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The benefits of deploying IT in the material procurement of ready mix concrete in the Irish construction industry

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Abstract

The current methods of processing orders, deliveries and invoices of concrete products in the construction industry is enormously inefficient, with vast quantities of paperwork, duplication of effort, scanning, re-keying and resolving mismatches between purchase orders, delivery dockets and invoices. This paper sets out results of a survey which reveals attitudes to Information Communication Technologies (ICT) in supporting the purchasing process in construction. The drivers and barriers to ICT use in construction purchasing is discussed from both the contractor's and supplier's perspective. The paper goes on to describe the outcome of a pilot study in which the efficiencies are investigated arising from using available technology to provide proof of delivery. The response of site personnel in using this technology is discussed, together with lessons learned in the pilot study. Arising from the survey and pilot study results, a proposal is made to re-engineer the procurement process, taking into account the available technologies. The re-engineered solution seeks to achieve an integrated three-way electronic match of the purchase order, delivery note and supplier invoice. Suggestions are made as to the benefits of introducing such an integrated system in the Irish construction industry.

Keywords business-to-business, construction, e-commerce, integration, purchasing.

1. INTRODUCTION

Over recent decades, industry generally has come to recognise the inefficiencies that exist in paper-based systems. Many sectors of industry have replaced their paper-based systems with electronic systems. The construction sector, however, lags behind other business sectors in harnessing the greater potential of Information Communications Technology (ICT) (Thomas and Hore, 2003; Gunnigan et al., 2004; Hore and West, 2005a).

It is generally accepted that building materials can account for up to 50% of all costs on a typical construction project. There are millions of trading documents produced by both main contractors' and suppliers', such as purchase requisitions, purchase orders, delivery notes, supplier invoices, supplier statements and remittance advice notes. Each of these documents has to be re-keyed individually as they pass between different locations and computer applications (Hore et al., 2004).

In Sweden (Laage-Hellman and Gadde, 1996), Finland (Wegelius-Lehtonen, 1995) and in the UK (Dawood, 1997), materials management has been identified as an area where significant cost savings could be made. 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, Electronic Commerce (EC) provides unparalleled opportunities for businesses to bring greater efficiencies in transaction based commercial activities (Shaw, 2000). Li (1996) argues

that the benefits of ICT deployment are marginal, if simply imposed on an already inefficient construction process. He argues that business processes should be redesigned to maximise the use of ICT. Hammer (1990) described how heavy investments in information technology in the 1980's delivered disappointing results, largely because companies tended to use technology to mechanise old ways of doing business.

The purpose of this paper is support the contention that the current purchasing process in construction is highly inefficient and that available ICT can be deployed to dramatically improve the process. The authors also set out the results of a survey carried out in 2004 which reveal attitudes to ICT, the drivers and barriers to ICT use in construction purchasing from both the contractor's and supplier's perspective. The paper progresses to share the experience gained by the authors in carrying out a pilot study in 2004 which seek to explicitly deals with the problem of proof of delivery. The paper concludes that the re-engineered solution will be enabled by the progression to a further more fully integrated ICT pilot solution, which will explicitly deal with all the problems that currently exist within the construction purchasing process.

2. TRADITIONAL PURCHASING PROCESS

The traditional process of procuring materials in construction is dependent on a number of factors. For example, the size of the project, size of firm, organisation structure of the firm and the roles and responsibilities of the employees within that organisation. The process typically involves both centralised and decentralised personnel. The sophistication of the process varies widely, with many of the more established firms possessing company manuals detailing the procedures and standard forms that staff should adopt (Canter, 1993). Figure 1 depicts an outline of the material purchasing process during the construction stage.

