is a danger that the UCC will be seen mainly as a financial drain as a result of a focus on the direct monetary costs associated with its operation. The diffuse nature of the costs and benefits certainly presents a challenge that needs to be addressed before it is likely that UCCs will become more widespread – a clear framework for quantifying and assessing all the impacts, both positive and negative, is required, together with an agreed mechanism for ensuring that there is an equitable distribution of the costs and benefits so that certain parties do not become disillusioned by having to shoulder a disproportionate share of the costs without reaping adequate benefit.

In existing schemes it appears that part (or all) of the financial running costs will be met by the final receiver with the longer term expectation that they should accept higher charges because of the improvement to delivery arrangements. However there are examples of schemes where the transport company also meets part of the costs by a payment on a ‘per delivery’ basis when they leave goods at the UCC for onward movement. There is no evidence that receivers that meet part of the costs are able to negotiate reduced upstream costs with their supply chain partners. The cost of establishing the UCC may be met in part through support from a range of sources including commercial and local authority (city authority) funding. In some cases EU support may also be provided (e.g. CIVITAS projects and INTERREG funding of the City Ports Project).

Lessons learned from existing and attempted urban consolidation centres

Despite the limited evaluation of UCCs in the literature to date, it has been possible to draw out some key lessons from the combination of the desk research and interviews undertaken in the course of the research project being reported on. A number of key themes have emerged:

- Organisational considerations
- Scheme funding
- UCC operations issues
- Awareness and understanding of the UCC concept

Organisational considerations

It appears that imposed UCC solutions are successful only if the imposing organisation is able to control or strongly influence all the players. Thus, at London Heathrow, for example, British Airports Authority (BAA) has been able to insist that the retailers in its terminals use its dedicated consolidation centre, and has also determined the ground rules under which Exel manages the centre and the freight operation. As landlord, BAA is clearly in control. A similar approach could be applicable with new major retail developments. By contrast, voluntary schemes seem often to be loosely constituted and are made up of a variety of players and vested interests. In some cases these schemes appear to have been established with only limited prior research and analysis. As a result, in the absence of early success, the arrangements quickly dissolve.

From this it is possible to infer, though there is not sufficient evidence to support it, that the most likely successful alternative to an imposed UCC will be the bottom up approach. In this scenario the initiative would come from, for example, a street association or the traders in a location who wish to improve their local retailing environment. Such a group would drive the project by demanding the co-operation of their local authority in terms of traffic regulation and apply pressure to freight operators to devise a traffic minimisation scheme that by definition would entail a scheme of consolidation. In the United Kingdom, Freight Quality Partnerships (FQPs) provide a possible structure within which UCC schemes can be developed.

The process leading to the establishment of a UCC will require the involvement of many parties from both the private and public sectors (e.g. local government, potential UCC operators, trade associations, local logistics companies, police authorities) and it is essential that everyone who is likely to have any involvement is part of the discussion and planning process. Without such comprehensive involvement the prospects of success are disproportionately diminished as it is only through involvement that commitment is gained. Persistence is also seen as a key element in establishing a successful UCC. Early success is unlikely and it will only be through continually adapting the operation to meet the needs of existing and prospective clients and constantly promoting the idea that success is likely to be achieved as the initial uptake will inevitably be slow. Experience in mainland Europe suggests a preference for legally constituted bodies involving all the main players to establish and operate UCCs, whereas in the UK the approach has been for a commercial organisation to take the lead and decide the legal and commercial framework under which it will operate. It would seem that the European approach risks becoming bureaucratic and inflexible whereas the UK approach places responsibility with one organisation that is then responsible for agreeing all the sub-contracts and service level agreements that are required to make the whole process work. Certainly, the evidence from the UK suggests that success is more likely where the involvement of private companies in using a UCC is voluntary, rather than imposed by public bodies on to private companies who tend not to have a sound understanding of the commercial considerations of the private companies. The role of local authorities, therefore, is likely to focus on promoting UCC-friendly urban policies, bringing together those with an interest in UCCs and their potential benefits, and scheme funding (see below). It is important not to underestimate the task involved in developing a scheme that addresses the requirements and views of the disparate parties likely to be involved.

Scheme funding

The general consensus is that UCCs must be financially viable in their own right in the medium- to long-term and that subsidies are not a desirable solution. As part of wider financial considerations, however, a case might be made for hypothecated funds from other transport-related sources such as congestion charging and road pricing being used to underwrite or pump-prime UCC operations. It is apparent that, without some initial funding from central or local government to pay for the research work and pilot studies, any form of UCC that is not related to a major new development is unlikely to proceed let alone succeed. In order to establish a successful trial it may be desirable for the participating players to keep the initial cost base low. It is important that the trials be fit-for-purpose but that the investment be kept to a minimum. Rather than build a new centre, part of an existing building (with expansion potential) could be used at the outset. Physical expansion, more elaborate handling systems, or additional capabilities such as chilled and frozen produce storage, could be developed over time.

The standard objection to UCCs is that they will lead to increased costs in the delivery operation. It is therefore important to discuss the wider implications of such schemes with the road transport industry and potential customers, and to demonstrate that by using such centres costs in other parts of their operation could be reduced. Such reductions may be achieved through, for example, less time being spent on deliveries in difficult and/or congested areas, shorter journey times and increased vehicle utilisation, and the possibility of night-time deliveries into the UCC. In this respect one of the key considerations is how to allocate the costs and benefits resulting from a UCC scheme as a whole and not solely the cost impact on a part of the supply chain or a single player. This is not a simple matter and it is suggested here that the allocation of costs and benefits needs to be the subject of a more comprehensive and detailed pilot study. Such a study would encompass both the financial costs and benefits along the whole supply chain and the wider issue of how to handle the environmental costs and benefits.

UCC operations issues

In the same manner that it is proposed that any initial financial investment be minimised, the same applies to the operating methods employed during any trial. It is at the pilot stage that the players will be persuaded of the validity or otherwise of the concept and it is therefore important that the issues do not become clouded by operational complexity. It may therefore be appropriate to consider only simple handling and sortation methods at first. In addition, while the vehicles used should meet all the necessary environmental standards it may be inappropriate (and detrimental to the long term goal) to insist on using specific types of vehicle such as battery powered goods vehicles. On the other hand it may be possible to adopt specific technologies if appropriate vehicles are already owned by the organisation, or if external funding is available to test them or a manufacturer is prepared to provide them for trial purposes. The UCC concept proposed in the UK in the 1970s assumed that all deliveries within the area served by a UCC would be made on small vehicles (<3.5 tonne gvw) so as to exclude heavy goods vehicles (HGVs). It is now recognised that there is no benefit, and indeed there are often environmental and cost penalties, in decanting the contents of a well laden HGV into a greater number of light goods vehicles (LGVs).

Whereas the primary focus of a UCC is to consolidate loads on the inbound journey, if the transport operation is to be optimised it is equally important that vehicles returning to the UCC are as highly utilised as possible. To achieve this, inter-site transfers, unsold stock, waste and damaged material for recycling and orders placed by customers may all be candidates for return loads. Having additional services at the UCC may both increase revenue and augment the overall use of the UCC and therefore its role within the urban area. The range of such activities can be various: pre-retailing operations such as price ticketing and the removal of outer packaging; the assembly of promotional offers; waste recycling; providing a post-sale collection service for the retailers' customers; and field stores for service engineers are typical examples. Given that one of the non-financial objections to UCCs is typically the loss of control and responsibility for the final leg of the delivery operation, this can be overcome by the UCC operator becoming the "final signatory" for a delivery and then employing, for example, a system of roll cages with computerised contents tracking to ensure that the final leg is undertaken with maximum security. Dedicated roll cages would be provided by the UCC operator and would be in a captive loop with tracking between the UCC and the delivery points. Their use would also serve to speed-up the delivery process as the recipient would only have to sign for a number of sealed cages and not conduct a full item check at the time of delivery.

Design and operational aspects of UCCs will need to reflect the scale and type of activity and the range of products being handled. However, this does not preclude the development of a set of good practice guidelines. The location of the UCC in relation to its target market will have important consequences for the traffic and environmental benefits associated with the scheme as well as the commercial benefits of using it. If the UCC is located several kilometres from the final delivery points this has the advantage that vehicles delivering goods to the area from some distance away would not need to enter into the urban area at all. In addition, the distance over which specially designed environmentally-friendly vehicles were operated could be maximised. However, if small vehicles were used from the UCC, the number of vehicle trips and kilometres may increase. Alternatively, if the UCC was located very close to the area which it serves, this reduces the distance over which environmentally-friendly vehicles from the UCC operate, and hence the environmental benefits of the UCC. There is a clearly a need to carefully balance such issues when deciding upon the location. It is also important to note that a UCC will generate inbound and outbound goods vehicle movements. Therefore, the area in which the UCC is based may experience goods vehicle traffic growth, while the delivery area served by the UCC will gain the traffic benefits. This implies the need for neighbouring authorities to work closely together in planning UCCs with the objective of mitigating the impact on any one authority. It also suggests that evaluation of the success of UCCs needs to take place over the entire geographical area covered by the UCC. While a single UCC may be beneficial to a specific location, it is not yet clear what the impacts would be, particularly on the haulage industry, if a given region were to establish a number of UCCs, perhaps even one in each town. In such circumstances the benefits to the haulage industry could potentially be significant.

Awareness and understanding of the UCC Concept

It seems there is a fairly widespread lack of awareness both within the public and private sectors as to the opportunities that UCCs might provide if they were to be

established in appropriate situations. In the public sector in Britain, references to UCCs are frequently found in Freight Strategies and proposals for Freight Quality Partnerships (FQPs). However, it is rare for there to be a clear understanding of the nature of UCCs and the role that they can potentially play when associated with developments such as multiple retail complexes and the establishment of pedestrian-friendly streets in historic centres. From discussions with representatives of local government there is a desire to be in receipt of Planning Guidance as to where consideration should be given to the establishment of UCCs when major development proposals are being considered and when town centres are being restructured. The greater availability of information and the greater ease of determining costs and benefits mean that at present it would be easier to produce guidance for a site-specific UCC than for a one serving a wider location. As noted earlier, there may be considerable merit in undertaking an extended pilot project in a suitable locality. Part of that trial should include, perhaps for the first time, the undertaking of the very detailed levels of measurement that have been lacking in other trials and which could demonstrate or disprove the true benefits of UCCs. However, there is a commonly held misconception that there is only one model for a UCC - this is not the case. The evidence indicates that UCCs need to be customised to the requirements of the locality and clients that they serve, and therefore it is regrettable that when, on learning of an unsuccessful scheme, individuals all too readily assume that the concept does not work or is not applicable in their circumstances.

In the private sector, those who are most likely to instigate the development of a UCC are the “customers” (e.g. retailers) and freight carriers. The latter are, in the main, intuitively resistant to such developments as they see them adding to their cost base and reducing their control over, and responsibility for, the products they deliver on behalf of their clients. Retailers are also concerned about the cost implications and whether these costs can be recouped through improved retail efficiency resulting from the UCC scheme or from other supply chain partners. These are, in themselves, valid objections but they are not insurmountable. To succeed, it must be demonstrated that the additional costs associated with a UCC operation may not have to be borne by the freight carrier or retailer, or if they do have to be that there may be significant benefits elsewhere in the operation that can reduce if not eliminate them. For example, in the case of a freight carrier, more efficient daytime deliveries through not having to enter a congested city centre and the possibility of night time delivery into the UCC could between them improve fleet utilisation and reduce running costs significantly. There will also be the opportunity in some localities to avoid congestion charges and similar time or money penalties. Similarly retailers may be able to use UCCs to improve their retail space and product assortment resulting in improved sales, and may also benefit from more reliable and less time-consuming deliveries. Prospective UCC operators will need to be able to demonstrate their ability and willingness to adopt stock receipt, inspection and control procedures and take responsibility for the “last mile” of a delivery thereby relieving freight carriers of any concerns they may have in that respect.

As indicated above, by undertaking a carefully measured trial it should be possible to provide the data that are needed to enable freight carriers to evaluate the facts and consider the option of routing via a UCC. By this means and through general education on the subject of UCCs it should be possible to make the freight carriers aware of the problems that congested areas face and thereby engage them in helping to solve those problems. Not unexpectedly there is reluctance on the part of the individual players throughout the supply chain to consider anything but their own aspect of the operation.

Consequently the “total picture” – a combination of supply chain and environmental/social factors – is seldom considered and any potential overall benefits are dismissed. However, unless solutions are to be imposed on unwilling participants, it is vital that a positive consensus as to the benefits of a UCC be developed before any project will be able to progress.

Conclusions

Given the relatively low success rate of UCCs to date, especially in mainland Europe, it is clear that any applications have to be specific with well understood objectives, a clear understanding of the nature and volume of the traffic to be handled and a pre-determined and measurable set of criteria upon which to determine success. The basis of any proposed UCC has to be a detailed analysis of the traffic flows into and away from the designated area together with an objective view of the additional services that could be introduced both to financially support the operation and to enhance the service offering to attract greater throughput. This will entail not just extensive measurement, itself no simple matter, but also detailed discussion with all the potential users to both explain the potential benefits that could be available to them and to identify the additional services that they might favour and use. What must be determined from the outset is whether the scheme has the potential to attract a critical mass of users and volume proportionate to its size. All too often it would appear that UCC projects have been based on intuition rather than hard facts and as a consequence are never likely to be viable. Equally the arguments that suggest that the concept “will never work” are based on a combination of vested interests and intuition, and in the absence of hard facts are not easily refuted. While it is perhaps inevitable that politicians and civil servants do not wish to be seen to spend unnecessarily on schemes such as UCCs, it is vital that sufficient consideration is given to the evaluation of schemes that are implemented so that good practice can be identified and lessons for the future can be learned. Also, it is important that there is policy consistency; there is a tendency for different types of transport initiatives to be in favour at different times, and for certain initiatives to fall down the political agenda before their worth has been fully evaluated.

Many UCCs focus on retail operations. They appear to offer greatest scope for those retailers, predominantly smaller stores and independent retailers, who are not part of supply chains in which deliveries are already highly consolidated at distribution centres into full vehicle loads, since vehicles already carrying full-loads for a single retail outlet will not benefit. It is also important to be aware of the potential role of UCCs in other sectors including construction, offices, service organisations such as maintenance engineers, hotels and other tourist services and residential homes. Where final deliveries are multi-drop in nature, and geographically spread across an urban area, transport operators tend to suffer major inefficiencies in the “last mile” delivery operation. In a general sense, therefore, the concept should benefit those transport operators making small, multi-drop deliveries where the location, parking and unloading time are disproportionate to the size of the delivery, and where vehicle utilisation could be increased through consolidation. It is important, though, to realise that UCCs are likely to be better suited to some types of goods than others. In particular, the concept is

unlikely to be suited to perishable and highly time-sensitive products and goods with specific distribution and handling requirements.

In terms of specific location types, UCCs are most likely to succeed in the following places:

- Specific and clearly defined geographical areas such as historic town centres with a high incidence of small traders/outlets who are not part of a regional/national business with a dedicated and sophisticated supply chain and who are looking for a competitive edge.
- Town centres that are undergoing a "retailing renaissance" and that have transport infrastructure that would be unable to cope with the resultant increase in freight.
- Historic town centres and districts that are suffering from delivery Problems (e.g. poor vehicle access, significant traffic congestion, constrained loading/unloading facilities) where there is a common interest in improving the street environment, rather than large town-wide schemes.
- New and large retail or commercial developments (both in and out of town) where there is the opportunity to consolidate all the goods receiving and related activities within a dedicated part of the complex from the outset and as part of the total design, particularly if there is a single manager or landlord to coordinate and/or enforce UCC usage. From the developers perspective this also provides the opportunity to maximise the amount of rentable space.
- Major construction sites where for the duration of the building programme an organised and disciplined flow of materials both reduces costs and facilitates an uninterrupted building programme.
- Where there is "spontaneous" bottom up pressure for such a development from a group of potential users who have interests and objectives in common. The common elements could be trading in a defined geographical area or trading in a similar range of products over a wider area and not being part of a national organisation.

Finally, it is important to reinforce the need for the availability of funding, since there is no strong evidence that any truly self-financing schemes yet exist, and strong public sector involvement in encouraging (or forcing) their use through the regulatory framework.

Acknowledgements

The authors would like to thank the Department for Transport for supporting the research project upon which this paper is based, together with those organisations who assisted with the research.

References

- Battilana, J. and Hawthorne, I. (1976) *Design and Cost of a Transshipment Depot to Serve Swindon Town Centre*, Laboratory Report 741, TRRL, Crowthorne.
- City Ports (2005) *Project Interim Report*, available on-line at: http://www.regione.emilia-romagna.it/wcm/ERMES/Canali/trasporti/logistica_merci/distribuzione_merci_citta/pubbl_3/City_Ports_vol7_ingl.pdf
- Department for Transport (2002) *Heathrow Airport Retail Consolidation Centre: BAA PLC*, Good Practice Case Study 402, Energy Efficiency Best Practice Programme, Department for Transport.
- Dunning, J. (1997) "Lorries in town: could transshipment schemes really deliver the goods?", *Local Transport Today*, 28 August 1997.
- Exel (2004) *Exel to Operate a Leading-Edge Urban Consolidation Centre in the UK*, Exel Press Release, 14 April 2004, Exel.
- GLC London Freight Conference (1975) *The scope for transshipment and consolidation operations in London: An analysis of available goods vehicle and commodity movement data*, Background paper No.8 (April 1975), Greater London Council.
- Hesse, M. (2004) "Logistics and Freight Transport Policy in Urban Areas: A Case Study of Berlin-Brandenburg/Germany", *European Planning Studies*, Vol. 12, No. 7, pp. 1035-1053.
- Institut für Seeverkehrswirtschaft und Logistik (2005) *City Logistics: Experiences and Perspectives*, ISL, Bremen.
- Köhler, U. and Groke, O. (2003) *New Ideas for the City-Logistics Project in Kassel*, Proceedings of 3rd International Conference on City Logistics, in Madeira, pp.331-343.
- Lorries and the Environment Committee (1976) *Report on Transshipment London*, 1976; PE Consulting Group 'Transshipment' London.
- McKinnon, A. (1998a) *International Review of Urban Transshipment Studies and Initiatives*, Report prepared for the Retail and Distribution Panel of the UK Government's Foresight Programme, Heriot Watt University.
- McKinnon, A. (1998b) *Urban Transshipment: Review of Previous Work in the UK*, Report prepared for the Retail and Distribution Panel of the UK Government's Foresight Programme, Heriot Watt University.
- Nathaniel Lichfield and Partners (1975) *Chichester Central Area Servicing System: Local Interchange Depot Study*, Nathaniel Lichfield and Partners, London.
- Nemoto, T. (1997) "Area-wide inter-carrier consolidation of freight in urban areas", *Transport Logistics*, 1(2), pp 87-101.
- University of Westminster (2005) *Urban Freight Consolidation Centres*, Report for Department for Transport (DfT), available on-line at: <http://www.freightbestpractice.org.uk/imagebank/Consolidation%20centres%20Finalreport%20Nov2005.pdf>.



