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ICT innovation diffusion in small logistics service providers: An empirical survey

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Keywords: Innovation, ICT, Small Italian logistics service providers, Questionnaire survey

Abstract

For companies competing in highly dynamic markets, innovation is considered a fundamental component of a successful business as it allows companies to sustain profit margins, sales growth and reduce competitors' pressures. Information and communication technology (ICT) is essential innovation enablers especially in service companies. The focus of the paper is on the analysis of the role of ICT in innovation processes of small third-party logistics service providers (3PLs). On the basis of quantitative evidence emerging from a recent survey carried out on the Italian 3PL market, the paper analyses how ICT is used to support innovation and the factors the inhibit/facilitate the usage of ICT in such companies. Implications for supply chain innovation management are derived from the research and managerial perspectives.

1. INTRODUCTION

There is general agreement that innovation in service firms has different features from manufacturing (OECD, 2000; Johne, Storey, 1998). Traditional dimensions of manufacturing paradigms used to describe innovation appear not to be fully applicable to services. In fact, innovations in services often involve small and incremental changes in processes and procedures. Many service innovations are not very radical and have often already been implemented in or by other service organisations. A recent report of the European Commission (2007) documented how services are becoming more R&D intensive in recent years and service firms are even more innovative than in the past.

Although innovation in services is often viewed as non-technical in nature, ICT plays a primary role in service innovation considering their positive impact on the quality aspect of service innovation (Licht, Moch, 1999). ICT can be seen to influence business growth and productivity improvements in several service sectors such as transportation, communications, wholesale and retail trade, finance and business (Pilat, 2000). ICT is a vehicle that activates and/or enhances service processes and then is considered one of the most important factors that support service innovation. ICT, and the Internet in particular, facilitates radical innovation of the range of services supplied (Kandampully, 2002). In fact, ICT can be simultaneously the platform on which the provision of service is based on the one hand, and an integral part of service itself on the other. Examples can be found in the bank, assurance and transport service sectors in which ICT increase the value perception of service by the customer and dramatically reduce the cost of service delivery.

As shown above, ICT play a key role in innovation processes of service. Nevertheless, research to assess the role of ICT innovation in specific service sectors is limited. The logistics service industry provides a good example of this void as the literature on the subject is very little.

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. The limited number of research available gives rise to the need to develop investigation in order to acquire a deeper understanding and in-depth knowledge concerning the existing level of technology capability in small 3PLs and the main processes, driver and enablers through which ICT may improve the competitive abilities of these companies. This situation appears critical for the EU logistics service market that is characterised by the strong presence of small logistics service providers. This is particularly true in the Italian market where the transport and logistics service sector is highly fragmented, with a large proportion of small providers. The main aim of this paper is to shed some new light on the role of ICT innovation in small 3PLs.

The paper is organised into five sections. Following this introduction, the second section analyses the literature on the impact of ICT on the logistics service industry with particular reference to the small 3PL companies. The research approach and the methodology adopted is described in the third section. In the fourth section the main survey findings emerging from a questionnaire survey carried out on a sample of 153 small Italian 3PLs are presented. The concluding section discusses the research and managerial implications of the research work.

2. ICT INNOVATION IN 3PL INDUSTRY: A LITERATURE REVIEW

There is little doubt that the logistics service industry is undergoing a major transition. In the last few years a series of major changes have occurred which have profoundly affected the logistics service industry at an international level. One of the main driving forces is the widespread adoption of the SCM concept by manufacturers and retailers in managing their businesses (Christopher, 2005). This has resulted in the delivery system becoming an integral part of their product, to the extent that transportation and logistics have become as important as the product itself (Sheffi, 1990). In the context of evolving SCM adoption, manufacturers and retailers are pursuing two complementary strategies. On the one hand, such companies have increased the outsourcing of significant parts of their logistics activities (McKinnon 1999) and have reduced 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). On the other hand, they are demanding a higher degree of integration from all supply chain participants. The shift from traditional supply chain configurations, often characterised by fragmentation, to more coordinated and integrated approaches is central to SCM. This emphasis on integration gives ICT an increasingly important role within contemporary SCM strategy.

