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Realising Electronic Purchasing in the Irish Construction Industry

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Abstract

The use of Information Communication Technologies (ICT) in construction purchasing has been sporadic and piecemeal. Very significant inefficiencies and problems still exist in both paper transactions and non-integrated electronic solutions. At the simplest level, the electronic transmission of business documents offers savings in paper and postage. By going a step further, businesses can make strides in communicating with their partners, at relatively low cost, through direct links between their computers. Existing ICT 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 Proof of Delivery (POD) pilot project carried out by the Construction Information Technology Alliance (CITA) in 2004 indicates that significant cost savings can be achieved by trading partners by the adoption of existing technologies.

Keywords: Construction, e-commerce, information technology, procurement, purchasing.

1. Background

CITA is a collaborative organisation aimed at bringing together academia and practitioners, with a common purpose to promote the application of ICT in the Irish Construction Industry [1]. A Special Interest Group within CITA was formed in 2002 to consider specifically the administration involved in ordering, delivering and invoicing of building materials. CITA approached a number of interested parties within the Alliance to lead a proof of concept pilot project to show how costs can be minimised and efficiencies gained in the ordering, receipt and payment of construction materials by the effective use of ICT.

It is generally accepted that building materials account for up to 50% of all construction costs. In this field of business-to-business (B2B) interactions, there is a huge untapped potential for

productivity gains. In Sweden [2], Finland [3] and in the UK [4], materials management has been identified as an area where significant cost savings could be made. Laage-Hellman and Gadde gave an account of the progress made by the Swedish construction company Skanska in its attempts at introducing EDI into its purchasing system. The cost of processing an invoice was found to be SEK 300 (approximately US$45). Laage-Hellman and Gadde concluded that this cost could be reduced by 90% by using EDI.

The purpose of this paper is to share the experience gained by the authors in carrying out a pilot study and to identify the main problems that exist with the current mainly paper-based process adopted in the purchasing of materials in the Irish Construction Industry. The authors conclude that the re-engineered solution proposed will explicitly deal with all the problems that currently exist.

2. Traditional Purchasing Practice in Construction

Purchasing procedures typically involve a paper-based communication process between the purchaser and supplier. Evidence shows that the construction industry is lagging behind other industries globally in adopting new technologies [5]. The process invariably commences with the sourcing of the materials. This typically involves site personnel requisitioning the project material requirements on a daily basis. Once a suitable supplier has been selected, the next step is to raise and issue a purchase order to the supplier. On delivery of the materials to site, a delivery docket is signed by the contractor and forwarded to head office as proof of delivery. Payment of the invoice is made following the matching of the invoice to the original purchase order and signed delivery docket. Kong et al identified the limitations of the traditional material procurement process [5]. As every step is reliant on input from one or more individuals, there are frequently problems in the process. For example, the requirements of the contractor are misinterpreted by the supplier, a docket goes missing, transcription errors occur, the invoice is not correct, the goods are not all delivered at the same time, the delivery docket does not match the order, payment is held pending matching of documents, etc. Any of these problems can add significant delay and cost to the process.

3. Available Technology

Technologies are in place to process electronic transactions more easily and at less cost than one can process paper transactions [6]. 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 [7]. 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 [8]. Li argues that the benefits of ICT deployment are marginal, if simply imposed on an already inefficient construction process [9]. He argues that the processes should be redesigned to

maximise the use of ICT. Hammer described how heavy investments in ICT in the 1980's delivered disappointing results, largely because companies tended to use technology to mechanise old ways of doing business [10].

4. The Pilot

4.1 Aims and Objectives of Pilot

The overall aim of the pilot was to prove that delivery data can be captured electronically and be acceptable as "Proof of Delivery" for the construction industry by use of readily available technology. The underlying objectives of the pilot project included: -

- To develop a clear understanding of how the existing purchasing systems operated in both contractor and supplier organisations.

- To confirm ICT operational systems and their current reliability in both the contractor and supplier organisations.