An investigation into outsourcing practice in Ireland: a new direction in logistics and supply chain management

Aoife O’Riordan ^{1*}, Edward Sweeney ¹

¹ *National Institute for Transport and Logistics, Dublin Institute of Technology, Ireland*

Abstract

Companies are increasingly focusing on the development of core competencies as an integral part of their overall strategy development and implementation. The corollary of this is that functions regarded as being non-core are being outsourced. This paper investigates the case for and against outsourcing and in addition what is happening in Ireland regards outsourcing. Furthermore to analysis of current literature in the field, an Irish-wide postal and e-mail survey, as well as three case studies revealed many interesting facts. The key findings of the work are manufacturing outsourcing is now the most popular function to be outsourced for both small to medium sized enterprises (SMEs) and large enterprises. Large enterprises (LEs) do not prepare or examine hidden costs more than SMEs, nor do they differ much in relation to the use of consultants. Furthermore, the importance of time spent on preparing or producing contract, and the impact the contract can have on the supplier-buyer relation do not differ significantly. It was found that most companies outsourced within Ireland, which led to further investigation in that area. In relation to logistics outsourcing specifically, this has become very important in the supply chain over the last 20 years as an activity that was traditionally handled by firms as a support function. At that time logistics activities such as warehousing, distribution, transportation and inventory management were given low priority compared with other business functions within the organisation. However, since the customer has become more demanding, the logistics function has now become a source of competitive advantage and there has been a growing emphasis on providing good customer service..

Keywords: Outsourcing; Ireland; Logistics.

Introduction to supply chain management and logistics outsourcing

Supply chain management (SCM) is concerned with the total management of the supply chain. The overall objectives of SCM are to optimise total supply chain costs and investment, in addition to deliver appropriate levels of customer service in targeted market segments (Sweeney, 2003). SCM provides the end customer with the right product at the right time, priced at the right level, in the right quantity and quality. Also,

* Corresponding author: Aoife O’Riordan (aoife.oriordan@gmail.com)

the ability to satisfy customer demands while responding to relentless competitive pressure requires creative and often complex approaches to managing a company's supply chain (Trent and Monczka, 2003).

Traditionally the functions in Fig. 1 were managed in isolation and often operated at cross purposes.

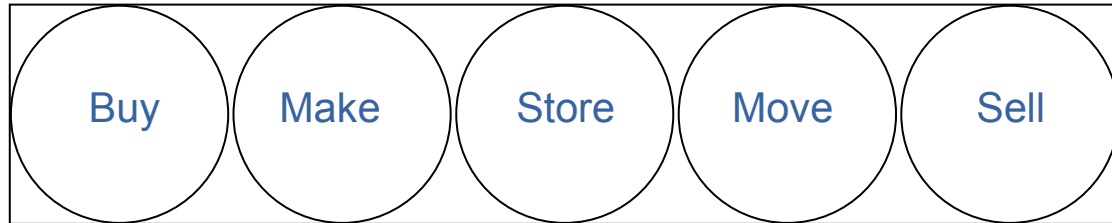


Figure 1: Functions in a traditional Company.
Source: Carroll and Sweeney (2005).

Supply chain management (SCM) integrates these functions by holistically managing the information, material and financial flows (see Fig 2). In addition for a chain to be as competitive as possible the material, information and money flows need to be managed across the supply chain which has implications for the way in which companies deal with their customers and suppliers (Sweeney, 2002).

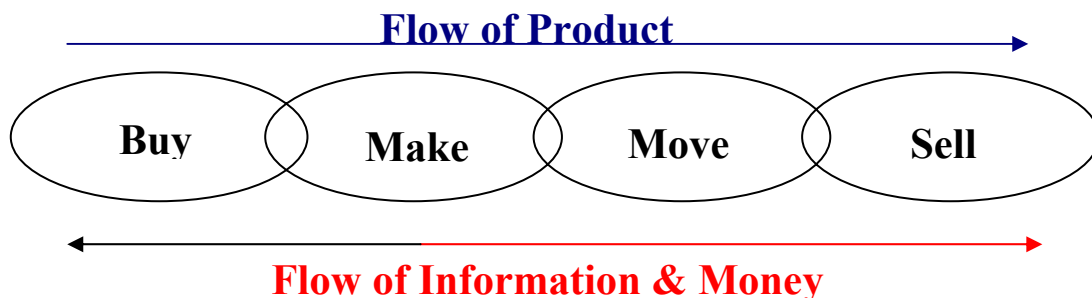


Figure 2: Functions in a company with SCM implemented.
Source: Carroll and Sweeney (2005).

SCM applies to all entities in all sectors. Improving an individual enterprise does not guarantee success in today's competitive market. Without the right companies up and down the supply chain to work with, a company will not achieve its true potential. In addition, recent advances in supply chain information technology (IT) and e-commerce have provided businesses with the potential to improve competitive advantage.

Growing international competition has forced manufacturers in many industries to guarantee fast and reliable deliveries of an increasing variety of high quality products. This has resulted in placing pressure on established companies in industrialised nations and has created opportunities for the new entrants and the nations which more recently have taken the path to industry. "This effect has been very pronounced in the West, with industry in Europe and America suffering particularly severely" (Sweeney, 2005).

Internationally and domestically the modern business environment in which we work is significantly different from that of the past. New competitors are coming in at ferocious speeds and have eroded barriers that had previously protected a company's markets. This has resulted in challenges for market share, reduced prices margins for many companies (Sharland, 1996).

In order to survive, companies are outsourcing significant parts of their operations to cut costs and bring in companies with best in class technology and knowledge to their organisations. Cutting edge technology and knowledge are now recognised as competitive weapons but are expensive to acquire. In addition, start-up companies no longer “play by the rules” and are writing new ways about how to conduct business (Hammer and Champy, 1992). Hines and Rich (1998) claim that for a few of the world’s most successful organisations competitive advantage is being sought and achieved through their direct and indirect network of suppliers.

Outsourcing is not a new phenomenon. Its evolution is closely connected with the evolution of SCM. Services such as security and canteen management have been outsourced since the early 1960s and earlier. However, the volume and range of activities has significantly increased in the last 10–15 years to include IT, personnel, logistics, finance and accounting and even activities traditionally central to the firm such as manufacturing and R&D (Bailey et al., 2002).

Ireland, as with other Western European manufacturing countries, is currently experiencing a change in the way that customers and suppliers relate. The use of outsourcing is becoming more important and is growing significantly in a range of industries including: electronics, pharmaceutical, medical devices, automotive and food and beverage production. Consequently, organisations need to focus on areas where they have or can gain a competitive advantage and strengths that will enable them to participate successfully in an advancing global marketplace.

Ireland has a unique and unrivalled experience of SCM. This has resulted from several factors including: the open nature of the economy, the high levels of imports and exports and the strong IT base and almost uniquely diverse base of the economy (Sweeney, 2003a).

Ireland has seen an unprecedented growth since the early 1990s – the so called “Celtic Tiger” which was helped by public investment in education, high success levels by the Industrial Development Agency (IDA) in attracting inward investment and EU funding of infrastructure investment. One of Ireland’s bigger attractions was a ready supply of skilled workers, including scientists, engineers and business school graduates. As far back as the 1960s, the country had been investing heavily in both secondary and higher education.

Now, Ireland faces more intense competition than it did, often from lower-cost rivals that are becoming equally adept at attracting FDI (foreign direct investment), investing in education and encouraging indigenous industries and higher inflation than in rival countries means that Irish competitiveness is being steadily eroded (Economist, 2004).

Traditionally outsourcing is an abbreviation for “outside resource using” (Arnold, 2000). Currently, in the simplest of forms, outsourcing takes place when an organisation transfers the ownership of service or function that used to be done in-house to a supplier. The degree of transfer of control is the defining characteristic of outsourcing. It concerns such questions as “the transfer of routine and repetitive tasks to an outside source,” “...having an outside vendor provide service that you usually perform in-house” and “... paying other firms to perform all or parts of the work” (Zineldin and Bredenlow, 2003).

Historically outsourcing was used when an organisation could not perform to world-class excellence in all sectors of the organisation due to many factors including: incompetence of staff and/or management, lack of capacity with the organisation, financial pressures, or technological pressures. In its most basic of forms it started from

the basis of a single service such as canteen management, buildings management or computing. In addition, outsourcing was applied in overhead functions or activities which had no potential for competitive advantage and business processes where an end user could create a competitive advantage through partnerships with vendors specialising in a particular area (Dole, 1998). Now, outsourcing is used to build on core competencies and recognise that serving the customer is critical to the organisation.

Outsourcing is not simple or easy to create or develop and support. It can have both positive and negative effects on key areas of the supply chain (Mason et al., 2002). There are many implementation problems and the failure rate is often quoted to be as high as 70 percent (Zineldin and Bredenlow, 2003). In addition, it can adversely affect employees and many transitions have been unsuccessful (Logan, 2000). Even with these problems recent studies have indicated that 85 percent of all companies outsource at least one function or service (Logan, 2000).

Outsourcing can also help the company focus on its core competency or competencies. To decide what should be outsourced, a company should go back to the origins of the company and outsource everything else (Hammer and Champy, 1992). In other words, if the service/function is not a core competency of the company it should be considered for outsourced. Non core competencies are sidelines to a company's core competency and do not always generate profits and may even reduce profits and outsourcing your non-core competencies is to ultimately gain the company a competitive edge (Insignia, 2000).

Logistics outsourcing has become really important in the supply chain in the last 20 years as it was traditionally handled by firms internally as a support function. At that time logistics activities such as warehousing, distribution, transportation and inventory management had been given low priority compared with the other business functions within the organisation. However, since the customer has become more demanding, the logistics function has now become a source of competitive advantage (see Table 1) and there has been a growing emphasis on providing good customer service (Razzaque and Sheng, 1998).

“Logistics is the process for the efficient and timely flow of goods, services and information from the point of origin to the point of consumption” (Candler, 1994).

Table 1: Types of Logistics services that can be outsourced.

<i>Warehousing</i>	<i>Outbound Transportation</i>	<i>Freight bill auditing/ payment</i>	<i>Inbound Transportation</i>
Freight Consolidation/ Distribution	Cross-docking	Product Marking/ Labelling/ Packaging	Selected Manufacturing Activities
Product returns & repair	Inventory Management	Traffic Management/ Fleet Operation	IT
Product Assembly/ Installation	Order Fulfilment	Order Entry/ Order Processing	Customer Service

Source: Cap Gemini Ernst & Young (2001).

According to Wilding and Juriado (2004) it has been estimated that about 40 percent of global logistics is outsourced.

The management of the logistics function in modern organisations involves decision making for the complete distribution of goods and services in the marketing function

with a view to maximise value and minimise cost (Razzaque and Sheng, 1998). What has become apparent is that competitive advantage now comes from the delivery process as much as from the product being delivered (Razzaque and Sheng, 1998) which has transformed logistics from a traditional back-room function into a front office function. Consistent service at appropriate levels is necessary for a well run and well designed logistics system.

However, in order for an organisation to handle its logistics activities efficiently and effectively, it must consider the following:

1. Can it provide the service in-house
2. Can it outsource the function
3. Can it set up a subsidiary by buying a logistics firm which will provide its logistics function.

It was evident that there was a huge variety of information found on the topic of outsourcing but the overall knowledge within those papers was not very widely ranged. Therefore, in order to add to the body of knowledge that is out there already and to find out information on outsourcing and business performance from an Irish perspective it was decided initially to conduct a survey on the Top 1,000 companies in Ireland. The survey will obtain a shallow amount of information from a wide number of study participants, then to conduct three case studies that will provide a deep amount of information from a small number of participants. The survey should throw up any information if anomalies occur between theory and what is happening. Anything that is not covered fully in the survey, or needs further clarification will be covered in the case study section. Therefore by the end of this piece of research, the results of the literature review will either be confirmed or contradicted by what is happened in Ireland and the results of the survey and the case studies will be triangulated.

Introduction to the survey instrument

The survey instrument is a standardised semi-structured questionnaire consisting of 35 multiple choice questions and four open text questions. They were grouped into five categories: general company information; general outsourcing; latest outsourcing project; outsourcing preparation and company experience. The survey was piloted in 10 companies and a response rate of 60 percent was recorded. However, given that there were changes to the survey at this point these were not included as part of the final sample frame.

A survey was conducted of managing directors, supply chain managers and purchasing managers in the Top 1,000 Companies in Ireland (The Irish Times, 2005). In all, 978 surveys were sent out – 151 by e-mail and 827 by post and 133 replies received. Of this, 131 usable responses were obtained and 25 were returned as undeliverable. Excluding returned mail, the response rate was approximately 14 percent.

Level 1: Total Population = 978 companies

Level 2: Sample Frame = Total Population = 978 companies

Level 3: Sample Size =131

For the postal questionnaires, they consisted of a cover letter, questionnaire and a postage paid return envelope. For the e-mail questionnaires, they consisted of a cover letter which contained a link to the on-line questionnaire.

The responses were received in two waves, some weeks apart. An analysis of the responses in each wave indicated that the late respondents were drawn from the same population as the early wave. Overall there was no statistical significance found between the early and late respondents which indicate that there are no real differences between the companies who replied very quickly and those who took longer to reply. It further indicates that there is no bias between them.

The majority of survey respondents were from the manufacturing sector (25.5 percent) with just over 18 percent in the service sector (see Fig. 3).

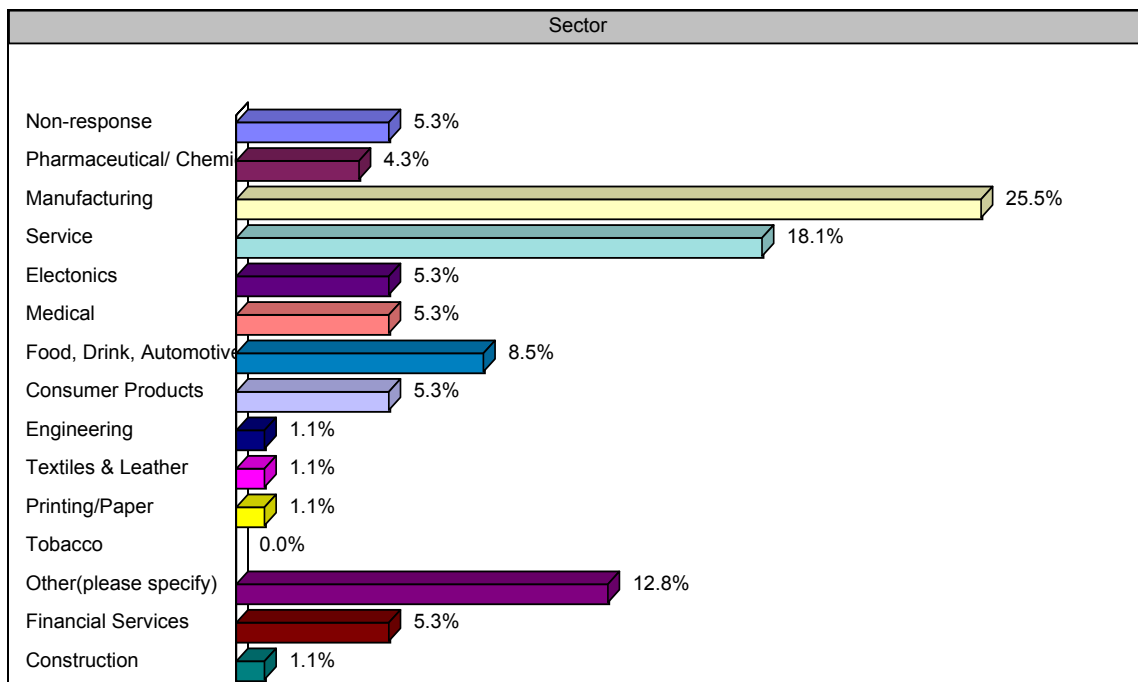


Figure 3: Sectoral Response.

In addition, since two modes were used to get the surveys to the study participants, postal versus e-mail comparisons were carried out. Sphinx survey was used to analyse the results. For the purposes of this research, probability analysis was used to show if a value was statically significant or not.

To ensure that the results from the survey are not biased and there were no differences between the late and the early respondents some analysis was done to compare these. These were done by using the same type of analysis as in the survey.

Main survey findings

In all, two hypotheses were tested in the course of the survey analysis: These were defined as follows:

Hypothesis 1: “Total outsourcing is the main type of outsourcing that companies in Ireland are involved in”

Hypothesis 2:

- a) “The amount of outsourcing projects a company is involved in increases with the size of the company”
- b) “The service/function outsourced depends on the size of the company”
- c) “Cost goals are more important for SMEs than LEs”
- d) “LEs prepare more and look into more hidden costs than SMEs”
- e) “LEs offshore outsource more than SMEs”
- f) “SMEs use consultants more than LEs”
- g) “Employees affected varies by size of company”

From the results, it was found that the selective outsourcing is the main type of outsourcing the study participants are involved in. Furthermore, it was found that there was no statistical significance between the types of outsourcing SMEs and LEs are involved in. The results also indicate that total outsourcing is not the most popular type of outsourcing companies are involved in. In addition, there are very few differences in the types of outsourcing LEs and SMEs are involved in and the types of outsourcing do not vary by sector.

It was further indicated in the study that the number of outsourcing projects a company is involved in does not increase with the size of the company. From the results it was found that there was no statistical significance found between the number of outsourcing SMEs and LEs are involved in. However, SMEs seem more consistent in the number of projects they outsource with projects.

Manufacturing outsourcing is now the most popular function to be outsourced by both SMEs and LEs in the Irish Republic. This concurs with objective one where we saw that the service sector was mainly the sector where companies have set up in Ireland since 1990 thus indicating that manufacturing is moving out of Ireland. Other common areas for outsourcing are for both SMEs and LEs are: logistics and freight forwarding.

It was also indicated that the initial goals of the outsourcing initiative do not depend on the size of the company. The initial goals for SMEs and LEs were the same, the only differences being their positioning in the top five. The top five initial goals were to be:

Table 2: Types of Logistics services that can be outsourced.

<i>SMEs</i>		<i>LEs</i>
1.	Cost Reduction	Cost Reduction
2.	Increase Service Levels	Efficiency Improvements
3.	Improve Cost Control/Structure	=3 Improve Cost Control/Structure
4.	=4 Efficiency Improvements	=3 Increase Service Levels
5.	=4 Better Quality	Gain Competitive Advantage

It was also indicated that LEs do not prepare more or look into hidden costs more than SMEs. However, a small percentage of companies – 3.5 percent of SMEs and 5.3 percent of LEs do not look into any hidden costs which is worrying given the number of problems outsourcing can cause

There was no statistical significance found between the size of a company and whether they offshore although it was found that LEs offshored more than SMEs with. Less than one in three LEs offshore outsourced and less than 15 in 100 SMEs offshore outsourced. Most companies seem to outsource within Ireland and given that manufacturing is now the most popular type of outsourcing (according to this study), it

seems to be counter-intuitive. Cost goals and non-cost goals are used in equal numbers for both SMEs and LEs.

