THE USE OF ICT BY LOGISTICS SERVICE PROVIDERS AND IMPLICATIONS FOR TRAINING NEEDS. A CROSS-COUNTRY PERSPECTIVE

Pietro Evangelista
Institute on Service Industry Research (IRAT), Naples, Italy
Edward Sweeney
National Institute for Transport and Logistics (NITL), Dublin, Ireland

1. INTRODUCTION

The last 10 years have seen a technological revolution that has offered solutions that make logistics and Supply Chain Management (SCM) even more streamlined and efficient than it has ever been. One key component of SCM is Information and Communication Technology (ICT)[1] since "no product flows until information flows". The need to serve customers in a flexible and speedy manner has forced manufacturers and distributors to effectively exploit ICT, by creating "global nervous systems" that link a continuous flow of supply and demand information between suppliers and customers (Edwards, Peters and Sharman, 2001). This has raised the level of information intensity in logistics and SCM services.

In this context, ICT developments have increasingly influenced the transport and logistics services market, shifting the focus from a physical to a more electronic one and giving rise to new organisational forms for these services. As a result, growth in the volume of electronic communication along the supply chain is expected to double by 2005. For example, electronic exchanges of transport documentation, invoices, order instructions and payments are forecast to grow by 59% (Trilog, 1999). This has led to an increasing interest in assessing the effects of ICT on the transport and logistics service industry.

Unlike other industrialised countries, the Italian and Irish transport and logistics service industry lags behind somewhat in adopting ICT. Generally speaking, this situation can be attributed to the following factors: the traditional resistance by owner-managers to change; the small size of most third party transport and logistics service providers (3PLs) inhibiting investment in ICT; the lack of user-friendly applications; technology choice difficulties as a result of ICT solutions proliferation; and, the inadequate ICT skills of 3PLs personnel. This last point is critical because the growing dissemination of such technologies in 3PLs is making even more urgent the need for the development of new technical and other relevant competencies (Morvillo, 2002).

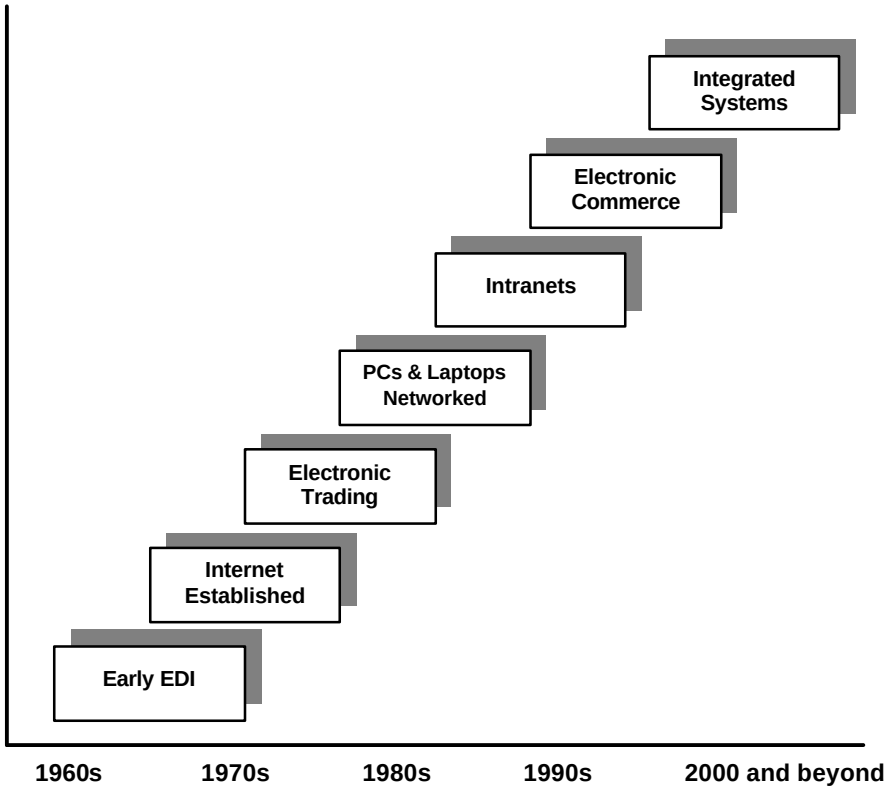
The aim of this paper is to assess use of such new technologies is affecting 3PLs' training needs. The second section provides a conceptual framework for assessing the impact of ICT on the transport and logistics sector. Within this framework the effects on 3PLs is examined. In the third section the state of ICT dissemination in the Italian and Irish transport and logistics sector is

outlined. In the fourth, a number of case examples of 3PLs operating in the Italian and Irish transport and logistics service market are presented. In the concluding section, the impact of ICT on the training needs of 3PLs is discussed and implications for the development of appropriate training policies are assessed.