Accordingly, 3PLs have started to transform the scope and characteristics of their services in order to improve customer service levels (Daugherty et al., 1992). As a result, 3PLs play a more important role than in the past insofar as they are entrusted with the task of integrating and accelerating physical and information flows along multiple levels of the supply chain (Cooper et al., 1998). This has given 3PLs a new potential role in customising supply chains as they assume responsibility for a growing number of activities beyond transportation and warehousing. For example, the practice of postponement of product finishing to downstream stages of supply chains means that 3PLs have the opportunity to offer services such as final assembly and customisation of products. Offering these services gives 3PLs the opportunity to penetrate segments of supply chains with higher added-value services compared to traditional transportation and warehousing services. The supplementary customised services can give a differentiation edge, while raising added value in services can improve margins, as well as deepen the relationships with customers.

In this scenario, the major challenges for 3PLs include meeting demands for global sourcing, supply chain integration, "one-stop" solutions, and flexibility in service offerings. With more companies opting to outsource distribution and logistics activities to 3PLs, the ability to differentiate becomes critical. Logistics service providers are under constant pressure to enhance their customer relationships and continually expand the range of services offered. Core service offerings are being commoditised, while value-added services and technological capabilities are considered points of differentiation (Evangelista, 2004). While primary driving forces in the 3PL sector previously were to reduce cost and release capital for alternative purposes, the driving forces today have more strategic influences in terms of market coverage, improving the level of service or increasing flexibility in view of the changing requirements of customers (Ojala, 2003). This has given 3PLs a new potential role in customising the supply chain as a growing number of activities beyond transportation and warehousing can be carried out by logistics service providers (Cooper *et al.*, 1998). For example, providing solutions that include value-adding services, such as final assembly, packaging quality control and information service, 3PLs can improve their competitive

position through increasing the level of customisation of the service offered (Skjoett-Larsen, 2000).

The growing need for businesses to diversify and delegate as their supply chains become broader and more complex has validated the role of 3PLs in every aspect of logistics. After gaining acceptance in logistics operations and growing with notable speed over the last few years, 3PL providers are settling into their roles as integral parts of their customers' business plans. This has fuelled the transition from the traditional “arms length” approach to the supply of integrated logistics services packages on a “one-stop shopping” basis and has further facilitated the migration of companies from asset-based to information and knowledge-based, value-added logistics service enterprises. Accordingly, the 3PL market is moving towards a tiered system. Three different evolving stages can be identified during the last three decades. In each stage different type of companies entered the logistics service market according to the different levels of customer logistics outsourcing. During the first wave (1970s-1980s) commodity providers (carriers) operated in the market as transportation was the main outsourced activity. The competitive weapons of these companies were mainly based on operational efficiency and a resulting low cost base. In the second wave (1980s-1990s) third party logistics companies (3PLs) appeared on the market. The competitive abilities of these companies mainly relied on integrated transport and warehousing services provided in combination with a range of customised value-added logistics services. Such companies often outsourced basic and low margin services (such as transportation) to carriers which worked as tier suppliers in the system. The most recent wave (2000 and beyond) has been characterised by the entry of a new type of company (fourth party logistics service providers or 4PLs) offering integrated strategic supply chain orchestration. 4PLs typically handle all aspects of the supply chain from procurement through to inventory control, final delivery and invoicing. In this context, 4PLs are able to supply highly customised and specialised services through the control of strategic functions such as supply chain design and integration on a global scale, while value-added services and other logistics activities are outsourced to local 3PLs that act as sub-contractors.

Logistics service companies have the opportunity to evolve from playing their traditional tactical roles (first wave) to become adaptive supply chain providers (third wave). The key challenge is to decide which of these three tiers they are going to concentrate on and then to build an organisation to support this strategy. These tiers mirror those within the automotive sector with the first tier taking full responsibility for the co-ordination of their customers’ supply chains, (with a strong emphasis on introducing innovation), as well as managing a second tier of companies.

It is evident that in the evolving landscape of the logistics outsourcing market, ICT is playing an increasing important role posing new strategic challenges and opportunities to logistics service providers. In today’s turbulent supply chain environment characterised by time compression and the need for agility, ICT 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 of the service provided (Van Hoek, 2002).