The service/function outsourced does not necessarily depend on the size of the company but SMEs might not have all the services/functions LEs have due to their size, for example, canteens. In addition, LEs do not prepare more or look into any more hidden costs than their smaller counterparts, however there were many differences in what they looked into.

Introduction to case studies

The rationale for using the case study approach was that there were a number of determinants which had to be taken into account that could not be studied effectively except as they interact and function within the organisation themselves, for example, practices and processes within a company. The survey analysis threw up many questions that could not be analysed except with face to face interviews with companies.

One case study was examined. The case study was chosen on the basis of seven criteria:

1. Sector
2. E-mail or postal survey
3. Company size
4. Business performance rating
5. Overall rating of outsourcing
6. If they are considering outsourcing again
7. When the company was set up

The information for the case study was gleaned from a number of sources including: published papers about the companies; the company websites; annual financial reports; the questionnaire they filled out and interviews with key decision making personnel in the company. In all, about 10 percent of the information was gleaned from published sources with the other 90 percent gained from the interview process.

The case study followed the same logic as the questionnaire design and is ordered in such a way so as to complement the construction of it and throw out common threads between the two.

Company a is part of a much larger organisation based in the USA. It has many plants throughout the world, primarily in America. It has a turnover worldwide of \$1 billion per annum. In Ireland, it has a turnover of €100 million. The company was set up in the 1970s and is a large company.

Logistics case study analysis

Company A has been involved in four outsourcing projects. It has outsourced its security, canteen management, logistics and cleaning services. It initially outsourced their logistics function as it was seen that there were huge cost savings to be achieved by outsourcing it. Since then it has outsourced their canteen management, security and

cleaning services. The company's definition of outsourcing is: "Taking a key activity and giving the responsibility to manage this activity to an outside company".

The latest function it has outsourced was the re-outsourcing of the logistics function. For this it has been involved in total outsourcing with 100 percent of the function outsourced. The logistics function is primarily a load on/load off business, with 40/45' high cube containers and use a multimodal transport system (see Fig 4).

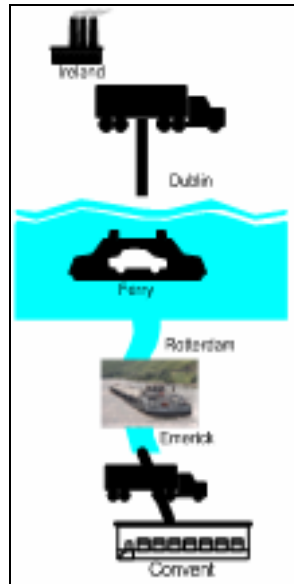


Figure 4: Multimodal Transport Network.

After the products are manufactured in Ireland, the containers are loaded onto a 40/45' truck. They are then taken via road to Dublin. The containers are then loaded onto a ferry and taken through the Irish Sea to Rotterdam. At Rotterdam they are taken off the ferry and loaded onto a barge and are sent up the Rhine to Emerick. Once again they are off loaded at Emerick and put on a trailer and moved 5 miles via road to the warehouse in Convent. If the need arises they will use rail. It started on their latest outsourcing project between January 2004 and December 2004 and is currently post implementation. It affected less than 30 percent of its employees and the length of the contract it awarded was three years. Company A recognised ten to fifteen years ago for them to stay competitive and survive in a very tough environment it had to become masters of its own destiny. Huge numbers of competition were coming in from the Far East, Taiwan and China.

A joint decision between the Commercial Director and the Supply Chain Manager within the organisation made the decision to outsource. When it was moving at a reasonable pace and they both agreed it was a viable option they made a presentation to the Directors of the organisation. They explained to them exactly what they were doing and how they would ensure that the outsourcing initiative would be a success. From this presentation, the company Directors made the decision that the outsourcing initiative should proceed. In other words it was driven from the top of the company.

The decision to outsource logistics was almost forced through a number of factors. When the Supply Chain Manager started in Company A seven years previously they ran a logistics seminar in order to reduce costs. They invited all of their suppliers into the factory to discuss the logistics of the company, the costs involved and how the impact of

competition was affecting their prices. After this, they asked the logistics providers to go away and come back with some cost reductions. From the seminar two things came out:

1. They had 35 to 40 different suppliers
2. The company were not sure they were using the right people with the correct level of expertise

The initial goals of the outsourcing initiative can be seen in Table 3.

Table 3: Initial Goals of the Outsourcing Project.

1	<i>Increased Service Levels</i>
2	Efficiency Improvements
3	Cost Reduction
4	Increased Economies of Scale
5	Better Quality

In addition, it was evident in the company that it was lacking expertise. It knew that the only ones that knew the real costs of moving goods were those that ran the ships. This was recognised within the company. It was further recognised that it did not have the expertise or the knowledge to get this information. Plus, the only way to get that was by outsourcing it to someone who had the knowledge and who would be hungry enough to get the business and cut costs.

In addition to the initial goals of the project, there were also some factors that influenced the company to outsource; these can be seen in Table 4.

Table 4: Factors Influencing the Decision to Outsource.

1	<i>Better Customer Service</i>
2	Lower Costs

It saw that since they were spending €10-13 million per year on logistics and could it get even a two percent saving by outsourcing it would mean €200,000 the company.

Company A chose Ireland for the outsourcing of logistics as they felt the first port of call was to look locally. If it did not find a candidate or company that it felt would be successful in doing what it wanted in Ireland at the end of their research, it would have then looked next to the UK. Again if it was not successful there it would go to central Europe and so on.

The company are very familiar with Europe. The company has warehouses in the UK, Germany, and Belgium and are also very familiar with running logistics in Europe and in dealing with Europeans. It found that there were many problems with offshoring due to language barriers. The language issues are bigger than people realise because their understanding of English is not the way it thinks it is. Companies think they understand what we are saying but the specifics/details of what we speak are not always what they understand. Thus, it can have huge ramifications when it comes to doing what we want. From a language perspective and from a locality perspective Ireland seemed the most logical and best place to start. And since it found two suitable candidates in Ireland that could do exactly what they wanted, that is why it did not move to the UK.

But in saying all that, it never considered offshoring initially. It always considered Ireland its first port of call. However, it would consider offshoring if it was to outsource

it again, especially into mainland Europe. It will depend on a number of criteria though, as to tender it into the European market will mean a horrendous amount of work, as it will get every freight company in the whole of Europe trying to get the business. It has to consider this carefully otherwise it could get swamped with documents and it could take up to one year to process it, or even get an understanding of it and have all the required meetings.

As a result, it feels that the best place to keep these types of things is locally because it is dealing with local ports, local shipping etc. So, even if Company A tender it internationally and choose a foreign company who are experts in logistics, the outsourcing supplier still have got to talk to EUCON in Ireland and deal with them in Ireland. Hence, they are not going to get away with the Irish side of it which makes up approximately 30 percent of the total logistics. However, if the Irish company is not performing it will tender it out.

Even though Company A chose Ireland, there are many problems here. For example, if you take the cost of energy, for example, oil, which relates to the cost of electricity - the costs have doubled since 2005. It contemplates that their energy bill alone in 2006 will be €1 million higher than in 2005. As a result, it has got to make €1 million more to compensate for this loss in Ireland. These are the things that are crippling industry in Ireland but in particular manufacturing. If you go to Poland, their energy bills are lower (but not significantly) but what is drastically lower are labour costs and consequently companies are moving over there.

When it outsourced the logistics function initially there were five people in the shipping department – one supervisor and four administrators. When it was outsourced two of the employees moved into the customer care department as they were restructuring in there and found that there were two roles available.

In the shipping department one of the roles was kept and one of the other people stayed on with the new company and one person was offered redundancy. All avenues were considered for the other person. It was given the choice to stay, but its role in the company would have been deflated. It decided to do it in-house even though the company had very little experience of outsourcing. This was because logistics was an activity the supply chain manager (who was leading the project) knew a lot about. He had worked in logistics for over 20 years and gained a lot of experience in shipping and logistics. From that perspective, although they did not have any experience of outsourcing, it had a lot of experience of the decisions that had to be taken to ensure that it would work. It never even considered consultants as the company claims that the project did not need them. In addition, the cost of the consultants was a barrier to using them.

It did in-depth company research and looked into what it called the main hidden costs of outsourcing – overheads, contract management, cost of transition period and the costs of layoffs. In addition, it went into the marketplace and examined all the relevant shipping companies in Ireland. Then the company went back into their own organisation and asked “what did they need to give the potential suppliers enough information for them to come back and tell them what they would do the business”. In essence it was pulling out data from its own systems, looking at what they were doing from an activity perspective and then handing the information out to the potential suppliers.

By doing that it essentially let the potential outsourcing suppliers lead it. They were given the following information to work on:

- A. What was going on in Company A now
- B. What Company A's business was
- C. How the logistics function was made up

From this the potential suppliers had to come up with a plan of how they were going to run and manage the logistics function. However, the company did not do any major risk analysis. It did not look into cultural issues as they were outsourcing within Ireland or language barriers (for the same reason as before). If they were outsourcing into Central Europe, it acknowledged that cultural problems and language barriers would have been very critical issues.

The main hidden costs they looked into were from a training perspective because it was looking for experts in the field. The team that was in Company A was the main logistics team in the company. It had the knowledge and they were the ones that trained the new people from the outsourcing supplier. Instead of hiring in "experts" it kept the original employees in their roles for an extra couple of months. As a result there was very little cost to that. The company did not see it as a cost as such, it was just a later cut-off from going from the old system to the new.

It also used the sourcing activities with the potential suppliers as a learning ground for them. Essentially, they were learning about Company A's business and what they do. Since the supplier was an expert in the field most of the learning's were coming to Company A and the knowledge transfer was coming from the outside into them.

The company received many benefits as a result of the careful planning and choices they made as a result of the outsourcing initiative. Table 5 shows the top eight benefits the company experienced as a result of the outsourcing venture.

Table 5: Top 8 Benefits of Outsourcing – Company A.

1	Lower Prices
2	Greater Flexibility
3	Closer Proximity to Markets
4	Service Levels Increased
5	Better Customer Satisfaction
6	Better Quality Services
7	Better Customer Service
8	Company more Profitable

One thing that is very prevalent about logistics, according to Company A, is that the two most important things about logistics are:

1. The service to the customer - Company A will spend any amount of money to get the product to the customer when they need it, but how they share the costs depends on the situation.
2. Cost

Other benefits include a significant reduction in costs - in the order of €3 million per year and the fact they were able to demonstrate to the people in the company and people on the periphery of the company that they were a very professional organisation. Also, that it was well able to manage their logistics and it was professional at doing it. This

was because one of the main reasons they outsourced was because Company A felt they were not doing it right. In addition, it is now able to manage their cash flow better.

Furthermore it gave the company a professional image of its logistics function and the customer service levels significantly improved. Since the function was running more smoothly they were able to put more energy into delivery and lead times because it had much better synergies at their base. It spent most of their time in the past fighting suppliers trying to curb costs. Now it spends most of their time looking at where the best place to position their product, what is the biggest order size it can do, what is the best route and overall what is the most economical way of doing things.

Since it is now dealing with just one supplier there has been a significant reduction in the administration costs in their finance department (see Table 6).

Table 6: Administration Before and After Outsourcing

	<i>Before Outsourcing</i>	<i>After Outsourcing</i>
No. Of Suppliers	35-40	1
No. Of Invoices (Monthly)	2000	4
No. Of Payments (Monthly)	100's	4

The biggest benefit to Company A is that now it is spending less time being focused on unimportant issues. As a direct result, it can now focus on issues that were important to the customer i.e. service to the customer and managing their cost base.

With regards some of the measures in the company like profitability, customer satisfaction the affect outsourcing had on them can be seen in Table 7. More importantly, although none of the indicators shot up, they helped prevent losses.

Table 7: Measures associated with Outsourcing – Company A

<i>Business Performance Measures</i>	
Shareholder Price Increased	Agree
Profitability Increased	Agree
Customer Satisfaction Increased	Agree
Sales Increased	Disagree
Cash flow Increased	Mainly Yes

It also received intangible benefits. For example, a more professional image of logistics created a “feel good” factor throughout the organisation and more harmony among people. Since the outsource team now worked very closely with the customer care team, they now treat the customer care team like their customer. In the old scenario, the shipping team fought with the customer care team, because the customer care team would ask them to do things which they felt were impossible but it was the message of the customer.

When asked in the survey about problems in the outsourcing initiative Company A said it had no problems. When pressed on this the supply chain manager said that this was because it had planned it well. It looked at the people they had, the knowledge they had within the company and how they would integrate the new team with the old team. It was here that it found a few minor issues – one person within Company A just could not get on with the outsourcing supplier. In addition, there were a few set up issues and a few with the supplier it had pre-outsourcing. It could see very quickly that it was going to lose a lot of business.

Other problems that have cropped up since the start of the outsourcing initiative include is that the outsourcing supplier is trying to keep a distance between Company A and their suppliers. This could have resulted in Company A losing touch with its main customers and their suppliers end up making the decisions. Before this was identified as a problem five or six key suppliers ended up talking to the outsourcing supplier because they feel that it is the ones that are making the decisions. To overcome this problem Company A arranges a twice yearly meeting with their main suppliers to discuss all important company business. In addition, it visits its warehouse¹ sites at least once a quarter. Here, it discusses the business and any issues that have cropped up since the last meeting.

In addition, its outsourcing supplier is good at giving Company A good news, but the supplier is not as quick or forthcoming about giving you bad news. Its supplier is not good at giving Company A information when the supplier is performing badly or not doing something right.

Company A claim that the few problems they encountered come down to the fact it carried out a lot of before the fact preparation about what it was going to do with logistics once they went with it.

But, even though Company A revealed many benefits, it is more important to establish the real impact of those benefits and problems encountered by its organisation. Since it is operating in a very competitive environment it must run its logistics very professionally and cost effectively as they are spending between €10-13 million per year on it. It is the second biggest budget within the organisation and if it is not running correctly it can have a huge impact on the profit margin of the organisation. Company A found the real impact to be:

1. They can now do a line by line cost saving
2. The can now calculate an accurate monthly incentive for their outsourcing supplier
3. On time shipment – 95 percent + against customer requirements
4. They moved from 20 percent deliveries direct to the customers to 70 percent (see Fig. 5). This system reduces double handing and lowers costs.

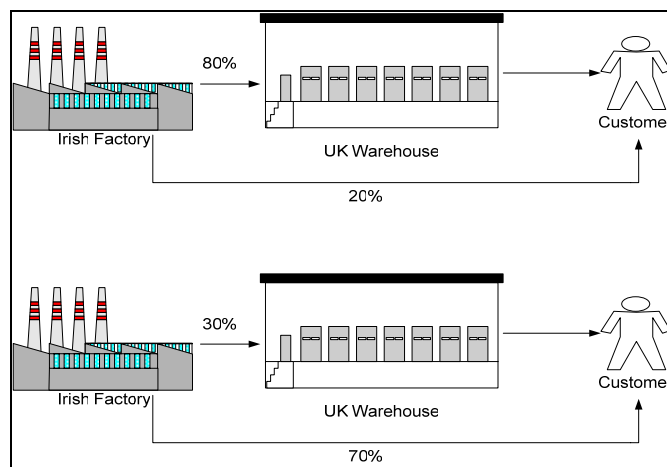


Figure 5: Direct to Customer Move.

¹ These are very important as they hold approximately 200,000 tonnes of product in each of their warehouses.

Since it can now spend more time on important issues like cost savings, the following was the impact on the organisation:

1. Using a single haulier with a light weight chassis system enables them to get an extra 1 – 1.5 tonnes into each container (Inbound a saving of €200,000 and outbound a saving of €100,000 was recorded)
2. Using Swift Post instead of a courier service saves ~€20,000 per year
3. Increasing bale size by 10kg saves ~€80,000 per year
4. Going direct to more customers in Europe and the UK instead of going via warehouse - €30,000 –€50,000 per year.
5. Increasing order size from 18-20 tonnes to 22-24 tonnes

Company A rate their company's experience of outsourcing as very good. This is based on the criteria described in the case study and a combination of supplier and outsourcer input. In addition, these include all the benefits it has acquired, especially the €3 million saving per year. It claims the key to its success was the relationship they struck up with their supplier as this also brought natural benefits to the outsourcing initiative.

Company A is very dependent on the supplier. If something goes wrong with the supplier Company A will be left without a logistics function. On a more positive note, there are a lot of companies available to take over the business. It has not considered outsourcing again, but will do if the need arises. What it envisages will happen is the maintenance function will soon be outsourced.

Conclusions

Outsourcing, as it is today, would not exist if it was not for contemporary processes and trends related to supply chain globalisation. Companies are now experiencing greater competitive pressures from lower cost countries than ever before. This has resulted in companies not competing against other companies but supply chains competing against other supply chains. Outsourcing is potentially one of the vital elements of an organisational strategy aimed at lowering costs and keeping the companies in high costs economies afloat. It is helping developing countries to increase their GDPs as a consequence of inward investment in industrial capability.

Outsourcing is an important area for companies in Ireland as labour and other costs have risen rapidly over the last 20 years. Companies, as this study demonstrated, are looking for ways to increase profitability and to lower the costs of supplying products. Outsourcing is one of the ways companies can do this. By outsourcing to a country with lower labour costs, companies can take advantage of the costs savings. However, outsourcing does not come problem-free. It can affect the performance of a business both positively and negatively. It was found from this study that the benefits gained by a company are unique and cannot be easily replicated in another company.

Ireland has been used as an outsourcing country for American multinationals since the early 1960s. Companies like Dell, Intel, Wyeth Medica, Apple and Wyeth Biopharma all have operations there. However, Ireland is now becoming an outsourcer. Many companies are outsourcing to lower labour cost countries/regions like Eastern Europe

and China to try and overcome the high level wages that are now demanded. In this scenario, higher skilled jobs can often be retained in Ireland.

Two hypotheses were constructed for the purpose of this project. The hypotheses were analysed in the survey review section in the project. For hypothesis 1 the hypothesis was rejected as selective outsourcing is the main type of outsourcing companies in Ireland are involved in. The sub hypotheses were also rejected as there was no statistically significant difference found between the types of outsourcing companies are involved in by size or by sector.

For hypothesis 2 there were six objectives within the hypothesis to be tested and one sub hypothesis. All the objectives within the hypothesis were rejected as was the sub hypothesis.

- The number of outsourcing projects a company is involved in does not increase with the size of the company;
- The service/function outsourced does not depend on the size of the company;
- Cost goals and non-cost goals are of almost equal importance;
- LEs and SMEs prepare the same amount;
- LEs and SMEs offshore approximately the same amount;
- SMEs and LEs use consultants to the same extent.

The explorative research, with its theoretical and industry contributions suggests avenues for future research. The findings from this study are valuable and important in the context of outsourcing in Ireland in order to identify areas for future research within outsourcing in Ireland. It is recognised that there are limitations in terms of recommendations and conclusions that can be derived. However, it is felt that it provides a robust foundation for future research into outsourcing in Ireland.

Finally, outsourcing is an important strategy for companies as cost pressures increase and customers continue to demand more for less. The information generated through this research and the roadmap proposed provides companies with a robust basis for the planning and implementation of outsourcing initiatives.

