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A SURVEY OF ELECTRONIC PURCHASING PRACTICE IN IRELAND: A PERSPECTIVE FOR THE IRISH CONSTRUCTION INDUSTRY

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ABSTRACT: There are many millions of trading documents (such as purchase orders, delivery notes and invoices) currently exchanged on paper in business to business (B2B) transactions, each having to be re-keyed as they pass between different locations and computer applications. Existing Information Communications Technologies (ICTs) such as the Internet, Bar-Coding, Radio Frequency Tagging, Electronic Data Interchange (EDI), Electronic catalogs and Enterprise Resource Planning Software (ERP) have facilitated electronic commerce (EC) functionality within many business sectors. However, the adoption of such technologies in the Irish construction industry has been very slow with only limited evidence of their application. The results of a structured online questionnaire is reported, which was conducted among the top 75 companies in Ireland. The results indicate little EC activity within the Irish Construction Industry supply chain and significant opportunities to introduce the most routine EC applications to support their B2B purchasing transactions.

Keywords: construction, eCommerce, information technology, Internet, purchasing.

1. INTRODUCTION

Information communications technology (ICT) is changing almost all functional aspects of a modern business in Ireland, particularly in industries such as financial services, travel and retailing. With the continued expansion of the Internet, EC provides unparalleled opportunities for businesses to bring greater efficiencies in transaction based commercial activities (Shaw, 2000). Technologies such as Automatic Identification (Auto-ID) and bar coding have become widespread within manufacturing, medicine and retail industries. However, the rate of adoption in other business sectors, such as the construction industry has been very slow and piecemeal (Hore and West, 2005).

A survey of the top 75 Irish businesses was necessary in order to learn from the experience of other industries and gauge attitudes from the various business sectors to the adoption of EC technologies into their B2B purchasing transactions.

Survey results are analysed in order to determine the major factors that are likely to attract organisations to use EC technologies, the driving forces which attract organisations to implement electronic purchasing, the barriers to preventing organisations from applying these technologies and the future developments which would encourage higher usage of electronic purchasing within the respective business sector supply chain. Recommendations are made concerning

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issues which should be addressed as part of an overall strategy to promote greater use of EC technologies within the Irish construction industry.

2. THE SURVEY

The themes of the survey formed the basis of similar surveys carried out in the construction industry in the UK and in Ireland by Marsh and Finch (1998) and Hore and West (2005) respectively. The questionnaire was structured in four core parts, as follows.

ICT Take-Up: opinion as to the general level of ICT utilisation within the Irish business; the general level of ICT usage within the organisations B2B purchasing transactions; current state of awareness of ICT deployment in B2B purchasing; willingness to consider applying exiting technologies in B2B transactions; importance of linking EC to business strategies; increasing significance of EC in the next 3 years; extent of use of particular EC technologies and concerns over web-based strategies.

Driving forces: the major factors which attracted, or are likely to attract, organisations to apply EC technologies. This part of the questionnaire contained questions relating to ten potential driving forces.

Barriers to adoption: the major barriers which have prevented the adoption of EC technologies in the Irish business construction supply chain. This part of the questionnaire contained questions relating to a total of twelve potential barriers.

Future directions: future events which were perceived as important in enticing more Irish businesses to use EC technologies for labelling materials and components. This part of the questionnaire contained scenarios relating to nine potential future directions.

The questionnaire was internet-enabled and a total of 75 companies were emailed the website link, together with a background to the survey and detailed explanations as to how to complete the survey. All companies surveyed had turnovers in excess of €40 million. A total of 38 responses were received.

3. OVERALL LEVELS OF ICT TAKE-UP

The purpose of this section of the survey was to measure the overall level of ICT sophistication present in the sample. For the purpose of the survey, ICT was defined as any computer hardware or software that collects, processes, stores, analyses, and disseminates information for a specific business purpose.

