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ICT adoption and impact on the Italian logistics service providers' performance

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Introduction

The dissemination of ICT has affected the competitive scenario of the 3PL industry in recent years contributing to change the supply chain role of Third Party Logistics (3PLs) significantly. Logistics service companies play a more important function than in the past insofar as they are entrusted with the task of integrating and accelerating physical and information flows at multiple levels of the supply chain. This new supply chain role of 3PLs has emphasised the need to measure their performance. There has been little empirical research focused on 3PLs performance measurement, especially in order to structure KPIs for the evaluation of value added services. In addition, the impact of ICT on logistics service companies has amplified the difficulties in measuring performance as it is particularly hard to identify the specific contribution of ICT in generating superior company performance. Empirical evidences on the ways in which ICT influence the competitive performance of 3PLs are very limited. Therefore the purpose of this paper, which is exploratory in nature, is to identify critical elements of the ICT adoption process that may influence 3PL performance. The paper is organised into four sections. A literature review on ICT adoption and performance measurement is given in the second section. The third section illustrates findings emerging from two recent surveys on ICT adoption in Italian 3PLs. The third section compares and discusses findings in order to identify critical dimensions in the relationship between ICT adoption and performance measurement in 3PLs. Finally, conclusions are give in the fifth section.

Literature review

In recent years, there have been many research efforts to identify factors and practices indicating how technological innovation may support company in creating a competitive advantage. The common ground of such research is the relationship between innovation and the development of competitiveness. For example, Tidd et al. (2001) argued that the possible contribution of innovation to create competitive advantages ranges from the continuous assessment of the cost/performance ratio, as in the case of incremental innovation, to the establishment of completely new competitive rules, as in the case of disruptive innovation. Information and communication technology (ICT) is one of the most important and fast growing technological innovations that provide companies with a wide range of opportunities to improve efficiency and effectiveness and even gain competitive advantage (Porter and Millar, 1985). The use of ICT in supply chain and logistics management has attracted increasing attention of the business and academic world. Lee and Wang (2001) addressed the possibilities of reducing the bull whip effect in supply chains through Internet based collaboration. Technology application in supply chain context may provide benefits in the following areas: improve supply chain agility, reduce cycle time, achieve higher efficiency, and deliver products to customers in a timely manner (Radjou, 2003). Ovalle and Marques (2003) found that supply chain performance would be significantly increased if the members of the supply chain collaborated through Internet tools. However, the diffusion of ICT in managing supply chain processes is having a profound impact on supply chains. For manufacturers and retailers, information management has become as critical as the physical movement of goods. As a result, poor ICT resource management by one or more actors in the supply chain could have negative repercussions on the performance of the entire supply chain in terms of planning ability, customer service and costs (Lee and Billington, 1992). Furthermore, ICT may further reduce existing wastes and inefficiencies along the supply chain through increasing real-time movement of shipment and operational control of logistics activities. However, increasing expenditure on ICT in the supply chain process does not automatically result in higher firm

