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ICT and innovation processes in small logistics companies

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1. Introduction

In any industry, staying close to customers and continuously innovating products and services in response to their specific needs represents the essence of any potentially successful competitive strategy. Innovation is considered a fundamental component of a successful business as it allows companies to sustain profit margins and sales growth and to reduce pressures coming from competitors. For third-party logistics service providers (3PLs) closeness to customers is critical to the development of logistics innovation. A key element feeding innovation processes is information. Capturing and analysing customer information and sharing such 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 Information and Communication Technology (ICT). However, little has been written about the role of technology in logistics innovation of small

3PLs. This is reflected in the existing gap in the literature where the role of ICT in improving innovative capabilities of small 3PLs have received little attention.

This paper investigates the role of ICT in logistics innovation. The focus of the paper is on the effects that ICT usage is having on the management of small 3PLs. On the basis of quantitative and qualitative evidences (Evangelista *et al.*, 2005 and 2006) emerging from a recent survey carried out on the Italian logistic service market, the paper analyses how ICT is used to support logistics innovation and the factors inhibiting/facilitate the usage of ICT in such companies. Implications for logistics innovation management will be outlined from both research and managerial perspectives.

2. Service innovation and the role of ICT

Innovation is generally associated with something new or perceived as new. Schumpeter (1939, pp. 87-88) defines innovation as "...the setting up of a new production function. This covers the case of a new commodity as well as those of a new form of organization or a merger, or the opening up of new markets". In Schumpeter's theory, innovation is a wide concept that it is not limited to the technology/manufacturing environment but it involves organisational application and demand related aspects.

Rogers (1995, p.11) defined innovation as "...an idea, practice, or object that is perceived as new by an individual or other unit of adoption". In Roger's theory innovation is not necessarily something new to the world. Furthermore, innovation can be based on limited or even no creative effort. It is enough that the result of innovation is perceived as new by the user. The above two broad definitions highlight how the concept of innovation is not limited to the manufacturing environment.

Innovation is also an important issue in "non-material product" such as in services, although the role and the impact of innovation in services firms has been largely neglected. Service companies are often considered passive to innovation and too frequently seen as being innovation 'laggards' (Miles, 1993). Over the last few years innovation in services attracted the attention of an increasing

number of scholars of technological change (Barras, 1986; Gallouj and Weinstein, 1997; Metcalfe and Miles, 2000). There is general agreement that innovation in service firms has different features from in manufacturing (OECD, 2000; Johne and 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.

As research increased in this area, a number of interesting trends have been identified. A first trend is that services are becoming more R&D intensive in recent years. A recent expert report of the Commission of the European Community (2007) shows that in business, R&D performed in the European service sector increased from 11.5% in 1997 to 15.1% in 2003. Secondly, service firms are even more innovative than in the past and are generating more innovations over time. Across the OECD member countries the average annual rate of service-sector R&D increased by 12% compared to approximately 3% for the manufacturing sector from 1990 to 2003.

Although innovation in services is often viewed as non-technical in nature, ICT plays a primary role in service innovation. Technology innovation in services is often based on the adoption of information technology. Investment in ICT, human capital, and organisation produce a higher levels of productivity and performance in firms as innovation requires that companies expand their networks and exploit cooperation opportunities. Licht and Moch (1999) provide empirical evidences about the positive impact of information technology on the quality aspect of service innovation. There are also evidences about the influence of ICT on business growth and productivity improvements in several service sectors such as transportation, communications, wholesale and retail trade, finance and business (Pilat, 2000). Information technology is a vehicle that activates and/or enhance service processes and then is considered one of the most important factors that support service innovation in the today knowledge-driven economy. Kandampully (2002) assigns to ICT a fundamental role in service innovation. ICT, and the

Internet in particular, have had positive effects on service innovation as it facilitates radical innovation of the range of services supplied. ICT can be simultaneously the platform on which the provision of service is based on the one hand, and the 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 delivering.

3. Logistics innovation and ICT in 3PL industry

The short literature review summarised in the previous section shows the importance of innovation for service organisations and the key role played by ICT. Nevertheless, research to assess innovation in specific service sectors is very limited.

This is particularly true in the case of the logistics service industry where there is a limited number of contributions. There is also a gap in the literature in assessing the role of ICT in the innovation process of logistics companies. This section provides a brief review of the existing literature on the subject in the order to define the state of knowledge in this area. A first issue is how to define logistics innovation. Only two papers provide a definition and both papers focused on logistics service companies.