- To investigate the ease/constraints with which information can be captured from or added to contractor and suppliers existing purchasing systems.

- To test and confirm ICT handheld usability in a construction environment.

- To confirm productivity improvements and potential savings as a direct result of this pilot with both the contractor and the supplier.

4.2 Methodology

The methodology adopted for the pilot included five inter-related steps, involved: -

1. The vision/scope of the pilot,

2. proof of concept,

3. pilot itself,

4. evaluate pilot and

5. post pilot evaluation.

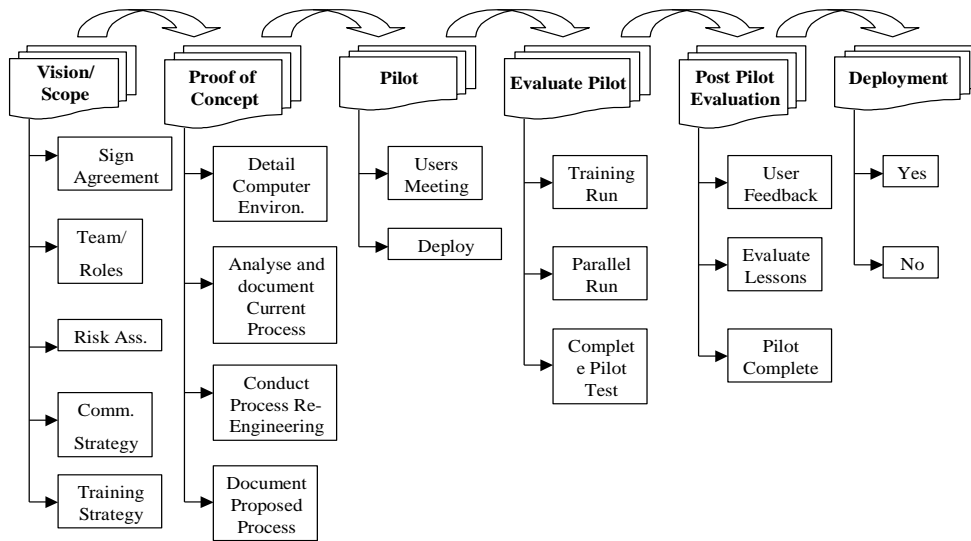The methodology process is shown in Figure 1.

Vision/ Scope — Sign Agreement — Team/ Roles — Risk Ass. — Comm. Strategy — Training Strategy

Proof of Concept — Detail Computer Environ. — Analyse and document Current Process — Conduct Process Re-Engineering — Document Proposed Process

Pilot — Users Meeting — Deploy

Evaluate Pilot — Training Run — Parallel Run — Complete Pilot Test

Post Pilot Evaluation — User Feedback — Evaluate Lessons — Pilot Complete

Deployment — Yes — No

Figure 1. CITA Pilot Project Methodology

4.3 Pilot Team

The pilot team members principally included the lead author, main contractor, building supplier, ICT providers and an independent monitoring consultant, all of which were members of CITA. Figure 2 illustrates the communication relationship between the parties.
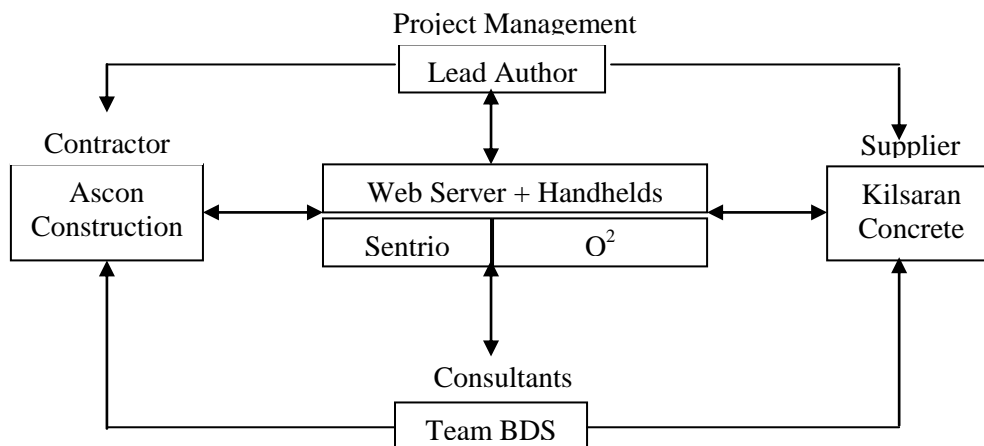
Project Management — Lead Author

