

TECHNOLOGY USAGE IN THE SUPPLY CHAIN: THE CASE OF SMALL 3PLs

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Brief biography

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Brief biography

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Abstract

Purpose - In today's supply chain management (SCM) practices, a successful strategy depends increasingly on the performance of Third Party Logistics (3PL) providers as they play a key integrative role linking the different supply chain elements more effectively. Information and Communications Technology (ICT) has become an important element of 3PL competitive capability as it enables higher levels of supply chain integration. Recent industry developments have widened the technological gap between large and small 3PLs. This is critical particularly for those markets populated by a large number of small 3PLs such as the Italian logistics industry. The purpose of this paper is to provide an overview of ICT adoption in small logistics service providers. The focus of the study is the Italian 3PL market.

Design/methodology/approach - The methodology adopted in this paper is based on the action research framework and it is a combination of theoretical analysis and empirical findings (focus groups and surveys). Firstly, a literature review on ICT dissemination in the international and Italian 3PL industry has been carried out. Then, a field survey has been developed preceded by two focus groups. The empirical investigation examined a sample of 153 small Italian 3PLs on the base of a definition and taxonomy proposed by the authors.

Findings - The results provide a useful technological profile of the surveyed companies, as well as an analysis of the role of ICT in customising services and of the factors influencing ICT adoption.

Research limitations/implications - To give a more robust scientific justification of the survey results it would be useful to carry out an additional large scale analysis including other countries with a high presence of small logistics service companies. Furthermore, a complementary case study analysis would be of help in defining the role of specific factors in different types of 3PL. Given the importance of small logistics providers in contemporary supply chain configurations, the main implication from a research point of view is that further investigations in this field are needed to better understand innovation paths, and how ICT can improve the competitive capabilities of 3PLs and of the wider supply chain.

Practical implications - The practical implications deriving from this paper are twofold. Firstly, managers of small 3PLs can use findings to set up guidelines for improving a company's technology innovation. Technology vendors can use findings to better market their service/product into the small logistics service provider segment.

Originality/value - Despite the fact that much has been written about the dissemination of ICT, there is still a shortage of research in the field of small 3PLs with little empirical investigation into the usage of ICT by small 3PLs. This paper provides a contribution to the filling this void and suggests some possible research directions.

Key Words ICT usage, Supply chain, Competitive advantage, Small logistics service providers, Italian logistics service market, Empirical survey

Paper type Research paper

Introduction

In recent years, a growing number of manufacturers and retailers have adopted the SCM concept in the management of their businesses. For these companies the delivery system has become an integral part of their product, to the extent that transportation and logistics are as important as the product itself (Sheffi, 1990). The application of the SCM concept leads manufacturers and retailers to outsource significant parts of their logistics (McKinnon, 1999), as well as to select and reduce the number of logistics providers with which to establish long-term relationships for the supply of “tailor-made” transportation and logistics services (Razzaque and Sheng, 1998).

Logistics companies play a more important role than in the past as they coordinate and accelerate physical and information flows along multiple levels of the supply chain (Cooper, Lambert and Pagh, 1998). Indeed, in keeping pace with rapid market changes the whole logistics system has become more efficient and flexible. This has forced 3PLs to look for accurate and real-time information on the status of the entire shipment process to increase their planning capacity and to improve customer service levels (Stough, 2001).

ICT is also of critical importance in developing logistics services in a customised supply chain context. In this regard, Sauvage (2003) noted that in a highly competitive business characterised by time compression, technological effort becomes a critical variable and a significant tool for differentiation of logistics services. Van Hoek (2002) assigned a specific role to ICT for 3PLs aiming to perform customising operations for service users. The author pointed out that the use of specific technological capabilities may leverage transport and logistics services and facilitate more effective integration across companies in the supply chain. For 3PLs, ICT capabilities can assure the rapid customisation of products and maintain competitive lead-times. The result is that competitive advantage in the 3PL industry will be based increasingly on creating value for customers as many value added activities are directly or indirectly dependent on ICT applications (Crowley, 1998).

Nevertheless, the use of ICT in the 3PL sector is unevenly distributed between large and small-medium sized logistics service providers [1]. Large firms have heavily 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 logistics service providers, on the other hand, have more difficulties in setting up ICT applications due to reluctance to change and insufficient human and financial resources. This has further complicated the competitive position of small logistics service providers - it seems that they have underestimated the potential of ICT as an enabler for increasing cost-efficiency and improving customer service. The real risk is that small 3PLs could either be marginalised in the marketplace as “tier suppliers” of large logistics companies, or even forced out of the market completely. The scenario that might arise could present small 3PLs with two different alternatives: survive in a low-cost world of transportation carriers (commodity providers), or pursue the expensive and problematic path of becoming value adding providers through innovation in technology and in other aspects of their operation (advanced logistics providers). This situation appears particularly critical in those markets characterised by a large number of small 3PLs and where multinational logistics companies hold a substantial market share as in the case of the Italian 3PL industry.

From a research point of view, while information technology in large 3PLs has been widely investigated (Larson and Gammelgaard, 2001; van Hoek, 2000; Berglund, van Laarhoven, Sharman and Wandel, 1999; Peters, Cooper, Lieb, and Randall, 1998) there is still a shortage of research in the field of small 3PLs with little empirical investigation analysing the adoption of ICT by these companies. Considering the limited quantitative evidence about the usage of ICT in small logistics service providers, the study described in this paper attempts to fill this void through an empirical investigation developed on a sample of small Italian logistics service providers. The survey is aimed at analysing ICT usage in the sector and at identifying the main factors affecting the adoption of technology.

Following this introduction, an overview of the Italian logistics service market is provided. The subsequent section analyses the recent trends associated with the dissemination of ICT in the international transport and logistics service industry, followed by an analysis of information technology usage in the Italian 3PL sector. The research approach used to investigate ICT usage in a sample of 153 small Italian logistics companies through a mail survey is described. The main research findings are then presented. The concluding section discusses the managerial and research implications of the survey.

Background to the Italian logistics service industry

Several sources estimate that in 2001, the Italian 3PL market was the fifth largest European market (after Germany, UK, France and Benelux) with the highest expected growth rate in Europe in coming years (Harvey, 2003). Nevertheless, it is approximately four times smaller than the German market (€13.9bn against €2.9bn). In the same year, the total value of logistics outsourcing was approximately €12bn (3.6% of the Italian GNP). 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.