The widespread use of ICT is reinforced by the trend towards the outsourcing of shippers’ information applications. According to a survey by Lieb and Schwarz (2002), many users of 3PL services rely upon their 3PL providers for ICT support. Users were asked to identify the information-based services they have outsourced to their 3PLs. The information-based

services most frequently outsourced to 3PL providers are freight payment services (45%), transportation planning/optimisation (45%), warehouse management systems (27%), shipment tracking (18%), and international documentation (18%).

The supply of information-based services (such as real-time tracking and tracing of shipments) is a great challenge for 3PLs, particularly for small and medium-sized logistics service providers. Such companies have more difficulties in using ICT due to reluctance to change and insufficient human and financial resources. ICT is often perceived as an added cost involving company re-organisation and the skills development associated with technology investments. The result is that small 3PLs generally underestimate the potential of ICT as a tool for increasing cost-efficiency and improving customer service simultaneously (Evangelista and Sweeney, 2006).

The increasing role of ICT has contributed to the evolution of the competitive scenario in the international 3PL industry. It has allowed the entry of new players in the market from unexpected industries and has led to changes in the way 3PLs conduct their business (Regan and Song, 2001). The following three trends emerge as a result of the impact of ICT and web technologies on the 3PL industry (Evangelista, 2003): 1. New e-services; 2. New functions; and 3. New alliances.

The literature review carried out above outlined the increasing role of ICT as a competitive weapon with the potential to enhance the overall 3PL's competence (Closs, *et al.*, 1997). At the same time, ICT is considered one of the most powerful drivers of changes of the logistics service industry. The result is that 3PL industry is in a transition phase where information management is gaining increasing importance in comparison with the traditional asset management approach. This new industry configuration makes the role of innovation, and ICT innovation particularly, even more critical for securing growth and profitability of logistics service companies. Capturing and sharing information with other partners requires 3PLs to handle an increasing number of electronic links along the supply chain. To manage this complexity, large logistics companies have invested significant financial and human resources in ICT innovation, while small 3PL companies lag behind. The shortage of papers witness how logistics and SCM literature devoted scarce attention to this area. Recently, some studies have been published. In their paper Gunasekaran and Ngai (2003) examined a case study of successful small logistics company based in Hong Kong. The authors developed a model describing how the case company reached the status of full-fledged 3PL. The model is based on five major dimensions including: a) strategic planning; b) inventory management; c) transportation; d) capacity planning and ICT. With reference to the ICT dimension, the authors argued that small 3PLs are flexible and innovative in executing logistics operations but they have problems in acquiring enough capital, resources and skills. Moreover such companies tend to lag behind in the implementation of information systems such as EDI, Internet, extranet and ERP.

Two other papers report empirical surveys investigating ICT usage in small logistics companies have been found. The main features, objectives and findings achieved in the two studies are summarised below.

The first study has been carried out by Pokharel (2005) and it deals with ICT perception by transportation and warehousing companies in Singapore. Although the paper is not specifically focused on small logistics companies, a significant proportion of the surveyed companies may be considered small firms. In fact, out of 45 respondents (25 transport companies and 20 warehousing companies), 28 companies (19 transport companies and 9