3.1 ICT usage in Sector

74% of all respondents to the survey were of the opinion that the current level of ICT take-up in the Irish business was good or very good. The authors are aware that the results report broad trends of opinion, which may not necessarily accurately reflect the particular level of uptake of ICT in any particular sector. The results however are indicative only, as they are dependent on the knowledge of the respondent. A breakdown of the sector responses to the overall ICT usage is shown in Table 1. Of the five construction companies surveyed all agreed that the current level

of uptake of ICT in their business sector was poor or satisfactory only. This contrasted significantly with the more positive results from all the other sectors surveyed.

Table 1. Current level of ICT usage in Sector

Sector	Poor	Satisfactory	Good	Very Good
Airline	0%	0%	0%	100%
Construction	40%	60%	0%	0%
Warehousing & Distribution	12%	12%	63%	13%
Food & Drink	0%	25%	63%	12%
Information Technology	0%	0%	50%	50%
Manufacturing	0%	14%	57%	29%

3.2 ICT usage in B2B transactions

Respondents were asked about the current level of ICT usage in their B2B purchasing transactions. A summary of the responses is shown in Table 2. The airline industry reported a 100% usage with 80% of construction companies reporting little use. However, when asked about their willingness to apply exiting technologies in their B2B transactions, all construction companies surveyed confirmed their willingness to adopt such technologies. 75% of companies surveyed agreed that EC was having a significant affect on their business strategy. However 40% of construction companies did not agree with this contention.

Table 2. Current level of ICT usage in B2B purchasing transactions

Sector	No Use	Little Use	Some Use	Moderate Use	Regular or Constant Use
Airline	0%	0%	0%	0%	100%
Construction	0%	80%	0%	0%	20%
Working & Distribution	0%	0%	25%	38%	37%
Food & Drink	0%	12%	37%	12%	38%
Information Technology	0%	0%	0%	0%	100%
Manufacturing	0%	28%	23%	34%	15%

3.3 Use of particular technologies to support purchasing transactions

Each sector was asked about the extent to which that they adopted the following technologies: -

1. Internet
2. Extranets
3. Electronic catalogs
4. Bar Coding
5. Smart cards

6. Radio frequency ID (RFID)
7. Enterprise resource planning software
8. Hand held computers
9. Electronic data interchange
10. Extensible mark up language (XML)
11. Electronic funds transfer (EFT)

The airlines surveyed confirmed that their communication infrastructure was firmly founded on Internet and Intranet technologies and that they had a capability to integrate their ICT systems with many of the technologies listed in the survey. The airlines confirmed that they used extensive B2B communication technologies with all their major suppliers, which was based on a platform of internationally recognised B2B airline communication standards.

The construction companies surveyed confirmed that the two main technologies they have adopted in recent years are the Internet and ERP software. These technologies, however, were not used specifically for B2B purchasing transactions, but mainly for integrated company communications. A small number of the companies surveyed reported that many of the technologies listed were been considered by the company for future B2B purchasing transactions. They were particularly concerned that standards should be adopted in the industry for the use of particular technologies such as XML.

Most of the warehousing and distribution companies surveyed confirmed that they used electronic means of ordering and invoicing as standard business practice. Almost half of the companies surveyed used advanced ERP systems to manage their internal communications. The use of EDI and bar coding was used extensively by the companies surveyed although EDI was reported to be very expensive for the sender to use. The industry was willing to adopt a web based EDI, XML and RFID solution, however, those surveyed felt that these technologies needed further development. The responses in this sector showed a very high level of sophistication in the use of ICT to support their purchasing processes. It appears to be routine that the larger warehouse and distribution companies supply eCatalogs to their customers, scan incoming goods, have direct Internet access to their suppliers and establish as routine Extranets networks for their customer base. A recurring theme in the responses confirmed that EC was a pre-requisite to dealing with major retailers and suppliers.

The food and drink sector companies surveyed confirmed that ICT was an integral part of their business processes. Many of the companies surveyed belonged to a co-operative and confirmed that ICT is an ideal tool for effective collaboration. Some of the companies stated that they were using EDI for up to 10 years and that use of an XML based standard to transmit orders and invoices was becoming the norm. Once again, bar coding, EDI, XML and ERP software figured high in their use in purchasing communications. Interestingly, the use of procurement cards for low value purchases figured highly in their use. There was a consensus that RFID technology was not a mature technology at this time.