2. THE IMPACT OF ICT ON LOGISTICS AND SUPPLY CHAIN MANAGEMENT

Information systems applications in the field of logistics and SCM are not new and have a long history, pre-dating the use of computer power. An early example was the maintenance of inventory records on ledger cards which at first were manually updated and later became semi-mechanically updated using magnetically encoded data. As such, the computer has facilitated faster data processing and allowed significantly more data and information to be handled.[2] Figure 1 illustrates the timeline of the main applications in logistics and SCM since their introduction in the 1960s, when systems of Electronic Data Interchange (EDI)[3] were first used to support logistics activity.

Figure 1: Indicative timeline of ICT applications in logistics and supply chain management

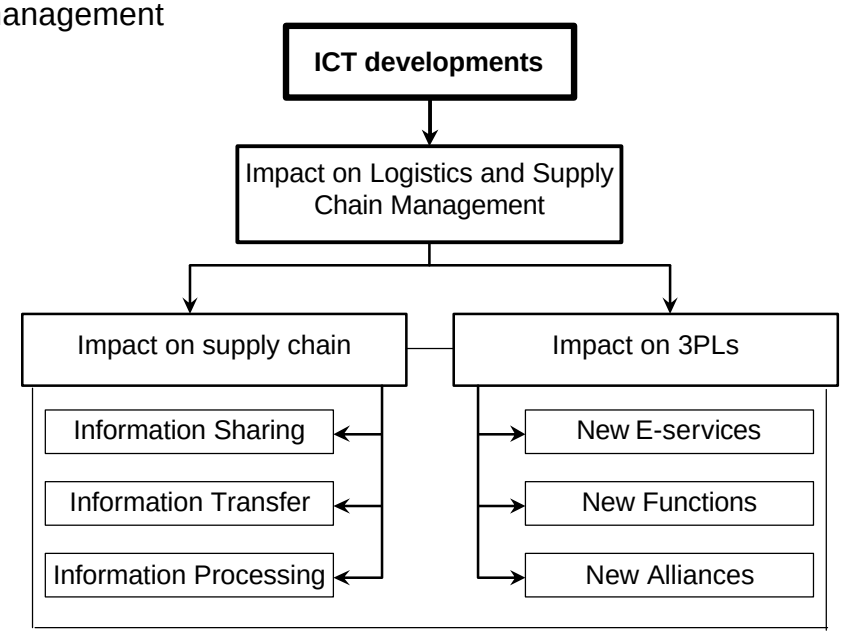


Since then logistics and SCM have changed rapidly, to the extent that the relationship between ICT and the supply chain now appears to be so close that it has even become difficult to establish whether ICT is a driving force or is simply an enabling factor.

2.1 A Conceptual Framework for Analysis

There has been a plethora of works in the literature which, from time to time, have underlined the general aspects (Introna, 1993; Hammant, 1995; Crowley, 1998) and specific impact (Peel, 1995; Kia *et al.*, 2000) of these technologies in logistics and SCM. According with the framework reported in the figure 2, the analysis will focus on the effects of ICT on 3PLs (section 2.1) as a detailed discussion of the impact of ICT developments on the overall supply chain is beyond the scope of this paper.

Figure 2: A framework for analysing the impact of ICT on logistics and supply chain management



2.2 Specific Effects of ICT on 3PLs

For manufacturers and retailers, information management has therefore 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 can have negative repercussions on the performance of the entire chain in terms of costs, planning ability and customer service (Lee and Billington, 1992). For these companies the selection of 3PLs has an even higher strategic value and the provider's information technology capability represents one of the most important selection criteria.[4] As a result manufacturers and retailers are demanding that all actors in the chain place even more attention to the integration of their business processes through ICT and Internet technologies. Under this strong pressure, 3PLs are attaching increasing importance to ICT in the management of their businesses to the extent that integration and co-ordination with other actors in the supply chain are becoming a vital elements in the business strategies of such firms. These developments raise two important questions:

- What is the impact of ICT on 3PLs?
- How are ICT and the Internet changing their business model?

The answer to these questions is not straightforward, nevertheless, some effects appear to be emerging and are briefly described as follows.