warehousing companies) declared less than 10 million S$ in total revenues. Moreover 80% of transport companies and 65% of warehousing companies employed less than 100 people.[1] The survey explored a number of interesting issues related to ICT usage and perception. With regard to ICT penetration it emerged that all companies have basic ICT in place (e.g. computer, Internet connection and EDI), but the usage of more advanced technology decreases in the two groups of companies, particularly in transport companies. In relation to motivators and barriers results show that increasing operational efficiency, decreasing data entry error, decreasing costs, and increasing customer service levels are the main reasons for ICT adoption. However, lack of adequate ICT resources, problems in quantifying intangible benefits (such as better coordination, increased variety and innovation), integration with current policies, higher costs, and longer anticipated time required for full implementation of ICT are some of the major barriers. An interesting comparison between small and large sample companies has been made by the authors. The analysis shows that large companies have a higher status of ICT implementation showing a significant difference between the perception of ICT in small and large companies. Smaller companies, in general, tend to serve a few customers or a small market area. Therefore, these companies may have a lower perception of ICT implementation in comparison with large companies. Pockarel (2005) also noted that large companies have more motivation to adopt ICT than small firms. Finally, concerning barriers the perception differs slightly in terms of organisational barriers between small transporters and small warehousing companies. However, the perception differs between large and small transporters in terms of management support, compatibility and quantifying intangible benefits. Small transporters perceive the lack of management support more serious barrier than their larger counterparts. Compatibility of ICT for organisational requirements is another concern for small transporters but the lack of better ICT resources in and outside the company is the concern of their large counterparts. Small transporters might have some difficulties in finding suitable ICT to implement in the company. The paper concludes that the study involved only transportation and warehousing as they are high cost contributors to logistics services. In order to understand a more general feature concerning ICT adoption and perception, the authors recommend the inclusion of other logistics services provider types in further research.

The second study has been conducted by Kilpala, et al. (2005) on ICT usage by small 3PLs in the Barents region. The work has been carried out in the frame of the Sustainable Transport in the Barents Region (STRB) research project. The Barents region refers to the Northern periphery of Europe. It constitutes the Northern counties of Finland, Norway and Sweden, and the North-Western counties of Russia. The micro and small logistics service providers in the Barents region typically have a few employees and their services provided are limited to basic transportation combined with few value-adding services. The Barents region has also attracted some large international logistics service providers to the region, such as DHL and UPS. The main focus of the study is on the cooperation practices and the ICT implementation in 3PLs. The results achieved are based on a questionnaire survey involved 168 3PLs in Finland, Norway, and Sweden. The survey results among the 3PLs in Finland and Sweden show similarities in most aspects regarding the overall development, cooperation practices and ICT implementation status. The 3PLs surveyed in Norway show some differences in comparison

[1] A similar breakdown between small and large companies has been obtained in the sample investigated by Piplani, Pokharel and Tan (2004). The study explored the perspective on the use of ICT by 61 3PLs based in Singapore. Out of 61 companies, 40 companies declared less than S$ 10 million in the total turnover.

with the companies operating in the other two countries as the Norwegian 3PLs showed a higher overall ICT implementation status. In all three countries, the 3PL sector consists of a large number of small and medium-sized companies. The results indicate that majority of the 3PLs are familiar with computer technology and have some ICT tools available. Yet not all 3PLs have the Internet connection and there are even companies that do not have a plan to move to the Internet-age. EDI implementation is in a very early stage in Finland and Sweden, whereas Norwegian 3PLs show a higher usage of this technology. Route planning tools were also more common among the surveyed 3PLs in Norway. The GPS technology implementation made an interesting exception: among the generally less "technology-oriented" 3PLs in Finland GPS systems were more common. It is of interest to further analyse the ICT implementation status and the underlying drivers for ICT implementation. Another issue investigated by the survey is motivators and barriers to ICT adoption. Improving control and planning was found to be an important motivator, while the most important barriers are the low level of compatibility with current system, lack of adequate employee training and system not being flexible enough. Difficulties in system acceptance by customer and difficulties in achieving the planned level of work efficiency have been considered barriers of less importance by the surveyed companies.

3. RESEARCH APPROACH AND METHODOLOGY

The basic research hypothesis of the project is that "the effective adoption of ICT innovation has the potential to improve the competitive capability of small 3PLs. This improvement is dependant on an understanding of major processes, drivers and enablers". Consequently, the following three research questions have been defined:

RQ1. What are the current ICT practices in the provision of value added services by small 3PLs?

RQ2. What are the critical enablers and inhibitors of ICT usage in small 3PLs?

RQ3. What is the relationship between ICT implementation and competitiveness of small 3PLs?

A key initial research task involves the definition of small and medium size 3PL service companies. The definition of the unit of analysis will also allow identifying the targeted population for the empirical investigations that will be carried out during the project. As this research project examining innovation and technology usage in small 3PL companies, particularly in the Italian context, a definition of small 3PL company is proposed. The derivation of the definition is based on the following three inputs: i) existing 3PL definitions from the literature; ii) structure and evolution of the Italian 3PL industry; and iii) specific issues associated with innovation and ICT.