Flint, et al. (2005, p.114), define logistics innovation as “.....any logistics related service from the basic to the complex that is seen as new and helpful to a particular focal audience. This audience could be internal where innovations improve operational efficiency or external where innovations better serve customers”. According to Nagarajan and White (2007, p. 10) logistics innovation could be “.....new to the world or new to the particular context of the firm and its stakeholders”.

The first definition appears more comprehensive as it includes radical and incremental innovation together with any possible solutions between the two extremes. Furthermore, it highlights the two areas of improvement on which innovation may impact (internal efficiency or customer service). The authors suggest a theoretical model of the logistics innovation process based on a

literature review and a number of interviews held with managers of logistics service companies. The model is structured in four linked stages. It describes the potential path for logistics innovation and new service development processes in the context of logistics service companies. The emphasis is on the importance of capturing customer views in order to design new services that are consistent with the current and future customer needs.

Nagarajan and White (2007) analyse multiple aspects of innovation in the U.S. logistics service industry. The authors tried to assess the innovative activity in the sector through a study of patent data combined with interviews with managers of top logistics firms. The study shows how logistics innovation U.S. logistics industry is essentially driven by customer.

The work of Soosay and Hyland (2004) analyses factors that stimulate innovation in distribution centres in Australia and Singapore using a case study approach. The authors set up a model in which there are external and internal factors. These factors can push or, in some cases, pull innovation in a particular direction.

Similarly Chapman et al. (2003) recognise the need for logistics companies to anticipate and innovate service to meet customers' evolving needs. The authors then identified technology, knowledge and relationship networks as the main factors influencing innovation in the logistics service industry.

The paper of Pedrosa et al. (2007) starts from a review of the main theoretical approaches suggested by two streams of literature on service innovation: the content and the innovation process. The paper explores the linkages between these two elements analysing the case of three large logistics companies. This analysis establishes a framework comprising process and content dimensions of service innovation in an integrated way.

Summarising the above, it appears that the concept of logistics innovation received little attention, but the importance of innovation in the logistics service industry has increased in the last few years due to the more complex role that 3PLs have to play to meet the changing supply chain requirements of their customers. Two common issues emerge from the works reviewed. Firstly, the logistics innovation process in the 3PL sector is customer driven and, secondly, information technology is considered the key

enabler in this process allowing new service design and implementation. With reference to the logistics service industry, the critical importance of ICT for 3PLs relies upon the opportunities to differentiate and/or develop logistics services in a customised supply chain context (Sauvage 2003; Van Hoek, 2002).

Hence, the role of ICT in the logistics innovation process of 3PLs is strictly linked to the achievement of the company's competitive advantage. For this reason it is interesting to investigate the factors influencing the adoption of new technology by logistics companies. Also in this case the literature does not pay so much attention to this issue. Recently, Lin and Jung (2006) study the factors influencing the ICT innovation of logistics service providers in Taiwan. They identified three influencing factors: technological, organizational and environmental factors. The analysis conducted on survey data confirmed that all these three determinants have significant influence on technological innovation of logistics companies surveyed.

4. An investigation on ICT usage by small Italian 3PLs: methodology and empirical findings

The main aim of this paper is to shed new light on the role of ICT in the logistics innovation process of small 3PLs. To achieve this objective, some of the findings (both quantitative and qualitative) emerging from a survey carried out on a sample of 153 small Italian 3PLs are used.

The quantitative findings have been obtained through a questionnaire survey (see Evangelista *et al.*, 2005, Evangelista and Sweeney, 2006), while the qualitative analysis has been based on a case study survey (see Evangelista *et al.*, 2006). The use of a multiple methodological approach allows to overcome the weakness of a single research approach (quantitative vs. qualitative) and to enrich data collection and analysis. The advantage is to combine methodological approaches which integrate strengths and mitigate shortcomings of quantitative and qualitative methods, the so called *triangulation*. Triangulation can therefore improve internal and external validity as the combination

of separate research methods in one study helps to counter the trade-offs inherent in others (Scandura & Williams, 2000). From this point of departure, it is expected that the results of case study analysis combined with the findings emerged from the previous field survey will provide a more clear and integrated picture of the impact of new technologies on small 3PL companies.