The most recent data estimate the number of firms in the sector at between 145,000 (Confetra [2]) and 205,000 (Unioncamere [3]). These data indicate that one of the main characteristics of the Italian market is its high fragmentation. For example, Albo Nazionale Autotrasportatori [4] estimates that in the road freight transport sector there are about 180,000 haulage companies with about 85% of them owning no more than 3 vehicles. Other European markets are characterised by fewer firms and a higher number of vehicles per company. For example in Germany there are 42,430 road haulage companies, 42,866 in France and 9,430 in The Netherlands (KPMG, 2003).

Furthermore, a recent analysis carried out by an Italian logistics magazine, *Il Giornale della Logistica* (June/July 2004, p. 48), on a sample of 1,000 Italian 3PLs ranked by turnover shows that: a) the first 100 companies produce 64% of the total sample turnover, and b) for the first 200 companies the percentage is 75%. The fragmentation of the market is also evident considering employee data. Confetra estimates the total number of employees in the sector at around 420,000 people in 2004. According to KPMG (2003) about 50% of Italian logistics providers employ less than 50 people, and that 35% of them employ less than 9 people. The fragmentation of the Italian logistics service industry emerging from the above picture has facilitated the entry of large foreign logistics groups, including TNT, Deutsche Post, Eurogate, ABX and British Post Office 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. It is worth noting that, excluding the Grimaldi Group based in Naples, no international acquisitions have been made by Italian companies on international markets in the same period (Federtrasporto, 2003). This is a further sign of their financial and competitive weakness in comparison to foreign companies.

Recent ICT trends in the international and Italian transport and logistics service industry

As noted earlier, in the context of evolving SCM adoption manufacturers and retailers are demanding a higher degree of integration of the business processes of all supply chain participants through ICT and Internet technologies. As a result, 3PLs are devoting increasing importance to ICT in the management of their businesses and ICT is fast becoming one of the main drivers of change, posing new strategic challenges to logistics providers.

The impact of ICT on the international 3PL industry

The increasing role of ICT has contributed to the evolution of the competitive scenario in the international 3PL industry (Regan and Song, 2001). The following three trends are evident as a consequence of the impact of ICT and web technologies on the industry (Evangelista, 2002).

New e-services. One of the first visible effects associated with the increasing dissemination of ICT in the logistics service industry is the integration of traditional services (transportation and warehousing) with information-based services (e.g. tracking & tracing, booking, freight rate computation, routing & scheduling). Although logistics companies may not be considered leaders in the field of technological innovation (Tilanus, 1997), over the last few years such companies have made significant progress in the adoption of new technologies, particularly those linked to the Internet (Lynagh, Murphy, Poist, and Grazer, 2001). Today, the main transport and logistics service firms are able to provide a variety of information via the Internet and to secure transactions online with customers through their websites (Ellinger, Lynch, Andzulis and Smith, 2003).

New functions. The dissemination of ICT has opened up new opportunities for the development of new roles in the supply chain, the so-called infomediaries or on-line freight e-marketplaces. The purpose of these web-based intermediaries is to give added value to transport and logistics businesses through greater efficiency and information transparency. They run Internet portals which bring together buyers and sellers of transport and logistics services (Gudmundsson and Walczuch, 1999). There are also a variety of e-marketplaces operating over the Internet and the dividing lines between them are somewhat blurred (Unctad, 2000).

New alliances. Another feature emerging alongside the Internet and e-business is the creation of a new category of service provider called Fourth Party Logistics (4PL). A 4PL is a supply chain integrator who assembles and manages the resources, capabilities and technology of its organisation with those of complementary service providers to deliver a comprehensive supply chain solution (Bade, Mueller, and Youd, 1999). 4PLs enable customers to outsource the management of the entire logistics network to a single organisation and to re-engineer supply chain

processes. Often 4PLs have been set-up through alliances formed with management consulting companies, financial service companies and technology providers. Beyond the emergence of 4PLs, there is an ongoing trend in the logistics service industry to form alliances with firms operating in other industries (Eyefortransport, 2001).

ICT usage in the Italian logistics service market

Although ICT development has strongly affected the international logistics service industry in recent years, the adoption of new technologies in the Italian logistics service market appears relatively low. A number of surveys confirm this situation. Merlino and Testa (1998) analysed the level of computerisation and ICT investment by 3PLs in Northern Italy. The study, carried out on a sample of 197 firms, revealed that these companies are only at the initial stage of adopting ICT. The survey highlighted that the dissemination of new technologies is proceeding at an intermittent and non-homogeneous pace. Investments in new technology are still motivated by a tactical rather than a strategic logic. The authors attribute this to the history of the firm and its entrepreneurial culture.

Another survey, aimed at assessing the relationship between company culture and the usage of ICT, was conducted on a sample of 48 shipping agents and freight forwarders located in Southern Italy, specifically in the Campania region (Minguzzi, and Morvillo, 1999). The results showed that investments in computer hardware and software are mainly associated with entrepreneurial culture rather than with economic and business matters.

Other recent surveys report a number of interesting issues. KPMG (2003) pointed out that in comparison to other industries, ICT investment in the Italian 3PL industry is limited. Furthermore, the level of outsourcing of ICT and e-business applications is very low. There is evidence of low penetration of telematics in the road transport segment due to high implementation/running costs and long investment payback periods (CSST and Cranfield University, 2002). Finally, a recent survey shows that the telephone is the most widely used communication tool, while the use of web-based technologies is still limited (Freight Leaders Club, 2003).

The results of the above studies indicate an interesting scenario. Despite the potentially important role of ICT in improving the competitive capability of 3PLs, there is a limited level of ICT adoption with particular reference to the Internet and e-business tools.

Research approach

ICT has triggered multiple waves of changes in the logistics service industry. New technology is reshaping the organisation and structure of this industry as ICT impacts significantly on the

operations of 3PLs. Accordingly, 3PLs are gradually shifting from an asset-based offer to a more process-oriented approach largely based on knowledge and information management.