New e-services. One of the first visible effects is the integration of traditional services with "new information services" spurred by the dissemination of the Internet. Although 3PLs have used telecommunication systems and networks for some time,[5] the sector as a whole may not be considered a leader in the field of technological innovation (Tilanus, 1997). However, over the last few years firms operating in the sector have made significant progress in the adoption of new technologies, particularly those linked to the Internet and e-business. Low-cost access to the Internet and the dissemination of e-business technologies have provided these firms with the potential to satisfy customer demand by using traditional services in conjunction with growing information-based services. Today, the main 3PLs are in a position to provide a variety of information via the Internet[6] and to secure transactions online with customers.

There are firms that initially used their own web sites as electronic service catalogues. Some firms have started to offer tracking and booking services, while others have tried to create a competitive advantage with their web pages by developing signature options unique to their brands. For example, the shipping company OOCL has developed a means of releasing bills of lading over the Internet. In other cases customised portals have been developed to provide support capabilities that can also be tailored to languages other than English. APL is a good example of these advanced applications of Internet portals. However, the rapid development of e-business is expected to give rise to a gradual increase in the functionality of web sites.

New functions. The dissemination of ICT has opened up new opportunities for the development of new roles and functions in the supply chain, i.e. information brokers, or infomediaries. The purpose of these web-based intermediaries is to give added value to the 3PLs through greater efficiency and information transparency. They run web sites - transport e-marketplaces - which bring together buyers and sellers of transport services, provide the buyer with information and make communication between the two faster and more direct.

There is also a variety of infomediary typologies in operation on the Internet. Even though it may not be possible to give a comprehensive taxonomy of such typologies, due to the extremely dynamic nature of the sector, a recent study by Regan and Song (2001) has identified at least five different categories, the dividing lines between each being somewhat blurred:

1. Spot Freight Markets: a spot market allows shippers and carriers to post available loads or capacity on the web;
2. Auction and Request for Quote (RFQ) markets: an auction space provides automated RFQ and auction capability;
3. Exchanges: an exchange may provide spot market and auction capabilities but must also provide creative e-business solutions for shippers, carriers and 3PLs;
4. Applications Service Providers (ASPs): ASPs are developing web-enabling and e-business enabling technology for the logistics industry; and

5. Purchasing Consolidation Markets: these sites provide an opportunity for member companies (typically small carriers) to purchase equipment and supplies at bulk rates over the Internet.

In reality, the use of web transport portals by 3PLs is difficult to assess due to the lack of consistent data on the overall volume of services sold. This problem is unlikely to be resolved until carriers remove confidentiality constraints on their service rates. These firms, in fact, seem reluctant to use infomediaries since they would be forced to share confidential information which, once disclosed, could be used to gain control of customer relations through, for example, the management of the booking process and the rate charged. Actually, a small number of traditional intermediaries are using online exchanges to help their shipper clients match with carriers.

A study carried out by KPMG and Benchmarking Partners, on the way in which carriers use the Internet would appear to confirm the above findings (Logistics Management & Distribution Report, 2000). Providers do not foresee that infomediaries will have a significant effect on their business, while only 50% of the shippers interviewed replied that they might use infomediaries in the near future.

New alliances. Another feature emerging alongside the Internet and e-business development is the creation of a new category of service provider called Fourth Party Logistics Provider (4PL). According to Bade et al. (1999), a 4PL is a supply chain integrator who assembles and manages the resources, capabilities and technology of its organisation with those of complementary service providers to deliver a comprehensive supply chain solution.

The emergence of these providers has been influenced by the lack of adequate technological and strategic capabilities in traditional 3PLs to meet the demand for re-thinking the supply chain strategies of their customers. In order to improve their skills, some 3PLs have started to secure alliances with complementary service providers (Rockwell, 1999). Some of these alliances have been formed with management consulting companies, ICT vendors and financial services providers.

4PLs enable manufacturers and retailers to outsource the entire re-engineering of their supply chain processes - from the design, implementation, and finally to the execution of comprehensive supply chain solutions - to a single organisation. Beyond the emergence of 4PLs, an ongoing trend in the international transport and logistics sector involves the formation of alliances with other firms operating in the complementary sectors (Eyefortransport, 2001).