The following taxonomy of small 3PLs has been used for data analysis: *Full Haulage Providers* (those companies for which transport activities represent 100% of turnover); *Basic Logistics Providers* (those companies for which transport and warehousing together comprise over 50% of turnover); and, *Advanced Logistics Providers* (those companies for which transport and warehousing together comprise less than 50% of turnover).

Seven companies participated in the case study survey divided for each provider type as follows: 2 Full Haulage, 3 Basic Logistics and 2 Advanced Logistics. Considering the results of the literature review, the evidence presented are referred to as: a) the role of ICT in supporting the customisation and differentiation of services; and, b) the factors influencing the adoption of ICT.

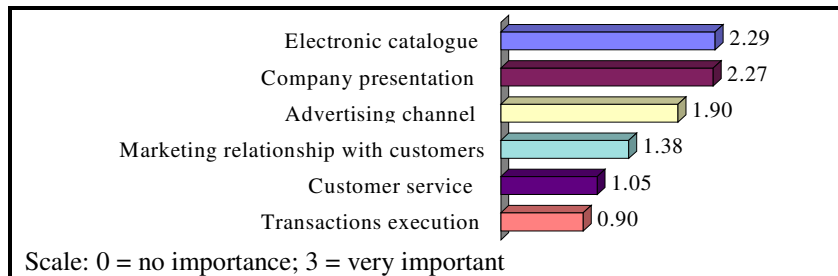
4.1 Quantitative findings

4.1.1 The role of ICT tools in supporting the customisation and differentiation of service

Website is one of the most important ICT tools and its effective use provide the potential to reduce costs and improve customer service. Based on the entire sample, it emerges that 105 (68.6%) have a website in place, while 48 companies (31.4%) do not. The level of company website adoption across the different provider types is: 61.1% for Full Haulage; 71.6% for Basic Logistics, and 72.9% for Advanced Logistics. This suggests that this tool is now reasonably established in small Italian 3PLs. Considering website adopters, data shown in figure 1 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. To assess the use of website the KPMG e-commerce business maturity model (Ellinger, *et al.*, 2003) has been used. Such model considers that website usage goes through four different stages - marketing, publishing, transactional and interactive - in connection with the evolution of the company's e-commerce strategy.

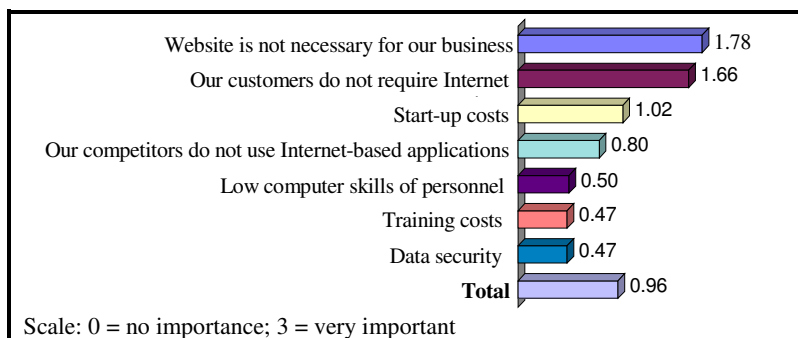
Figure 1 - Importance of Website Functionality



According to this model, the evidence confirms that the surveyed companies are still in the early stage of the model (basic marketing and publishing).

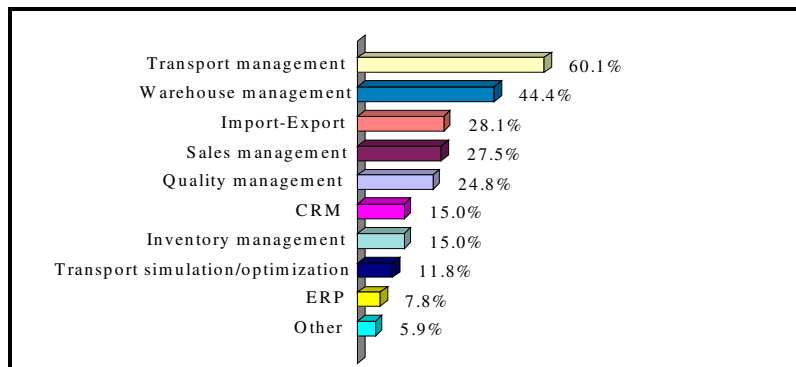
Reasons cited for non adoption of websites have also been considered (see Figure 2).