It was inevitable that the IT sector was the most sophisticated in regard to the usage of ICT. This was confirmed on the analysis of the results, with all the IT companies surveyed reporting regular or constant use of ICT in their purchasing transactions. As the ICT infrastructure is so evident in these companies, this allowed for the sector to concentrate on their core business, which is sales of products and services.

The manufacturing companies surveyed reported a high level of usage of ICT is their purchasing processes. They reported that ERP software was widely used in their companies and

that EDI remained the dominant data exchange standard in the industry, as there was little demand for anything else. The companies surveyed reported little use of XML in their industry.

A summary of the overall use of the various available technologies in these top companies is presented in Table 3. From this it can be observed that the Internet, Bar coding, ERP, EFT and EDI are well established, while smart cards and, surprisingly electronic catalogs have yet top gain popularity. There was a perception that RFID was at its infancy and it needed further development. It was felt by the respondents that this could take up to 5 years to have an impact and only initially on the upper level of the supply chain. Many respondents reported that EFT technology was not been adopted as it had a negative affect on company cash flow and, thus, a number of companies have avoided it. A number of companies in this sector felt that a limited best of breed ICT strategy would cause companies to be more flexible as a trading organisation. The authors appreciate that many of these technologies are not applicable for particular sectors, hence no criticism is implied.

Table 3. Overall results in the use of technologies in purchasing transactions

Technology	**Always**	**Most Times**	**Sometimes**	**Very Little**	**Not Yet Used**
Internet	26%	13%	37%	21%	3%
Extranets	18%	11%	42%	16%	13%
Electronic Catalogs	11%	21%	42%	13%	13%
Bar Coding	26%	26%	18%	16%	14%
Smart Cards	0%	8%	8%	34%	50%
Radio Frequency ID	3%	8%	18%	11%	60%
Enterprise Resource Planning (ERP)	45%	18%	8%	8%	21%
Hand Held Computers	13%	16%	34%	13%	24%
Electronic Data Exchange (EDI)	21%	26%	37%	11%	5%
eXtensible Mark-Up Language (XML)	13%	11%	24%	18%	34%
Electronic Funds Transfer (EFT)	18%	37%	37%	3%	5%

71% of all respondents did not have concerns about adopting a web-based strategy for future B2B purchasing transactions. However the remaining respondents had particular concerns about security of sensitive data; interoperability between transaction parties and the need for critical mass buy-in in order for the technology to gain widespread adoption. On analysis of the individual business sectors, 60% of the construction industry companies were concerned about adopting a web-based strategy for B2B purchasing transactions. This is noteworthy as it is uncharacteristically high and indicates how far this industry has to come to reach levels extant in other industries. Table 4 summarises the respondents' main concerns.

Table 4. Concerns over web-based communications

Concern	Most Concerned	Moderately Concerned	Not Concerned
Lack of awareness or knowledge of Internet capabilities	0%	38%	62%
Customer / supplier may not possess adequate eBusiness capabilities	36%	43%	21%
Lack of available funding	31%	31%	38%
Total costs	23%	38%	39%
Security of sensitive data	50%	7%	43%
Interoperability between transaction parties	50%	43%	7%
Legal implications	31%	31%	38%
Training and inability to use technology	0%	36%	64%
Need for critical mass buy-in	46%	23%	31%

4. DRIVING FORCES IN ELECTRONIC PURCHASING

Companies were asked to rank in order (1-10) the factors which attract, or are likely to attract, their organisation to employ exiting technologies in purchasing transaction. A summary of the overall results is shown in Table 5.

Table 5. Overall sample ranking of driving forces for adoption of exiting technologies

Rank	Driving Force
1	Saving manpower in processing invoices and other information
2	Fewer errors in recording and handling information
3	Avoidance of re-keying information into computer systems
4	Reducing paperwork (orders, invoices and delivery dockets)
5	Reduced cost of capturing data
6	Improved accessibility to time and cost data: providing real time information
7	Service differentiation from competitors
8	Clients who may encourage or stipulate the use of ICT in purchasing
9	Ability to contribute to data interchange in a national standard format
10	Competitor organisations who may have applied ICT in purchasing processes

Client persuasion or perceived threats by competitors who may have applied such technologies were, surprisingly, not considered to be major driving forces. However, all other driving forces met with either agreement or strong agreement. Reduced paperwork, savings in manpower and fewer errors in recording and handling information ranked higher than issues such as service differentiation and the position of competitor organisations. This indicates that ICT is perceived as a tool for cost reduction, rather than as a strategic issue within the industry.