performance. The debate on the ‘‘IT-productivity’’ paradox suggests that the impact of ICT on firm performance remains unclear (Brynjolfsson, 1993). This appears particularly true in the case of third party logistics service companies (3PLs). The rapid diffusion of technology has had significant impact on their traditional core-competencies - such as inventory management, distribution, and transportation (Evangelista et al., 2007). In fact, 3PLs are currently required to offer new and innovative ways to improve logistics effectiveness as result of the evolving business environment that is characterised by a growing rate of logistics outsourcing and pressured by ever-increasing customer demands for higher service level at lower costs. As result, ICT is increasingly important in the management of 3PLs business. Logistics companies are focusing on the enabling ICT as these technologies support the outsourcing of logistics activities from customer companies allowing superior logistics performance at equal or lower cost (Bowersox and Daugherty, 1995). Closs et al. (1997) provide empirical evidences indicating that technology has the potential to improve overall logistics capabilities. Evidence of the fact that technology capabilities are considered a necessary element of overall 3PL expertise emerges from a recent extensive study examining the perspectives of 3PL users conducted by Capgemini in 2008. The study indicated that ICT is a high priority for 3PL users. IT capabilities also are seen as exceptionally critical to the integration of logistics services provided by 3PLs. The study also shed light on the reasons behind the gap existing between IT expectation of users and 3PL performance in this area. The most prominent IT-based service problems are the inability to provide sufficient order/shipment/inventory visibility and a lack of integration among internal 3PL systems. Nevertheless, little research has been conducted on performance measurement in 3PL research. Selviaridis and Spring (2007) claimed that empirical research should focus on performance measurement in 3PL relationships and future studies needs to identify specific KPIs for value added services. In addition, the impact of technology innovation on logistics service companies has amplified the difficulties in 3PL performance measurement as it is particularly hard to identify the specific contribution of ICT in generating superior company performance. In order to overcome this void, some empirical studies have been developed in recent years. Wang et al. (2008) examined the relationship between IT and 3PL firms’ financial performance. In order to test this relationship the authors have developed a conceptual model linking financial performance, IT advantage and IT involvement in firm-wide strategy planning. The model has been tested on a sample of 105 3PL companies in China. The result indicated greater IT advantage, together with greater IT involvement, may result in better 3PL financial performance. Lai et al (2008) provided a further analysis using the same sample firms. The authors integrated the concept of technology orientation into the resource-based theory in order to investigate both the antecedents and the consequences of IT capability in 3PLs. The proposed model was tested using the same sample firms of Wang et al. (2008) and the results show that technology orientation impact significantly on resource committed to IT and managerial involvement in developing IT capability of 3PL firms. In addition, IT capability affects three important elements of the competitive advantage of these firms such as: cost reduction, provision of new and customised services, and service quality. Finally, the positive relationships between ICT usage and company performance has been found by a recent study conducted on the transport and logistics service sector in the (e-Business Watch, 2008, p.144). The study ascertains that firms that introduce ICT-enable innovations were more likely to have experienced sale growth and an increase in market share. The above works may be considered pioneer studies as they try to address conceptually and quantitatively the influences of ICT on 3PL firms’ performance. There is the need to increase research in this area. This paper may be considered a further attempt to analyse the impact of ICT on logistics service providers’ performance. For this reason the context of investigation is the Italian logistics serviced market. The Italian 3PL sector presents a complex structure as it is populated by a numerous small and medium sized companies. Nevertheless, a number of large companies play a leading role in this market. In the following two sections an overview of two recent surveys conducted on ICT adoption in the Italian logistics market has been provided. The result of the two investigations will be used to identify critical dimensions for building up a model describing the link between ICT usage and company performance.

Overview of previous surveys on ICT adoption in the Italian logistics service market

The main aim of this paper is to identify dimensions playing a critical role in the relationship between ICT adoption and 3PLs performance. The specific objective is to compare findings emerging from two recent surveys carried in the Italian logistics service market in order to analyse the level of ICT adoption, the importance of ICT in supporting the overall service strategy and the impact of ICT on firm performance. The first survey has been carried out in small logistics service providers segment, while the second covered a sample of large logistics companies. The comparison between the two surveys may allow defining a wider picture of how technology is used by Italian logistics service

companies and critical elements to assess the impact of ICT on firm performance. The method for data collection in both studies was the administration of semi-structured questionnaire. Both surveys have been preceded by interviews and meetings held with key actors to submit and discuss survey objectives and draft questionnaire. With reference to the survey on small Italian 3PLs, the final number of usable questionnaires was 153 (response rate 7.7%). In the second survey the number of questionnaires used was 48 (response rate 22.5%). The following two sections will provide an overview of the main findings obtained from the two investigations.