Contractor — Ascon Construction

Web Server + Handhelds — Sentrio — O^2

Supplier — Kilsaran Concrete

Consultants — Team BDS

Figure 2: Pilot Team

4.4 Problems to be addressed

The main problems encountered by the contractor and the supplier included very large volumes of paper generated in their purchasing processes; a significant amount of time

spent in carrying out repetitive tasks such as scanning, photocopying, matching documents; inaccuracies in the ordering and delivery process and the degree of mislaid delivery dockets, leading to delays in payment and in many cases non-payment. Table 1 documents the magnitude of the documentation that are created annually within the contractor and supplier organisations.

Table 1. Estimates of purchasing documentation created by contractor and supplier

Pilot Contractor	Pilot Supplier
78,000 invoices per annum with an average of 5 lines per invoice	31,000 invoices per annum with an average of 20 lines per invoice
390,000 goods received notes per annum	1,250 invoice queries per annum
20,000 missing documents per annum	375,000 delivery dockets for scanning per annum
10,000 order amendments	

It was decided by the pilot team to approach the pilot project in two phases. The scope of Phase 1 sought only to address the delivery aspect of the purchasing process as illustrated in Figure 3. The precise scope of phase 2 would be decided following an evaluation and review of Phase 1.
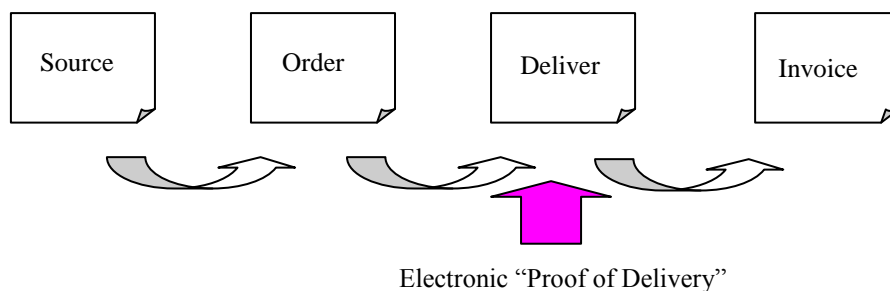

Electronic "Proof of Delivery"

Figure 3. Focus of Pilot

4.5 Technology Landscape

The technology landscape selected for the pilot was a web-based solution, as illustrated on Figure 4. This allowed for the capturing of the POD on a handheld device. The ICT landscape adopted did not in any way require the contractor or the supplier to re-configure their back-end ICT systems. The technology simply allowed for the purchase order to be captured on a mobile handheld device, which in turn allowed for the POD to be captured by way of a wireless connection on an independent website.
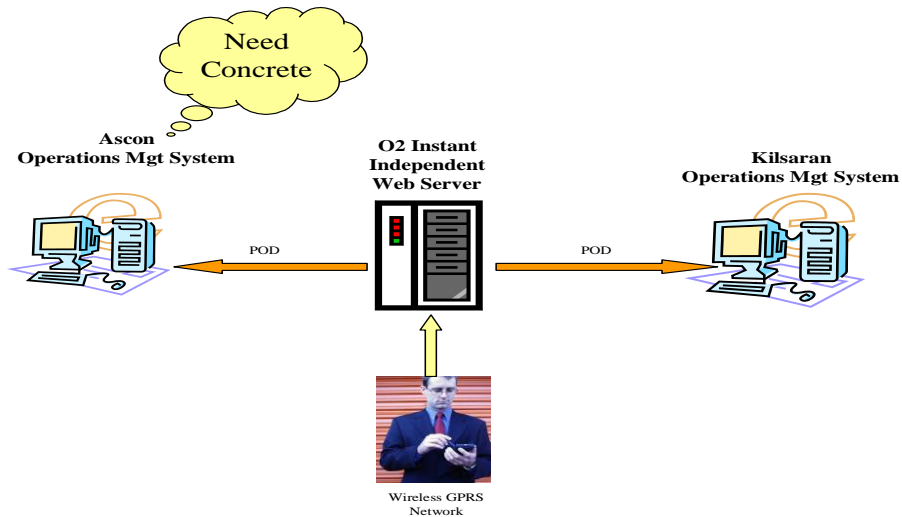
Figure 4. Technology landscape of Pilot for concrete supply