Based on the above three inputs, the following small 3PL definition modified from Berglund et al. (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 is consistent with the characteristics of the Italian industry and is, therefore, usable in the specific context 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 optional activity elements - this reflects the fact that for many logistics service providers their first foray into non-transport activities is in this area;
- the optional activity elements include both information related activities as well as elements of supply chain functionality which may be outsourced by customers;
- 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.

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. In addition, it is reasonable to expect that new technologies could have a different impact on different type of company. For this reason, based on the definition given above, a small 3PLs categorisation is proposed. The taxonomy is based on the following three categories:

1) *Full Haulage Providers*: those companies 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 (e.g. where more than 50% of the total turnover is generated by value added logistics and SCM services).

4. SUMMARY OF MAIN FINDINGS

This section reports the main findings emerging from the empirical part of the project. It documents and discusses the main questionnaire survey results achieved. A brief description of the specific method adopted in carrying out the survey will be followed by a presentation of the most significant results emerging from the research.

4.1 Survey method

The first research step is quantitative in nature and it has been carried out through a questionnaire survey (Evangelista, Sweeney, 2006). The specific objectives on which the survey has been based are as follows:

1) to set-up a technological profile of the surveyed companies;
2) to analyse the role of ICT tools in supporting the customisation of services;
3) to identify factors affecting the adoption of ICT.

The field survey method has been organised into the following five steps:

a) *Focus groups for discussing survey objectives and draft questionnaire*. Two focus groups were held in Rome and Milan. 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.

b) *Re-focussing of survey objectives and questionnaire*. Based on the focus groups outcome, 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.

c) *Population definition*. As the vast majority of firms in the Italian transport and logistics sector are small, they can be classified as 3PLs using the small 3PL definition given above. 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, 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. In order to define the population for this study, the estimate of the size of Italian logistics service market provided by Confetra in 2004 has been used. The Confetra research centre estimates in 140,550 the total number of Italian 3PL companies operating on the market (Leonida, 2004). Based on this, the total population in this research is estimated at 21,500 companies.

d) *Preparation of the mailing list*. The setting up of the mailing list of logistics companies to involve in the survey has been a difficult job as there is not one single reliable source of company information concerning Italian transport and logistics companies. A national directory of Italian logistics companies does not exist (there are only some lists for the road haulage sector such as Tuveri). The implication is that it was necessary to have access to a multiple sources of information. A first potential source of information of this kind is industry association. In the Italian logistics sector there is a large number of operating industry associations which adopt different 3PL taxonomies to classify their associated companies. This situation has produced a plethora of statistics calculated using different criteria and segmentation of the Italian logistics service market. This is reflected in the low level of consistency and quality of data and information concerning logistics companies operating in the Italian market. For this reason, company information to build up the survey mailing list where 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, etc.). A draft mailing list containing 2,464 companies was randomly compiled. The variety of sources used to create the survey mailing list required to be carefully scrutinised to avoid duplication or the involvement of company out of the scope of the survey. Each individual record was checked to ensure that companies selected were in line with the criteria on which the population has been defined. A number of inconsistencies were detected and this reduced the total number of companies included in the survey from 2,464 to 1,992.

e) *Survey implementation*. The questionnaire was mailed to 1,992 companies throughout Italy 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. The final number of usable responses was 153. 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. In order to detect non-response bias, a number of non-respondents were contacted and there was no evidence of any significant non-response bias. Table 1 shows a breakdown of the sample firms by provider type according to the small 3PL classification adopted.

Table 1. Sample firm classification

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

4.2 Main results

It follows the description of the main survey results for each research objective set out earlier.