References

- Allen, G. (2001) "Relationship Issues: The Next Generation of Logistics Outsourcing Models", CapGemini Ernst & Young.
- Arnold, U. (2000) "New dimensions of outsourcing: a combination of transaction cost economies and the core competencies concept" *European Journal of Purchasing and Supply Management*, Vol. 6, Issue 1, pp 23-29.
- Bailey, W., Masson, R. and Raeside, R. (2002) "Outsourcing in Edinburgh and the Lothians", *European Journal of Purchasing and Supply Management*, Vol. 8, Issue 2, pp 83-95.
- Candler, J. (1994) "You make it, they distribute it", *Nation's Business*, Vol. 82, Issue 3 pp. 46-48.
- Cap Gemini Ernst & Young (2001) "Third Party Logistics Survey – Results and Findings of the 2001 Sixth Annual Survey", Cap Gemini Ernst & Young.
- Carroll, L. and Sweeney, E. (2005) "Lecture notes on introduction to supply chain management", NITL
- Dole, R. (1998) *Business Process Outsourcing: a case study*, KPMG Peat Marwick LLP.
- Hammer, M. and Champy, J. (1992) *Reengineering the Corporation – A manifesto for Business Revolution*, Nicholas Breasley.
- Hines, P and Rich, N. (1998) "Outsourcing competitive advantage: the use of supplier associations", *International Journal of Physical Distribution and Logistics Management*, Vol. 28, No. 7, pp 524-546.

- Insignia, R. C. (2000) "Linking outsourcing to business strategy", *Academy of Management Executive*, Vol. 14, Issue 4, pp 58-71.
- Logan, M. S. (2000) "Using agency theory to design successful outsourcing relationships", *International Journal of Logistics Management*, Vol. 11, Issue 2, pp 21-32.
- Mason, S. J. et al. (2002) "Improving electronics manufacturing supply chain agility through outsourcing" *International Journal of Physical Distribution and Logistics Management*, Vol. 32, No. 7, pp. 610-620.
- Razzaque, M. A. and Sheng, C. C. (1998) "Outsourcing of Logistics Functions: a literature survey" *Journal of Physical Distribution and Logistics Management*, Vol. 28, No. 2, pp 89-107.
- Sharland, A. (1996) "Sourcing Strategy: the impact of costs on relationship outcomes", *International Journal of Physical Distribution and Logistics Management*, Vol. 27, No. 7, pp 395-409.
- Sweeney, E. (2002) "The four fundamentals of supply chain management", *Logistics Solutions*, Issue 1.
- Sweeney, E. (2003) "Supply chain benchmarking and performance measurement towards the learning supply chain", *Logistics Solutions*, Issue 6, No. 9.
- Sweeney, E. (2003a) "Supply chain management in Ireland – the future", *Logistics Solutions*, Issue 3.
- Sweeney, E. (2005) "Outsourcing a magic solution", *Logistics Solutions*, Issue 1.
- Trent, R. and Monczka, R. (2003) "Understanding integrated global sourcing", *International Journal of Physical Distribution and Logistics Management*, Vol. 33, No. 7, pp 607-629.
- Wilding, R. and Juriado, R. (2004) "Customer perceptions on logistics outsourcing in the European Consumer goods industry", *International Journal of Physical Distribution and Logistics Management*, Vol. 34, No. 8, pp 628-644.
- Zineldin, M. and Bredenlow, T. (2003) "Strategic Alliance: synergies and challenges – a case of strategic outsourcing relationship 'sour'", *International Journal of Physical Distribution and Logistics Management*, Vol. 33, No. 5, pp 449-464.

Acknowledgements

The authors wish to acknowledge the financial support of this research by Enterprise Ireland under the commercialisation fund – project ref. No. TD/03/411 (SIMCT) and is conducted collaboration with AMT and Enterprise Engineering, UL and NITL, DIT. Project managed by AMT, UL.



The perception on ICT use among small logistics service providers: a comparison between Northern and Southern Europe

Pietro Evangelista ^{1*}, Heli Kilpala ²

¹ *Institute for Service Industry Research (IRAT), National Research Council (CNR), Naples, Italy*

² *Faculty of Economics and Business Administration, University of Oulu, Finland*

Abstract

Many authors have suggested that logistics information system capabilities can significantly enhance overall logistics competence. Majority of the studies have, however, assessed benefits that large logistics service providers have gained from information and communication technology (ICT) usage. The purpose of this study is to shed light on the ICT use and issues relevant for implementation plans among small and medium-sized logistics service providers. The study compares survey findings from two different geographical areas where the logistics service industry consists of a large number of small companies. The study focuses on the current status of ICT implementation, the motivators and barriers for ICT use.

Keywords: Small logistics service provider; Information and Communication Technology (ICT); Empirical surveys; Northern and Southern Europe.

1. Introduction

Logistics service providers have a crucial role in facilitating the supply chain management (SCM) initiatives in Europe. There is an increasing trend to (re)locate manufacturing and other activities in the most favourable locations without increasing the customer lead times. In the context of evolving SCM adoption, manufacturers and retailers are increasing the outsourcing of significant parts of their logistics activities (McKinnon 1999). As a result, the business environment for logistics service providers is becoming more and more complex and technology is playing an increasing important role posing new strategic challenges and opportunities to logistics service providers (Regan and Song, 2001). In the today turbulent supply chain environment characterised by time compression, flexibility and agility, information technology capabilities become both a critical variable for logistics service differentiation (Sauvage, 2003) and a significant tool to cut costs and effectively serve clients through a better customisation

* Corresponding author: Pietro Evangelista (p.evangelista@irat.cnr.it)

of service provided (Van Hoeck, 2002). Logistics service companies are transforming the scope and characteristics of their services provision in order to improve customer service levels. This allows logistics service companies to assume responsibility for several activities beyond transportation and warehousing. Logistics service companies are increasingly asked for advanced information services such as real-time tracking and tracing of shipments in addition to basic services such as transportation and warehousing. These advanced information services are a great challenge particularly for small and medium-sized logistics service providers. Innovation linked to ICT usage in the logistics service sector is unevenly distributed between large and small-medium sized companies. Large logistics service providers have invested in ICT and have actively developed information systems. Furthermore they have been using in-house information systems to support their operations for a long time. Small and medium-size transport and logistics service providers,¹ on the other hand, have more difficulties in setting up ICT applications due to reluctance to change and insufficient human and financial resources. Smaller logistics service providers often perceive ICT as an added cost involving company re-organisation and skills development associated with technology investments. The result is that such companies have underestimated the potential of ICT as a tool for increasing cost-efficiency and improving customer service simultaneously as suggested by many authors that have stressed the potential role of information technology as a competitive weapon with a potential to enhance the overall company logistics competence (Closs *et al.*, 1997).

From the research standpoint, the existing studies have seldom focused on small logistics service providers (Gunasekaran, Ngai, 2003) and on the ICT usage in particular (Pokharel, 2005). This is reflected by the existing gap in the literature where information technology in large logistics service companies has been widely investigated (van Hoek, 2002; Larson, Gammelgaard, 2001; van Hoek, 2000; Berglund *et al.*, 1999; Peters *et al.*, 1998), while there is still a shortage of research in the field of small logistics service providers with little empirical investigation analysing the adoption of ICT by these companies (Evangelista, Sweeney, 2006). The limited number of quantitative surveys available gives rise to the need to develop research and investigation in order to acquire a deeper understanding and in-depth knowledge regarding the level of technology capability and the effects of new technologies on the competitive abilities of these companies. This is particularly critical for the EU logistics service market that is characterised by the strong presence of small logistics service providers.

Given the importance of such companies in the European scenario, comparative studies between logistics service industries in different countries are to be beneficial. The cross country analysis could be of help in understanding differences and commonalities of ICT adoption as well as motivators and barriers in investing in ICT by small logistics service providers located in different EU countries. Considering the existing gap of knowledge, such analysis could stimulate further research in this field. In addition, the result can help manager of logistics service providers in comparing business attitude of small logistics companies operating in different countries.

¹ In this paper, the EU definition of SMEs has been adopted. According to this definition, firms with less than 10 employees and turnover \leq € 2 million are considered “micro”, firms with 10 to 50 employees and turnover \leq € 10 million are “small”, and firms with less than 250 employees and turnover \leq € 50 million are considered “medium-sized”. For further details, see Recommendation 2003/361/EC.

The article deals with the use and implementation of ICT in the logistics service sector. Its focus is on information technology capability of small and medium-sized logistics service providers in Europe. The work compares two recent surveys conducted in two separate geographical areas. One survey covered the Southern Europe (Italy) and the other the Northern Europe. The results were analysed and the responses from the Southern and the Northern region were compared. The analysis is based on a total of 153 survey responses from Italy and 168 responses from the Nordic region. The results provide a number of information about the surveyed companies such as the general company profile, the technological profile, motivators and barriers in ICT investment and future areas of technology investment. It is to be noted that the paper is based on two different surveys carried out in isolation by the authors, which explains that there are some differences in the methodologies.

The paper has been organised into five parts. Following this introduction, an overview of the logistics service market in the Barents region and Italy is provided. The third section describes the methodological approach used in the two surveys. In the fourth section the main research findings emerging from the two surveys are then presented together with a comparison between them. The concluding section discusses implications for further research in this field.

2. Overview of the logistics service sector in the Barents region and Italy

A key characteristic of the European logistics service market relates to fragmentation. The EU transport and logistics service industry is populated by small logistics companies. Eurostat (2003) data confirm such market figure. Data about the average company size in the transport and logistics sector show that in most EU countries logistics service providers are small and medium sized companies (see table 1). As indicated in the table below, after Spain, Finland, Italy and Sweden are the markets where logistics companies are smaller in comparison to other EU countries.

Table 1: Average company size in the logistics sector in some EU countries – 2000.

<i>EU countries</i>	<i>Employees per company</i>
Spain	3.3
Finland	4.9
Italy	5.5
Sweden	6.8
Portugal	6.9
Denmark	8.3
France	11.5
Germany	14.2
Belgium	14.7
Austria	15.7
United Kingdom	16.1

Source: Eurostat, 2003.

The Barents region refers to the Northern periphery of Europe. It constitutes of Northern counties of Finland, Norway and Sweden, and the North-Western counties of Russia. The area's business environment is characterized by heavy, basic industries (e.g.

wood and paper, steel, mining, fishery, and oil) with customers worldwide, thinning population in many areas, long distances between major population centres both within the Barents region as well as to the centres outside the region. Companies operating in the Barents region must incorporate higher transportation costs in their product prices and yet strive to remain competitive in the global markets. Thus, logistics and transportation are clearly central factors in serving the industries in the Barents region.

In the Barents region, the logistics service sector is composed of a large number of micro and small companies, together with few large international companies. The micro and small logistics service providers in the Barents region typically employ only a few employees and their services provided are limited to basic transportation combined with few value-adding services. In Finland alone, 81% of the companies in the logistics service sector employ 0-4 employees only (Punakivi, 2004). The Barents region has also attracted some large international logistics service providers to the region, such as DHL and UPS. These companies have a very different role in logistics: they often manage all the logistics operations in their (major) customers' supply chains and are known as "Fourth party logistics integrators".

The Italian logistics service market was estimated the fifth largest European market (after Germany, UK, France and Benelux) in 2001 with a high expected growth rate in coming years (Harvey, 2003). Nevertheless, it is approximately four times smaller than the German market (€13.9bn against €2.9bn), while the total value of logistics outsourcing was approximately €12bn² (3.6% of the Italian GNP) in the same year.

Similarly to the logistics service sector in the Barents region, the Italian logistics service market is very fragmented. Confetra³ estimated that there are some 145,000 logistics service companies operating in the Italian market in Italy on 2004. The fragmentation of the market is also evident considering employee data. About 50% of Italian logistics providers employ less than 50 people, and that 35% of them employ less than 9 people (KPMG, 2003). The fragmentation of the Italian logistics service industry emerging from the above picture has facilitated the entry of large foreign logistics groups in recent years. Many of the most advanced and attractive Italian providers of larger size with consolidated business experience were acquired by multinational logistics groups in the period 1998-2001, while there have been no international acquisitions made by Italian companies on international markets in the same period (Federtrasporto, 2003).

3. Study methodology

The main objective of this paper is to compare findings emerging from two recent surveys in order to obtain information about the level of technological capability of small logistics companies operating in two geographical areas. One survey has been carried out in Southern Europe namely in the Italian logistics service market, while the second covered Northern Europe (Finland, Northern Norway and Northern Sweden,

² It should be noted that the difference between the above figures is because the first (i.e. €2.9bn) does not include transportation, while the second (€12bn) includes transportation services as part of the total value of logistics outsourcing.

³ Confederazione Nazionale del Trasporto (Confetra) is the largest Italian transport and logistics service company association.

Northern parts together known as the Barents region). The comparison between the two investigations enables better understanding of some of the key similarities and differences in technology usage by small logistics companies located in two different geographical areas.

A first methodological problem that both investigations faced was how to define logistics service companies. Many definitions of a logistics company can be found in recent literature. Some of the most important definitions are reported in table 2.

Table 2: Main definition of logistics company according with recent literature.

<i>Author/s</i>	<i>Definition</i>
Lieb, (1992)	...the use of external companies to perform logistics functions which have traditionally been performed within the organisation. The functions performed by the third-party logistics firm can encompass the entire logistics process or selected activities within that process
Virum, (1993)	...are the services offered by a middleman in the logistics channel that has specialised in providing, by contract, for a given time period, all or a considerable number of the logistics activities for other firms. It consist of a long term relationship between two parties which regard each other as partners
Sink, et al. (1996)	... are multiple activities provided by an external party, assuming no ownership of inventory to accomplish related functions that are not desired to be rendered and/or managed by the purchasing organisation
Coyle, et al. (1996)	...an external supplier that performs all or part of a company's logistics function
Berglund, (1997)	...organisations use of external providers, in intended continuous relationships bound by formal or informal agreements considered mutually beneficial, which render all or a considerable number of the activities required for the focal logistical need without taking title
Bagchi and Virum, (1998)	...a long-term partnership arrangement between a shipper and a logistics vendor for providing a wide array of logistics services The logistics solution is worked out in co-operation specifically for each shipper. The goal for the relationship should be to develop into strategic alliances with win-win for both parties
Murphy and Poist, (1998)	...a relationship between a shipper and third party which, compared with basic services, has more customised offerings, encompasses a broader number of service functions and is characterised by a longer term, more mutually beneficial relationship
Berglund, et al. (1999)	...are activities carried out by a logistics service provider on behalf of a shipper and consisting of at least management and execution of transportation and warehousing. In addition, other activities can be included, for example inventory management, information related activities, such as tracking and tracing, value added activities, such as secondary assembly and installation of products, or even supply chain management.
van Laarhoven, et al. (2000)	...undertake management, analytical and design activities associated with transport and warehousing such as inventory management, information related activities, including tracking and tracing, as well as the value-added activities of secondary assembly of products and supply chain management.
Langley, et al. (2002)	... a company that provides multiple logistics services for its customers, whereby the third-party logistics provider is external to the customer company and is compensated for its services... One desirable attribute of a third-party logistics provider is that the multiple logistics services be integrated as opposed to being performed on a stand-alone basis. By providing integrated solutions the provider can solve its customer's business problems more effectively.
Delfmann, et al. (2002)companies that perform logistics activities on behalf of others.

There are a number of features which are worth noting:

- the definitions range from the quite limited (e.g. Delfmann et al., 2002), which focus on a narrow range of activities, to the wide ranging (e.g. Langley et al., 2002). The latter emphasise the role of value-adding services. This implies a spectrum of

organisations, from those who focus mainly (or exclusively) on transport activities to those who provide a wide range of value-added services.

- a number of definitions refer to the requirement to provide “multiple” or “bundled” services (e.g. Sink et al., 1996; Langley et al., 2002; Virum, 1993).
- a number of definitions incorporate references to the relationship between the logistics service company and its customer base (e.g. Van Laarhoven *et al.*, 2000; Virum, 1993; Bagchi and Virum, 1998).
- the concept of service provision in an integrated manner is implicit in a number of definitions (see comments on “multiple” or “bundled” services above). However, Langley et al. (2002) explicitly notes the desirability of an integrated approach to solution provision.

In this paper the following modified version of the Berglund et al. (1999) logistics company definition has been used: *“Third-party logistics are activities carried out by a logistics service provider on behalf of a shipper and consisting of at least transportation. In addition, other activities can be integrated into the service offering, for example:*

- *Warehousing and inventory management;*
- *Information related activities, such as tracking and tracing; and*
- *Value added supply chain activities, such as secondary assembly and installation of products.”* (Sweeney and Evangelista, 2005).

There are a number of features of the definition that are worthy of comment: a) companies that provide purely transport services are included; b) the role of warehousing and the associated management of inventory, an integral part of many theoretical definitions, is cited as the first of the non-compulsory activity elements – this reflects the fact that for many logistics service providers their first foray into non-transport activities is in this area; c) the non-compulsory activity elements include both information related activities as well as elements of supply chain functionality which may be outsourced by customers; d) the word “integrated” is used to indicate the importance, where more than one service is offered, of providing a customer with a coordinated logistics solution. The vast majority of European logistics service providers are small companies that often provide a limited range of purely transport services. For the purposes of the research into ICT capability, the above logistics company definition has been narrowed to exclude very small providers that are marginal in the context of the wider supply chain.

The main method for data collection in both studies was a structured mail survey.⁴ Both surveys have been conducted between 2004 and 2005. Prior to mailing the questionnaire, in both surveys interviews and meetings has been held with key actors to get overall understanding on the business practices in the small logistics service sector and to submit and discuss the basic survey objectives and draft questionnaire. Two focus groups were held before the Italian survey in 2004. Almost 20 key actors (ICT managers of small logistics service providers, ICT consultants, directors of Italian

⁴ A detailed description of methodology and findings of the two survey is contained in Evangelista and Sweeney (2006) for the Italian investigation and in Kilpala *et al.*, (2005) for the Northern European survey.

logistics associations, researchers and academicians) were involved in the two meetings. Useful input was received in order to improve the suitability and the comprehensibility of the questionnaire. Furthermore, business associations were involved in administering questionnaires through the use of their mailing lists and the use of their logos. Similarly, several interviews were set up before the Northern European survey (see Pekkarinen *et al.*, 2004). These interviews provided basis for further study in the Barents region. Following the interviews, a mail questionnaire was constructed together with the research groups in Luleå (Sweden), and Narvik (Norway). The questionnaire was validated with a pre-test with a number of academics and the representatives from the Finnish Transport and Logistics Association (SKAL).

The following step in both surveys was to submit the questionnaire to a sample of small logistics service providers. In both surveys, the very smallest companies have been excluded from the surveys as the implementation of ICT systems for transport management can be commercially justified only for companies operating more than a couple of vehicles.