4.6 Pilot Process

A more detailed overview of the pilot process is shown in Figure 5. The pilot process commenced with the contractor calling-off material by phone call and confirming their request by use of facsimile. The supplier in turn generated the order details onto their ICT document management system and simultaneously onto the central web repository. Order details were then transferred onto a handheld device, which, on delivery to the site, were presented in an electronic format for signature on the device. Once signed the POD was instantaneously sent back to the central repository. This allowed both companies to check the delivery information and customer signature online. This enabled the parties to query delivery information using the central web application.
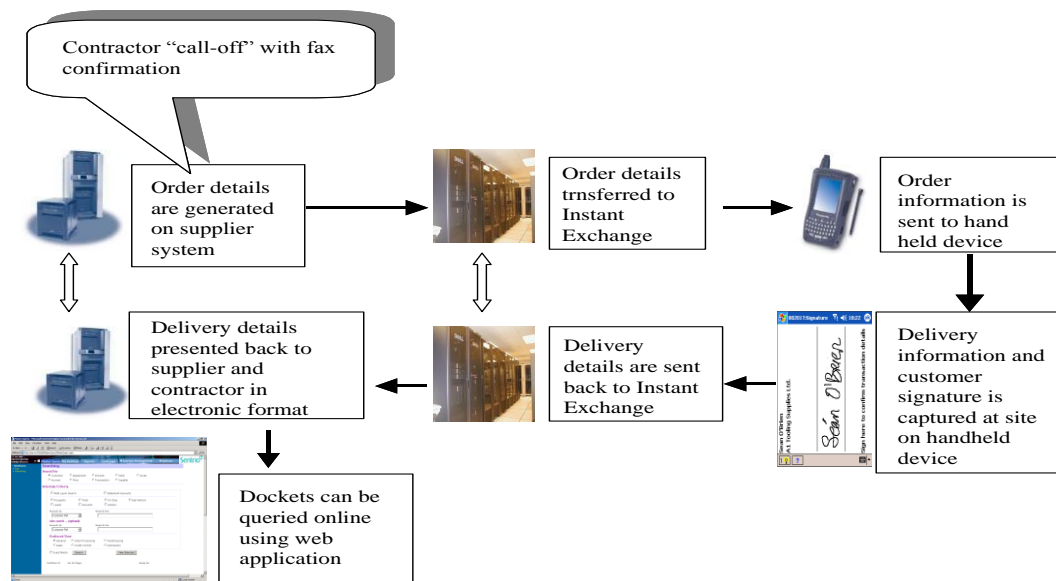

Figure 5. High Level Process for POD Pilot

4.7 Remaining Constraints

The pilot project allowed both the contractor and the supplier to report on the business benefits that would accrue if ICT was deployed in the ordering, receiving and invoicing processes of the purchasing cycle. Table 2 and 3 summarise the internal processes, constraints and opportunities for a further pilot project. It can be seen from both tables 2 and 3 that the pilot project only addressed the delivery element of the process. There remained a large number of constraints in both the contractor and supplier purchasing processes. For example, it was still necessary for the contractor to manually input a Good Received Note (GRN) of the POD information into their ERP systems. It is intended that all these constraints will be systematically dealt with in Phase 2 of the pilot, which is due to commence in spring 2005.