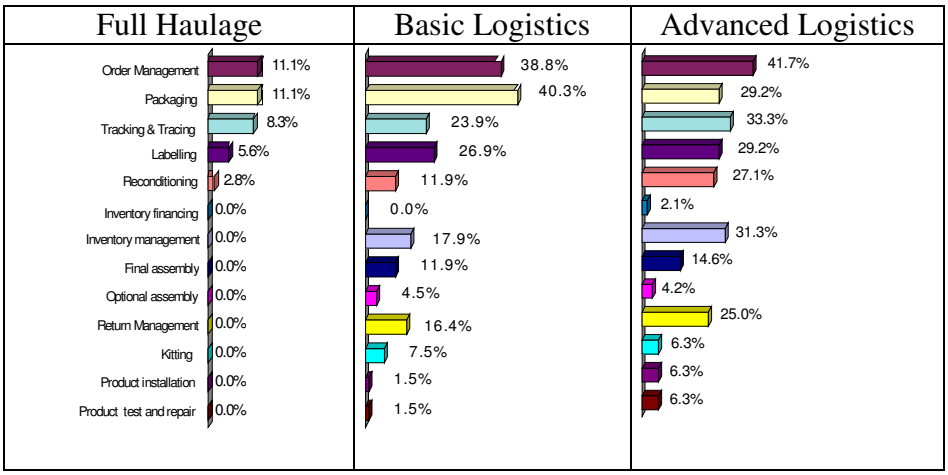
Sample characteristics. The sufficient size of the sample investigated is the first important characteristics. This means that it is possible to assume that data are sampled from a Gaussian distribution. Table 2 provides details concerning the distribution of the sample in terms of types of provider and firm size using employee bands according to the EU definition of SMEs (European Commission, 2005). Of the 153 respondents, almost 27% are micro companies and 42.5% are small, while about 30% are medium firms.

Figure 1 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.

Table 2. Sample firm classification and company 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. Value added services supplied beyond transport and warehousing



Technological profile. Data reported in Table 3 reveal that expenditure on ICT as a percentage of total company costs did not significantly vary among the different provider types (p=38.2%, chi2=8.55).

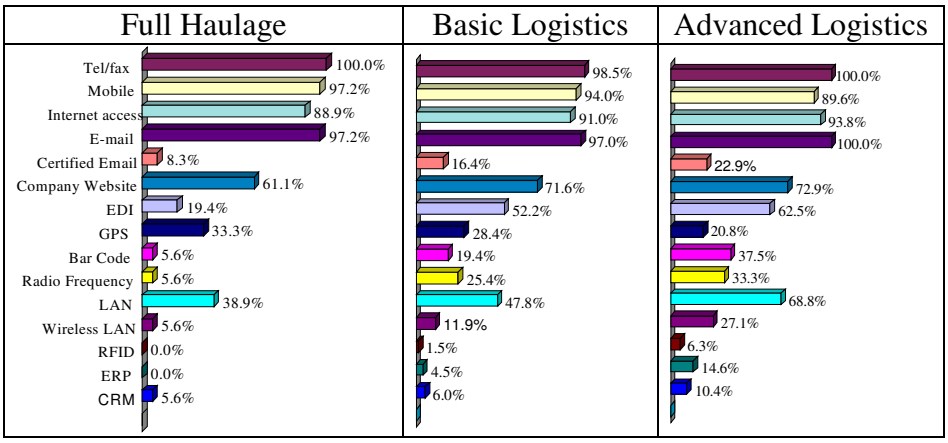
Of the 100 companies that responded to the question regarding ICT costs, 36 spent less than 1% of their total costs on ICT. 11 companies spent more than 10% of their total costs on ICT. Figure 2 illustrates the various ICT tools that the three provider types currently adopt in their relationships with both customers and other logistics providers.

Data indicate a low level of usage of relatively sophisticated technologies among all provider types, particularly in the management of relationships 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 3. Percentage of ICT costs on total company costs by provider types

ICT expenditure bands	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 2. ICT Usage by Provider Types



ICT in supporting service customisation. 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. 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 reasonably well established within Italian small logistics providers. Considering website adopters, data shown in figure 3 reveal that the most important functionality associated with website usage is in the areas of electronic service catalogues, company presentation and advertising channels.

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, *et al.*, 2003), this evidence confirms that the surveyed companies are still in the early stage of the model (basic marketing and publishing). Figure 4 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.