3. ICT DISSEMINATION IN THE ITALIAN AND IRISH TRANSPORT AND LOGISTICS SERVICE INDUSTRY

From the picture outlined above there is a clear relationship between ICT adoption and the competitiveness of the transport and logistics service industry. Its future strategy can no longer be considered separately from

innovation in ICT. This means that the development and efficiency of a country's transport and logistics service industry will depend increasingly on its position in the international technological scenario. In the following sections the dissemination of ICT in the Italian (section 3.1) and Irish (section 3.2) transport and logistics service industry is outlined. These countries form the basis of this research study for a number of reasons, including:

- Logistics is a key determinant of competitiveness in both countries due to location, a factor recognised by policy makers in both countries;
- Imports and exports come from, and go to, many similar markets;
- The transport and logistics sector largely comprises small companies in both countries; and
- A small number of large multinational companies hold a large share of the transport and logistics market in both countries – this tends to marginalise the smaller players.

Before examining the implications of the trends described in the previous section in terms of training and development needs, it is imperative to understand the levels of dissemination of ICT in the transport and logistics sector in both countries.

3.1 The Dissemination of ICT in the Italian Transport and Logistics Industry

The delay on the part of Italy in adopting ICT technologies (EITO, 2002) has negatively affected the efficiency of the transport system and, at the same time, has proved to be a constraint on the development of 3PLs. It should be pointed out that there are other constraints contributing to the poor dissemination of ICT in the sector such as the low level of technological and organisational innovation in Italian 3PLs, the poor exposure to ICT in SMEs and the inadequate ICT skills of personnel in such companies.

The characteristics of demand and supply of transport and logistics services in the Italian market has a significant impact on the above constraints (Evangelista and Morvillo, 2000). The effects of such factors on the developments of ICT in this market may be summarised as follows:

- On the demand side, the existence of cultural constraints *vis-à-vis* logistics is mainly due to the marked presence of SMEs in the manufacturing sector. This produces a low level of outsourcing of logistics activities beyond transportation; and
- On the supply side, the large number of small providers has resulted in fragmentation of the sector and control of supply chain processes has been yielded to large foreign companies.

Despite the lack of data and specific surveys, it is worth noting that the above factors have played a major role in determining the low level of ICT adoption in Italian 3PLs. This has held back the development of technological and organisational innovation processes needed to compete in a market characterised by the more complex requirements of customers. Furthermore the industry consolidation process has developed at a far slower pace than in other countries. This has inevitably had repercussions on the willingness of firms to adopt new technologies, which remain at a relatively low level.

These observations are largely confirmed by a number of other surveys. The first analysed the level of computerisation and ICT investments by 3PLs in Northern Italy, specifically the Genoa-Savona area (Merlino and Testa, 1998). The survey examined 197 firms and found that they are at the initial stage of adopting ICT and that their investments in new technology are still motivated by a tactical rather than strategic logic. The survey highlighted that the dissemination of new technologies is proceeding at an intermittent and non-homogeneous pace. This can be attributed in large part to the background history of the firm and its entrepreneurial culture.

The second survey analysed the relationship between the company's entrepreneurial culture and the usage of ICT. It was conducted on a sample of 48 shipping agents and freight forwarders located in Southern Italy, specifically Campania region (Minguzzi and Morvillo, 1999). It found that the willingness to invest in computer hardware and software is generally motivated by personal reasons rather than economic considerations.

Other recent surveys report a number of interesting issues. KPMG (2002) notes that in comparison with other industries, ICT investment in Italian 3PLs is not high and the level of outsourcing of ICT and e-business applications is very low. There is evidence of low penetration of telematic in the road transport segment due to high implementation/running costs and long pay back investment periods (CSST, Cranfield University, 2002). Finally, a recent survey (Freight Leaders Club, 2003) indicates that the most widely used communication tool is telephone, and that the use of web-based technologies is still low.

The results of the above studies underline a contrasting picture where ICT is concerned. While on the one hand the awareness of ICT as a success factor for 3PLs is evident, on the other there is a low level of ICT adoption with particular reference to the Internet and e-business tools.