Survey on ICT usage in small Italian 3PLs

The objectives of the survey on technology usage in small 3PLs are three: 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 (Evangelista, Sweeney, 2006). The analysis of survey data has been based on the following taxonomy of small 3PL companies: 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 more than 50% of the total turnover is generated by value added logistics and SCM services). The methodology has been organised into the following four steps:

- *Focus groups for discussing survey objectives and draft questionnaire*. Two focus groups were held in order to get useful feedback on the basic survey objectives and suitability and comprehensibility of questionnaire;
- *Re-focussing of survey objectives and questionnaire*. Based on the focus groups outcome, this step allows better focusing on the survey objectives and obtaining useful inputs in finalising the questionnaire;
- *Population definition*. To define the population for this study the Confetra research centre estimation has been used. This source estimates in 140,550 the total number of Italian 3PL companies operating on the market (Leonida, 2004). A draft mailing list containing 2,464 companies was randomly compiled. A number of inconsistencies were detected and this reduced the total number of companies included in the survey from 2,464 to 1,992;
- *Survey implementation*. The questionnaire was mailed to 1,992 companies 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. Table 1 shows the breakdown of the sample firms by company size and provider type according to the small 3PL classification adopted.

	Full Haulage		Basic Logistics		Advanced Logistics		**Total**	
Employee bands	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**

Table 1: Sample firm by provider type and firm size

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 significantly. This supports the validity of the classification adopted. Figure 2 illustrates the level of ICT adoption in each provider type. The data indicates a low level of usage of relatively sophisticated technologies among all provider types. 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 not surprising given the importance of satellite navigation in purely transport businesses. 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).

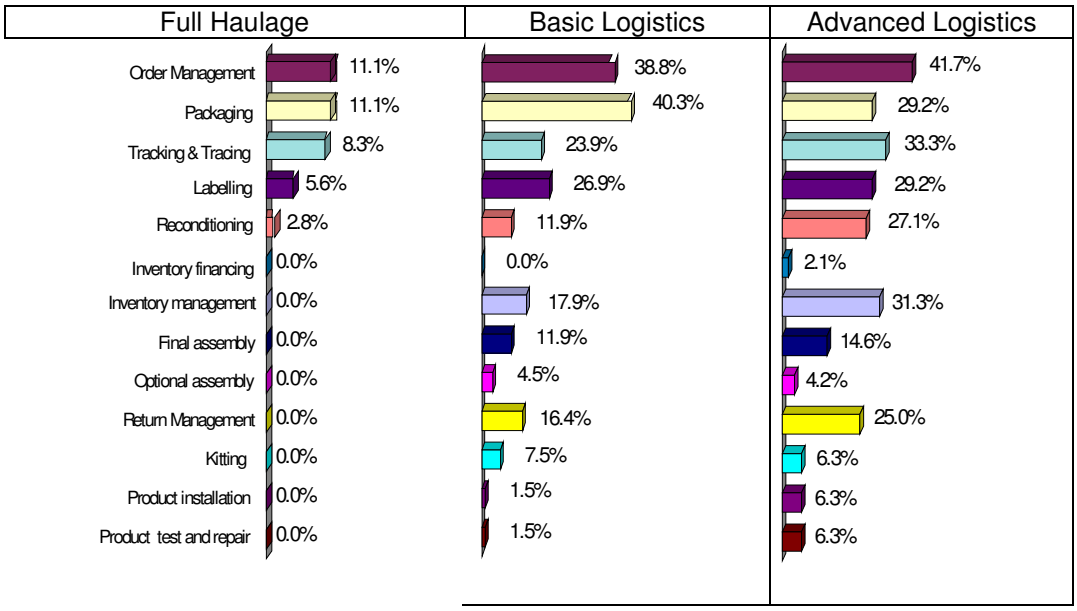

Figure 1: Value added services supplied by provider types

The usage of these technologies is quite low for full haulage providers (19.4% for EDI and 38.9% for LAN). Data show that more complex technologies (such as Wireless LAN, RFID, ERP and CRM) are more widely used by advanced logistics providers.