Within this process, while large 3PLs are gaining substantial benefits from technology usage and implementation, the nature of changes resulting from ICT usage in small logistics service providers remains unclear. This is reflected by the existing gap in the literature where the role, and the developing competitive capabilities, of small 3PLs are seriously underestimated. This is surprising considering that the vast majority of transport and logistics companies in the European Union are small [5]. This gives rise to the need to develop research and investigation in order to acquire a deeper understanding and in-depth knowledge regarding the improvement of competitive abilities of small logistics providers. This is particularly relevant for those markets in which there is a strong presence of small 3PLs. Consequently, the Italian logistics service market appears a suitable context for this research.

This research seeks to narrow the knowledge gap in the field of ICT adoption in small 3PLs through an empirical investigation. The aim of the survey is to provide an overview of ICT adoption in small logistics service providers. The specific objectives are as follows:

1. to set-up a technological profile of the surveyed companies in terms of both ICT investment size and information technology systems and tools adopted;
2. to analyse the role of ICT tools in supporting the customisation of services; and,
3. to analyse factors influencing the adoption of ICT.

Survey method

The survey methodology has been organised into the following seven steps:

a) *Definition of basic survey objectives and preparation of the draft questionnaire.*

b) *Establishment of focus groups.* These were held in Rome and Milan in April 2004. Almost 20 key actors (ICT managers of small 3PLs, ICT consultants, directors of Italian logistics associations, researchers and academics) were involved in the two meetings. The main aim was to submit the basic survey objectives and draft questionnaire in order to get useful feedback from participants and to test the suitability and comprehensibility of the questionnaire. A further aim was to get the help of associations in administering questionnaires through the use of their mailing lists and the use of their logos. In addition, an agreement was reached with four Italian magazines (two logistics/transport magazines and two ICT magazines) to give free annual subscription to respondents.

c) *Re-focussing of survey objectives and questionnaire.* Based on the focus group results, this step enabled a better focus on the survey objectives and obtained useful inputs in finalising the questionnaire. The final questionnaire contained 37 questions, divided into four sections.

d) *Population definition.* Based on definitions in the literature (Protrans, 2001) the structure of the Italian logistics sector and the specific objectives of this research, the following definition of 3PL is proposed (modified from Berglund, van Laarhoven, Sharman and Wandel, 1999, p. 59):

“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”.*

This definition reflects some of the thinking behind the definitions in the relevant literature. Furthermore, it is compatible with the specific characteristics of the Italian industry and is, therefore, usable in the context of the specific objectives of this research project. There are a number of features of the definition that are worthy of comment:

- Companies which provide purely transport services are included;
- 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 3PLs their first foray into non-transport activities is in this area;
- The non-compulsory activity elements include both information related activities as well as elements of physical supply chain functionality which may be outsourced by customers; and,
- The word “integrated” is used to indicate the importance, where more than one service is offered, of providing customers with a coordinated approach to the development and execution of logistics solutions.

As the vast majority of firms in the Italian transport and logistics sector are small and provide a very limited range of purely transport services, they can be classified as 3PLs using this definition. However, a recent study indicates that the implementation of ICT systems for transport management can be commercially justified only for companies operating more than 5 vehicles (McClelland and McKinnon, 2004). For the purposes of the research, therefore, the above 3PL definition has been narrowed to exclude very small providers that are marginal in the context of the wider supply chain. As pointed out earlier, Confetra’s most recent estimate (2004) of the total

number of Italian 3PLs is 145,000. Based on this, the total population in this research is estimated at approximately 21,500.

e) *Preparation of the mailing list.* The large number of associations and the different taxonomy adopted to segment the market have produced a plethora of statistics calculated using different criteria. In addition, a national directory of Italian logistics companies does not exist. This is reflected in the low level of consistency and quality of data and information about logistics companies operating in the Italian market. For this reason, 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) as reported in table 1. More information regarding population definition is provided in the next section.

Table 1
Data Collection and Mailing List

Sources	Number of companies
Confetra	677
Logistica Management	531
Logica	471
Il Giornale della Logistica	363
Assologistica	183
Ogenet	152
IRAT-CNR database	65
Freight Leaders Club	22
Draft mailing list	2,464
Duplications	237
Large companies	99
Non logistics companies	136
Final mailing list	1,992

After the draft mailing list was developed, each individual company was checked and a number of inconsistencies were detected. This reduced the total number of companies included in the survey from 2,464 to 1,992, as shown.

f) *Survey implementation.* The questionnaire was mailed to 1,992 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, as shown in table 2. Furthermore, to ensure data reliability and completeness,

respondents were subsequently contacted by email and telephone in order to clarify unclear responses or to add missing data. A number of non-respondents were also contacted. There was no evidence of any significant non-response bias.

Table 2
Sample Firm Definition

Companies contacted	1,992
Questionnaires received	169
Questionnaires unusable	16
Total usable questionnaires (<i>response rate 7.7%</i>)	153

g) *Sample classification.* Within the population, a taxonomy is proposed based on the following three categories:

1. **Full Haulage Providers**: those companies within the population for which transport activities represent 100% of turnover;
2. **Basic Logistics Providers**: those companies for which transport and warehousing together comprise over 50% of turnover; and,
3. **Advanced Logistics Providers**: those companies for which transport and warehousing together comprise less than 50% of turnover (i.e. where more than 50% of the total turnover is generated by value added logistics and SCM services).

Table 3 shows a breakdown of the sample firms by provider type according to the above classification criteria.

Table 3
Sample Firm Classification

Full Haulage Providers	36 (23.5%)
Basic Logistics Providers	67 (43.8%)
Advanced Logistics Providers	50 (32.7%)
Total	153 (100%)

Survey findings

In this section, the results of the empirical investigation are presented. Following an overview of the sample characteristics, the section documents and discusses the survey results for each research objective set out earlier.

Sample characteristics

Table 4 provides details about the distribution of the sample in terms of types of provider and firm size using employee bands according to the EU definition of SMEs. Of the 153 respondents, almost 27% are micro companies and 42.5% are small, while about 30% are medium firms.