Figure 3. Importance of website functionality

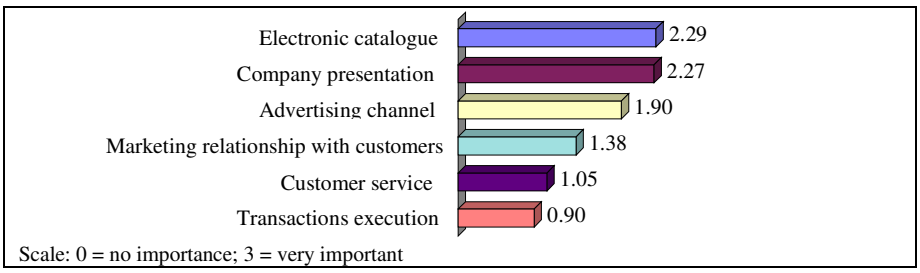
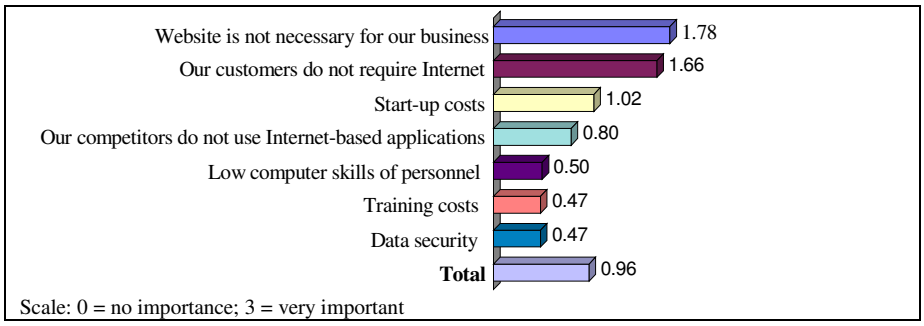


Figure 4. Reasons for non web site adoption



These results suggest that companies underestimate the potential value of websites in improving their businesses and as a instrument to customise the services supplied. Data concerning 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 5 reveals that software for transport management is the most widely used among adopters (60.1%).

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 4, 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 (Chi2=12.32, p=2.1%). This suggests that advanced providers are more oriented towards the customisation of their services.

Figure 5. Type of software used by the sample firms

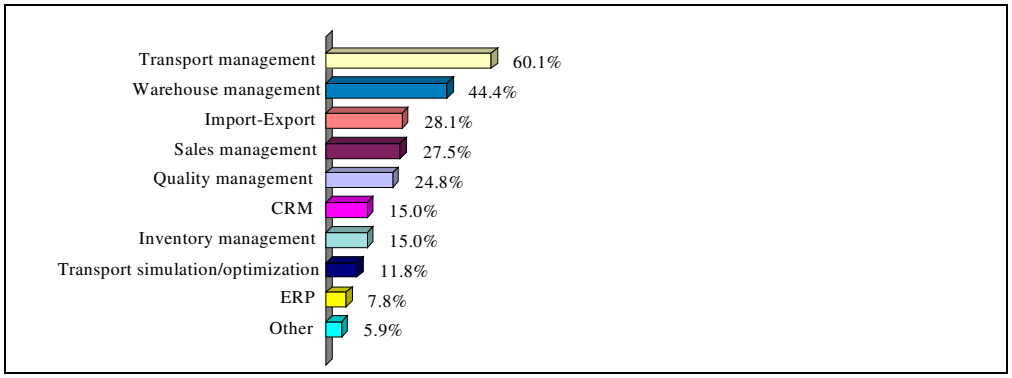


Table 4. Tracking and tracing services

	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	21	43.8	27	56.3	48	100
Total	93	60.8	57	38.9	150	100

Factors influencing 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 (Table 5). 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 5. Factors stimulating ICT usage