For the Italian survey, the company information was obtained from several sources - partly from the Italian logistics associations that took part in the focus groups and partly from other sources (including logistics magazine subscribers and transport e-marketplace databases). On the base of the most recent Confetra estimate, the total number of Italian logistics service providers is 145,000. Based on this, the total population in this survey was estimated at approximately 21,500 companies. After that a draft mailing list was developed containing 2,464 companies. Each individual company was checked and a number of inconsistencies were detected. This reduced the total number of companies included in the survey to 1,992. The questionnaire was mailed to companies throughout Italy in June 2004 with a stamped addressed return envelope for respondents' returns. The total number of questionnaires received was 169. The questionnaires collected were filtered to resolve inconsistencies and anomalies. 16 questionnaires were found unusable and excluded from the survey since they were incomplete or out of the scope of the research. The final number of usable responses was 153 (response rate 7.7%).

Regarding the Northern survey, a list of mailing addresses was also obtained from SKAL in Finland. The Finnish data includes companies in Southern Finland as well. Originally the plan was to separate companies in the Northern part of the country (Regions of Lapland, Oulu and Kainuu), but due to the relatively low number of responses, the whole data is used in this report. The questionnaire was sent to a total of 750 companies, resulting in 79 responses (response rate of 10,5%). One of the companies was no longer in business and the number of usable responses was thus 78. No telephone inquiries were conducted. In Sweden, a searchable web site, Affärsdata (www.affarsdata.se), PRV (Patent och Registreringsverket) and SCB (Statistiska Centralbyrån) were used to assess the number of logistics service providers in Norr- and Västerbotten. The search produces a list of 350 companies providing transportation services. All of the companies were selected for sample survey. The questionnaire was sent to 350 companies in Norr- and Västerbotten, resulting in 59 returns (response rate of 16.9%). In Norway, a searchable website "Guleside" (www.guleside.no) was used to find company information. A total of 268 companies were found in Northern Norway that categorized as logistics service providers. Of these 136 companies could be contacted by e-mail, 87 companies provided fax numbers and 45 companies could only be reached by regular mail. During the actual survey out-sending process, 125 surveys

were contacted by email, 77 by fax and 66 by regular mail. The survey in Norway resulted in 36 responses, of which 31 responses were effective. The response rate was thus 11.6%. The next section describes some of the main issues investigated in the two surveys. In particular, results about general company information, types of ICT tools adopted, motivators for ICT adoption, barriers and future areas of ICT investment are considered. Such results will be compared in the end of the section.

4. ICT usage among logistics service providers

General company information

The survey in the Northern region resulted in responses from a total of 168 logistics service providers in Finland, Norway, and Sweden (total response rate of 12,3%). The surveyed companies are small and the majority of them are classified as micro and small companies as summarized in Table 3.

Table 3: Respondent companies' size in the Northern region.

<i>Employee bands</i>	<i>Finland</i>	<i>Norway</i>	<i>Sweden</i>	<i>Total</i>	<i>Percentage</i>
Micro (less than 10)	70	18	42	130	77%
Small (from 10 to 50)	8	10	16	34	20%
Medium (from 51 to 250)	-	2	1	3	2%
Large (more than 250)	-	1	-	1	1%
Total	78	31	59	168	100%

In Finland and Sweden, the surveyed companies typically have 2-9 own vehicles (82% of the companies⁵). The majority of the surveyed companies operate in local and national markets only. In Finland, manufacturing industries, building trade and paper and forest industries were major customers for the highest number of logistics service providers (other industries included retail trade and dairy goods industry). In Norway, manufacturing, wholesale trade, mineral exploitation and forest industry were the major customer industries and in Sweden, forest industry, building trade, manufacturing industries. Table 4 provides details about the distribution of the Italian surveyed companies in terms of firm size using employee bands according to the EU definition of SMEs (see footnote 1). Of the 153 respondents, almost 27% are micro companies and 42.5% are small, while about 31% are medium firms. Thus, most of the sample consisted of small and micro companies.

Table 4: Respondent companies' size in Italy.

<i>Employee bands</i>	<i>N.</i>	<i>Percentage</i>
Micro (less than 10)	41	26.8%
Small (from 10 to 50)	65	42.5%
Medium (from 51 to 250)	47	30.7%
Total	153	100%

⁵ The question was not included in the Norwegian survey.

Figure 1 provides a breakdown of the respondents by the main Italian geographical areas. The majority of the sample firms are located in the North of Italy (76.5%). The main reason for this is that the most part of the Italian manufacturing activities is concentrated in the North of the country.

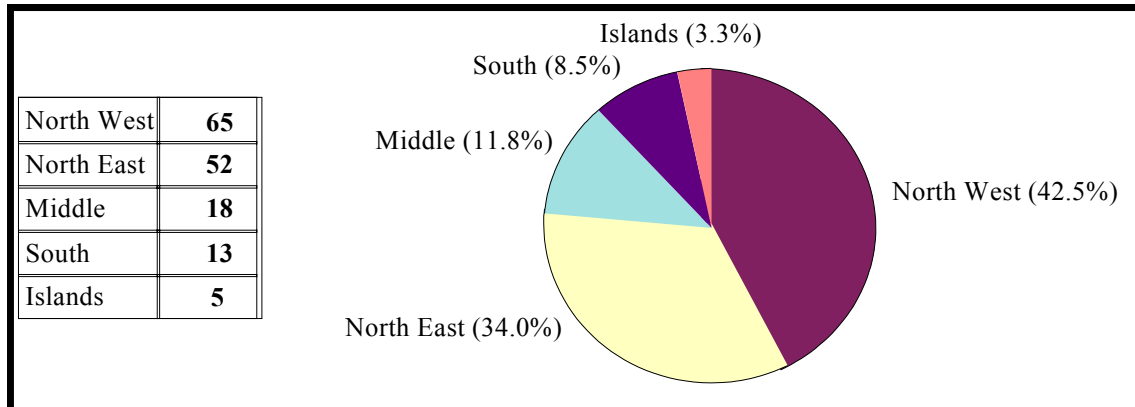


Figure 1: Italian sample firms by geographical area.

The vast majority of the sample firms serve customers mainly on the domestic and European market. The main served industries by respondents are food, beverage and tobacco, chemical, oil and plastics, textile and clothing/leather goods and electrical appliance and machine. Most of the surveyed companies serve 3 industries (32.4%) or more than 3 industries (50.3%) while only about 17% of companies serve one single industry.

Another issue investigated in this survey is the level of complexity of service supplied by the surveyed companies. The companies were asked to indicate the number of value added logistics services offered beyond basic service such as transportation and warehousing. Data analysis shows that 44 companies (28.8%) supply no value added service, 71 companies (46.4%) supply from 1 to 3 advanced services, 25 companies (16.3%) provide from 4 to 6 value added services and 13 companies (8.5%) supply more than 6 advanced services. This shows that, despite the small size of the companies investigated, a large number of them provide multiple advanced services in order to increase the customer satisfaction. About the type of service provided orders management (34.0%), packaging (30.1%) tracking and tracing (24.2%) labelling (22.9%) and third party inventory management (19.0%) are the main value added services supplied by the sample firms.

Types of ICT tools adopted

The performance of supply chain management is often closely associated with the level of electronic integration within the supply chain (Cassivi *et al.*, 2004). For this reason it is interesting to learn in detail about ICT tools and systems used by the surveyed companies.

In the Northern European survey, a 5-point Likert type of scale was used, “5” referring to “purchased and fully in use”, “4” referring to purchased but not fully in use, “3” referring to “purchased but not in use”, “2” referring to “planned to purchase”, and,

lastly, “1” referring to “not planned to purchase”. In figure 2 the percentages of companies that responded “3”, “4”, or “5” is depicted. These answers were chosen because they refer to a situation in which the company has invested and access to ICT tools. It can be seen that the majority of companies under investigation are familiar with computer technology and have some ICT tools available.

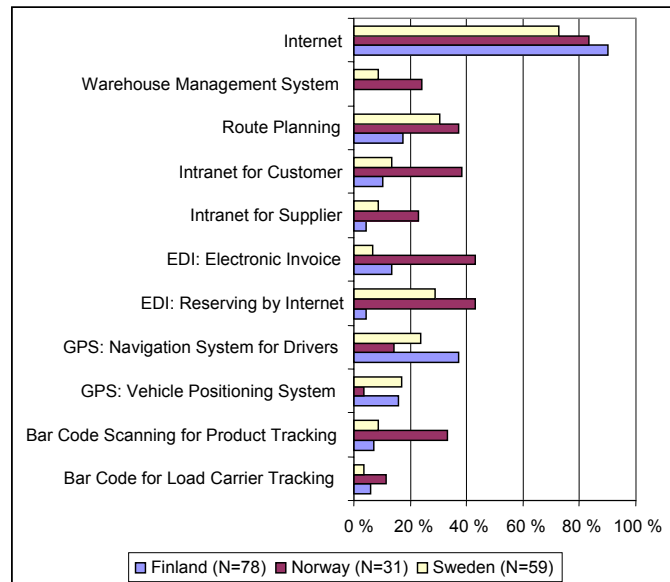


Figure 2: Types of ICT tools adopted by companies in Northern Europe.

Yet not all logistics service providers have Internet connection and the survey revealed that not all companies even planned to move to the Internet-age. The electronic data interchange (EDI) implementation is in a very incipience stage in Finland and Sweden, whereas some 40% of the surveyed Norwegian firms had EDI in use. Where the Norwegian firms were most “technology-oriented” in the Northern European survey, the implementation of GPS technology made an interesting exception: the GPS technology was more common in the Finnish companies.

Figure 3 illustrates the different kind of ICT tools that the Italian companies adopt. All surveyed companies use telephone, fax, mobile, Internet and email to a great extent. Apart from these basic technology tools, other ICT tools used by the sample firms are EDI applications, LAN, and company website. EDI and LAN are in use in approximately 50% of the surveyed companies. Almost 70% of companies have also established company websites. Data show that the adoption of more complex technologies and applications developed for more specific purposes is quite low in the sample firms. The figure clearly shows that, moving from the very top (basic ICT tools) to the bottom (advanced ICT tools) of the graph, the usage of more sophisticated technologies (such as Wireless LAN, RFID, ERP and CRM) decreases significantly.

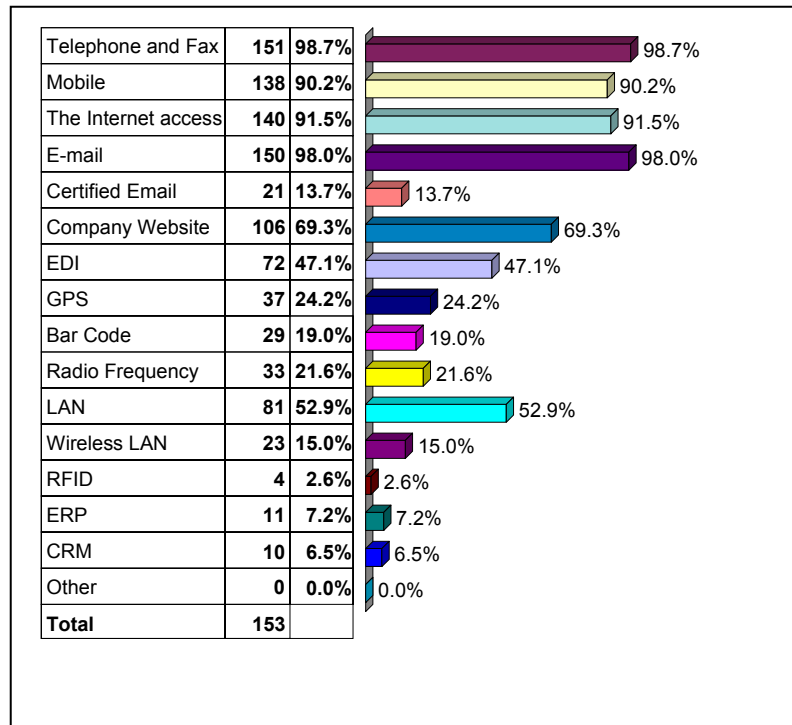


Figure 3: Types of ICT tools adopted by Italian companies.

Motivators for ICT adoption

Another issue investigated by the two surveys is what motivated small logistics service providers in Northern and Southern Europe to adopt modern ICT. In the Northern European survey, a 5-point Likert-type of scale was used. Table 5 shows that improving customer service level and improving control and planning are important motivators for the ICT implementation in the Northern Europe.

Table 5: Logistics service providers' motivators for ICT implementation in Northern Europe (scale: 1 = very small importance, 5 = very great importance).

<i>Perceived motivators for ICT implementation</i>	<i>Finland</i>		<i>Norway</i>		<i>Sweden</i>	
	<i>Mean</i>	<i>Std</i>	<i>Mean</i>	<i>Std</i>	<i>Mean</i>	<i>Std</i>
Improving customer service level	3.06	1.18	3.68	1.22	3.05	1.32
Reducing costs	2.68	1.21	3.19	1.25	2.56	1.24
Reduced needs for personnel in administration	2.06	1.17	3.39	1.17	3.08	1.32
Improving control and planning	2.93	1.36	3.89	0.92	3.25	1.24
Reducing human error	2.75	1.21	3.50	1.04	2.83	1.32
Integrating customers' logistics and production managem. systems	2.18	1.21	3.08	1.05	2.53	1.22
Improving capability to obtain customer feedback	2.66	1.21	3.00	1.15	3.14	1.29
Request from intermediaries	2.36	1.35	(n/a)	(n/a)	2.42	1.32

Improving control and planning was found an important motivator in the Northern European survey. The evaluation of the motivators imply that the small logistics service providers typically offer basic, point-to-point transportation services and motivators that are often reported important in the SCM literature (e.g. integration to customers' logistics and production management systems) do not show great importance here,

particularly among the surveyed companies in Finland and Sweden. It is important to note that except for one large company, all surveyed companies are small or micro companies. A major driver for ICT implementation that explains the differences between companies is the customer industries' required service level. Companies serving industries that are technologically less advanced typically show lower implementation rates. However, depicting such differences from our survey is challenging since many of the surveyed companies serve more than one customer industry.

In the Italian survey, the respondents were asked to indicate the importance of particular motivators (see figure 4). Improving customer service (43%) and higher in-company integration (36.4%) are both considered of high importance by the respondents in Italy. Small companies often have limited skills and resources for any development activities, and priority is thus given to improving the companies' internal operations. Improve information exchange with supply chain partner and company competitiveness have been considered of medium importance, while the improvement of company's brand perception and the enlargement of customers base are considered of low importance in influencing ICT investment.

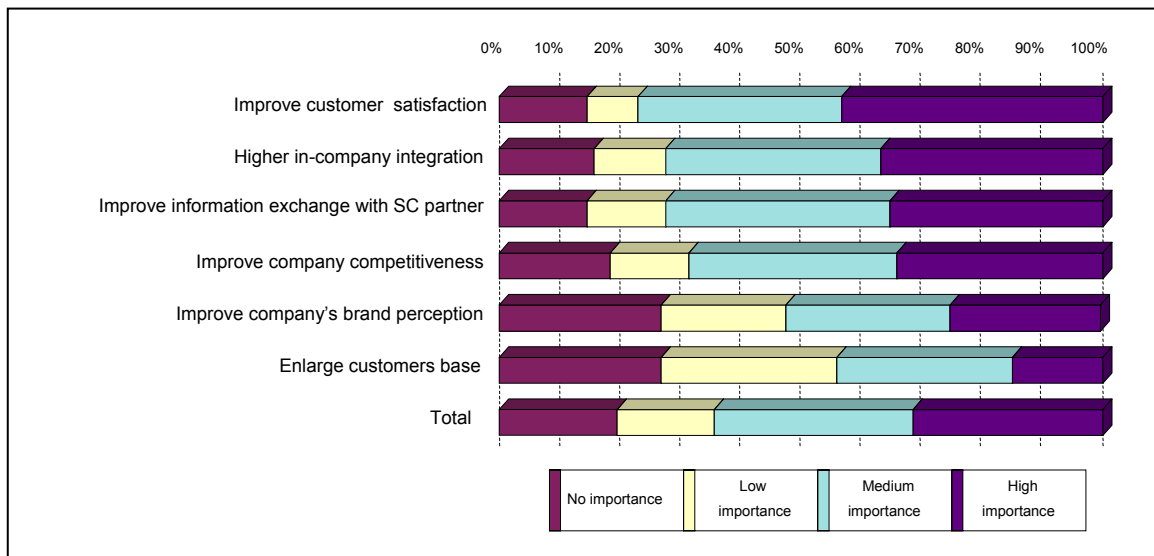


Figure 4: Logistics service providers' motivators for ICT implementation in Italy.

Barriers for ICT investment

Both surveys investigated the barriers that hindered ICT investment of small logistics service providers in the two regions. In the Northern Europe, the barriers for ICT investment and use were investigated in the Norwegian survey only and are reported in figure 5.

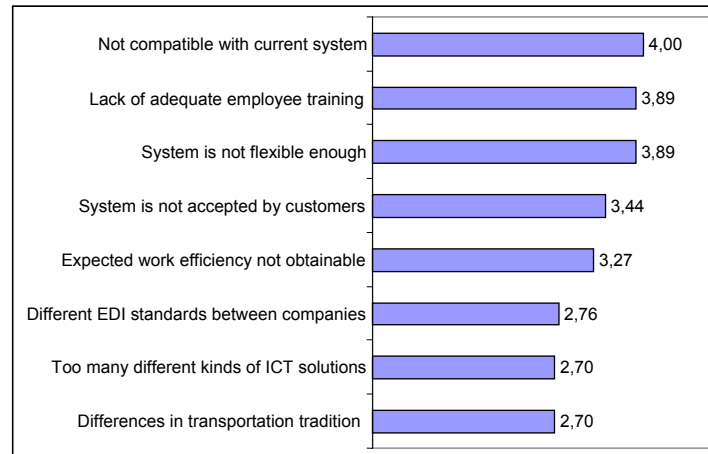


Figure 5: Barriers for ICT investment in Norwegian survey (scale: 0 = no importance, 5 = very important).

The Norwegian survey used a 5-point scale to measure the importance of the different barriers. The low level of compatibility with current system, lack of adequate employee training and system not being flexible enough were considered the most important barriers in this survey. Difficulties in system acceptance by customer and difficulties in achieving the planned level of work efficiency are both barriers of less importance.

With regard to the barriers inhibiting ICT investment in Italian companies, the analysis provides an interesting picture (see figure 6). The most important barrier that inhibits ICT investment is related to financial factors. The size of investment and the implementation costs, together with running costs, are considered the most influential barriers to ICT investment.

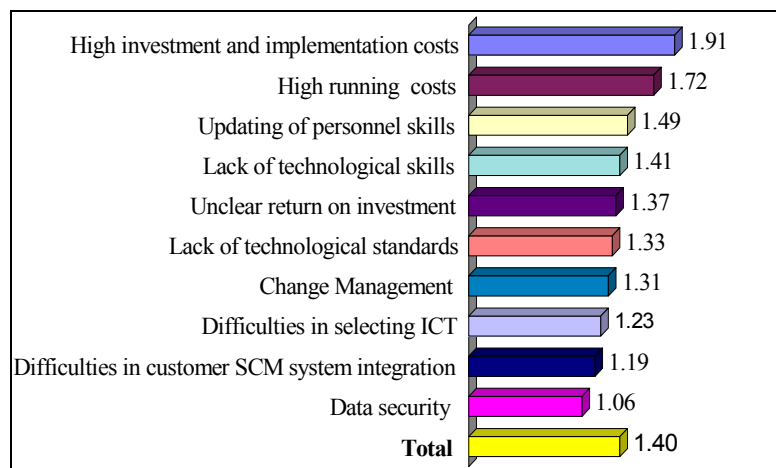


Figure 6: Barriers for ICT investment in the Italian survey (scale: 0 = no importance; 3 = very important).