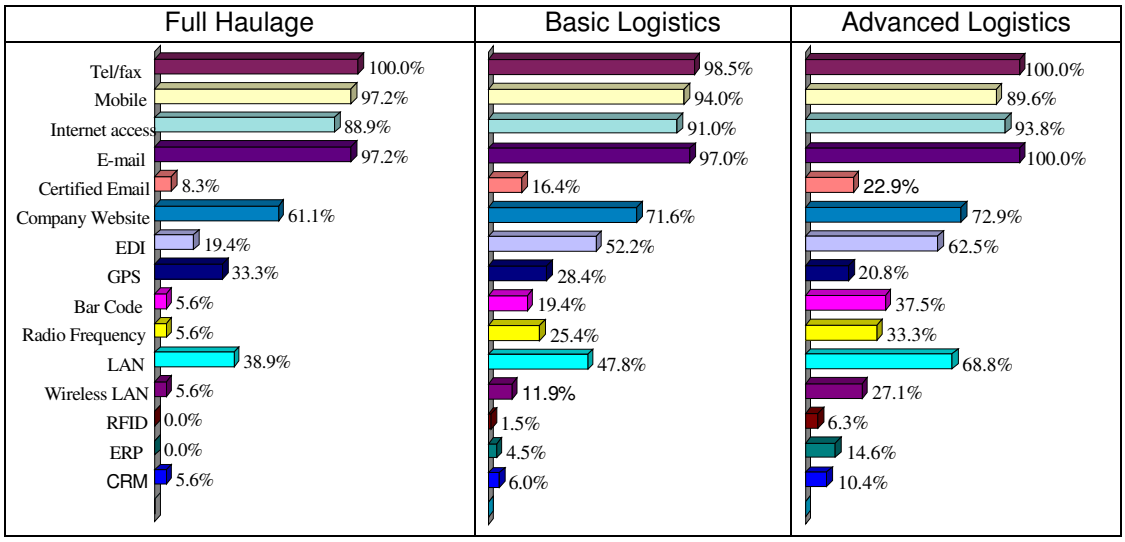

Figure 2: ICT usage by provider types

Data on information-based services supplied by small 3PLs reported in figure 3 do not indicate significant differences among provide types generally. Nevertheless, basic and advanced providers show a higher emphasis on information services connected with overall shipment status (e.g. tracking and tracing information) and delivery process (e.g. export declaration and customs clearing) in comparison with road haulage companies. This may be explained considering that full haulage companies have a narrow view of the supply chain length as they often act as subcontractors of larger 3PLs. In addition, these companies have a more domestic focus in comparison with basic and advanced providers. Figure 4 provides a snapshot of ICT role in improving company performance.

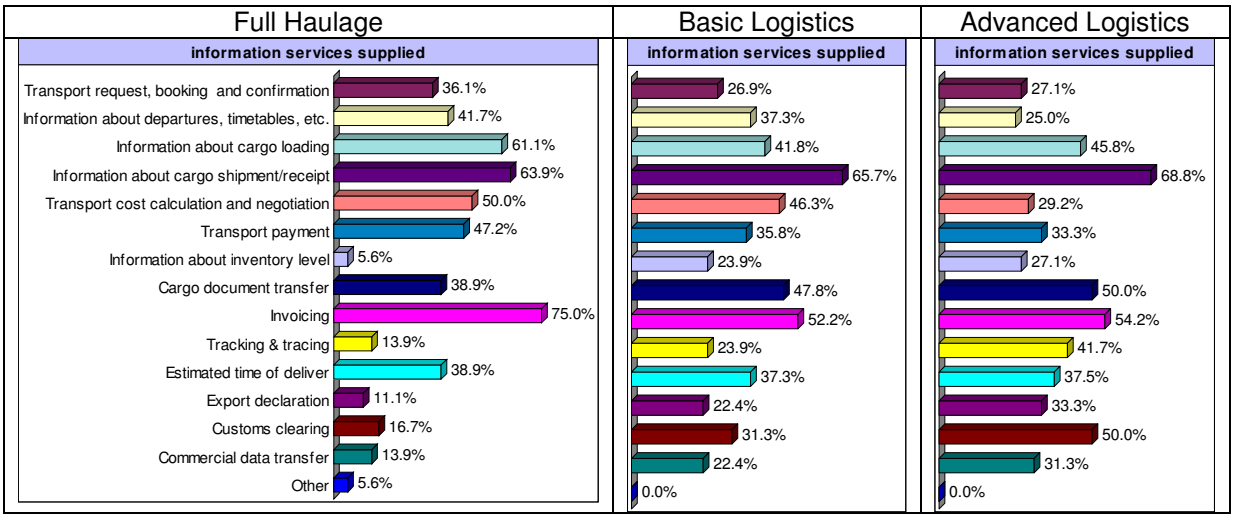

Figure 3: Information service supplied by provider types

Also in this case no significant differences emerge among provider types. It is worth noting that the role of ICT in improving cost efficiency (e.g. improvement of operation) is important for all provider types while basic and advanced logistics companies put more emphasis on the contribution of ICT in enhancing the level of customer service.