Figure 2 - Reasons for Non Web Site Adoption



The main reasons are: website deemed unnecessary for the businesses; customers do not require Internet services; and, website start-up costs. These results suggest that companies underestimate the potential value of websites in improving their businesses and as an instrument to customise/differentiate the services supplied. Data about the software usage indicates that 138 companies (90.2%) adopt software, while 15 companies (9.9%) do not use software to customise their services. Figure 3 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, software that has the greatest potential in terms of service customisation and interaction with customers (i.e. CRM and ERP) is not widely used.

Figure 3 - Type of Software Used by the Sample Firms



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 1, 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 customised services of this kind. However, there is a highly significant difference between the T&T capabilities of Advanced Logistics in comparison with Basic Logistics and Full

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

Table 1 - Tracking and Tracing Services

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

4.1.2 Factors influencing ICT adoption

Among the factors that stimulate the use of ICT (see table 2), the most significant difference emerges with reference to the improvement of information exchanged with supply chain participants.

Table 2 - Factors Stimulating ICT Usage

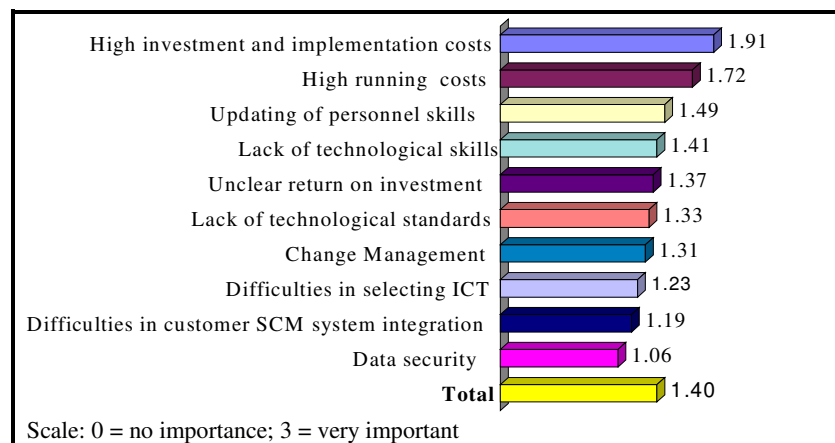
	Full Haulage		Basic Logistics		Advanced Logistics	
	Mean (n=36)	S.D.	Mean (n=67)	S.D.	Mean (n=50)	S.D.
Higher in-company integration	1.69	1.17	2.05	1.08	1.92	0.94
Improve customer satisfaction	1.78	1.02	2.06	1.09	2.23	1.02
Improve info exchange with customers and 3PLs	1.47	1.08	2.03	0.97	2.08	1.01
Enlarge 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

Advanced Logistics attribute greater importance to this factor than Basic Logistics and Full Haulage ($p=1.2\%$, $F=4.56$). 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 ($p=12.0\%$, $F=2.13$).

With regard to the factors inhibiting ICT adoption, the analysis carried out on the entire sample (see figure 4) provides an interesting picture. The most important reasons for non investment in ICT are related to financial factors.

Figure 4 - Factors Inhibiting ICT Adoption



The size of investment and the implementation costs, together with running costs, are considered the most influential factors inhibiting ICT investment. Human resources and the supply of ICT products and services represent further constraints on the adoption of technology.

4.2 Qualitative findings

A multiple case study approach was chosen for the purposes of this survey. The data collection strategy has built upon the information generated by the empirical survey and it has been organised in the following three phases: 1) selection of a set of companies from the sample firms of the previous field survey; 2) preliminary phone

inquiry conducted with the selected companies; 3) in-depth face-to-face interviews has been carried out in a subset of 7 companies chosen on the basis of their answers in the phone inquiry. According with the taxonomy reported above, three sets of companies has been selected from the sample firms using the following two criteria: a) the breakdown of the company turnover by the type of service provided and b) the level of information technology in the company in terms of number and sophistication of tools adopted.