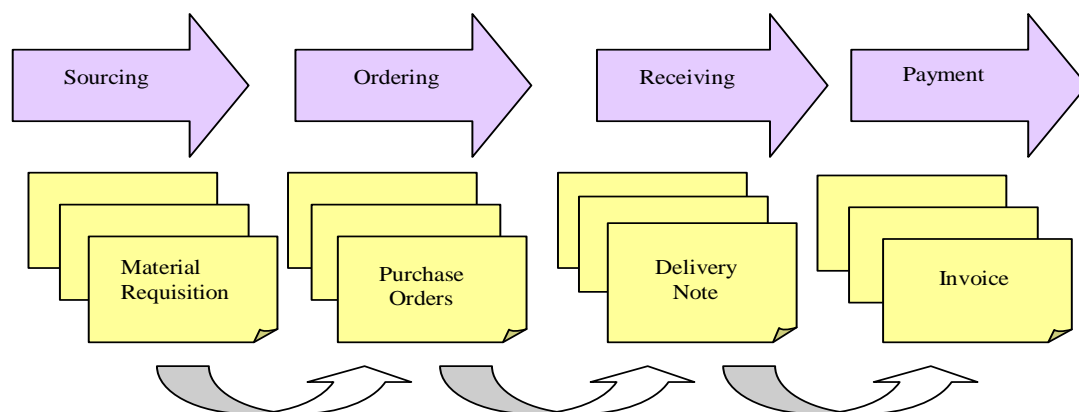


Figure 1. Traditional material procurement process (Hore and West, 2004)

Purchasing procedures typically involve a paper-based communication process between the purchaser and supplier. The process invariably commences with the sourcing of the materials. This involves site requisitioning the project material requirements on a daily basis. Once a suitable supplier has been selected, the next step in the purchasing process 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 will be made following the matching of the invoice to the original purchase order and signed delivery docket.

Kong et al. (2001) identified the limitations of the traditional material procurement process. 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. 2004 SURVEY

The authors carried out a survey in 2004, which focused on the use of ICT among the top 100 contractors' and suppliers' in the Irish construction industry. In particular, the survey focused on driving forces which attracted contractors' and suppliers' to adopt electronic purchasing and both the internal and external barriers preventing these organisations from applying ICT to support their purchasing processes.

The questionnaire was internet-enabled and a total of 98 companies were emailed the website link, together with a background to the survey and detailed explanations as to how to complete the survey. A total of 54 responses were received including 29 from building suppliers and 25 from main contractors. Both the contractors' and the suppliers' ranked reduced paperwork, fewer errors, and improved accessibility to information and manpower savings, as the main drivers that would attract their organisations to deploy EC technologies. Figure 2 illustrates the ranking of the driving forces to deploying IT in their Business-to-Business (B2B) purchasing transactions. The results suggest that ICT is perceived more as a tool for cost reduction, rather than as a strategic issue within the industry.

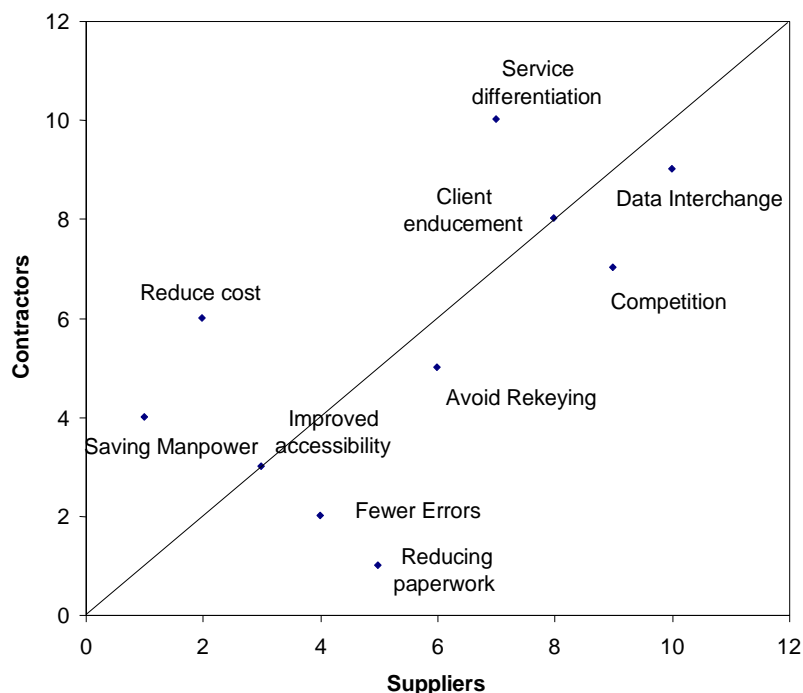


Figure 2. Ranking of Drivers to deploying ICT in construction purchasing

Respondents were also asked to rank the internal barriers that prevented them from deploying ICT to support their purchasing process. The results are illustrated in Figure 3.