Table 2. Contractors constraints with existing process

Contractor – Processes and Current Constraints				
Process	**Current**	**Constraint**	**Pilot Objectives**	**Opportunities**
Ordering	Supplier "Open Order"	Keep order adjustments	Auto order adjustments based upon delivery information	SIG 1 – Phase 2
Receiving/ GRNs	Hard copy Delivery Dockets	Missing documents. Scanning documentation. Manual creation of GRN in ERP system.	Electronic proof of delivery. Eliminate scanning. Auto generation of GRN in to ERP system	SIG 1 – Phase 1 SIG 1 – Phase 2 SIG 1 – Phase 2
Invoicing	Cross referencing Invoice with scanned delivery dockets/GRNS	Missing GRN/scanning documents.	Auto generation GRN in to ERP system	SIG 1 – Phase 2

Table 3. Supplier constraints with existing process

Supplier – Processes and Current Constraints				
Process	**Current**	**Constraint**	**Pilot Objectives**	**Opportunities**
Demand from customer	Phone and facsimile	Need to put manually into system	Auto ordering into system from customer	SIG 1 – Phase 2
Delivery	Hard copy Delivery Dockets	Missing documents. Packaging of delivery dockets from site. Scanning of delivery dockets in accounts.	Electronic proof of delivery. Electronic proof of delivery. Eliminate scanning.	SIG 1 – Phase 1 SIG 1 – Phase 1 SIG 1 – Phase 2
Invoicing	Invoice issued once delivery initiated	Missing GRN/scanning documents.	Auto generation GRN in to ERP system	SIG 1 – Phase 2

4.8 Pilot Results

As a direct result of the pilot project, both the contractor and the supplier reported the savings that would potentially accrue should the technology be adopted in a second phase pilot to address the constraints identified in Tables 2 and 3. Tables 4 summarises these savings.

Table 4. Summary of Potential Savings for Phase 2 of Pilot

Contractors Annual Costs in Euro			Suppliers Annual Costs in Euro		
78,000 Invoices per annum 390,000 GRNs per annum			60,000 Invoices per annum 2,400 queries per annum		
Process	Ordering	20,000	Process	Demand from customer	20,000
	Receiving/GRNs	15,000		Delivery	100,000
	Invoicing	67,000		Invoicing	24,000
Total Savings Projected		102,000	Total Savings Projected		144,000
Add Work Study Factor +30%		31,000	Add Work Study Factor +30%		43,000
Other savings		5,000	Other savings		5,000
Total Savings Projected for Phase 2		138,000	Total Savings Projected for Phase 2		192,000
Less predicted technology costs		38,000	Less predicted technology costs		108,000
Nett Saving predicted for Phase 2		100,000	Nett Saving predicted for Phase 2		84,000

The savings reported in table 4 are based on calculations and data furnished by the contractor and the supplier during the pilot and not by a direct work study. The figures presented by the authors are considered to be conservative, as additional indirect savings in regard to office expenses such as use of paper, printing and copier consumables are not included.

From a pilot perspective the supplier gained the more immediate and tangible benefits, from the first phase of the pilot. Table 4 summarises the financial benefits that should accrue to both the contractor and the supplier should the technology be deployed in a second more dynamic B2B pilot project.

4.9 Pilot Feedback in Phase 1

Feedback has been seen as a critical part of the pilot study, as it not only provides "lessons learnt" but also substantiates the credibility of the technology deployed in the first phase of the pilot. There were teething problems in using the technology, however these problems bated as familiarity emerged during the pilot study. Both the contractor and the supplier felt that there needed to be more time spent on training personnel on using the technology. They also felt that the website was not user friendly and did not produce suitable reports for their records. There was also strong opinion that the Personal Digitised Assistant (PDA) screen was not displaying the requisite information prior to signing the PDA screen. All the feedback gathered from the participants will be consulted in the planning and implementation of the second phase pilot.

