



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

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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

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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.

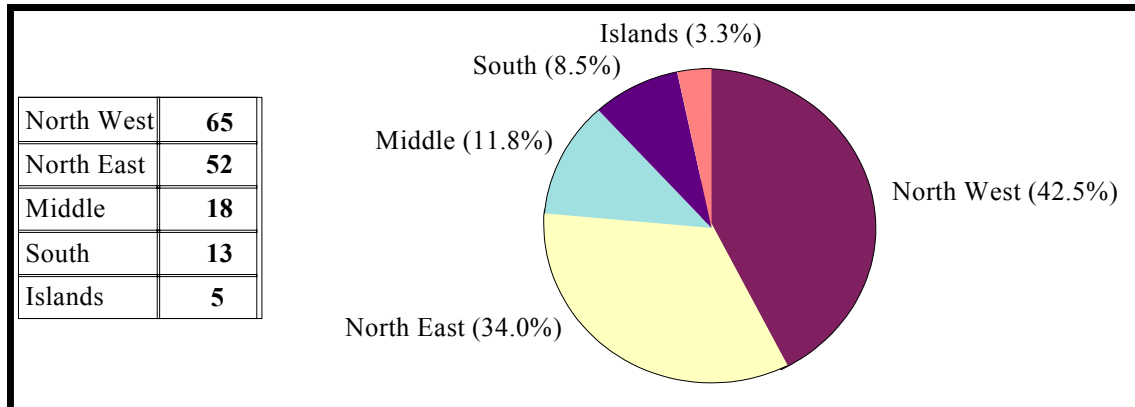


Figure 1: Italian sample firms by geographical area.

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.

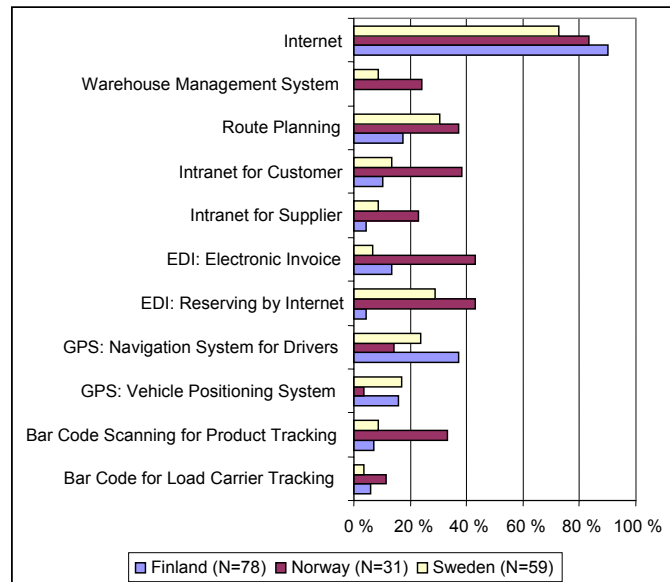


Figure 2: Types of ICT tools adopted by companies in Northern Europe.

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.

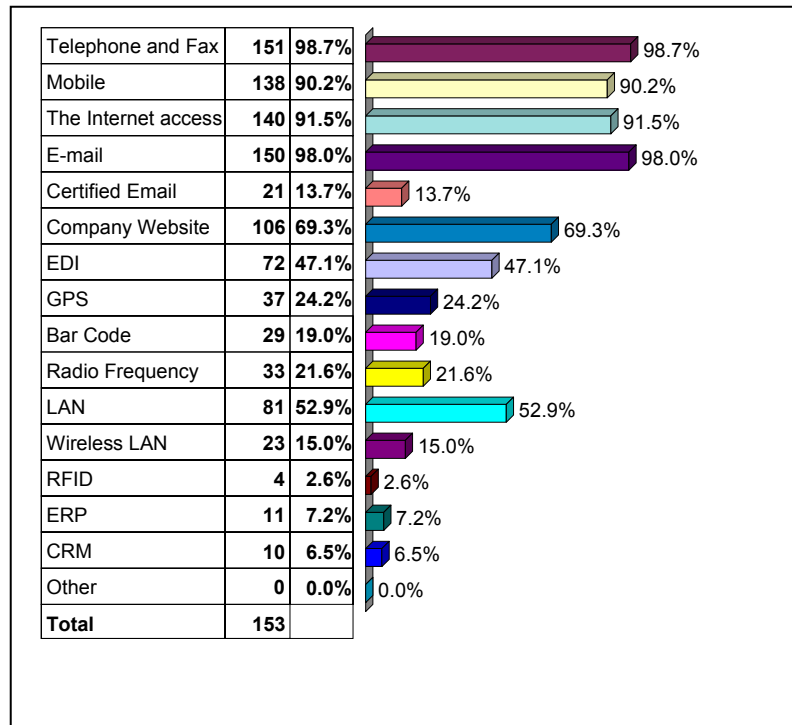


Figure 3: Types of ICT tools adopted by Italian companies.