A further group of factors related to human resources - particularly the need to upgrade the existing technological skills of staff together with the lack of ICT skills - seem to play an important role in inhibiting ICT expenditure. Finally, the importance given to the lack of technological standards and difficulties in selecting appropriate ICT tools and applications shows that the supply side of ICT products and services represents a further problematic issue in relation to the wider adoption of technology.

Plans for future ICT investment

In the Northern European survey, a question on the ICT adoption included a choice for plan to purchase a particular ICT tool (see figure 7). In all three surveyed countries in the Northern Europe, route planning software, EDI and GPS were most common tools that companies planned to purchase in the future. In addition, companies that had not yet adopted the Internet, planned to purchase it in the future. Hardly any company had plans to invest in WMS or bar code technology. The interviews conducted with the logistics service providers in Finland (Pekkarinen et al., 2004) confirm that there is an increasing pressure from the customer industries to implement technologies enabling tracking and tracing of goods. The survey results from the Northern Europe indicate that the surveyed logistics service providers are far behind the capability for offering product tracking and their do not have plans to invest in these capabilities.

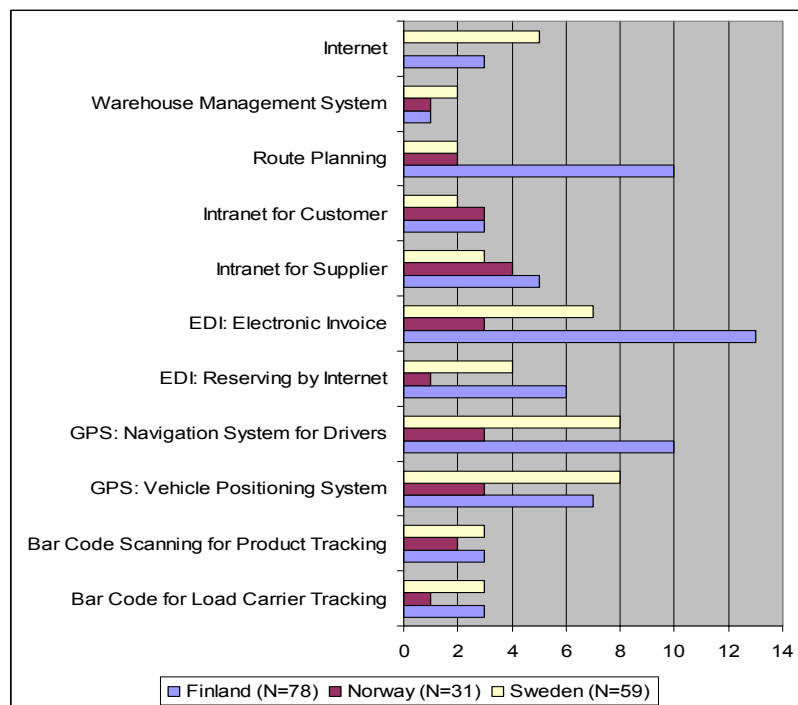


Figure 7: Number of companies planning to invest in different ICT tools in the Northern European Survey.

In the Italian survey directions of future ICT investment has been analysed considering general areas rather than a specific tool or system. Data shown in figure 8 provide details about the importance of future technological investment areas for the sample firms.

The emerging picture shows a stronger focus on competitive issues (cost reduction and competitiveness improvement) and customer service (error reduction, customer integration) rather than on company internal processes (internal functional integration, quality systems). Surprisingly, investment in the area of service differentiation and integration with other logistics service providers are considered of a lower importance.

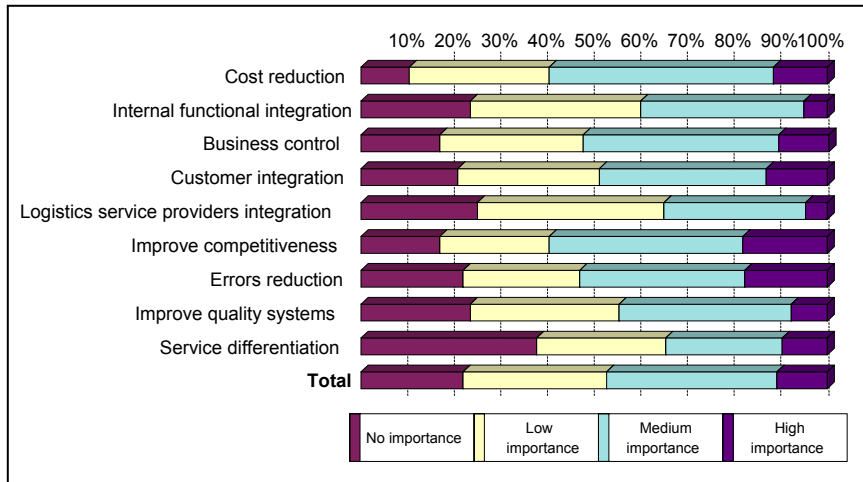


Figure 8: Importance of areas for future ICT investment in the Italian Survey.

Comparison of results

Logistics service industry is highly fragmented in both Northern and Southern Europe. The survey findings reported in this study consider small and medium-sized logistics service providers in two different study regions.

The results indicate that in both study regions, the majority of the logistics service providers are familiar with basic information technology and have some ICT tools available. In Italy, all companies have internet connection in place whereas in Northern Europe, not all companies have access to the internet and there are even companies that do not plan to move to the Internet-age. The EDI implementation is in a very incipient stage in Finland and Sweden, whereas 40% of the surveyed Norwegian companies and 47% of the surveyed Italian companies had adopted EDI. The GPS technology was most widely adopted by the logistics service providers in Finland in comparison to all other countries. Overall, companies in both study regions widely use basic technology tools (mobile phone, internet access, email) while the use of more sophisticated and advanced technologies is relatively low in the sample firms. This is particularly true for ICT tools that allow high level of interaction with customers (e.g. ERP, CRM). Small companies in the study regions do not typically have customised ICT solutions for planning or for other purposes.

Logistics service providers in both Northern and Southern Europe considered improvement of customer service level and better control and planning of its own operations for adopting ICT. Improving information exchange with other supply chain partners is also considered important.

Lack of compatibility with the current system, inadequate employee training, and system not being flexible enough were considered the most important barriers for ICT investment in the Northern Europe (Norway). In Italy, the ICT investment, implementation and the running costs were reported important barriers for ICT adoption. The questions in the Italian survey differed somewhat from the Norwegian survey, and it is thus not possible to make comprehensive comparisons here. However, the responses reveal some interesting differences in experienced barriers in Northern and Southern Europe. In Norway, lack of adequate employee training was considered a

very important barrier, while in Italy it was not the greatest barrier. The Italian survey also considered the ICT investment and implementation and the running costs, both being important barriers for ICT adoption. These costs are likely barriers in the Northern Europe as well, particularly at present when the price of diesel fuel has reached its peak and dramatically reduced companies' capability to invest in other purposes. Finally, the result from the two surveys put clearly in evidence the role of ICT supply as a barrier. Both surveys indicate the lack of technological standards as an important barrier for ICT investments, this being particularly true for the Northern survey.

Regarding the plans to invest in ICT tools, it seems that the Italian companies have started to look beyond the company boundaries and want use technology to improve interaction with customers and other supply chain partners. Logistics service providers in the Northern Europe seem to have more focus on improving company internal operations using ICT tools. In the North, companies do not have many ICT investment plans.

5. Conclusions and research implications

In supply chain management, ICT is used for several purposes, such as reducing transactions costs and supporting the collaboration and coordination of activities through information sharing between organisations. A number of case study evidence from the world leading companies has demonstrated the importance and success of the ICT tools in achieving network efficiencies. This article considered the ICT capability of small and medium-sized companies located in two different geographical areas. The results show that while external communication and information sharing needs are recognized in a number of sample firms, small logistics providers yet seek better coordination of internal functions within the company.

The logistics service industry in many European countries is highly fragmented and the average company size is very small. Small companies typically have limited resources (financial, skills) for development activities. Thus, the benefits of investing in modern ICT need to be clearly understood and achievable. New value adding services may justify the investment costs. For example, tracking and tracing of shipments throughout the supply chain is an increasingly common requirement in many industries. Small logistics service providers typically offer a limited range of value-adding services. ICT tools have the potential to enlarge the range of services offered by small logistics service providers. Furthermore, ICT could improve the customisation of services provided by these companies. The survey results put in evidence that this can be reachable if these companies will overcome the barriers for technological investment. In Italy, improvement of the financial situation of the micro and small logistics service providers would be needed to increase the ICT implementation as financial factors was considered the most important barriers for ICT implementation.

From a research point of view, a number of points seems to form a future research agenda in this field. Firstly, considering the increasing trend of customer industries requiring higher integration from their supply chain partners, future research has to focus on the specific information value-adding services that customer require. Secondly, it is also important to research the training needs associated to ICT use in small and

medium-sized companies. Thirdly, the role of ICT supply side in the innovation process of small logistics companies needs to be better assessed. Particularly, it is important to assess the gap between the needs of small and medium-sized logistics service providers and the current offerings of ICT vendors.

Finally, under the methodological point of view it is important to integrate findings emerging from the field surveys with a case study analysis. This improves internal and external validity of research and provides a more in depth and detailed analysis of main evidences achieved through the field surveys.

References

- Bagchi, P. and Virum, H. (1998) "Logistics Alliances: Trends and Prospects in Integrated Europe", *Journal of Business Logistics*, Vol. 19, No. 1, pp. 191-212.
- Berglund, M., van Laarhoven, P., Sharman, G. and Wandel, S. (1999) "Third party logistics: is there a future?", *International Journal of Logistic Management*, Vol. 10, No. 1, pp. 59-70.
- Berglund, M. (1997) *Third-Party Logistics Providers - Towards a Conceptual Strategic Model*, *Licentiate Thesis*, No. 7, International Graduate School of Management and Industrial Engineering, Department of Management and Economics, Linköping, Sweden.
- Cassivi, L., Lefebvre, E., Lefebvre, L. A. and Leger, P-M. (2004) "The Impact of E-collaboration Tools on Firms' Performance", *International Journal of Logistics Management*, Vol. 15, No. 1, pp. 91-110.
- Closs, D. J., Goldsby, T. J., and Clinton, S. R. (1997) Information technology influences on world class logistics capability, *International Journal of Physical Distribution & Logistics Management*, Vol. 27, No. 1, pp. 4-17
- Coyle, J., Bardi, E. and Langley, J. (1996) *The Management of Business Logistics*, West Publishing
- Delfmann, W., Albers, S. and Gehring, M. (2002) The impact of electronic commerce on logistics service providers, *International Journal of Physical Distribution & Logistics Management*, Vol. 32, No. 3, pp. 203-222.
- Eurostat (2003) *Panorama of Transport - Statistical overview of transport in the European Union, 1970-2001 - Part 2*, Office for Official Publications of the European Communities, Luxembourg, pp. 47-49.
- Evangelista, P. and Sweeney, E., (2006) "Technology usage in the supply chain: the case of small 3PLs", *International Journal of Logistics Management*, Vol. 17, No. 1, pp. 55-74.
- Federtrasporto (2003) "L'internazionalizzazione del trasporto: la posizione dell'Italia", *Bollettino Economico sul Settore dei Trasporti*, No. 10, Rome, Italy. (in Italian)
- Gunasekaran, A. and Ngai, E. W. T. (2003) "The successful management of a small logistics company", *International Journal of Physical Distribution & Logistics Management*, Vol. 33, No. 9, pp. 825-842.
- Harvey, J. (2003) "Where is the 3PL industry heading -trends, threats & opportunities? Tibbett & Britten: a case study", presentation given at the Eyefortransport 3PL Summit, 14th October, 2003, London, UK.
- Kilpala, H., Solvang, W. D., Widmark, J., Bagaeva, A. and Tuohinto, P. (2005) "Analysis of ICT use in the Barents region: research findings from logistics service providers and forest industry", *STBR (Sustainable Transport in the Barents Region) Publications 11/2005*, ISBN 952-5549-18-6, Available at <http://www.barentsinfo.fi/stbr/> (accessed 11.09.2006)
- KPMG (2003) "Logistica integrata ed operatori di settore: trend e scenari evolutivi del mercato Italiano", *KPMG Business Advisory Services*, Milan, Italy. (in Italian)
- Langley, C. J., Allen, G. R. and Tyndall, G.R. (2002) "3PL - Results and findings of the 2002 Seventh Annual Study", Annual Report.
- Larson, P. and Gammelgaard, B. (2001) "Logistics in Denmark: a survey of the industry", *International Journal of Logistics: Research and Applications*, Vol. 4, No. 2, pp. 191-205.
- Lieb, R. (1992) "The use of third-party logistics services by large american manufacturers", *Journal of Business Logistics*, Vol. 13, No. 2, pp. 29-42.
- McKinnon, A. (1999) "The outsourcing of logistical activities", Waters D. (edited by) *Global logistics and distribution planning*. London: Kogan Page, pp. 215-234.
- Murphy, P. R. and Poist, R. F. (1998) "Third party logistics usage: an assessment of propositions based on previous research", *Transportation Journal*, Vol. 37, No. 4, pp. 26-35.

- Pekkarinen, S., Väyrynen, L., Juga, J. and Kilpala, H. (2004) ”Matkalla Asiakkuuksien Kehittäjäksi – Logistiikkayritysten Asiakaslähtöinen Ongelmanratkaisukyky ja Joustavuus, *Publications of the Ministry of Transport and Communications*, 69. (in Finnish)
- Peters, M., Cooper, J., Lieb, R. C. and Randall, H. L. (1998) “The third-party logistics industry in Europe: provider perspective on the industry’s current status and future prospects,” *International Journal of Logistics: Research and Applications*, Vol. 1, No. 1, pp. 9-25.
- Pokharel, S. (2005) “Perception on information and communication technology perspectives in logistics - A study of transportation and warehouse sectors in Singapore”, *The Journal of Enterprise Information Management*, Vol. 18, No. 2, pp. 136-149.
- Punakivi, M. (2004) “Logistiikkatoimialan Yrityskartoitus”, *Report by the Centre of Expertise for Logistics*, Helsinki, Finland. (in Finnish)
- Regan, A. C. and Song, J. (2001) “An industry in transition: third party logistics in the information age”, proceedings of the 80th Annual Meeting of the Transportation Research Board, January, Washington DC, USA.
- Sauvage, T. (2003) “The relationship between technology and logistics third-party providers,” *International Journal of Physical Distribution & Logistical Management*, Vol. 33, No. 3, pp. 236-253.
- Sink, H., Langley, J. and Gibson B. (1996) “Buyer observations of the US third-party logistics market”, *International Journal of Physical Distribution & Logistics Management*, Vol. 26, No. 3, pp. 38-46.
- Sweeney, E. and Evangelista, P. (2005) “Third party logistics (3PL): definition and taxonomy”, *Logistics Solutions*, Vol. 8, No. 3, pp. 9-10.
- van Hoek, R. (2002) “Using information technology to leverage transport and logistics service operations in the supply chain: an empirical assessment of the interrelation between technology and operation management”, *International Journal of Information Technology and Management*, Vol. 1, No. 1, pp. 115-130.
- van Hoek, R. (2000) “The role of third-party logistics providers in mass customization”, *The International Journal of Logistics Management*, Vol. 11, No. 1, pp. 37-46.
- van Laarhoven, P., Berglund, M. and Peters M., (2000) “Third-party logistics in Europe - five years later”, *International Journal of Physical Distribution & Logistics Management*, Vol. 30, No. 5, pp. 425-442.
- Virum, H. (1993) “Third party logistics development in Europe”, *Logistics and Transportation Review*, Vol. 29, No. 4, pp. 355-361.



Approaches to supply chain logistics integration in the textile/clothing sector: an exploratory study in the Region of Campania

Marcella De Martino ^{1*}, Alessandra Marasco ¹

¹ *Institute for Service Industry Research (IRAT), National Research Council (CNR), Naples, Italy*

Abstract

Given its potential to reduce lead times and total costs of operations, increase delivery speed, responsiveness and flexibility, and ultimately customer satisfaction, supply chain logistics integration can help to improve the competitiveness of the Italian textile and clothing (T/C) firms. However, few research works on supply chain management in general, and few studies on logistics integration in particular have focused their attention on this sector. This paper analyses the approaches to supply chain logistics integration adopted by T/C companies located in the Region of Campania (Southern Italy) through a qualitative approach based on case studies. The preliminary findings of the study highlight that the prevailing approach to supply chain logistics integration is limited to functional boundaries within the firm.

Keywords: Supply chain logistics integration; Textile and clothing; Region of Campania.

Introduction

In the past years, European textile and clothing (hereinafter referred to as T/C) manufacturers have been facing unprecedented competitive pressures generated by the increasing globalisation trend, the process of trade liberalisation and the decline in international consumption. To cope with these pressures, the industry out-sourced operations with a lower value-added and re-engineered activities resorting to a higher use of quick response and more general applications of computer-aided techniques for design, cutting and finishing (Taplin and Winterton, 1997; Stengg, 2001). Despite these efforts, the increasing penetration of imports from low-wage newly industrialized countries makes competition on price more aggressive and the higher market volatility drives T/C manufacturers to get additional efficiency from extant production systems (Taplin, 2006).

* Corresponding author: Marcella De Martino (m.demartino@irat.cnr.it)

Notwithstanding its unique profile in the international scenario, also the Italian T/C industry has been subject to the tensions affecting this sector in other advanced industrialized countries. In the four-year period 2002-2005, T/C turnover in Italy declined by round 7 % and exports recorded a negative trend, leading to an over 10 % reduction in trade balance surplus (Smi-Ati, 2006). Despite the economic slowdown, the Italian T/C industry has maintained its leading position in the European scenario. Many manufacturers have been at the forefront of industrial upgrading, striving to compete on design, quality and fashionability, thus remaining in high value-added market segments. They also focused on rapid product innovation in order to enhance their brand power and offer “cutting edge” products that anticipate market trends (Burresti and Guercini, 2003).

While thanks to its creativity and product quality the Italian T/C industry has been able to maintain its competitive advantage vis-à-vis the rest of the world (Saviolo, Testa, 2000; Guercini, 2004), the rising complexity of the competitive scenario requires additional efforts aimed at optimising and integrating operations along the supply chain. Specifically, the major challenge that firms of this sector are facing is to meet the requirements of high quality products, minimal lead times and high flexibility while meeting a consumers' demand characterised by high levels of volatility (Vona, 2003; Galli e Brun, 2004; Boscacci, Lucca and Maggi, 2005). As Italian T/C companies are confronted with the need to focus on style and quality - while improving their operations so as to reduce lead times and achieve high flexibility - effective supply chain management (SCM) and supply chain logistics integration become increasingly critical factors. The integration of logistics activities amongst the supply chain members can significantly support Italian T/C firms' efforts to face the constantly changing competitive scenario, allowing for its potential to reduce redundancy and duplication costs, improve delivery times, responsiveness and flexibility and, ultimately, customer satisfaction (Stank et al., 2001). The supply chain logistics integration can potentially play an even more crucial role for the competitiveness of Italian T/C firms, given the high proportion of small-sized companies in the sector and the increased internationalisation of sub-contracting practices (Guercini, 2004), which combine to generate highly fragmented supply chains and, consequently, a higher logistical demand.