Table 4
Respondents by Provider Type and Firm Size

Employee bands	Full Haulage		Basic Logistics		Advanced Logistics		Total	
	N	%	N	%	N	%	N	%
Micro (less than 10)	12	29.3%	17	41.5%	12	29.3%	41	26.8%
Small (from 10 to 50)	16	24.6%	32	49.2%	17	26.2%	65	42.5%
Medium (from 51 to 250)	8	17.0%	18	38.3%	21	44.7%	47	30.7%
Total	36	23.5%	67	43.8%	50	32.7%	153	100%

Figure 1 provides a breakdown of the respondents by the main Italian geographical areas. The majority of the sample firms are located in the northern part of the country (76.5%). There are two reasons for this. Firstly, the majority of Italian manufacturing and economic activities is concentrated in the north of the country. This results in the vast majority of the Italian logistics companies being located in that area. Secondly, the relationship between economic context and the entrepreneurial culture of companies, especially in small business, is well documented (see, for example, Minguzzi and Passaro, 2000). In the case of Italy, the differences in the economic context between north and south has significantly affected the development of entrepreneurial culture in the two regions. Companies located in the south are generally characterised by a lower level of innovation and openness towards the external environment. This tends to reduce the willingness of companies to cooperate with academics and researchers (Evangelista and Morvillo, 1998; Minguzzi and Morvillo, 1999).

Figure 1
Sample Firms by Geographic Area

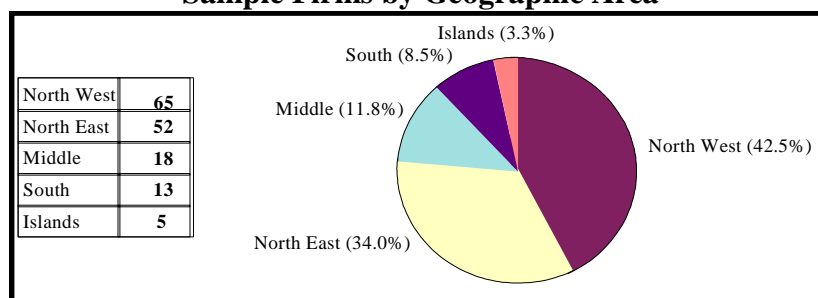
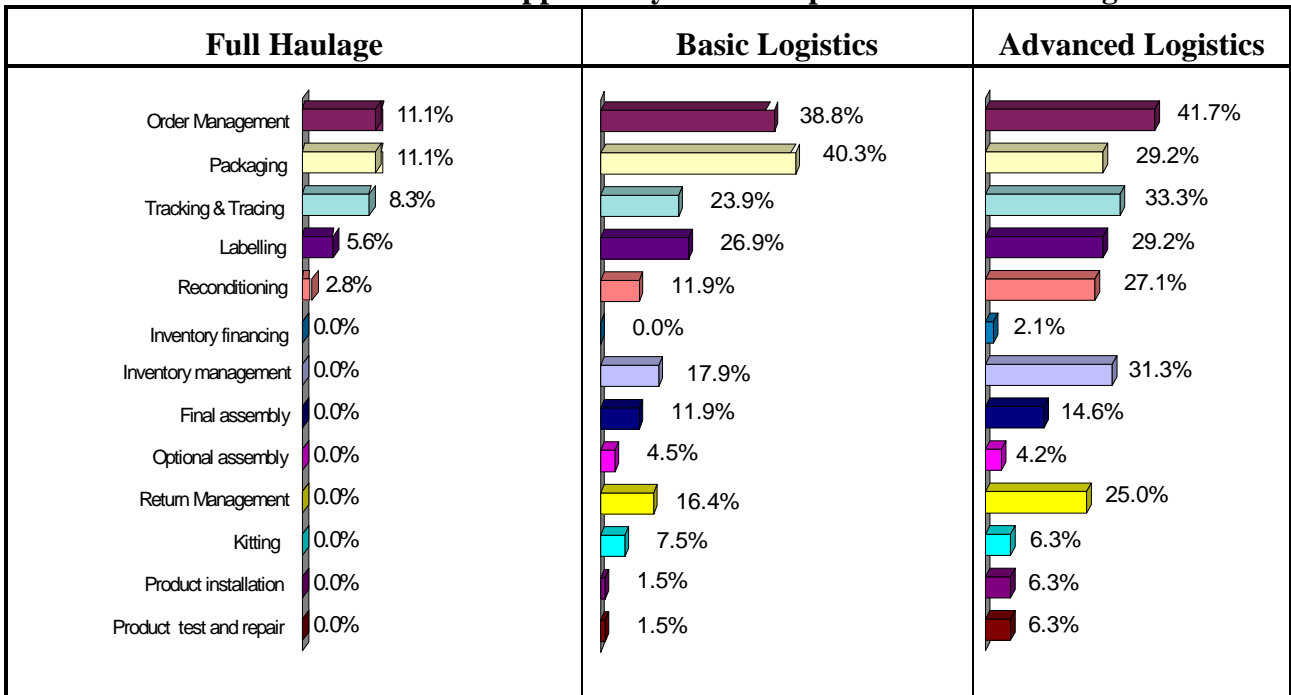


Figure 2 shows the number of value added services offered beyond transport and warehousing by the surveyed companies. Moving from full haulage to advanced logistics providers the number of value added services offered increases dramatically. This supports the validity of the classification criteria adopted in this study.

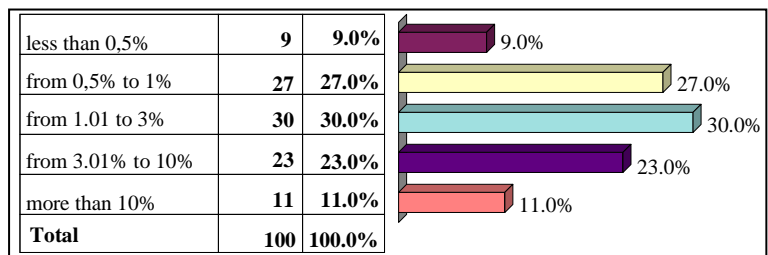
Figure 2
Value Added Services Supplied Beyond Transport and Warehousing



Technological profile of the surveyed company

The following set of data describes the technological profile of the surveyed companies. Figure 3 provides a summary of total ICT costs (hardware, software, employees, consultancy and communication costs) as a percentage of total company costs in 2003.