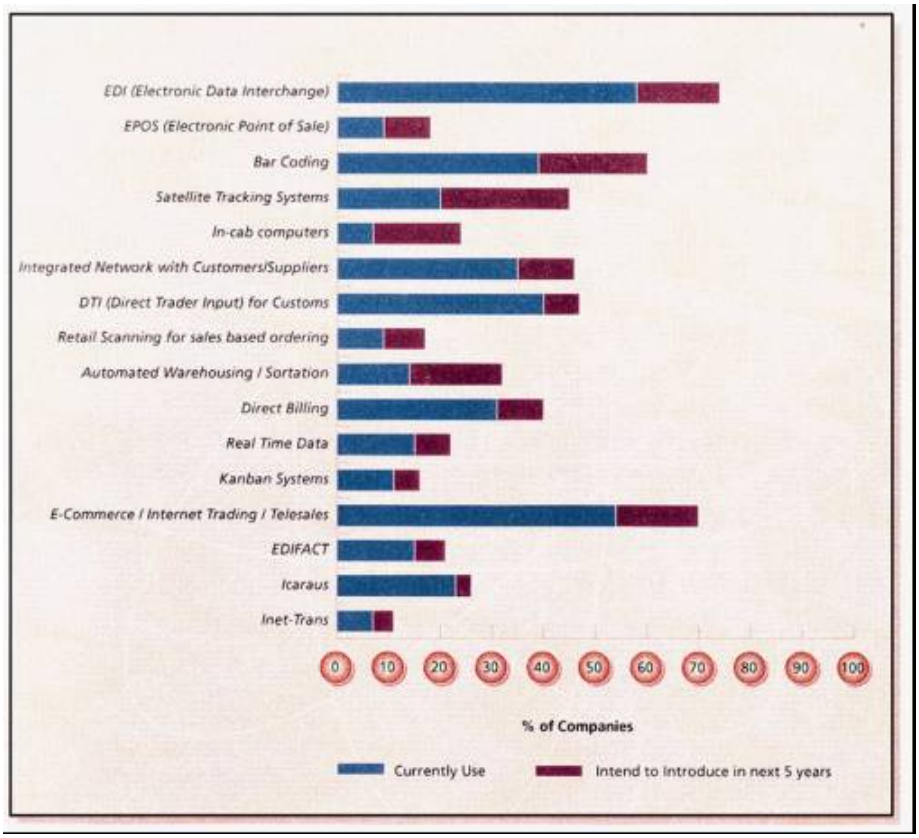
3.2 The Dissemination of ICT in the Irish Transport and Logistics Industry

A recent study (FAS, 2002)[7] indicates that the main usage of ICT in the Irish transport and logistics sector is in the area of EDI and e-business, which is used by just over 50% of companies. Figure 3 shows the current level of technology utilisation, as well as the intended developments over the next five years.

ICT tools which are regarded as essential for efficient logistics management such as automated warehousing/sortation, direct billing, direct trader input (DTI) for customs and bar-coding are used by one third or less of companies. Much of the deployment of this technology is on an incremental, ad hoc basis and the building up of supply chain management systems is not carried out on a systematic strategic business basis.
The same research indicates that there is a strong correlation between the use of ICT and company size. This is an important factor due to the small size

of the majority of companies in the sector. In particular, companies with 10 employees or less had the smallest usage of the full range of systems while large companies in turn utilise a broad range of ICT technologies.
Another recent survey (NITL, 2001) confirms some of these points. This survey examined the "logistics capability" of over 300 indigenous Irish companies. Less than 50% of companies regarded themselves as making effective use of appropriate ICT systems in the supply chain integration process. The report notes that the real situation is likely to be somewhat worse than this in reality as respondents were asked to assess their own level of proficiency in this area.

Figure 3: ICT usage in the Irish transport and logistics sector (FAS, 2002)



In summary, it can be stated that whilst pockets of excellence undoubtedly exist in terms of the effective exploitation ICT in the Irish transport and logistics sector there is still considerable room for improvement.

4. CASE EXAMPLE ANALYSIS OF SOME OF ITALIAN AND IRISH LOGISTICS SERVICE PROVIDERS

Tables 1 and 2 (below) show the main findings from case studies carried out recently by the authors. Three companies in both Italy and Ireland were selected as the basis for this work. This methodology is based on an approach to Italian 3PL market segmentation outlined by Evangelista et al (2003)[8]. Evidence suggests that a similar segmentation exists in Ireland (FAS, 2002).

One segment comprises the myriad of small and very small firms mainly performing (often as sub-suppliers of bigger firms) in the road transportation segment, where price is the main leverage for competition.