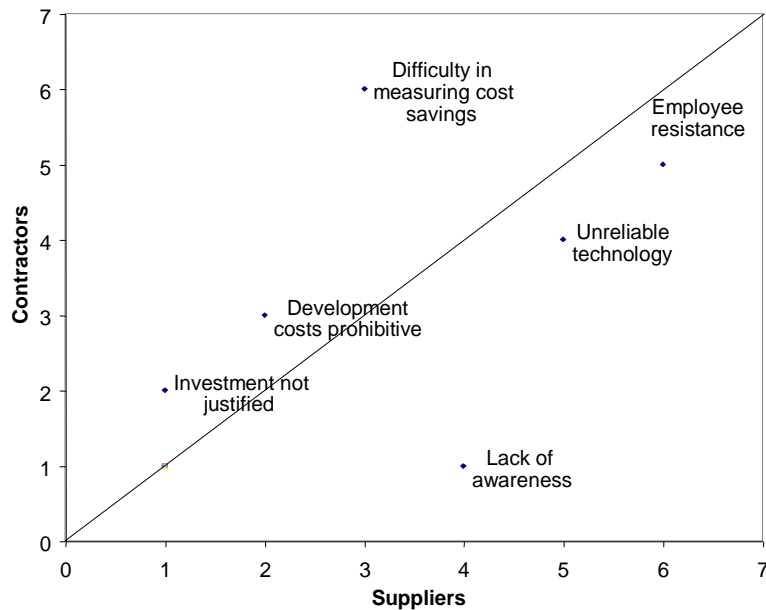


Figure 3. Ranking of internal barriers to deploying IT in construction purchasing

Once again respondents were mainly concerned about the cost of deploying such technologies and their return on the investment. Respondents were asked to rank the order of importance in respect to the perceived barriers to the adoption of EC within the Irish construction industry. The results of the external barriers preventing contractors' and suppliers' adopting ICT in construction purchasing are shown in Figure 4.

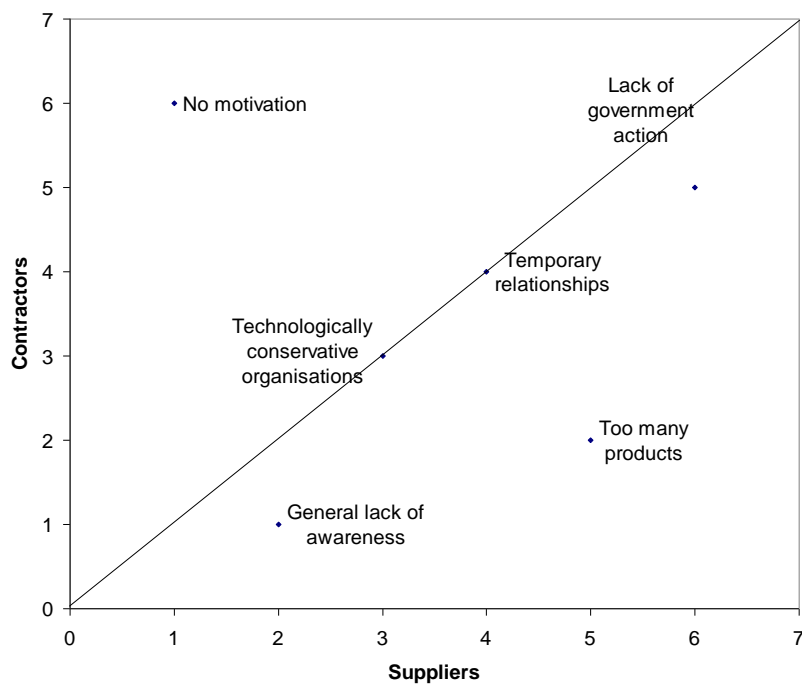


Figure 4. Ranking of internal barriers to deploying IT in construction purchasing

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 organisations to the greater deployment of electronic purchasing.

In addition to identifying the drivers and barriers to deploying IT in construction purchasing, the results of this survey confirmed that the overall use of ICT in construction purchasing in Ireland is very low at present. It also revealed that ICT deployment is greater among the suppliers surveyed. There was considerable concern within the sample in respect to the adoption of a web-based strategy in construction purchasing, due to the perceived lack of security of transaction data and lack of broadband facilities across the country. 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.