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.

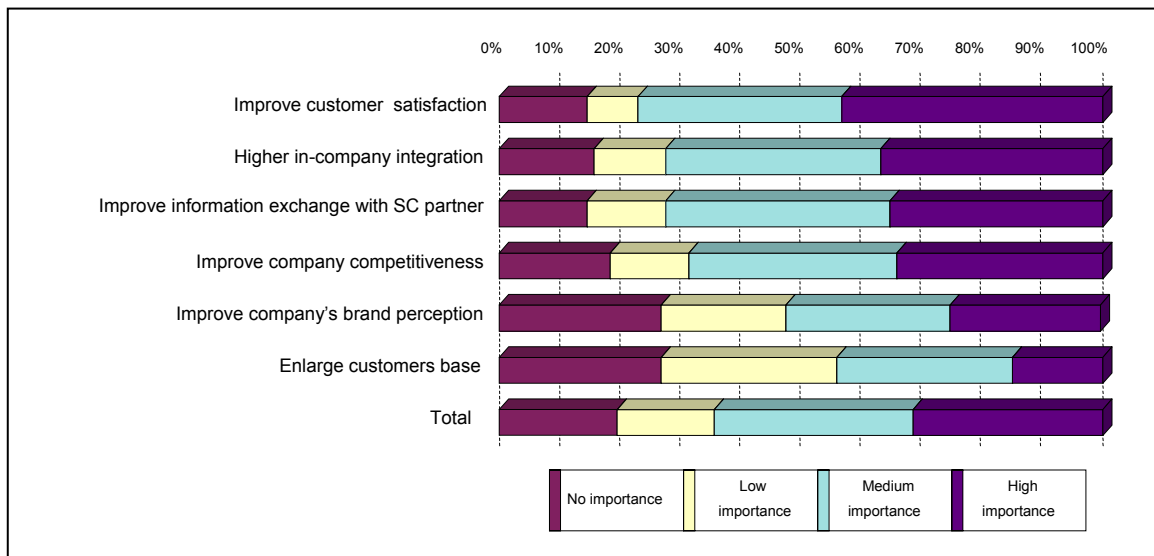


Figure 4: Logistics service providers' motivators for ICT implementation in Italy.

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.

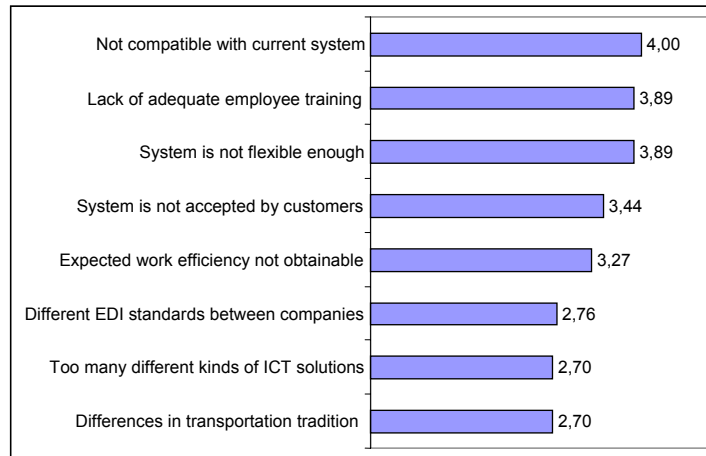


Figure 5: Barriers for ICT investment in Norwegian survey (scale: 0 = no importance, 5 = very important).

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.