Figure 3
Percentage of ICT Costs on Total Company Costs (2003)



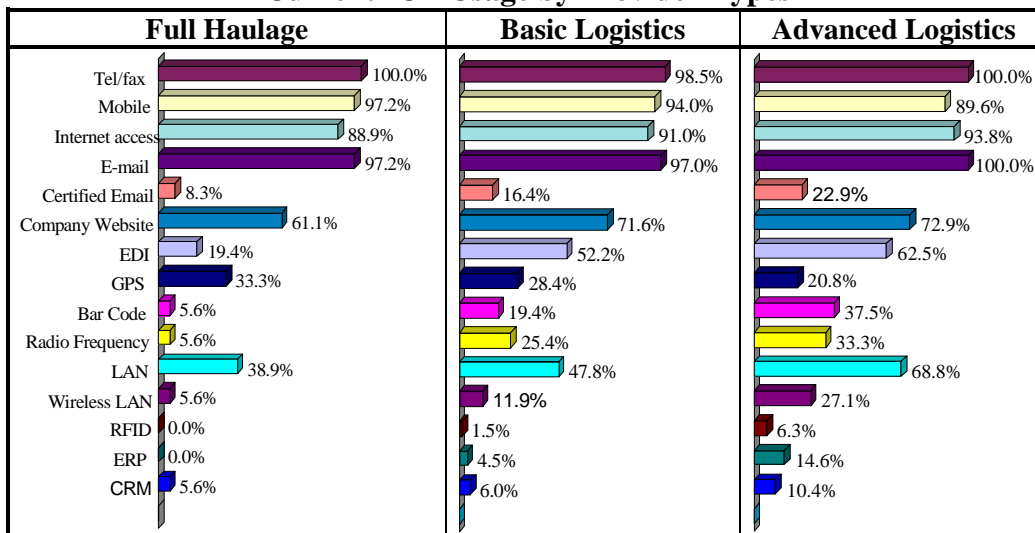
Of the 100 companies that responded to this question, 36 spent less than 1% of their total costs on ICT. 11 companies spent more than 10% of their total costs on ICT. Data reported in table 5 reveal that expenditure on ICT as a percentage of total company costs did not significantly vary among the different provider types ($p=38.2\%$, $\chi^2=8.55$).

Table 5
Percentage of ICT Costs on Total Company Costs by Provider Types - 2003

	Full Haulage		Basic Logistics		Advanced Logistics		Total	
	N	%	N	%	N	%	N	%
Less than 0.5%	4	16.7%	3	6.8%	2	6.3%	9	9.0%
From 0.5% to 1%	7	29.2%	15	34.1%	5	15.6%	27	27.0%
From 1.01% to 3%	4	16.7%	15	34.1%	11	34.4%	30	30.0%
From 3.01% to 10%	6	25.0%	7	15.9%	10	31.3%	23	23.0%
More than 10%	3	12.5%	4	9.1%	4	12.5%	11	11.0%
Total	24	100%	44	100%	32	100%	100	100%

Figure 4 illustrates the various ICT tools that the three provider types currently adopt in their relationships with both customers and other logistics providers.

Figure 4
Current ICT Usage by Provider Types



The data indicates a low level of usage of relatively sophisticated technologies among all provider types, particularly in the management of relationship with customers (e.g. ERP and CRM). The figure clearly shows that, moving from full haulage to advanced logistics providers, the use of more sophisticated technologies increases significantly. However, GPS is relatively widely used in full haulage providers (38.9%). This is perhaps not surprising given the importance of satellite navigation in purely transport businesses.

All providers use telephone, fax, mobile, Internet and email to a great extent. In relation to other ICT tools, more than half of both basic and advanced logistics providers use EDI (52.2 % and 62.5 % respectively) with similar numbers using LAN (47.8 % and 68.8% respectively). The usage of these technologies is quite low for full haulage providers (19.4 % for EDI and 38.9% for LAN). Though the adoption of more complex technologies (such as Wireless LAN, RFID, ERP and CRM)

is quite low in all firms, data show that these technologies are more widely used by advanced logistics providers.

Table 6 describes the degree of overall information system (IS) integration in the supply chain for different types of provider [6]. The degree of IS integration in the supply chain is quite low overall. Nevertheless, data reported in the table reveal that advanced logistics providers have a significantly higher degree of IS integration ($p=0.9\%$; $F=4.86$).

Table 6
Overall IS Supply Chain Integration

Provider type	Degree of IS integration in the supply chain
Full Haulage	1.19
Basic Logistics	1.90
Advanced Logistics	2.44
Total	1.90

Scale: 0 = no IS integration; 1 = partial IS integration; 2 = full IS integration

A more detailed analysis of information system integration is given in table 7. These data confirm that most providers have no integration with other supply chain participants (85.9%). The data indicates a significant difference among the types of provider as in the case of advanced logistics, which have the highest number of companies fully integrated in comparison with full haulage and basic logistics ($p=4.8\%$; $\chi^2= 9.58$).

Table 7
Information Systems Integration

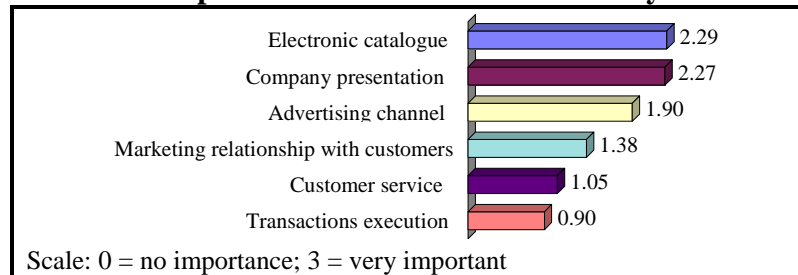
	Full Haulage		Basic Logistics		Advanced Logistics		Total	
	N	%	N	%	N	%	N	%
No integration	35	97.2%	58	87.9%	35	74.5%	128	85.9%
Limited integration (i.e. MRP)	0	0.0%	3	4.5%	3	6.4%	6	4.1%
Full integration (i.e. ERP)	1	2.8%	5	7.65%	9	19.1%	15	10.0%
Total	36	100%	66	100%	47	100%	149	100%

The role of ICT tools in supporting the customisation of service

In this section data relating to ICT applications used in the customisation of logistics services is presented. Amongst the most important of these tools are websites. Effective use of this tool provides the potential to simultaneously reduce costs and improve customer service. Based on the entire sample, it emerges that 105 (68.6%) have a website in place, while 48 companies (31.4%) do not. The level of company website adoption across the different provider types is: 61.1% for full haulage; 71.6% for basic providers; and 72.9% for advanced providers. This suggests that this

technology is now well reasonably established within Italian small logistics providers. Considering website adopters, data shown in figure 5 reveal that the most important functionality associated with website usage is in the areas of electronic service catalogues, company presentation and advertising channels.