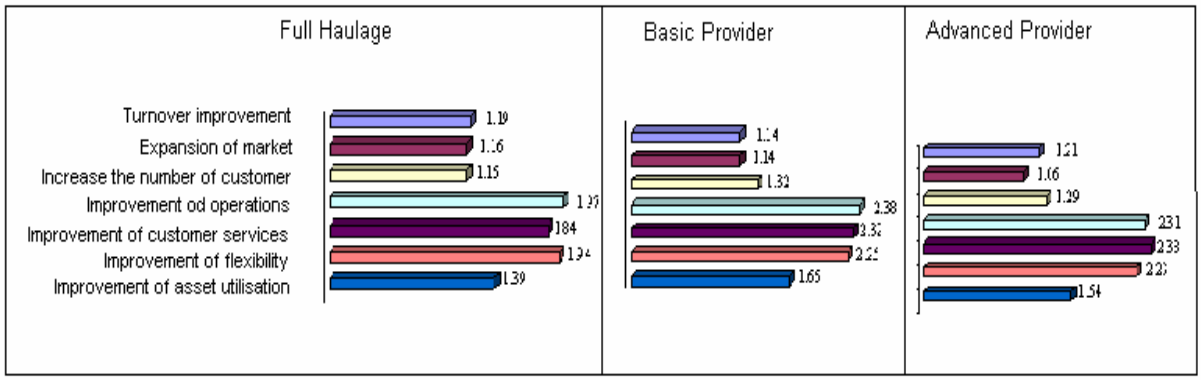

Figure 4: ICT contribution to improve company performance by provider types
(0 = no contribution; 3 = High contribution)

Survey on ICT usage in medium and large Italian 3PLs

The objectives of the survey on technology usage in medium and large Italian 3PLs 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, 4) to understand the benefits and impact on performance associated with the use of ICT. The survey research method has been organised as follows:

- *Planning of survey tools.* Structured telephone interviews were used for gathering data from managerial-level staff, such as CEOs, CIOs and COOs;
- *Sample gathering.* Company information was obtained from several sources – partly from Italian logistics association and partly from managers, which have attended conferences or MBA classes at Politecnico di Milano. The companies included in the survey were 213;
- *Survey respondents.* Firms were contacted three times. The total number of responses was 56. Among these, 8 firms answered inconsistently. The final number of usable responses was 48 (response rate 22.5%). These firms cover different roles in the logistics service market such as: carriers, logistics operators, couriers and express couriers, multimodal transport operators, railway and maritime carriers, firms that manage port and intermodal terminals.

The distribution of the firms investigated on the basis of the size is depicted in table 2.

Employee Bands	Less than 100	Between 100 and 250	Between 250 and 500	Between 500 and 1000	More than 1000	Total
Number of firms	18 (38%)	6 (13%)	5 (10%)	6 (13%)	13 (27%)	48 (100%)

Table 2: Sample firms by employee bands

The data concerning value added services and information services are reported in figure 5.