On analysis of the ranking by individual business sectors, this trend of ranking was maintained. However, it is important to recognise that this survey was targeted at IT managers and not senior management, therefore strategic driving forces were not considered in this part of the survey. One interesting observation is the lack of priority given to the ability to contribute to data interchange standards.

5. BARRIERS TO ADOPTION OF ELECTRONIC PURCHASING

This part of the survey concentrated on ranking the perceived barriers to electronic purchasing within the top 75 Irish companies that undermine the use of ICT both within business organisations and within their overall particular business sector.

Respondents were asked to rank the order of importance in respect to the perceived barriers to the adoption of EC within their organisation. A summary of the overall results is shown in Table 6.

Table 6. Ranking of barriers which undermine the use of ICT within business sectors

Rank	Organisational barrier
1	Potential benefits of electronic purchasing are not likely to be sufficient to justify investments
2	Development costs are prohibitive (hardware, software and training)
3	A lack of awareness of ICT deployment in purchasing
4	Employees are likely to resist the introduction of new technologies
5	Technology is not yet reliable enough
6	Uncertainty about how to measure the costs and benefits of such investments

Respondents tended to disagree with the suggestions that employees are likely to resist the introduction of new technology, that the technology was unreliable and that there was uncertainty about how to measure the costs and benefits of ICT investments. Perhaps unsurprisingly, development costs and reliability issues were considered to be particularly important barriers within organisations.

They also disagreed with the suggestion that there were too many products and components in their industry to make the adoption of ICT in purchasing widespread. Surprisingly the sample did not feel there was a general lack of leadership from the Irish government to actively promote the use of ICT in procurement. A high incidence of technologically conservative organisations, a general lack of awareness of the ICT capabilities and benefits to the sector supply chain, the temporary nature of B2B relationships and an unwillingness to invest to the betterment of others were the main barriers reported by the sample.

Respondents were also asked to rank the order of importance in respect to the perceived barriers to the adoption of EC within their respective industries. Again, there was common agreement in the survey concerning the general factors in the industry, which undermine the use of ICT in construction purchasing. Table 7 presents the overall results.

Table 7 – Overall sample ranking of barriers against adoption of ICT within business sectors

Rank	Industry barrier
1	There is a high incidence of technologically conservative organisations in your industry sector
2	There is no motivation for organisations to apply ICT in purchasing when other parties will benefit
3	There is a general lack of awareness of ICT capabilities in purchasing and its potential benefits to the supply chain
4	The temporary nature of relationships between organisations results in an unwillingness to invest in ICT which may only be short lived
5	There is a general lack of leadership from the government to actively promote the use of ICT in procurement
6	There are too many products and components to make the adoption of ICTs in purchasing widespread

6. FUTURE DIRECTIONS

This part of the survey focused on the respondent's position in regard to statements as to the likely future direction of EC in the respective business sectors. The results revealed either agreement or strong agreement with almost all of the future directions aimed at encouraging adoption of electronic purchasing. Table 8 summarises the results.

Table 8. Overall importance of future directions for adoption of electronic purchasing

Future directions	Strongly Agree	Agree	No Opinion	Disagree	Strongly disagree
There is a general awareness of the benefits of deploying existing technologies in purchasing processes	46%	33%	3%	13%	5%
An industry standard should be introduced for electronic data interchange in business-to-business transactions	41%	41%	10%	5%	3%
There is an increase in IT literacy and familiarity of electronic purchasing	33%	49%	10%	8%	0%
There should be a longer term relationships between supply chain organisations	28%	46%	8%	15%	3%
Closer collaboration is required between buyers and suppliers	23%	56%	10%	5%	6%
Buyers should stipulate the use of electronic purchasing in future business-to-business transactions with suppliers	38%	36%	15%	7%	4%
Time consuming and inappropriate search methods for the mass of information available on the Internet, discourage one from making full of the technology	14%	24%	24%	32%	6%
Involvement in e-business is of vital importance for improving efficiency and effectiveness along the supply chain	34%	55%	8%	3%	0%
Customers/Manufacturers/Suppliers are very keen on doing business with our company electronically via the Internet	18%	51%	8%	18%	5%