Figure 5
Importance of Website Functionality



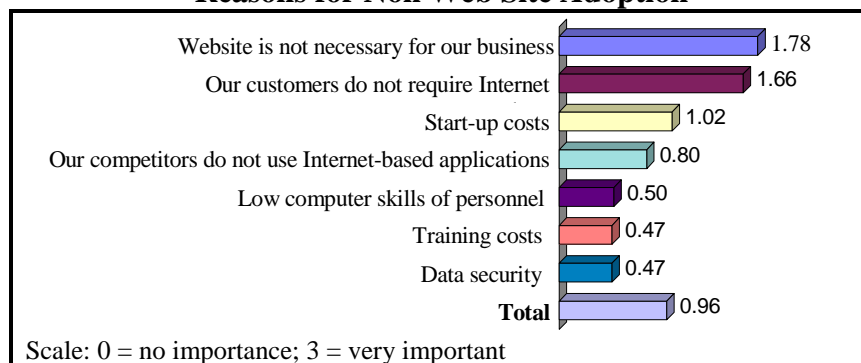
This means that adopters are not very innovative in the use of their website. In fact, according to the KPMG e-commerce business maturity model (Ellinger, Lynch and Hansen, 2003), this evidence confirms that the surveyed companies are still in the early stage of the model (basic marketing and publishing).

Figure 6 shows the reasons cited for non adoption of websites. The main reasons are:

- website deemed unnecessary for their businesses;
- customers do not require Internet services; and,
- website start-up costs.

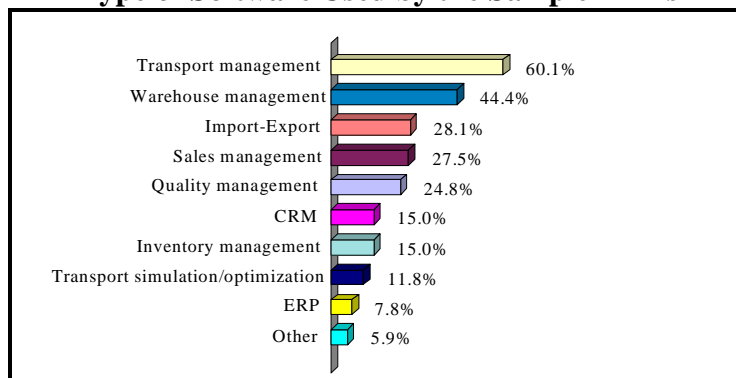
These results suggest that companies underestimate the potential value of websites in improving their businesses and as a instrument to customise the services supplied.

Figure 6
Reasons for Non Web Site Adoption



Data about the software used by the sample firms highlight that 138 companies (90.2%) adopt software, while 15 companies (9.9%) do not use business software to customise their services. Figure 7 reveals that software for transport management is the most widely used among adopters (60.1%).

Figure 7
Type of Software Used by the Sample Firms



Warehouse management software is also quite widely used (44.4%). Software to manage import-export processes (28.1%), sales (27.5%) and quality management (24.8%) are also popular within these companies. Nevertheless, the types of software that have the greatest potential in terms of service customisation and interaction with customers (i.e. CRM and ERP) are not widely used.

Finally, a very important ICT application in today's electronic transportation and logistics landscape is related to the capability of logistics providers to supply tracking and tracing (T&T) services to their customers. According to data in table 8, the majority of the 150 respondents (60.8%) do not provide this type of service. This confirms the low level of capability of the sample firms in the supply of customising services of this kind. However, there is a highly significant difference between the T&T capabilities of advanced providers in comparison with basic providers and full haulage ($\chi^2=12.32$, $p=2.1\%$). This suggests that advanced providers are more oriented towards the customisation of their services.

Table 8
Tracking and Tracing Services

	The company does not offer T&T services		The company does offer T&T services		Total	
	N	%	N	%	N	%
Full Haulage	29	80.6%	7	19.4%	36	100%
Basic Logistics	43	64.2%	23	34.3%	66	100%
Advanced Logistics	21	43.8%	27	56.3%	48	100%
Total	93	60.8%	57	38.9%	150	100%

Factors influencing the ICT adoption

In this section, an overview of the main factors influencing the adoption of ICT in the sample firms is provided. Firstly, the survey analysed the factors that stimulate the use of ICT in the sample firms (see table 9).

The most significant difference emerges with reference to the improvement of information exchanged with supply chain participants (namely customers and logistics providers). Advanced logistics providers attribute a higher importance to this factor in comparison with basic logistics and full haulage companies ($p=1.2\%$, $F=4.56$). A significant difference also exists with reference to the improvement of customer satisfaction ($p=14.8\%$, $F=1.92$) and to the enlargement of customer base ($p=12.0\%$, $F=2.13$).