4.2.1 The role of ICT tools in supporting the customisation and differentiation of service

Despite this all the case companies have a website in place, the level of usage is more focused on providing users with general company information than to use it in a more interactive way. The application of the KPMG's model cited above suggests that no companies in the sample reached the highest stage (interactive). Most of the case companies, 4 out 7, (Full Haulage 1 and 2, Basic Logistics 2 and Advanced Logistics 2) use their website at the marketing level. In such companies web pages are used simply to provide general information about the company and advertise services offered. It is interesting to note that this level of usage of the company website is common in all three provider categories. Basic Logistics 1 has been positioned at the second level of the model (publishing) as beyond providing general company information, web pages are particularly used in exchanging information with the customer about shipments. Finally, Basic Logistics 3 and Advanced Logistics 1 have been positioned at the third stage of the model (transactional) as the use of website is mainly focused on providing higher service level (i.e. T&T functionality) and to improve the relationship with customer and other supply chain participants through a better exchange of information.

Software is widely used in the sample. Most of the case companies (5 out 7), use software applications to customise their services. Reasons were rather similar between the companies. In using software, companies aimed to improve effectiveness of services, reduce their cost and deliver a higher value to the customer.

Transport, warehouse, order management and value added services (in the case of Advanced Logistics) were the logistics services most supported by software application. Standard software packages that can be integrated with specific modules are generally used by the case companies. Only two companies do not use software package (Full Haulage 1 and Basic Logistics 2). Different reasons have been given for this, such as: software was unnecessary to support service supplied, it is not used because it is costly and it has a low level of flexibility and user-friendliness.

The provision of T&T capability is more limited in the sample. Only two companies (Basic Logistics 3 and Advanced Logistics 1) provide this T&T functionality through their company website. Basic Logistics 3 provide T&T to increase the value delivered to the customer. Interestingly, Advanced Logistics 1 provides such service as a result of an analysis of current and future customer needs analysis. The main reasons given by the remaining five companies are focused on the fact that such service is not required by customer or the company has not got the appropriate technology in place to provide such service.

Finally, about the impact of the Internet on the company competitiveness, the vast majority of companies (6 out 7), consider the web an important driver in influencing their competitive position. Different reasons have been given for this. Some companies (full haulage 2, basic logistics 1 and 2) have pointed out the potential of the Internet to facilitate information retrieval and comparison (i.e. research of new customer, research and comparison of service price information), contributing to reduce marketing and communication and cost. The remaining three companies (basic logistics 3 and advanced logistics 1 and 2) emphasised the increased possibility of the web to integrate systems and applications of different companies operating in the supply chain improving the exchange of information with supply chain partner.

4.2.2 Factors influencing the ICT adoption

The case analysis enlarged the range of factors inhibiting/stimulating ICT dissemination in the sample firms in comparison with the findings related to the field survey. For Basic

Logistics 1 and 3, financial and cost factors are the main inhibitors of wider ICT dissemination. Full Haulage 2 and Basic Logistics 2 stated that ICT products and services are generally not in line with small 3PLs needs. Advanced Logistics 1 and 2 suggested that low level of technological development in small 3PLs is mainly the result of the high degree of industry fragmentation and market uncertainty. For Full Haulage 1 ICT tools can negatively influencing truck drivers as such tools can be used to control their performance.

About factors stimulating ICT, Basic Logistics 1 and 3 and Advanced Logistics 1 identified elements related to the ICT supply side such as improving in technological standards, the increasing benefits coming from ICT and the availability of new ICT products and infrastructures. Benefits linked to technological development are the most stimulating factors for Full Haulage 2 (price reduction in technology tools) and Basic Logistics 2 (higher capacity to get information about market trends). Advanced Logistics 2 argues that changing legal rules (such as in the case of traceability for food products) is a powerful factor stimulating ICT adoption. Full Haulage 1 stated that technology embedded in new trucks is having a strong influence in increasing the level of ICT usage in road haulage companies.

5. Conclusions

Considering the above results, it appears that the level of logistics innovation in sample firms is quite low as reflected by the relatively low level of ICT usage. A more detailed analysis indicates that ICT offers a means of achieving differentiation by innovation. This changing role is influenced by closeness to the customer. Accordingly, Advanced Logistics companies, which generally have a closer and direct relationship with customers, adopt a longer term strategic view of the use of ICT. Basic Logistics 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 Full Haulage appears very

limited. Full Haulage 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 Advanced Logistics firms "external" factors (industry fragmentation and ICT supply side issues) are the main ICT inhibitors. For companies in the Basic Logistics category cost factors are preventing technology innovation initiatives. For Full Haulage 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.

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