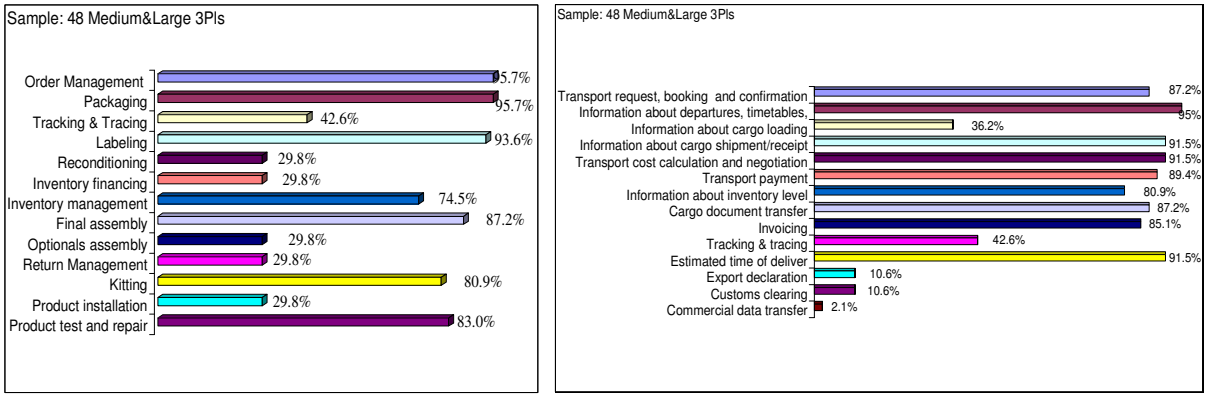

Figure 5: Value added services and information services supplied

As for the value added services, it is possible to highlight that the majority of medium and large 3PLs in Italy provide order management service (95.7%) and little customization of the final products (packaging 95.7%; labelling 93.6%; final assembly 87.2%). More advanced services, both “immaterial” such as tracking and tracing (46.2%), inventory financing (29.8%) and “material” such as optional assembly (29.8%) are provided by a quite smaller number of companies. In relation to information services, the majority of the firm provide services such as information departures and timetables (95.7%), estimated time of delivery (91.5%), information about cargo shipment/receipt (91.5%), transport cost calculation and negotiation (91.5%). The only services which are provided by a low number of companies are the ones related with the specific process of intermodal or international transport, since they are provided only by the firms operating in this business (for example export declaration, 10.6%; customs clearing, 10.6%).
Considering the ICT usage of the 3PLs surveyed, the survey shows a wide adoption of the most traditional solutions (telephone, fax, mobile, internet access, e-mail, 100%; company website, 91.5%; LAN, 87.2%; EDI, 72.3%) on the one hand, and a limited adoption of the most innovative solutions mainly based on Mobile & Wireless technologies (Radio-frequency, 42.6%; GPS, 40.4%, RFID, 17.0% etc.) on the other hand. Results are pictured in figure 6.

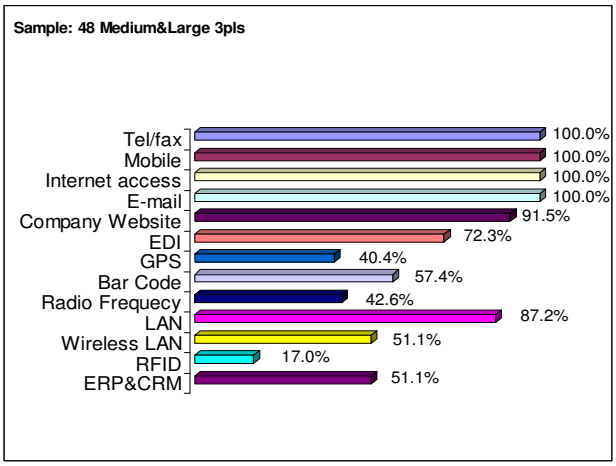

Figure 6: ICT usage

The results of the ICT impact on firm performance perceived by the managers interviewed (measured using a 4 points Likert scale where 0 = no impact and 3 = high impact) are pictured in figure 7.