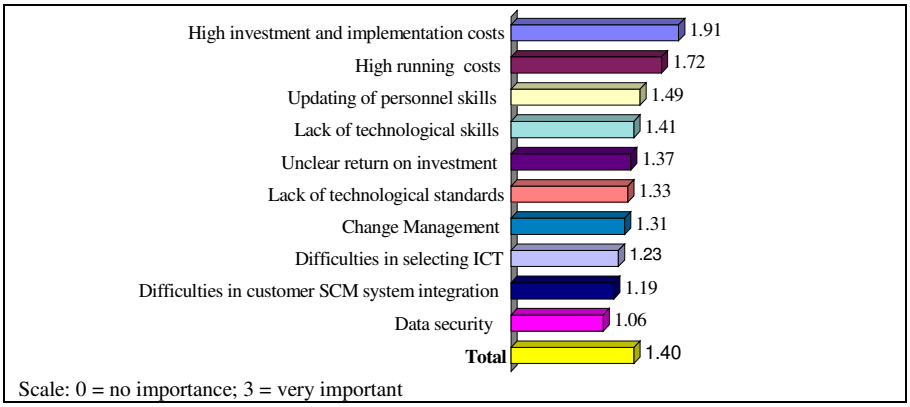
Factors	Full Haulage		Basic Logistics		Advanced Logistics	
	Mean (n=36)	S.D.	Mean (n=67)	S.D.	Mean (n=50)	S.D.
Higher in-company integration	1.69	1.17	2.05	1.08	1.92	0.94
Improve customer satisfaction	1.78	1.02	2.06	1.09	2.23	1.02
Improve info exchange with customers/other 3PLs	1.47	1.08	2.03	0.97	2.08	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

With regard to the factors inhibiting ICT adoption in the sample firms (Figure 6), significant differences do not emerge between the provider classifications. The most important reasons for non investment in ICT are related to financial factors. 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.

Figure 6. Factors inhibiting ICT adoption



5. CONCLUSIONS AND IMPLICATIONS

In today logistics service industry scenario, the availability of capable ICT-based services is an expected dimension of 3PL service supply. The cost of entry into the 3PL arena now includes technology and implementation capabilities for warehouse management, transportation management, and web-enabled communications. Users of 3PL services anticipate that the near-term differentiators will include electronic markets, supplier management systems, and supply chain planning. Going forward, the success of 3PLs will depend on their ability to deliver an integrated, end-to-end solution that provides significant improvements in financial and operational performance. Consequently, 3PLs need to focus on a number of key objectives, including implementing ICT. Considering that customer demands for performance and sophistication are accelerating, improving these areas is a key imperative for 3PLs. The competitive landscape for small 3PLs is then 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. Small 3PLs typically offer a limited range of value-adding services and ICT tools have the potential to enlarge the range of services offered. Furthermore, ICT may contribute to improve the customisation of services provided by these companies.

The survey results widen the knowledge base in relation to ICT usage in small 3PLs 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 in relation to the future role of ICT that are evident in each category.

The questionnaire survey results indicate that the use of relatively advanced ICT is more prevalent in AL. Given the nature of these activities in the emerging value adding business models of AL this trend is likely to continue. Moreover, the current levels of expenditure on

ICT in relation to overall company cost base do not vary significantly across provider categories. 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. 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.

The analysis indicates that ICT offers a means of achieving differentiation by innovation. This changing role is influenced by closeness to the customer. Accordingly, AL companies, which generally have a closer and direct relationship with customers, adopt a longer term strategic view of the use of ICT. BL companies have the potential to reinforce their technological capability to support the service improvement and differentiation, but this potential has not been fully exploited. Finally, the role that ICT may play in FH appears very limited. FH providers seem to have little interest in developing innovative actions and this increases the risk of these companies remaining providers of 'commodity' services. The analysis of factors influencing ICT adoption supports this interpretation. For AL firms "external" factors (industry fragmentation and ICT supply side issues) are the main ICT inhibitors. For companies in the BL category cost factors are preventing technology innovation initiatives. For FH companies the role of technology remains unclear. It seems that the use of more sophisticated information systems predominantly depend from the capacity of the technology supply side (both ICT vendors and truck companies) to stimulate these companies through simple technologies for which it is easier to evaluate the impact on costs/productivity. It should be noted that these factors are in many ways interdependent and this issue is worthy of further research. The author's 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.

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