5. Proposed System Architecture for Effective ePurchasing

The first phase of this pilot project only dealt with the delivery aspect of the entire purchasing process. Figure 6 illustrates how existing technologies can be fully integrated to eliminate paper-work from the entire purchasing process. All purchasing documentation, such as requisitions, purchase orders, delivery dockets and invoices can be passed electronically through the central web server, which in turn can be electronically posted into both the contractors' and suppliers' ICT back-end systems. The architecture of the platform will enable a handheld application with an electronic signature capture capability to transmit wirelessly a POD from the PDA to both the suppliers and contractors ICT systems via an independent central web-based server. The web-based solution will provide on-line access to an image of the signed POD, which will allow for automated matching of the order, the delivery record and the supplier invoice.
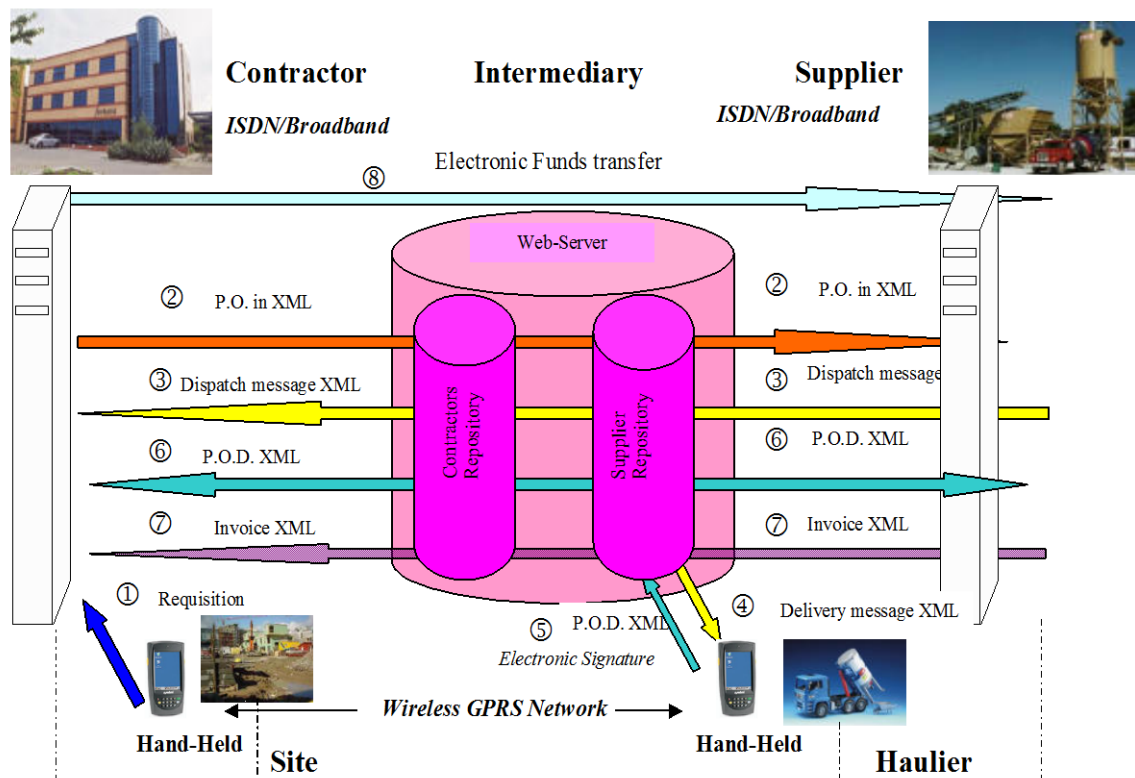

Figure 6. Systems Architecture for Effective ePurchasing

The operation of the proposed solution will involve the following sequential tasks, as identified in Figure 6.