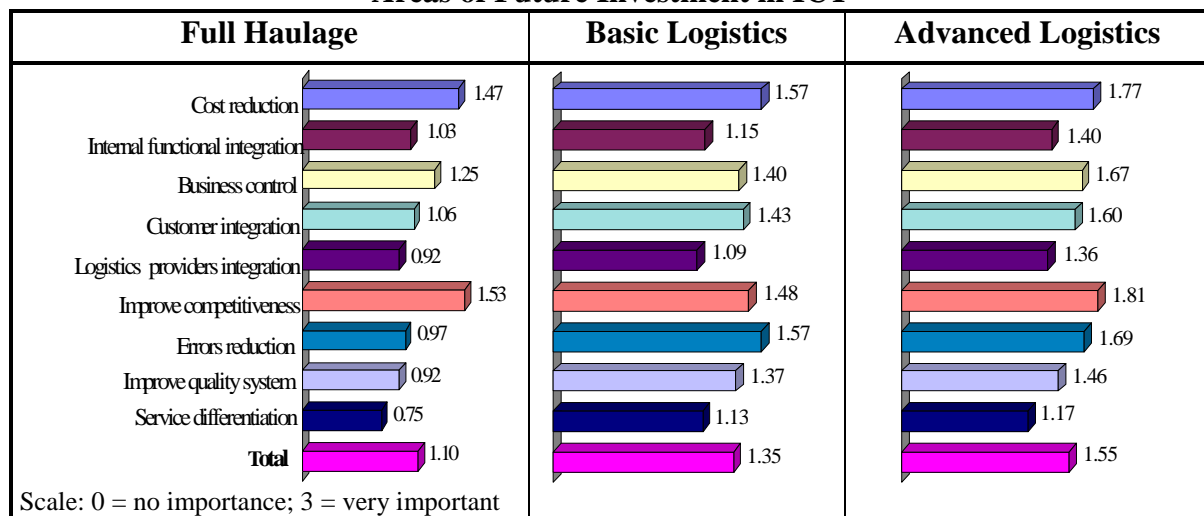
Table 9
Factors Stimulating ICT Usage

	Full Haulage		Basic Logistics		Advanced Logistics	
	Mean (<i>n</i> =36)	S.D.	Mean (<i>n</i> =67)	S.D.	Mean (<i>n</i> =50)	S.D.
Higher in-company integration	1.69	1.17	2.05	1.08	1.92	0.94
Improve customer satisfaction	1.78	1.02	2.06	1.09	2.23	1.02
Improve information exchange with customers/other 3PLs	1.47	1.08	2.03	0.97	2.08	1.01
Enlarge customer base	1.00	1.07	1.37	1.04	1.44	0.97
Improve company competitiveness	1.78	1.2	1.78	0.99	1.90	1.13
Improve company's brand perception	1.25	1.22	1.49	1.11	1.65	1.10

Scale: 0 = no importance; 3 = very important

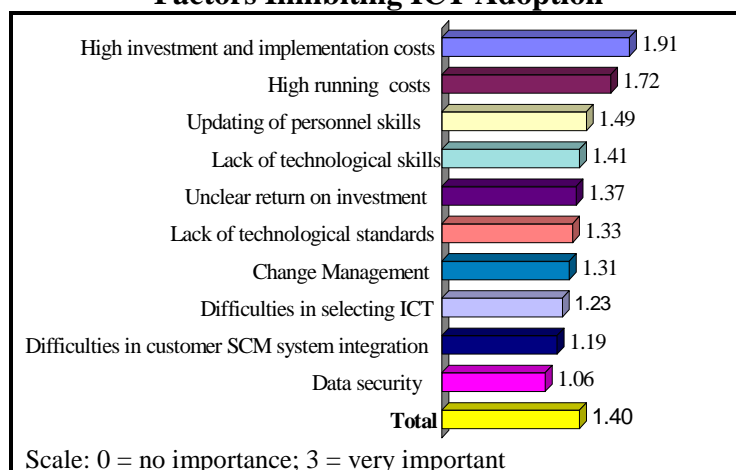
Data shown in figure 8 provide details about the importance of future investment areas in ICT by different provider types. It indicates that the area in which there is the greatest significant difference between advanced logistics and other types of provider is in relation to error reduction ($p=0.3\%$, $F=6.08$). This again suggests that advanced providers have a stronger focus on customer service delivery. Other areas where significant differences exist are: improvement of quality system ($p=1.7\%$, $F=4.21$); improvement of customer integration ($p=3.0\%$; $F=3.56$); and, improvement of integration with other logistics service providers ($p=4.7\%$, $F=3.11$).

Figure 8
Areas of Future Investment in ICT



With regard to the factors inhibiting ICT adoption in the sample firms, significant differences do not emerge between the provider classifications. For this reason the analysis of these factors has been carried out with reference to the entire sample (see figure 9). The results provide an interesting picture. The most important reasons for non investment in ICT are related to financial factors.

Figure 9
Factors Inhibiting ICT Adoption



The size of investment and the implementation costs, together with running costs, are considered the most influential factors inhibiting ICT investment. A further group of factors related to human resources - particularly the need to upgrade the technological skills of staff - seem to play an important role in inhibiting ICT expenditure. Finally, the importance given to the lack of technological standards demonstrates that the supply of ICT products and services represents a further problematic issue in relation to the wider adoption of technology.

Conclusion

The survey results widen the knowledge base in relation to ICT usage in small logistics providers and allow some conclusions to be drawn. The analysis suggests that the proposed provider classification is relatively robust given the different levels of ICT adoption and plans about the future role of ICT that are evident in each category. Having said that, a number of other findings are worth highlighting.

The survey results indicate that the use of relatively advanced ICT is more prevalent in advanced providers. This is particularly the case in relation to the level of IS integration and the exchange of information with other supply chain participants. Given the nature of these activities in the emerging value adding business models of advanced providers this trend is likely to continue. Despite the fact that current levels of expenditure on ICT in relation to overall company cost base do not vary significantly across provider categories, there are significant differences with regard to future investment plans. This is particularly true in the area of integration with both customers and other 3PLs. This indicates that a longer term strategic view is being adopted by more advanced providers, thus increasing the possibility of the less developed providers being further marginalised in the evolving competitive landscape. This is an area which is worthy of further investigation.

However, in general terms ICT is not widely used in customising service offerings. This is particularly true in relation to website utilisation, business software usage and T&T. The potential benefits of these tools are not being exploited and the reasons for this need to be more clearly understood. The factors inhibiting ICT adoption do not significantly vary between provider types but the most important inhibitors are primarily financial. Human resource implications and ICT supply have also an important role in inhibiting ICT investment. It should be noted that these factors are in many ways interdependent and this issue is another which is worthy of further research. The authors' experience suggests that a lack of knowledge of ICT is in many cases the biggest single inhibitor and this can in turn result in concerns relating to financial and HR issues in particular.

To stimulate ICT innovation and knowledge, several organisations (e.g. business consortia, trade associations, etc.) have a potential role to play. Such organisations could act in promoting the dissemination of technological knowledge, assessing the main and most critical future technological trends, or developing and adapting specific ICT applications in response to the needs of the associated companies. In this way, small 3PLs will be facilitated in shifting the focus of ICT expenditure from a short term and functional approach to a more strategic view of technology as an enabler for improving competitive capability.

In conclusion, the competitive landscape for small 3PLs is continuously changing to reflect evolving customer requirements and other business pressures. The capability of emerging ICT is increasing at a rapid rate and its effective adoption has the potential to significantly enhance the competitive capability of small 3PLs. However, it is clear that many barriers exist to the successful adoption of ICT by these providers. Given the importance of such companies in contemporary supply chain configurations it is important that these issues are fully understood.