Table 1: Italian case examples main findings

	CASE 1	CASE 2	CASE 3
Context of Operation:			
Unique Selling Proposition	Long tradition in transporting liquid foodstuffs in bulk	Specialist in health care and medical logistics	Global automotive maritime transport and logistics leader
Revenues 2002	1 - 2.5 Million Euro	23 Million Euro	495 Million Euro
Employees	Owner-manager plus 16 (part-time)	150	2,000 (worldwide)
Customer Profile	Small and medium agri-food producers	Multinationals diagnostic and bio-medical companies	Large car manufacturers, road hauliers and freight forwarders
Type of Services	Purely road transport	Transportation, warehousing and added value supply chain services	Maritime and intermodal transport, warehousing, and added value customised services (pre-delivery inspections, quality control, waxing and un-waxing, car hi-fi installation, customs brokerage, etc.)
Scope of Service	Italy	Europe	Worldwide
Technology & Training:			
ICT Tools	E-mail	Internet, E-mail, EDI via Internet, traditional EDI, radio-frequency, bar-coding, Internet real-time tracking and tracing	E-mail, EDI via Internet, traditional EDI, client system to send information via the Internet from port terminals to central system in Naples; file transfer software to exchange data and information with customers; Internet real-time tracking and tracing
Web Usage	No Internet usage	Advertising tool	Business transaction tool
ICT Activities: in-house vs. outsourced	In-house	80% of ICT activities outsourced	Not disclosed
ICT Staff Profile (no., level, qualification)	1 Operator	6 staff members: 1 operator, 4 software developers, 1 maintenance	13 staff members (at the Naples headquarters): 2 operators, 7 software developers, 4 maintenance
Current ICT Training Provision (in house/external)	None	In house ICT training provision	In house ICT training (both provided by internal employees and external trainers) and external courses
Future Planned ICT Developments	No short term investment plans	Growing importance of web-technologies	Better exchange of supply chain information
Future ICT Skill Requirements	Not applicable	Internet technologies skills	Communication technologies skills
Future ICT Training Requirements	Not applicable	Internal/external networking using Internet	Networking with customer using Internet

A second segment comprises a group of innovative small and medium-sized providers. These firms are focusing on their ability to segment the market and identify specialised niches (in term of geographical area and/or type of service). Such an ability is generally associated with, and supported by,

relatively high levels of ICT investment. In the last two decades, these providers have evolved from the role of simply "tier suppliers" for large companies to a better position in the market.

Table 2: Irish case examples main findings

	CASE 1	CASE 2	CASE 3
Context of operation:			
Unique Selling Proposition	Long established company with loyal local customer base	Advanced ICT and supply chain design knowledge allied to traditional skills in original business	Part of extensive pan-European logistics network
Revenues 2002	< 2.5 Million Euro	> 100 Million Euro	Not disclosed
Employees	6 full-time plus casual seasonal	500+	300+ (extensive use of casual labour)
Customer Profile	Small and medium manufacturers and "one-offs"	Mainly large hi-tech MNCs but diversifying into other areas	Mainly large hi-tech MNCs but diversifying into other areas
Type of Services	Road transport with limited warehousing capacity	Transportation, warehousing, assembly, inventory management and various added value supply chain services	Intermodal Transport, warehousing and limited number of additional services
Scope of Service	Mainly UK and Ireland	International (almost global)	Predominantly Europe
Technology & Training:			
ICT Tools	E-mail	Internet, e-mail, web-enabled ERP, RFID technology, bar-coding, real-time track and trace, advanced demand planning/management, procurement and CRM applications	Internet, e-mail, EDI, bar-coding, limited track and trace
Web Usage	General but very limited	Essential business tool used extensively by staff in all parts of the company	Mainly advertising; some track and trace
ICT Activities: in-house vs. outsourced	In-house	Mostly in-house, small number of specialist activities outsourced	Some in-house; some sourced from parent company
ICT Staff Profile (n. level, qualification)	Limited to knowledge of general office automation applications	Large ICT department; high level of ICT knowledge throughout company	Variable: a small number of well qualified ICT staff; most staff have little relevant training
Current ICT Training Provision (in house/external)	None	Continuous at all levels; mix of internal and external	Limited: awareness for ICT staff; mainly skills training for others
Future Planned ICT Developments	No short term investment plans	Continuous updating of all systems; strong emphasis on integration	No specific plans; aspirations in relation to web-based applications
Future ICT Skill Requirements	Not applicable	Wide range of defined skills in all areas	Numerous but not well defined
Future ICT Training Requirements	Not applicable	Based on developments and investments in ICT and on further expanding service offering through ICT	As above

The third segment comprises large transport and logistics companies with branches in various countries. The three companies selected as the basis for the case examples in both countries operate in each of the above three segments.

A number of points are worth noting with regard to these findings. These are now outlined in relation to each of the cases in both countries.