1) Site requisition goods via a hand held device or mobile data terminal.
2) Contractor ICT system passes purchase order to the independent web-server, which ensures that the purchase format is correct and passes it to the suppliers ICT system.
3) The suppliers ICT system creates a dispatch notice and informs the contractor system if there is any variation between the order and dispatch notice.
4) The delivery details are sent to a delivery driver's hand-held device in XML format via a GPRS network. This message is triggered from the independent web-server based on the supplier dispatch message.
5) Once the delivery is complete the driver captures a signature on site, that is transmitted back to the independent web server.
6) The POD is then sent from the independent web-server to both the supplier's and contractor's ICT systems.
7) Supplier invoices the contractor via the independent web-server, using XML messaging technology.
8) On electronic invoice approval the contractor authorises electronic funds transfer direct to supplier.

5. Conclusions

Technologies are at last in place to process electronic transactions more easily and at less cost than one can process paper transactions [6]. 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 [7] and [11].

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. ICT 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. 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. 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 [12]. Particular efforts should be made to

increase awareness of EC technologies among contractors and suppliers with lower levels of ICT utilisation [13] and [14].

References

[1] Thomas K. and Hore A.V., (2003), 'A reflection on the development, activities and deliverables of the Construction IT Alliance (CITA) in Ireland', *CIB W89, International Conference on Building Education and Research, 9-11 April*, pp. 381-895.

[2] Laage-Hellman, J. and Gadde, L.E., (1996), 'Information technology and the efficiency of materials supply: The implementation of EDI in the construction industry', *ISPERA Conference, Eindhoven*, pp. 62-69.

[3] Wegelius-Lehtonen, T., (1995), 'Measuring and re-engineering logistics chains in the construction industry, Re-engineering the enterprise', *Proceedings of the IFIP TC5/WG 5.7 Working Conference on Re-Engineering the Enterprise, Galway, Republic of Ireland, pp.21-28.*

[4] Dawood, N., (1996), 'A strategy for a computer-based materials management system for the building industry', *Journal of Financial Management of Property and Construction,* 1(4), pp.17-28.

[5] Kong C.W., Li H. and Love P.E.D. (2001), An e-commerce system for construction material procurement, Construction Innovation, 1, 43-54.

[6] Kalakota, R. and Whinston, A.B., (1996), *Frontiers of electronic commerce*, Addison-Wesley, New York.

[7] Shaw, M.J., (2000), *Electronic commerce: state of the art, Handbook on electronic commerce*, Springer, pp. 3-24.

[8] Hore, A.V. and West R.P., (2005), 'Attitudes towards electronic purchasing in the Irish construction industry", *Accepted for 2005 CIB W92/T23/W107 International Symposium on Procurement Systems, Las Vegas, USA*

[9] Li, H. (1996), The Role of IT Manager in Construction Process Re-engineering, Building Research and Information, 24, 124-128.

[10] Hammer M., Re-engineering Work (1990), Don't Automate, Obliterate, Harvard Business Review, July-August.

[11] Wong, C.H. and Sloan B., (2004), 'Use of ICT for eProcurement in the UK construction industry: a survey of SMEs readiness', *Incite 2004 Conference, Designing, Managing and Supporting Construction Projects Through Innovation an IT Solutions, 18-21st February 20904, Langkawi, Malaysia*, pp. 459-466.

[12] Gunnigan L., Orr T.L.L. and Hore A.V., (2004), 'Rationalising the construction materials purchasing process', *The International Salford Centre for Research and Innovation (SCRI) Research Symposium and International Built and Human Research Week, Salford University, Manchester, pp. 376-385.*

[13] Hore, A.V. and West R.P., (2004), 'A Proposal for re-engineering the procurement of building materials by effective use of ICT', *Incite 2004 Conference, Designing, Managing and Supporting Construction Projects Through Innovation an IT Solutions, Langkawi, Malaysia*, pp. 375-380.

[14] Hore, A.V., West R.P. and Gunnigan L., (2004), 'Enabling the re-engineering of material purchasing in the construction industry by the effective use of information technology', *The International Salford Centre for Research and Innovation (SCRI) Research Symposium and International Built and Human Research Week, Salford University, Manchester*, pp. 386-395.