References

- Bade, D., Mueller, J. and Youd, B. (1999), "Technology in the next level of supply chain outsourcing. Leveraging the capabilities of fourth party logistics", <http://bade.ascet.com>
- 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.
- Cooper, M.C., Lambert, D.M. and Pagh, J.D. (1998), "What should be the transportation provider's role in supply chain management?", proceedings of the 8th World Conference on Transport Research, 12th-17th July 1998, Antwerpen, Belgium.
- Crowley, A.G. (1998), "Virtual logistics: transport in the marketspace", *International Journal of Physical Distribution & Logistics Management*, Vol. 28, No. 7, pp. 547-574.
- CSST - Centro Studi sui Sistemi di Trasporto and Cranfield University (2002), *Transport and Logistics in the digital era: A survey of telematic use by European Road Freight Operators*, Survey Report, Fiera di Genova, 28th-29th October 2002, Genoa, Italy.
- Eyefortransport (2001), "Digital logistics: value creation in the freight transport industry", Eyefortransport, First Conference Ltd., www.eyefortransport.com
- Ellinger, A.E., Lynch, D.F., Andzulis, J.K. and Smith, R.J. (2003), "B-to-B E-commerce: a content analytical assessment of motor carrier websites", *Journal of Business Logistics*, Vol. 24, No. 1, pp. 119-220.
- Ellinger, A.E., Lynch, D.F. and Hansen, J.D. (2003), "Firm size, web site content and financial performance in the transportation industry", *Industrial Marketing Management*, Vol. 32, pp. 177-185.
- Evangelista, P. (2002), "Information and communication technology key factor in logistics and freight transport", Ferrara, G. and Morvillo, A. (eds.) *Training in Logistics and Freight Transport Industry. The Experience of the European Project ADAPT-FIT*, Ashgate Ltd., London, pp. 15-36.
- Evangelista, P. and Morvillo, A. (1998), "The role of training in developing entrepreneurship: the case of shipping in Italy", *Maritime Policy & Management*, Vol. 25, No. 1, pp. 81-96.
- 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.
- Federtrasporto (2003), "L'internazionalizzazione del trasporto: la posizione dell'Italia", *Bollettino Economico sul Settore dei Trasporti*, No. 10, Rome, Italy.
- Freight Leaders Club (2003), *Flussi informativi nel trasporto merci e nella logistica. Criticità, stato dell'arte e proposte*, Quaderni No. 14, Milan, Italy.
- Gudmundsson, S.V. and Walczuch, R. (1999), "The development of electronic markets in logistics", *The International Journal of Logistics Management*, Vol. 10, No. 2, pp. 99-113.
- 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.

- KPMG (2003), "Logistica integrata ed operatori di settore: trend e scenari evolutivi del mercato Italiano," KPMG Business Advisory Services, Milan, Italy.
- 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.
- Lynagh, P.M., Murphy, P.R., Poist, R.F. and Grazer, W.F. (2001), "Web-based informational practices of logistics service providers: an empirical assessment", *Transportation Journal*, Vol. 40, No. 4, pp. 34-45.
- McClelland, D. and McKinnon, A. (2004), "Use of Vehicle Telematics Systems for the Collection of Key Performance Indicator Data in Road Freight Transport", Heriot Watt University, UK, p. 4, www.sml.hw.ac.uk/logistics
- McKinnon, A. (1999), "The outsourcing of logistical activities", Waters D. (edited by) *Global logistics and distribution planning*. London: Kogan Page, 1999, pp. 215-234.
- Merlino, M., Testa, S. (1998), "L'adozione delle tecnologie dell'informazione nelle aziende fornitrici di servizi logistici dell'area genovese-savonese: i risultati di un'indagine empirica," proceedings of the 2nd Workshop *I processi innovativi nella piccola impresa*, 21st-22nd May 1998, Urbino, Italy.
- Minguzzi, A. and Morvillo, A. (1999), "Entrepreneurial culture and the spread of information technology in transport firms. First results on a Southern Italy sample," proceedings of 44th ICSB World Conference *Innovation and Economic Development: the Role of Entrepreneurship and Small and Medium Enterprises*, 20th-23rd June 1999, Naples, Italy.
- Minguzzi, A. and Passaro, R. (2000), "The network of relationships between the economic environment and the entrepreneurial culture in small firms", *Journal of Business Venturing*, Vol. 16, No. 2, pp. 181-207.
- 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.
- Protrans (2001), "The Role of Third Party Logistics Service Providers and their Impact on Transport", Deliverable no. 1 *Analysis of third-party logistics market*, pp. 21-23.
- 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.
- Sheffi, Y. (1990), "Third party logistics: present and future prospects", *Journal of Business Logistics*, Vol. 11, No. 2, pp. 27-39.
- Stough, R.R. (2001), "New technologies in logistics management," Brewer *et al.* (eds.) *Handbook of Logistics and Supply Chain Management*, Elsevier Science Ltd., p. 517.
- Razzaque, M.R. and Sheng, C.C. (1998), "Outsourcing of logistics functions: a literature survey", *International Journal of Physical Distribution & Logistics Management*, Vol. 28, No. 2, pp. 89-107.
- 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.
- Tilanus, B. (1997), *Information Systems in Logistics and Transportation*, Pergamon, London.
- UNCTAD (2000), *Review of Maritime Transport*, United Nations, p. 87.
- 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.

Notes

[1] In this paper, the EU definition of SMEs has been adopted. According to this definition, firms with less than 10 employees (and a turnover \leq € 2 million) are considered “micro”, firms whose employees range from 10 to 50 (and a turnover \leq € 10 million) are “small”, while firms employing less than 250 people (and a turnover \leq € 50 million) are considered “medium”. For further details, see Recommendation 2003/361/EC.

[2] Confederazione Nazionale del Trasporto (Confetra) is the largest Italian transport and logistics association.

[3] Unione delle Camere di Commercio (Unioncamere) is the Italian federation of chambers of commerce.

[4] Albo Nazionale Autotrasportatori is the official registration body for the Italian road haulage industry.

[5] See 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.

[6] The analysis was built up using a scoring model linking IS integration to different SC participants (customer, customer’s customers, suppliers and other 3PLs). The scale was based on 0 = no IS integration, 1 = partial IS integration and 2 = full IS integration. The scores for each of the four SC participants were added. Consequently, the highest level of SC integration achievable is equals to 8. The values included in the table represent the average value of IS integration in the supply chain for each provider type.