7. RECOMMENDATIONS

Increased awareness within the Irish construction industry is likely to be the key factor in encouraging wider uptake of EC technologies. An industry-wide education initiative, which combines the results of a pilot programme with dissemination of information within the technical press, could, in part achieve this goal. Such an initiative would most fruitfully comprise of a special interest group to pilot test the technology (Gunnigan et al, 2004). Particular efforts should be made to increase awareness of EC technologies among contractors and suppliers with lower levels of ICT utilisation (Hore and West, 2004 and Hore et al, 2004).

Influential organisations (who have the power to enforce the use of technology on a project-wide basis) should also be made aware of the potential benefits of electronic purchasing. Such organisations would include larger contractors, suppliers and clients who have an ongoing interest in construction. In retailing, a relatively small number of large influential retail outlets were able to exercise sufficient pressure to ensure the adoption of electronic purchasing on an industry wide basis. In construction, such an approval would require the co-operation of many small contractors and suppliers, for whom the required level of capital investment could represent a significant cost to their businesses. Common technological and operational guidelines or protocols would play a crucial role in easing the application of electronic purchasing.

The Construction Information Technology Alliance (CITA), which represents all the sectors of the Irish construction industry, is well positioned to oversee the development of such guidelines (Thomas and Hore, 2003). This body should address a number of issues including standards for EC techniques, EDI standards such as the use of eXtensible Mark-Up Language (XML) messaging, facilitation of pilot projects, as well as recommending procedures for implementing the technology at an organisational level.

8. CONCLUSIONS

The results of this survey suggest that the construction industry in Ireland does not compare favourably with other Irish business sectors in respect to the deployment of EC technologies in B2B purchasing transactions. This finding is supported by a recent survey by Wong and Sloan (2004) in the UK construction SME sector, which indicated that the majority of the construction companies surveyed were not ready for ICT implementation to support even the most routine electronic purchasing activities.

There was considerable concern within the construction sector surveyed as to the adoption of a web-based strategy in B2B purchasing, due to the perceived lack of security of transaction data and lack of broadband facilities across the country. Reduced paper volumes, error reduction and manpower savings were ranked as the most important driving forces for applying ICT in construction purchasing. The lack of clarity as to the potential benefits of electronic purchasing and the prohibitive costs associated with implementation of such technology were considered to be the major barriers within construction organisations to the greater deployment of electronic purchasing. Increased awareness and the introduction of industry standards were seen as the most important future directions, which would encourage the greater use of electronic purchasing. Other important issues included the need for increased ICT literacy skills within the workforce and the fostering of long-term relationships between organisations within the supply chain.

Technologies are at last in place to process electronic transactions more easily and at less cost than one can process paper transactions (Kalakota and Whinston, 1996). ICT is changing almost

all functional aspects of a modern business, particularly in industries such as financial services, travel and retailing. With the continued expansion of the Internet, EC provides unparalleled opportunities for businesses to bring greater efficiencies in transaction based commercial activities (Shaw, 2000; Wong and Sloan, 2004).

Specific EC deployment is having a varying impact on different business sectors. It will take the main players within each sector to adopt a new technological strategy. It is this driver that will force companies to embrace EC in B2B purchasing transactions. The technology behind EC is not the problem. The problem is getting the buy-in from all parties concerned. It must be seen as beneficial to everyone and not another burden imposed by the buyers. Esoteric applications like auctions, complex choreography of interactive messages and point-and-click catalogue technology are not practical applications for the Irish construction industry. The biggest savings from eBusiness can be achieved from exchanging orders and invoices electronically. B2B savings can be realised on the elimination of duplicate data entry by achieving a three-way match of the purchase order, delivery advice note and the invoice.

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