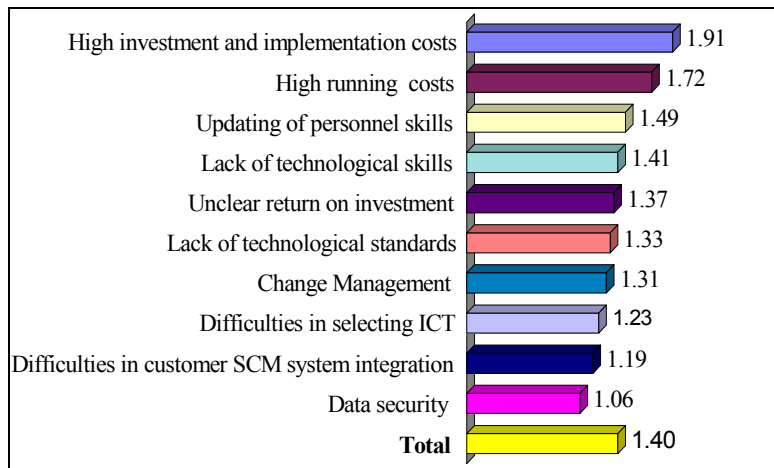


Figure 6: Barriers for ICT investment in the Italian survey (scale: 0 = no importance; 3 = very important).

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.

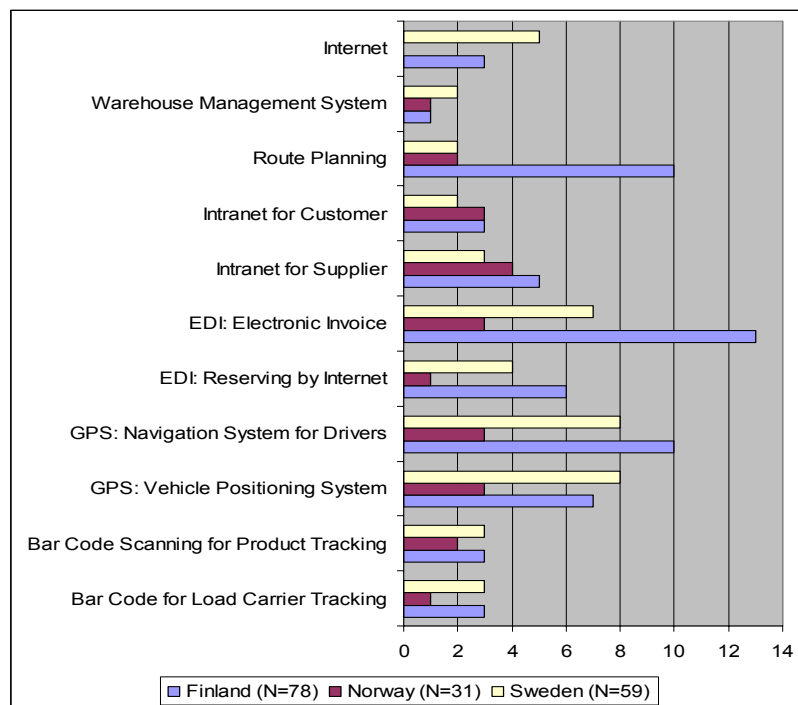


Figure 7: Number of companies planning to invest in different ICT tools in the Northern European Survey.

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.

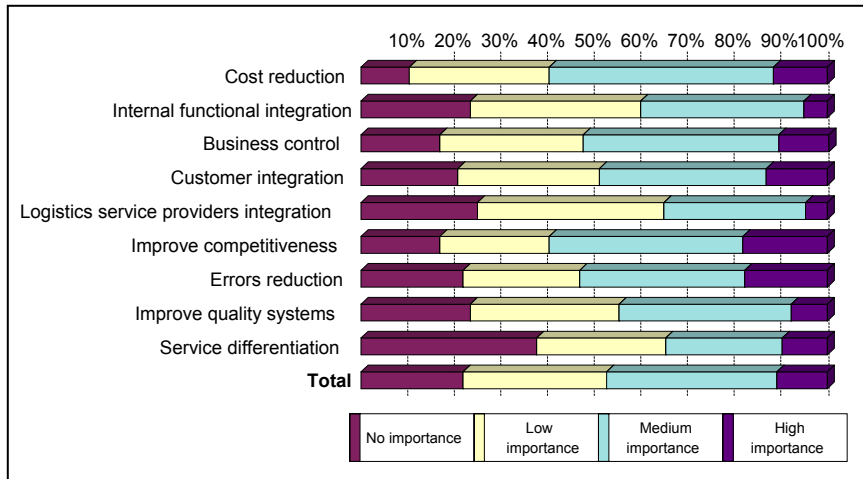


Figure 8: Importance of areas for future ICT investment in the Italian Survey.

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.

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