Given this scenario, this paper analyses the approaches to supply chain logistics integration adopted by the T/C companies of the Region of Campania. This paper is sub-divided as follows. In the first section, the concept of supply chain logistics integration is introduced, analysing the essential features of logistics process integration within the supply chain management. The integration of logistics activities along the supply chain is identified as a crucial leverage to achieve a higher performance. An overview of the structure of the T/C sector in the Region of Campania is then provided to better describe the area investigated. The methodology applied in this study is then illustrated and the preliminary findings of the research work are presented. Finally, in the last section the authors draw some conclusions and implications that might be useful for further research.

Supply chain logistics integration

In the past decade, literature and practice focused their attention on the integrated management of supply chain processes, also referred to as Supply Chain Management (SCM). The conventional wisdom in most supply chain management literature is that “the more integration - the better the performance of the supply chain” (Bagchi and Skjoett-Larsen, 2005). Indeed, the major assumption behind the SCM concept is that there is an economic rationale in integrating and coordinating activities and processes carried out in sequence (Christopher, 1992; Hakansson and Persson, 2004).

In this respect, the logistics function plays a key role. Logistics has been traditionally defined as the process of planning, implementing and controlling the efficient flow and storage of goods, services and related information from the point of origin to the point of consumption in order to meet customers’ requirements (Council of Logistics Management, 1998). Given its “boundary-spamming” nature, logistics can be used as a vehicle for cross-functional integration (Morash et al., 1996) as well as for coordination and integration of activities along the chain (Langley and Holcomb, 1992; Bowersox and Closs, 1996; Min and Keebler, 2001). Overall, in the SCM literature there is general agreement that competitive supply chains employ well-integrated logistical processes (Stank et al., 2001).

The traditional approach of logistics integration focused on functional boundaries within a firm (Bowersox and Daugherty, 1987), whereas a more recent approach of logistics integration expands the scope of integration across firm boundaries along the entire supply chain (McGinnis and Kohn, 1990; Stock et al., 1998, 2000). In this respect, supply chain logistics integration is characterized by the integration of logistics activities across functional departments within the firm, as well as by the integration of the firm’s logistics activities with the logistics activities of other supply chain members (Stock et al., 1998). This notion of supply chain logistics integration reflects the growing importance of logistics as a coordinating mechanism amongst the actors of the supply chain and, ultimately, as a source of customer value and competitive advantage (Chen and Paulraj, 2004).

Research on the topic has provided evidence of an increased operational and/or organizational performance as result of the integration of logistics processes within and across firm’s boundaries. Larson (1994) reported a significant relationship between inter-organizational logistics integration and total costs reduction. Ellinger et al. (1997) provided empirical support for the relationship between integrated management of logistics activities and customer service performance. Stock et al. (1998, 2000) found high levels of internal and external logistics integration to be crucial for improving the performance of firms in extended manufacturing supply chains. Empirical evidence supporting the link between logistics integration and superior operating performance has been also provided by Bowersox et al. (1999) and Stank et al. (2001).

However, research works on supply chain management in general (Bruce, Daly and Towers, 2004) and studies on logistics integration in particular have usually neglected this sector.

The textile/clothing sector in the Region of Campania: an overview

The notable dimension of the Italian T/C sector is still an element that distinguishes Italy from other European countries with high labour costs (Stengg, 2001; Guercini, 2004; Taplin, 2006). The T/C sector represents a substantial share of the Italian manufacturing industry (over 9 % of the turnover and 12% of the total employees working in this industry). These figures are considerably higher than EU average, accounting for 3.7 % of turnover and 7.2 % of employees in the manufacturing industry (Eurostat, 2003). The peculiarity of the Italian T/C sector within the European scenario is also due to a number of differences concerning the industrial organization of the manufacturing process and the structure of the apparel distribution channels (Guercini, 2004). With regard to the manufacturing process, a striking feature is the considerable number of Italian T/C firms, most of which are quite small and locally aggregated in industrial districts. As to the distribution channels, independent and traditional retailers cover the largest market share, whereas other European countries are characterized by an increasing predominance of large distribution chains and specialised chains.

Analysing the regional distribution of the Italian T/C industry, round 26% of the firms in this sector are based in Southern Italy. Campania is the second region, following Puglia, with 31% of the total T/C firms in this area (Consorzio Promos Ricerche, 2005). The profile of the T/C firms in the region reflects the specificities of the sector at the national level in terms of both industrial organization and distribution structure. The vast majority of T/C firms operating in the region are small and medium-sized enterprises (SMEs) locally aggregated in the five industrial districts ratified by the Campania region¹ (Grumo Nevano-Aversa, Calitri, Sant'Agata dei Goti, San Marco dei Cavoti and San Giuseppe Vesuviano). Moreover, as for the whole Italian T/C industry, the retail distribution of apparel in the region consists of independent retailers that, despite the recent decline of their market share, still hold a leading position within the total market of apparel consumption.

The region is characterized by a strong vocation for clothing, with over 80% of the firms in the sector focusing on apparel manufacturing (Table 1).

Table 1: Campania T/C sector – number of firms.

	2001		2005	
	No.	%	No.	%
Textile	864	18	1204	19
Clothing	3855	82	5224	81
Total	4719	100	6428	100

Source: Consorzio Promos Ricerche, 2005.

Specifically, apparel companies can be sub-divided into two main groups. The first group includes few companies with strong brands that are successfully positioned on the national and international markets and cover upper-class niche segments. The second

¹ It is worth noting, however, that in most cases the mechanisms of exchange, generation and reproduction of intangible resources (knowledge, trust) and the integrated set of social and economic relations that usually characterize the entrepreneurial approach in the industrial district do not fully work within these local systems. In this respect, the traditional economic notion of “industrial district” cannot be fully applied to the regional systems specialized in T/C (Izzo and Ricciardi, 2006).

group comprises the vast majority of very small firms typically specialised in single activities of the apparel manufacturing cycle (cutting, sewing, ironing, etc.) and acting as subcontractors for larger firms at the local or national level. As illustrated in Table 1, textile manufacturers are a small percentage of the T/C firms in the region; most of them are specialized in top quality products, such as fine fabrics for furnishings targeted to the end user market.

The complex and fragmented structure of the T/C pipeline in the region is illustrated in Figure 1.

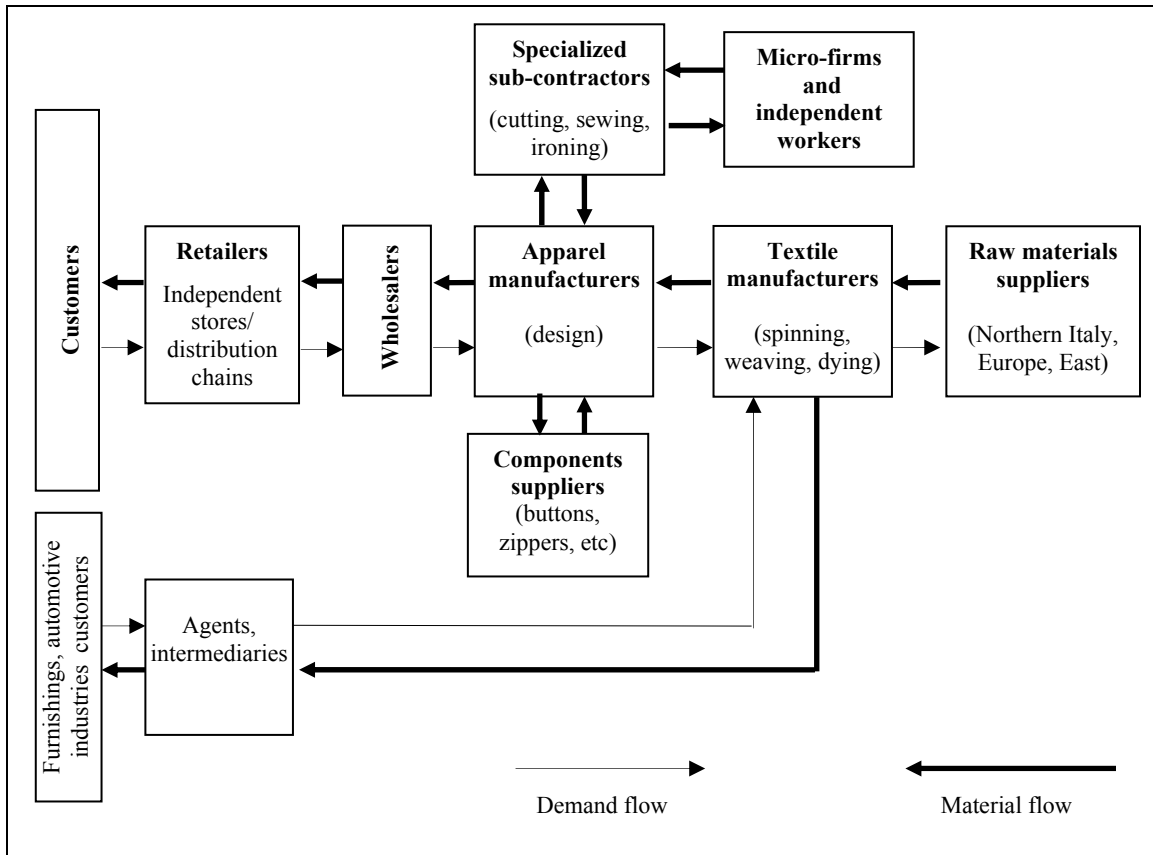


Figure 1: Campania textile/clothing pipeline.
Source: adapted from Izzo and Ricciardi (2006).

Research methodology

As already mentioned, the research was of an exploratory type being focused on an industry where few research works on supply chain logistics integration had been previously conducted. For this reason a qualitative approach was chosen, based on case studies. Indeed, the case method lends itself to early, exploratory investigations in areas where the variables are still unknown and the phenomenon is not fully understood (Meredith, 1998; Stuart et al., 2002). This approach gave us the necessary background to gain a first insight into the complex phenomenon of supply chain logistics integration in the T/C sector as a first step to outline questions and assumptions for a following study (Voss et al., 2002; Yin, 1994). Case studies were aimed at identifying and

comparing the approaches through which logistics integration (if any) is achieved from the perspective of T/C manufacturers.

The research work was sub-divided into three stages. In the first stage, loosely structured interviews with a range of industrial stakeholders, mainly belonging to the Campania T/C trade associations, were carried out to better identify questions and criteria for case selection. In particular, discussions with experts highlighted the need to exclude from the research the firms operating as subcontractors for larger T/C companies. Actually these firms have a low potential of logistics integration in the wider supply chain context and their priority seems to be reducing their dependency on larger companies by creating their brand identity. An initial list of potential firms to be included in the research work was then made including companies facing potentially relevant logistics demands also allowing for the international scope of their business. Case selection was based on companies' diversity in terms of manufacturing specialisation (clothing or fabrics), type of production (ready to wear or planned seasonal production) and critical success factors (cost or quality).

In the second stage, three case studies were conducted involving two apparel manufacturers and one fabric producer. A semi-structured interview guide was used to gather data on the following issues:

(1) General characteristics of the company (e.g. number of employees, type and range of products, markets served).

(2) General description of the company's supply chain in terms of activities, relationships and actors involved.

(3) Approach to logistics integration. In particular, based on the review of the relevant literature (e.g. Bowersox et al., 1999; Stank et al., 2001; Stock et al., 1998, 2000), the approach to supply chain logistics integration was captured and analysed in terms of:

(a) Internal logistics integration across its functional boundaries, denoted by the degree of interaction of logistics activities with other functional areas. Indications of internal integration include a number of features such as: organizational culture encouraging openness and teamwork; increased communication (electronic and interpersonal) between logistics and other departments; coordination of logistics activities with other departments through cross-functional work teams, procedures and performance standards/measures.

(b) External integration of logistics activities across the firm's boundaries, denoted by the degree of integration of the firm's logistics activities with the logistics activities of its suppliers and customers. External integration includes, for example: structural adjustment of logistics facilities and network; development of customer-specific logistics programs; organizational culture encouraging inter-firm collaboration (e.g. through a shared mental framework with customers and suppliers, sharing of strategic information with selected suppliers and/or customers); electronic and interpersonal communication with customers and suppliers (e.g. through the use of cross-organizational information systems, frequent formal meetings, frequent informal communication); coordination of logistics activities with operations carried out by customers and suppliers (e.g. through cross-enterprise work teams, cross-enterprise and overall supply chain performance standards and measures, shared rewards and risk systems).

As to data collection, the company's owners and the managers responsible for the strategic setup and daily operations of the logistics activities were interviewed. In

addition to the interviews, the company's documents and websites were analysed and used for data collection.

In the last stage, the research findings were analysed within and across the three case studies to draw some conclusions based upon the results obtained.

Preliminary findings

Three companies were investigated to understand the approaches to supply chain logistics integration adopted in the textile/clothing sector in the Region of Campania, namely two apparel manufacturers and a fabric producer. Although the sample size is small and the results may not have any statistical significance, these case studies might provide interesting insights into the topic under investigation.

Table 2 includes key information concerning the companies analysed and their logistics integration practices.

Company A

Company A is a small apparel manufacturer of women's wear for the ready to wear apparel mass market. The company is part of a group of three firms operating at different points of the textile and apparel chain, namely a fabric producer, an apparel manufacturer (company A) and a wholesale retailer respectively. The company's success primarily relies on cost efficiency that enables it to compete very aggressively on price in both the national and European market. The company's supply chain is illustrated in fig. 2.

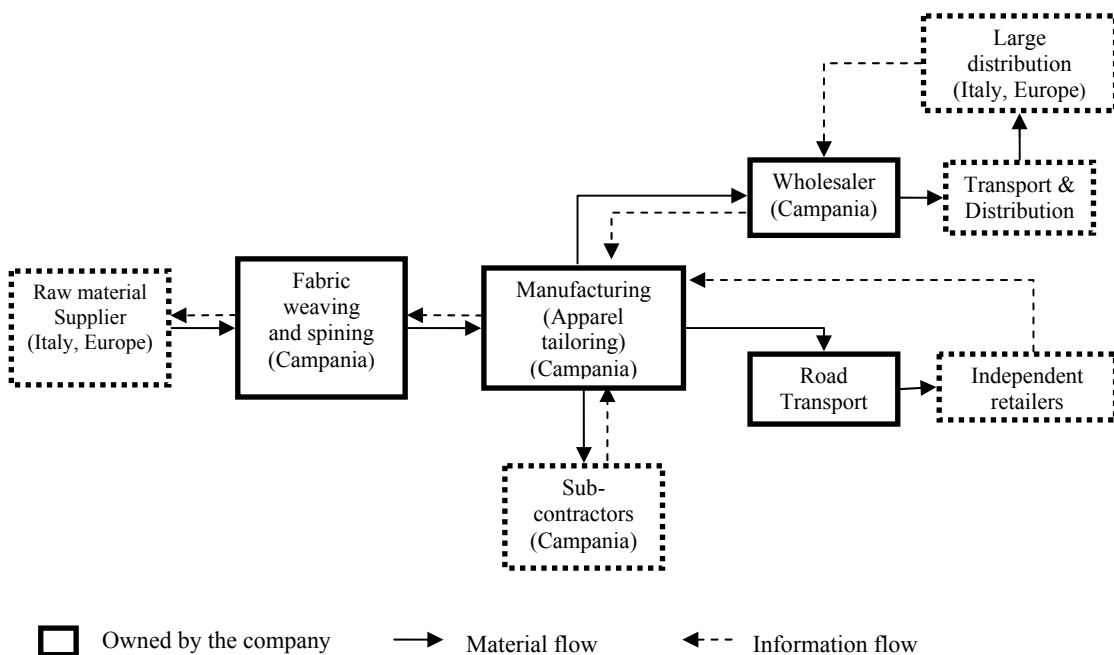


Figure 2: The supply chain of company A.

The company purchases most of its textile fabrics from the group's fabric producer and relies on the group's retailer for the wholesale of its products, which are mostly placed on the national market by large distribution firms. Manufacturing activities (cutting, sewing, ironing, etc.) are outsourced to a group of about ten local small sub-contractors with whom the company has established close, long-term partnerships; this enables it to achieve cost efficiency and production flexibility.

For better co-ordinating its operations with those performed by the other firms of the group, the company recently implemented structural adjustments of its logistics facilities. In particular, a large centralised warehouse was created to store fabrics and finished products. This facility is an integration interface for the logistics operations within the group as well as between the company and its suppliers (small sub-contractors). Integration of logistics activities is also facilitated by a close relationship with the sub-contractors that results in collaborative practices associated with the execution of manufacturing operations as well as with logistics issues. Actually, the collaboration between the company and its selected suppliers makes it possible to have a constant exchange of information related to production quality, schedules and delivery, thus enhancing coordination of operations.

As to transport and distribution of finished products, the company adopted two different procedures. Transport of products to large distribution chains is outsourced by the group's wholesaler to express couriers selected based upon the final destination and the logistical requirements of the consignments. The degree of satisfaction of these customers is monitored through a formal program based on monthly reports. By contrast, transport of finished products to independent retailers is carried out by company A with its own logistical resources so as to guarantee flexible deliveries.

Company B

Company B is a small premium brand manufacturer of men's wear and women's wear. Its brand is well known at the international level, with over 70% of its total sales absorbed by the European and U.S. markets. It is a young company in its sixth year of trading, with ten employees. The company strategy is to be viewed as one of the exclusive Italian brands in design, a modern company with a top-quality design profile. To this end, it heavily invests in design skills and has two full-time designer employees. Along with design, sourcing of materials is another critical area for the company's success, which significantly relies on the high quality and innovativeness of the textile fabrics used. Figure 3 illustrates the company's supply chain.

Most fabrics are purchased from Italian leader producers directly. Manufacturing of finished garments is outsourced to a group of about fifteen small local laboratories having stable relationships with the company. Recently, the company invested in a new computer system that makes it possible to track the development stage for each batch of fabrics and garments. Despite the availability of an advanced IT system, data/information sharing with the manufacturers still relies on traditional communication devices, such as telephone and fax. To speed up the process and increase its effectiveness, Company B is urging its suppliers to adopt and implement IT systems. Finished products are distributed in Western Europe and U.S. markets through Italian and foreign agents. Transport is totally outsourced based on short-term contracts with express couriers (such as DHL, TNT and Ambrosetti Group) selected by the

company on the basis of different geographical areas and the clients' specific logistics requirements.

The company's internal logistics integration is primarily denoted by the blurred distinction between logistics and other areas of the firms, by the high level of communication (both electronic and interpersonal) amongst the company staff.