4. 2004 PILOT STUDY

In May 2001, the lead author, along with academic colleagues, formed the Construction Information Technology Alliance (CITA). CITA was founded to provide independent and active leadership to the Irish Construction Industry in the application of current and emerging information and communication technologies throughout the entire construction process.

The main barometer of the organisation's success is based on the progress of its Special Interest Group (SIG) network (Thomas and Hore, 2003). The very first group formed by the author in 2001 was SIG 1, which focused on Electronic Purchasing in the Irish construction industry. The group, consisting of a number of main contractors, suppliers and ICT vendors, who aimed to use ICT to minimise the cost of administrating the ordering, delivery and invoicing of construction materials.

This group saw ICT as the main driver that will enable companies to embrace EC B2B in construction purchasing transactions. It quickly became apparent that the technology behind EC was not the problem. The problem was getting the buy-in from all parties concerned. It was reported in a CITA member meeting in November 2004 that the biggest savings from eBusiness can be achieved from exchanging orders, delivery notes and invoices electronically. The group, which is chaired by the author, believe that an increased awareness within the Irish construction industry is likely to be the key factor in encouraging wider uptake of EC technologies. The author carried out an ePOD pilot project in 2004, under the auspices and with the co-operation of the SIG, in order to realise the electronic proof of delivery of materials in the Irish construction industry. The overall aim of this pilot was to prove that delivery data could be captured electronically and be acceptable as a Proof of Delivery (POD) for the construction industry.

The pilot team members consisted of the author, acting as the team leader and the project manager, a main contractor (Ascon), a building supplier (Kilsaran Concrete), an independent management consultant (Team BDS) and the ICT providers (Sentrio and O₂). Figure 5 illustrates the relationship between pilot participants. The role of the consultant was to independently verify the business benefits accruing from the performance of the pilot.

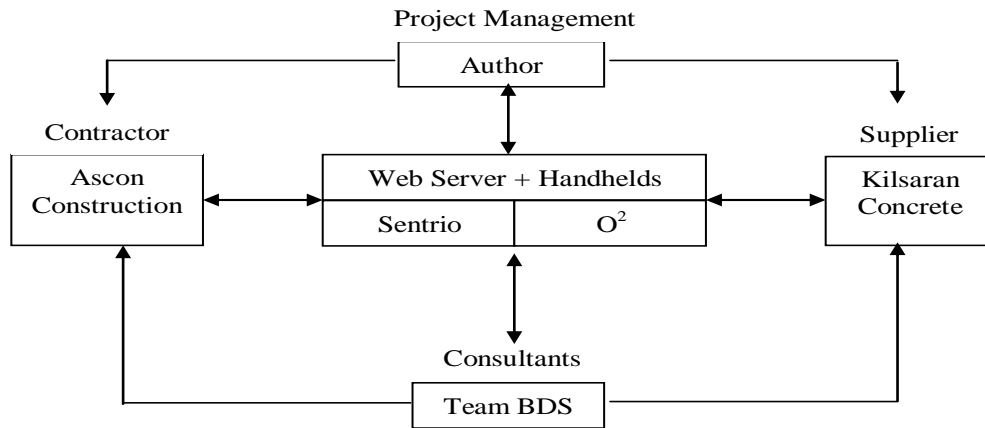


Figure 5. CITA Phase 1 pilot team (Hore and West, 2005b)

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, all of which led to delays in payment and, in many cases, non-payment. Table 1 documents the estimated volume of documentation that was created in 2004 within the contractor and supplier organisations.

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	

Table 1. Estimates of purchasing documentation created by contractor and supplier (Hore and West, 2005b)

The first phase pilot sought to address the electronic capture of the “Proof of Delivery”. When goods were delivered to a site, a number of issues arose, namely :

- If an authorised signatory was unavailable, the delivery docket was unsigned and a manual process of trying to get a signatory to sign the dockets after the event took place. This wasted time for both the supplier and the customer.
- If the delivery details had to be changed, a manual adjustment had to be made on the docket, which then had to be traced by back-office administration in both the supplier and contractor organisations.
- A copy of the docket had to be returned by the authorised site signatory to the site administration office, and from there, it had to be inputted into the contractor’s back-office system by way of a Goods Received Note (GRN).
- A copy of the docket had to be returned by the driver to the supplier office, so that the supplier can raise an invoice.