Case 1. The two companies are very similar in scale and scope. The Irish company does make limited use of the Internet; the Italian company does not. The Italian company does have a member of staff specifically assigned to ICT duties; the Irish company does not. Both are traditional, long established companies and appear to be typical of the large number of small and very small firms in both countries. Cost control and reduction is the major focus in both cases. This is not surprising given the relatively small profit margins which are a feature of this very competitive segment. ICT appears to be used only where it is considered to be absolutely essential. ICT investment decisions and training plans do not exist in any formal way.

Case 2. Although the Irish company is the larger (in both scale and scope), several similarities again exist. The Irish company regards ICT as central to its business model and the development of appropriate ICT competencies is high on its agenda. There is a formal approach to ICT strategy development and implementation, including the upgrading of staff skills and knowledge. A similar, albeit less formal, approach exists in the Italian company. There are several ICT specialists employed in-house and a large amount of activity is outsourced. Clear ICT priorities have been identified and associated training interventions are being developed (particularly in the area of web-based technologies). One major difference between the companies is in terms of customer base: the Italian company specialises in the diagnostic and bio-medical area; although the majority of the Irish company's business is in the hi-tech sector, it has developed quite a broad portfolio of customers.

Case 3. Both companies are large 3PLs operating in several countries (mostly in Europe). The Italian company specialises in automotive maritime transport and logistics; the Irish company has customers in a range of sectors but most are multinational manufacturers based in Ireland. Both have extensive pan-European infrastructure and assets, and offer a range of customised "added value" supply chain services. An important characteristic of both companies is that they have grown significantly in scope in recent years as their major customers have outsourced increasing amounts of their supply chain functionality. Both have moved from a predominantly transport and freight forwarding focus to more of a logistics/SCM solutions provider orientation. Although both companies have made significant investments in ICT in recent years, the Italian company considers improvement in exchange of supply chain information and developments of related skills as a major future development, while in the Irish company there appears to be a lack of clarity in relation to future plans.

5. THE IMPACT OF ICT ON THE TRAINING NEEDS OF LOGISTICS SERVICE PROVIDERS: SOME IMPLICATIONS FOR TRAINING POLICY

Several ICT training policy issues are evident from the case examples. The following provides an overview based around three themes which emerge:

- Knowledge-intensity of the transport and logistics sector;

- Strategy as a driver of ICT investment decisions and training plans; and
- ICT as a supply chain integration enabler.

5.1 Knowledge-intensity of the Transport and Logistics Sector

There can be little doubt that effective logistics is largely concerned with effective information management. As pointed out earlier, “no product flows until information flows”. Effective information management has the potential to reduce inventory and other costs, and to improve customer service. Recent years have seen rapid developments in ICT which have had a major impact on most business sectors, including transport and logistics. This trend is likely to continue, with specific reference to new e-services, functions and alliances (see section 2.2). Whilst ICT adoption levels have been relatively low in the sector, ICT has nonetheless had a major transforming effect on the industry. In the process, the sector has moved towards a more knowledge-intensive focus. This has a major impact on the overall training requirements of 3PLS, particularly in the area of ICT. Some companies (e.g. Irish Case 2) have used ICT as a major source of competitive advantage and have developed training and development programmes in line with this approach. At the other end of the spectrum, some companies (e.g. Irish and Italian Case 1) appear to have barely considered ICT in any meaningful way. The message is that all supply chain players will inevitably be impacted upon by ICT developments. From the case examples, it appears that there is no culture of either ICT or of structured training in the small road haulage companies. As it is likely that the successful 3PLs of the future are likely to have relatively high levels of integration with their customers, this raises serious issues for training policy in such firms.

5.2 Strategy as a Driver of ICT Investment Decisions and Training Plans

Whilst this general shift to a more knowledge focus exists, it is also evident from the case examples that there is no one uniform approach to ICT training which is applicable to most 3PLs, or even to most 3PLs within a particular segment. The reality is that the sector is highly fragmented and that, from an ICT perspective, there are huge variations in the levels of investment, functionality, knowledge and skills between different companies.

A robust approach to ICT training can only be developed if there is clarity in relation to the role of ICT in the overall strategy of the 3PL in question. For some companies, ICT may be regarded as a required core competency (e.g. Irish Case 2) while for others it may simply be that it is regarded as a possible approach to efficiency improvement (e.g. Italian and Irish Case 1). In short, the overall strategy and business model of a particular 3PL determines its overall approach to ICT investment decision making. This, in turn, impacts on the development of ICT training policy. Key questions in this regard include:

- What is the role of information management in overall strategy?
- What ICT exists to support this?
- Is ICT an order-winner or an order-qualifier in existing and targeted market?
- Is there is need to be an ICT leader (proactive) or is being a follower (reactive) sufficient?