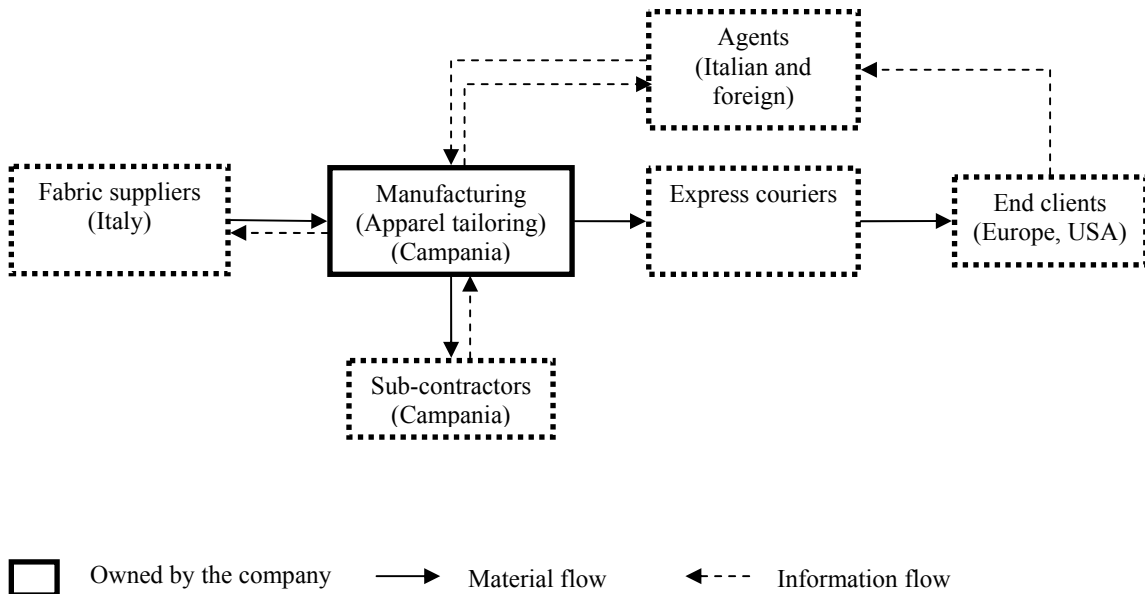


Figure 3: The supply chain of company B.

Coordination of logistics flows between the company and its suppliers (both raw materials and sub-contractors) is achieved through the centralised management of warehousing. Despite the possibility to plan these flows in advance (planned seasonal production), the deficiency of logistics facilities that characterises its sub-contractors forces the company to have a high stock of raw materials.

Company C

Company C is specialised in producing fabrics for furnishings. It has a long-established tradition (dating back to 1885) and employs over 200 people. The company's critical success factors are design and high quality of products that in the past decade enabled it to increase its market share at worldwide level. Following the increase in competition, the company made its major efforts to strengthen its brand reputation as a way to protect itself against cheaper products; it invested in R&D to develop top quality, innovative fabrics. Its final market is mainly an international market (Europe, U.S.A and Arab Countries) while the national market accounts only for 30% of its total sales. The company's supply chain (fig. 4) shows a quite linear structure due to the low number of external actors involved in the processes.

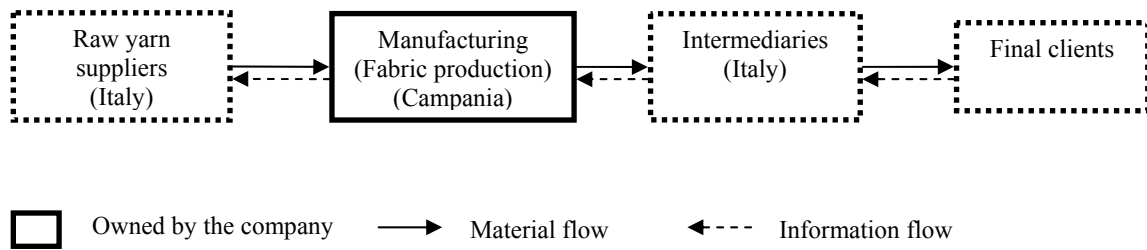


Figure 4: The supply chain of company C.

The company purchases raw yarns from few Italian high profile suppliers with which it has established long-term partnerships. Production is totally carried out in-house by highly skilled personnel so as to guarantee a high quality level, while distribution is carried out by a group of about forty Italian specialised intermediaries. Transport is totally outsourced to express couriers.

Table 2: Approaches to supply chain logistics integration adopted by the firms investigated.

	<i>Company A</i>	<i>Company B</i>	<i>Company C</i>
Firm's characteristics			
Product	Women's wear	Women's wear, Men's wear	Fabrics for furnishings
Production	Ready to wear production	Planned seasonal production	Planned seasonal production
Market	Italy, Europe	Europe, USA	Europe, USA, Italy
Critical success factors	<ul style="list-style-type: none"> • Cost leadership 	<ul style="list-style-type: none"> • High quality design • Innovativeness of the fabrics used 	<ul style="list-style-type: none"> • Brand reputation • High quality products • High quality design
Main features of the supply chain	<ul style="list-style-type: none"> • Vertical integration • Outsourcing of low value-added manufacturing activities to small sub-contractors 	<ul style="list-style-type: none"> • Outsourcing of low value-added manufacturing activities to small sub-contractors • Distribution through agents 	<ul style="list-style-type: none"> • Direct sourcing of raw materials from few Italian suppliers • Production totally performed in-house • Distribution through intermediaries
Logistics integration			
Internal	<ul style="list-style-type: none"> • Single centralised warehouse for fabrics and finished products 	<ul style="list-style-type: none"> • Enterprise information system 	<ul style="list-style-type: none"> • Enterprise information system • Cross-functional work team
External with suppliers	<ul style="list-style-type: none"> • Centralised warehouse 	<ul style="list-style-type: none"> • Centralised warehouse 	<ul style="list-style-type: none"> • Long-term partnerships
External with customers	<ul style="list-style-type: none"> • In house transport of finished products to independent retailers 		

An Enterprise information system (ERP) guarantees the coordination of logistics activities amongst the firms' departments. However, the company has recently set up a cross-functional work team charged with developing and implementing a formal

procedure to facilitate information sharing and reporting amongst the various departments. By contrast, external integration can be found in the management of upstream flows only, coordinated through long-term partnerships with few and selected raw materials suppliers responsible for the transportation of raw yarns to the company site. The close relationship with these suppliers guarantees both frequent, on time and reliable deliveries and a good level of flexibility associated with the demand variability.

Conclusions

Given the crucial role that might be played by supply chain logistics integration for the competitiveness of T/C firms, this paper aims at providing an insight into the approaches to logistics integration through a multiple case analysis of T/C companies based in the Region of Campania (Southern Italy).

Based upon the findings of the research work, the companies investigated seem to be oriented towards an internal logistics integration. Such an integration is differently achieved through a centralised warehouse for raw materials and finished products, electronic and interpersonal communication amongst the firm's staff and cross-functional work teams. This is likely to be relevant as far as the achievement of supply chain logistics integration is concerned in that the relevant literature reckons intra-company integration to be a pre-requirement for inter-company integration. Actually, one of the major obstacles to fully integrating materials and information flows across the supply chain lies in the inadequacy of the internal management systems of the individual firms - e.g. fragmentation in information flows, lack of integration amongst different company's departments/functions, low level of rationalisation and standardisation in operational processes (Hamblin and Groves, 1995; Forza et al., 2000; Simchi-Levi et al., 2000, Romano, 2003). However, findings provide little evidence for external logistics integration, which in the firms investigated appears to be limited to the upstream flows in the supply chain (i.e. involvement of raw materials and finished products suppliers in planning and organizing logistics activities).

In summary, the cross-case analysis highlights that the prevailing approach to supply chain logistics is limited to functional boundaries within the firm regardless of the specific characteristics of the companies. This apparently leads to question the importance of the type of production – ready to wear versus planned seasonal production - and market orientation of the firm - basically price versus quality - as variables that might have an impact on the extent of the supply chain logistics integration. In this respect, efforts to collect data on a large sample of firms should be made - including the perspectives of other actors within the supply chain (especially retailers - to support more exhaustive and final conclusions as to the status of supply chain logistics integration in the sector.

References

- Bagchi, P. K. and Skjoett-Larsen, T. (2005) "Supply chain integration: a European survey", *International Journal of Logistics Management*, 16 (2) pp. 275-294.
- Boscacci, F., Lucca, D. and Maggi, E. (2005) *I servizi di logistica per la competitività della filiera italiana della moda*, Politecnico di Milano, Isfort, available at: <http://www.isfort.it/>
- Bowersox, D. J. and Closs, D. J. (1996) *Logistical management: The integrated supply chain process*, McGraw-Hill, New York.
- Bowersox, D. J. and Daugherty, P. J. (1987) "Emerging patterns of logistical organization" *Journal of Business Logistics*, 8 (1), pp. 46-60.
- Bowersox, D. J., Closs, D. J. and Stank, T. P. (1999) *21st Century Logistics: Making Supply Chain Integration a Reality*, Council of Logistics Management, Oak Brook, IL.
- Bruce, M., Daly, L. and Towers, N. (2004) "Lean or agile. A solution for supply chain management in the textiles and clothing industry?" *International Journal of Operations & Production Management*, 24 (2), pp. 151-170.
- Burresi, A. and Guercini, S. (2003) "Nuovi attori e integrazione di funzioni nel marketing strategico della distribuzione", Proceedings from the International Conference "Marketing trends in Europe", Venice, 28-29 November.
- Chen, I. J. and Paulraj, A. (2004) "Understanding supply chain management: critical research and a theoretical framework" *International Journal of Production Research*, 42 (1), pp. 131-163.
- Christopher, M. (1992) *Logistics and supply chain management*, Pitman Publishing, London.
- Consorzio Promos Ricerche (2005) *Import-export in Campania*, Assessorato all'Agricoltura ed alle Attività Produttive della Regione Campania.
- Council of Logistics Management (1998) retrieved from the World Wide Web: www.clm1.org/
- Ellinger, A. E., Daugherty, P. J. and Gustin, C. M. (1997) "The relationship between integrated logistics and customer service" *Transportation Research - Part E*, 33 (2), pp. 129-138.
- Eurostat (2003), available at: <http://europa.eu.int/comm/enterprise/textile/statistic.htm>
- Forza, C., Romano, P. and Vinelli, A. (2000) "Information technology for managing the textile apparel chain. Current use, shortcomings and development directions" *International Journal of Logistics: Research and Applications*, 3 (3), pp. 227-243.
- Galli, B. and Brun, A. (2004) "Un approccio per migliorare i processi logistici nel settore tessile" *Logistica Management*, January-February, pp. 75-84.
- Guercini, S. (2004) "International competitive change and strategic behaviour of Italian textile-apparel firms" *Journal of Fashion Marketing & Management*, 8 (3), pp. 320-339.
- Hakansson, H. and Persson, G. (2004) "Supply Chain Management: The Logic of Supply Chains and Networks" *International Journal of Logistics Management*, 15 (1), pp. 11-26.
- Hamblin, D. and Groves, G. (1995) "Managing advanced manufacturing technology in the clothing industry" *The Journal of Clothing Technology and Management*, 12 (2), pp. 1-12.
- Izzo, F. and Ricciardi, A. (2006) *Relazioni di cooperazione e reti di imprese. Il caso della Campania*, Franco Angeli, Milano.
- Langley, J. C. Jr. and Holcomb, M. C. (1992) "Creating customer logistics value" *Journal of Business Logistics*, 13 (2), pp. 1-27
- Larson, P. D. (1994), "An empirical study of inter-organizational functional integration and total costs" *Journal of Business Logistics*, 15 (1), pp. 153-169.
- McGinnis, M. A. and Kohn, J. W. (1990) "A factor analytic study of logistics strategy" *Journal of Business Logistics*, 11 (2), pp. 41-63.
- Meredith, J. (1998) "Building operations management theory through case and field research" *Journal of Operations Management*, 16 (4), pp. 441-454.
- Min, S. and Keebler, J. S. (2001) "The role of logistics in the supply chain", In: Mentzer, J.T. (eds), *Supply Chain Management*, Sage Publications Inc., Newbury Park, CA.
- Morash, E. A., Droge, C. L. and Vickery, S. K. (1996) "Boundary spanning interfaces between logistics, production, marketing and new product development" *International Journal of Physical Distribution & Logistics Management*, 26 (8), pp. 43-62.
- Romano, P. (2003) "Coordination and integration mechanisms to manage logistics processes across supply networks" *Journal of Purchasing and Supply Management*, 9, pp. 119-134.

- Saviolo, S. and Testa, S. (2000) *Le imprese del sistema moda. Il management al servizio della creatività*, RCS Libri, Milano.
- Simchi-Levi, D., Kaminsky, P. and Simchi-Levi, E. (2000) *Designing and Managing the Supply Chain. Concepts, Strategies, and Case Studies*, Irwin McGraw-Hill, New York.
- Smi-Ati, Federazione Imprese Tessili e Moda Italiane (2006) *Il tessile-moda italiano nel 2005 e nei primi mesi del 2006*, available at: http://www.smi-ati.it/documenti/centrostudi/TA2006_aprile_def.pdf
- Stank, T. P., Keller, S. B. and Closs, D. J. (2001) "Performance benefits of supply chain logistical integration" *Transportation Journal*, Winter/Spring, pp. 32-46.
- Stengg, W. (2001) "The textile and clothing industry in the EU" *Enterprise Papers*, No. 2-2001, European Commission, Brussels.
- Stock, G. N., Greis, N. P. and Kasarda, J. D. (1998) "Logistics, strategy and structure: a conceptual framework" *International Journal of Operations & Production Management*, 18 (1), pp. 37-52.
- Stock, G. N., Greis, N. P. and Kasarda, J. D. (2000) "Enterprise logistics and supply chain structure: the role of fit" *Journal of Operations Management*, 18, pp. 531-547.
- Stuart, I., McCutcheon, D., Handfield, R., McLachlin, R. and Samson, D. (2002) "Effective case research in operations management: a process perspective" *Journal of Operations Management*, 20, pp. 419-433.
- Taplin, I. M. (2006) "Restructuring and reconfiguration. The EU textile and clothing industry adapts to change" *European Business Review*, 18 (3), pp. 172-186.
- Taplin, I. M. and Winterton, J. (Eds) (1997) *Rethinking Global Production*, Ashgate, Aldershot.
- Vona, R. (2003) "Marketing e produzione nel pronto-moda: il "modello" Zara", Proceedings of the International Conference "Marketing trends in Europe", Venice, 28-29 November.
- Voss, C., Tsiriktsis, N. and Frohlich, M. (2002) "Case research in operations management", *International Journal of Operations and Production Management*, 22 (2), pp. 195-219.
- Yin, R. (1994) *Case Study Research Design and Methods*, Sage Publications Inc., Newbury Park, CA.

Acknowledgements

The authors wish to thank Dr. Alfonso Morvillo for his insightful suggestions and precious support to carry out this study.



Instructions to Authors

Papers should be written in English and submitted electronically to trasportieuropei@istiee.org and, by regular mail, in printed form in duplicate to:

prof. Romeo Danielis
Dipartimento di Scienze Economiche e Statistiche, Facoltà di Economia
Università degli Studi di Trieste. P.le Europa, 1, 34100 Trieste, Italy
Phone: +39-0405587076 - Fax: +39-040567543

Submission of a manuscript is considered to be a representation that it has been neither copyrighted (or if copyrighted is clearly marked so that the appropriate permission can be obtained) nor published, that it is not being submitted for publication elsewhere, and that, if the work results from a military contract, it has been released for open publication. As a condition of final acceptance of a paper for publication in European Transport (Trasporti Europei), the author(s) must indicate if their paper is posted on a working paper website, other than their own. They are responsible for assuring that, if any part of the paper has been copyrighted for prepublication as a working paper, the copyright can and will be transferred to ISTIEE when the paper has been accepted. This includes both print and electronic forms of the paper. On acceptance, the text, or any link to full text, must be removed from the working paper websites, other than the author's own website. Other material such as book reviews and announcements should also be sent to the Editor.

Manuscripts should contain only endnotes. Figures are required in a form suitable for photographic reproduction. Any one of a number of forms will be acceptable, e.g., laser printer drawing, original black ink drawings, or high-quality glossy prints. Lettering should be uniform in size and style and sufficiently large to be legible after reduction. Figures should be designated by arabic numbers and referred to in the text by number. Figure legends should be collectively provided on a separate sheet rather than placed on the figures themselves. Tables may be typed on sheets separated from the text. Each table should have a caption that makes the table entries clearly independent of the text; complicated column headings should be avoided. All tables should be numbered and referred to in the text by number.

In mathematical expressions, authors are requested in general to minimize unusual or expensive typographical requirements; for example: authors are requested to use the solidus wherever possible in preference to built-up fractions, to write complicated exponentials in the form $\exp()$ and to avoid subscripts and superscripts on subscripts or superscripts. Subscripts and superscripts should be shown large and clear, Greek letters and unusual symbols should be labeled on first occurrence, as should subscript "zero", to distinguish it from the letter "oh". Whether each letter is capital or lower case should be unambiguous. Equation numbers must be at the right.

Each paper must be accompanied by an abstract of about 100 words. The abstract should be adequate as an index and should summarize the principal results and conclusions. The first section of the article should not be numbered. References to related previous work should be reasonably complete, and grouped at the end of the paper. References in the text should be cited by the author's surname and the year of publication, e.g.: (Jansson, 1980), (Marguier and Ceder, 1984). The following format should be used for references:

Article in a journal:

Swait, J. (2001) "A non-compensatory choice model incorporating attribute cut-offs" *Transportation Research, Part B: Methodological*, 35, 10, pp. 903-28.

Chapter in a book:

Regan, A. and Garrido, R. (2001) "Modelling Freight Demand and Shipper Behaviour: State of the Art, Future Directions", In: Hensher, D. (eds) *Travel Behaviour Research: The Leading Edge*, Pergamon, Amsterdam.

Working paper:

Gavish, B. and Graves, S.C. (1981) "Scheduling and Routing in Transportation and Distribution Systems: Formulations and New Relaxations", *Working Paper 8202*, Graduate School of Management, University of Rochester, Rochester, NY.

Book:

Urban, D. (1993) *Logit - Analyse. Statistische Verfahren zur Analyse von Modellen mit qualitativen Response-Variablen*, Gustav Fischer, Stuttgart.

Dissertation:

Jaillet, P. (1985) Probabilistic Traveling Salesman Problems, *Ph.D. thesis*, Massachusetts Institute of Technology, Cambridge, MA

Presentation at a conference:

Maggi, R. and Bolis, S. (1999) "Adaptive Stated Preference Analysis of Shippers' Transport and Logistics Choice", *World Transport Research - Proceedings from the 8th World Conference on Transport Research*, (H. Meersman, E. Van de Voorde, W. Winkelmanns eds.), Pergamon, Amsterdam.

Authors are responsible for revising their proofs, and should limit alterations to the strict minimum. The editorial management of ISTIEE reserves the right to accept only those changes that affect the accuracy of the text.