- With copies of the docket needing to be sent to the administration within both the supplier and the contractor offices, the potential for loss/misplacement of dockets was very obvious. ‘Dockets-in-pockets’ was a term often used by the contracting representative on the pilot team.
- When there were issues with delivery dockets or returns, it was normal for copies of dockets to be requested by the contractor. The supplier had invested in scanning technology, to scan all dockets received, but this incurred costs for scanning equipment, scanning software, and labour costs to physically scan dockets. While scan rates were reasonably accurate, there was often manual intervention required to process torn, poor quality or damaged dockets. When scanning was not used, copies of delivery dockets were retrieving, photocopied and faxing to the contractor.

The net results of the above problems were the imposition of unnecessary administrative overheads, delays in payments to suppliers, inefficient distribution activity, and wasted sales time.

The technology landscape selected for the pilot was a web-based solution, as illustrated in Figure 6. The technology involved linking the ICT systems of the contractor and the supplier to the O₂ Instant Web Server, which was, in turn, networked to field handheld devices.

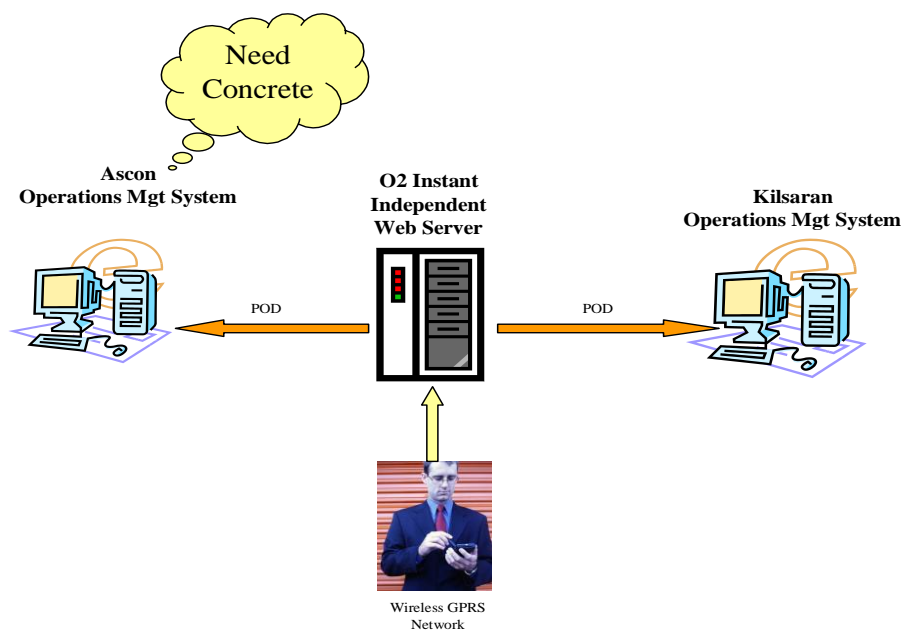


Figure 6. Technology landscape of Pilot for concrete supply (Hore and West, 2005b)

This ICT infrastructure 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, which was an important factor for the two parties. The technology simply allowed for the purchase order information to be uploaded onto a handheld device, via the O₂ Instant Web Server, which in turn

allowed for the electronic signature of the delivery information to be captured by way of a wireless connection to the O₂ Instant Web Server.

For the purposes of the pilot, an order was recorded on the supplier's ICT system in the normal manner. ePODs were captured on the handheld device and subsequently transmitted to the supplier's ICT system for invoice processing and to the contractor's system for inclusion in the purchase ledger. Once deliveries were reconciled against orders, downstream activities such as invoicing and payment processing should proceed smoothly.

It was decided at a very early stage to choose a supplier of bulk material, such as a ready-mixed concrete supplier, for the initial phase. The reason for this decision was to simplify the process so that the project team could concentrate on a proof of concept that the technology would operate efficiently in a construction site environment. For pragmatic purposes, it was also decided to allow the site administrator to retain possession of the handheld device in lieu of the driver or haulier of the material. There were a very large number of drivers who operated as sub-contractors to the concrete supplier, which would have proved difficult to manage and finance should they all possess individual handheld units. This did not affect, however, the principle being tested.