Many 3PLs have expanded the scope of their activities in response to the changing requirements of their customers. This has largely happened as customers outsource an increasing amount of their supply chain functionality which they regard as non-core. Consequently, the scope of activities carried out by many 3PLs has increased greatly over a relatively short time (e.g. Italian and Irish Case 3). This raises many questions with regard to the required competencies - including ICT competencies - of 3PLs. Training policy needs to be informed by these developments.

5.3 ICT as a Supply Chain Integration Enabler

The case examples indicate that a major driver of any ICT training agenda is *integration*. Shippers are demanding higher levels of integration with their suppliers (including 3PLs). This integration extends to ICT integration and connectivity. The ICT capability of customers is a key determinant of requirements, For example, 3PLs mainly servicing a particular sector (e.g. Italian Case 2) require a level of ICT which is least on a par with that of the sector generally. For a 3PL who is very dependant on the business of a single customer (e.g. Italian Case 3) there is a clear need to have high levels of ICT integration with this customer. For 3PLs servicing a wide range of sectors (e.g. Irish Case 2 and 3) matters can become more complex with the requirement to integrate with customers with widely varying ICT configurations. Even for the small, cost-oriented 3PLs in the road haulage industry (e.g. Italian and Irish Case 1) this need for higher levels of integration is likely to eventually become an issue. In any case, the key supply chain management objective of integration is a major driver for ICT training policy in 3PLs.

CONCLUDING COMMENTS

Effective ICT adoption has become more critical for 3PLs as the drive towards higher levels of supply chain integration continues. This raises many issues with regard to ICT knowledge and skill sets. The case examples outlined in this paper point to a number of implications in terms of developing appropriate ICT training policies. Clearly, it is difficult to draw definitive general conclusions from a limited number of case examples. However, the case work does provide some useful insights and forms part of a larger research project which aims to comprehensively address the main issues. Broader survey-based work will draw on the lessons from the cases. It can be concluded from the 3PLs studied that this is a complex and rapidly changing area. The successful 3PLs of the future are likely to be the ones which embrace the issues raised in this paper in a logical and systematic manner.

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Notes

[1] OECD (1998) defines the ICT industry on the basis of two principles. For *manufacturing* industries, the products of a candidate industry must be intended to fulfil the function of information processing and communication including transmission and display and must use electronic processing to detect, measure and/or record physical phenomena or to control a physical process. For *services* industries, the products of a candidate industry must be intended to enable the function of information processing and communication by electronic means.

[2] ICT has in the last decade undergone rapid progress largely due to numerous technological developments in computer production (e.g. exponential increase in computer power, lower unit cost of data processing, reduction in size of processors) and in telecommunications (e.g. shift from analog to digital conversion, emergence of optical fibre transmission systems).

[3] Hammant (1995, p. 33) defines EDI as "the computer to computer exchange of inter- and intra-company business and technical data, based upon the use of agreed standards."

[4] In relation to this, Justin Strother, the centralised operations manager of Fleming Companies Inc. a retail company operating in Lewisville, Texas, declared: "When we select carriers, we not only ask about rates and services, but also their technological capabilities. Some carriers may have competitive rates, but if they don't have the technology in place, they can actually end up being more expensive. It costs us more to have to arrange for an employee to follow up and double-check on their activities." (Atkinson, 2001).

[5] The first applications were tried out in the air transport sector at the beginning of the 1960s. Later, their use was extended first to maritime transport and then, in the 1980s, to other transport modes.

[6] This refers to the supply in real time of information concerning for example freight rate, booking, routing and scheduling, tracking and tracing, shipment documentation and freight billing.

[7] This study was based on a survey of 250 logistics service providers employing 15,600 people. This survey is part of a larger research project that includes two other major surveys of the activites of manufacturing companies and logistics education providers.

[8] There are two further segments in the Italian 3PL market. The first comprises well-established medium-sized Italian firms. Most of these companies have been acquired by large foreign groups expecting high levels of growth in market demand. The second comprises a small group of logistics companies that result from the spin-off strategies implemented by large manufacturing companies (both Italian and multinational). Such companies are able to leverage their strong managerial experience acquired in the manufacturing sector together with a good marketing capabilities. Relevant examples are Samec from Unilever, Number 1 Logistics Group from Barilla and Benlog from Benetton.