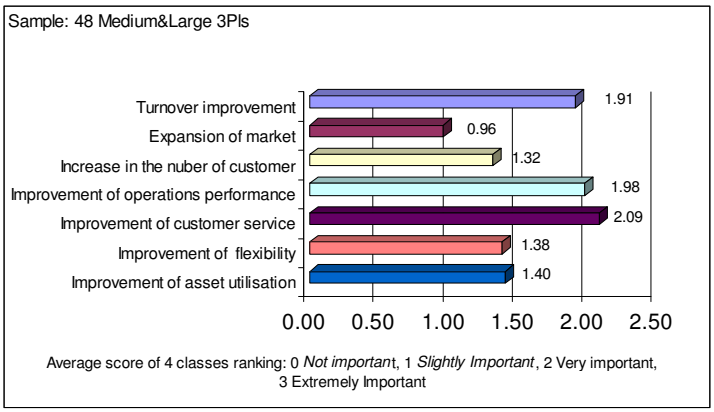

Figure 7: ICT impact on company performance

These data show that 3PLs consider ICT adoption as a way to improve their customer service (2.09) and their turnover (1.91). In the perception of managers, technology has a low impact on the expansion of market (0.96) and the enlargement of the customer base (1.32). Basically, it seems that companies are investing in ICT in order to retain their customers and maximise the average return per customer. For example, large 3PLs provide to customer the value added services and information services cited above.

Comparison and discussion of key findings

A number of interesting elements emerge comparing the results of the two surveys. Firstly, comparing the level of ICT adoption it emerges that larger providers show higher technological profile than smaller 3PLs companies. Only small "advanced logistics providers" show a level of ICT adoption comparable with their larger counterparts. The adoption of most traditional solutions (such as telephone, fax, mobile phone, LAN and EDI) is similar in both samples while there is a substantial gap in the adoptions of more innovative solutions (e.g. RFID, CRM and ERP). This gap may be explained considering the higher cost of most innovative ICT solutions and the shortage of financial resource to be invested in technology by small 3PLs. In relation with the value added services supplied, large 3PLs provide a higher level of these services in comparison with smaller companies. It is interesting to note that in large 3PLs the provision of a wider range of value added services seems enabled by the use of technology. With reference to firm performance, both large and small 3PLs use ICT to improve performance of operations and customer service. Moreover, larger companies use ICT to improve turnover more than small providers, since they can better measure the impact of technology on company turnover. On the other side, small companies seem to use ICT to improve flexibility.

Hypotheses	Elements of the survey on small Italian 3PLs supporting hypotheses	Elements of the survey on large Italian 3PLs supporting hypotheses
• H1: The level of ICT adoption is positively correlated with the service dimension	• The profile of ICT adoption is higher for companies providing value added services (Value Added Providers)	• The profile of ICT dimension (basic solution quite diffused and advanced solution with low diffusion) is similar to the profile of service dimension, especially for value added services
• H2: The level of ICT adoption is positively correlated with firm performance	• Managers agree on the positive effect of ICT dimension on performance dimension, especially in terms of improvement of customer service, operations and flexibility	• Managers agree on the positive effect of ICT on dimension, especially in terms of improvement of customer service, operations and turnover
• H3: The service dimension is positively correlated with firm performance	• Advanced Providers attach higher importance to the effect of ICT on customer service than other types of players	• Companies invest in ICT for providing value added services to their clients with the objective to improve the average return per customer

Table 3: Survey results supporting hypotheses on ICT, service and performance dimensions

The comparison of survey results presented above highlights the importance of three key elements: ICT adoption (ICT dimension); Value added services and information services supplied (service dimension); ICT impact on firm performance (performance dimension).
These dimensions are only in part addressed by the existing literature (see for example Lai et al., 2008). For this reason it is important to model the possible relationships between the above dimensions. More specifically, it is possible to develop the following three hypotheses:

- H1: The level of ICT adoption is positively correlated with the service dimension
- H2: The level of ICT adoption is positively correlated with firm performance
- H3: The service dimension is positively correlated with firm performance

These hypotheses may be justified by using some of the surveys results described above. In the table 3 above it is described how the results each survey supports the three proposed hypotheses. Moreover, preliminary statistical tests conducted on survey data show the soundness of the proposed hypotheses (analysis available on request).

Conclusions

The paper has identified three dimensions playing a key role in the relationship between ICT adoption and performance measurement in 3PLs. These dimensions will be used to building up and test a conceptual model in order to provide empirical evidences and quantitative support for this relationship.

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