The pilot was also designed to minimise the impact on the resources of the contractor and the supplier. Therefore, the following measures ensured the least disruption to their business processes :

- Ensure that electronic POD operates alongside traditional paper-based process.
- Select a specific project.
- Ensure deliveries from a specific location or depot.
- Only nominated and trained staff were to use the system.

The case study site was the Ascon Eden Quay project in Dublin City Centre. The supplier, Kilsaran Concrete, dispatched deliveries from its Hanover Quay depot. Only one person in the contractor and the supplier companies were trained to use the system for the purposes of the pilot. The pilot study was carried out over six weeks during July and August 2004. During this time, 38 batches of ready-mixed concrete were delivered to site. The pilot team reported a 100% success rate in the receipt of the ePODs.

5. PILOT STUDY FEEDBACK

Feedback had been seen as a critical part of the pilot study, as it not only provided "lessons learnt" but also substantiated the credibility of the technology deployed in the first phase of the pilot. There were teething problems in using the technology. For example, the information initially displayed on the Personal Digital Assistant (PDA) screen did not provide the necessary degree of information regarding the materials delivered. Also, the persons signing the PDA were initially unclear as to what to write on the screen. This varied from unauthorised signatures, authorised signatures, unclear signatures, insertion of dates and insertion of quantities received. 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 in training personnel to use the technology.

The supplier representatives surveyed included the financial controller and the operations manager in Kilsaran Concrete Limited. Both individuals were satisfied that

the pilot objectives were realised and were agreement to progress to a further more fully integrated pilot study, in order to seek to achieve an electronic match of the purchase order, delivery docket and the supplier invoice. Both individuals also ranked the reduction of paperwork, avoidance of re-keying of information, elimination of errors and savings in manpower as the main drivers for their company partaking in the pilot. This result largely mirrored the feedback gained from the 2004 survey, which was discussed earlier.

The pilot study sought to capture the delivery information electronically and to provide the team with the confidence that the technological functionality was appropriate for construction. This pilot study provided the technological confidence that both parties required in the proof of delivery technology.

Many lessons however, have been learned from this pilot study, such as, the correct level of information is made available on the screen of the handheld device. The signatory should be aware of the product description and the quantity. In order to develop additional confidence in the technology, the contractor asked that a security pin number be used prior to the signature on the screen. This added layer of security will be introduced in the latter phase. During the pilot study, all ePOD information was routed back to the O₂ Instant website site. In order to view this ePOD, both the contractor and the supplier had to exit their respective ICT systems and log onto this website to view this information. This matter will be resolved in the latter phase, as the ePOD information will be routed back to the contractor's and the supplier's back-end ICT systems direct, thus creating an eGRN. It was not a practical suggestion to provide the supplier drivers with handheld devices. All of the ready-mixed concrete lorry drivers were subcontractors to the supplier and the supplier was unable to allocate drivers to particular sites. In order to reduce the costs of the pilot, it was decided that only one handheld would be used.

6. CONCLUSION

The pilot study is only part of the overall re-engineered solution. The 2004 pilot project showed that, by integrating handheld wireless technology and a web-based repository, that electronic proof of delivery is achievable for ready mixed concrete suppliers in the Irish construction industry. A number of constraints were identified as remaining in the pilot study, which will need to be explicitly dealt with in the latter phase. The first phase pilot provided the platform for the pilot team to move to a second phase, in order to achieve a three-way electronic match of the purchase order, delivery note and the supplier invoice.

The ePOD technology is a necessary ingredient of the fully integrated re-engineered solution devised by the author. The success of POD pilot study is a platform for the trading partners in which to move forward to the fully re-engineered process. There is a general awareness in the construction industry of the benefit of deploying readily, available technologies in improving purchasing process in construction. The reality however, is that in order to achieve these business benefits, the larger construction companies need to invest in ICT. Future research will need to show how the Irish construction supply chain can benefit overall from an industry wide solution. In order to achieve this closer collaboration is needed between the major players in the industry and longer term relationships are needed between supply chain organisations

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