

# ASSESSING THE POTENTIAL FOR CONSTRUCTION COLLABORATION TECHNOLOGIES (CCT) IN SMALL TO MEDIUM ENTERPRISES IN THE IRISH CONSTRUCTION INDUSTRY

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The problems associated with fragmentation of the construction process have been well documented. The adoption of Construction Collaboration Technologies (CCT) has been posited as a solution to the poor levels of communication and information exchange between parties in the construction process. From an Irish context, the potential benefits that CCT have to offer the construction industry are beginning to be realized. Indeed many of the leading stakeholders in the industry are now actively involved in the work of the Construction Information Technology Alliance (CITA) in seeking to improve the use of ICT, including CCT. The problems of fragmentation and resulting levels of poor communication and information exchange are not however, limited to the larger organizations. There is a distinct lack of empirical research into the possibilities for the adoption of CCT within small to medium enterprises (SMEs) involved in project management roles in Ireland and elsewhere. This paper reports upon ongoing research, the aim of which is to assess the potential use of CCT in SME project management organizations. The main focus of the paper is a review of literature pertaining to CCT, specifically in the context of SMEs in the Irish construction industry, and outline the proposed future research. This research will focus on an in-depth case study of a current construction project in Ireland where the lead project management responsibility and associated activities are being carried out by an SME without the use of CCT. This study will include structured interviews with the relevant staff in the project management SME and also with the other SME stakeholder organizations involved in the project. Each interview will include reference to their current use of ICT, their potential for adopting CCT and barriers to such adoption. It is expected that a key outcome of the research shall be a proposed framework for the implementation of CCT in SMEs engaged in construction project management.

Keywords: collaboration technologies, Irish construction industry, project management, SMEs.

## INTRODUCTION

Information and Communication Technologies (ICT) has changed nearly every aspect of the economy, fuelling several paradigm shifts in business management except in the construction sector (Dulaimi *et al.*, 2004). The evolution of ICT has led to widespread informal ICT use in the construction industry (e.g. e-mail, mobile phone) but, as of yet, limited use of it for formal communication and business management (Rowlinson and Croker 2006). It has been documented that two-thirds of problems on

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a construction project are caused by inadequate communication and exchange of information between the construction project team members (Cornick 1990, Evbuomwan and Anumba, 1997). The adoption of Construction Collaboration Technologies (CCT) have been posited as solutions to the poor levels of communication and information exchange between parties to the construction process.

From an Irish context, the potential benefits that ICT have to offer the construction industry are beginning to be realized. Many of the leading stakeholders in the Irish construction industry are now actively involved in the work of the Construction Information Technology Alliance (CITA) in seeking to improve the use of ICT. The problems of fragmentation and resulting levels of poor communication and information exchange are not however limited to larger organizations. There is a distinct lack of empirical research into the possibilities for the adoption of ICT systems within small to medium enterprises (SMEs) involved in project management roles.

## THE IRISH CONSTRUCTION INDUSTRY

Ireland is now into its thirteenth year of exceptionally strong growth, broadly in line with or, at times, slightly above its long-run potential growth rate of about 4.5 to 5 per cent per annum (Davy 2006). Forecasted growth is to remain strong in 2007 with GNP and GDP growth of 5.75% and 5.5 %, respectively.

The construction industry is a key indicator and driver of this economic activity and wealth creation in the Irish economy. It is one of the most important sectors in any developed country, for Ireland this is certainly true with total construction output in 2006 at €36.5bn, equivalent to 24% of GNP. This represented a 10.3% increase over 2005 and provides further evidence of the sector's influence on the country's economy. In 2007, growth in the construction sector *"is likely to be more muted at 4.2% and forecasted at 1.3% in 2008, reflecting the changing proportions of construction activity in the economy"* (CIF, 2006).

In 2006 the construction industry directly employed approximately 281,600 (CSO, 2006). The National Workplace Strategy indicates that 96,900 and 93,500 construction employees are employed in enterprises of sizes of 0-9 or 10+ respectively. This indicates that approximately 64 per cent of the Irish Construction Industry enterprises fall under the categories of micro or small enterprises.

Highlighting the fact that innovation and research in SMEs can have a huge effect on the industry. The construction industry is almost unique in its dependence on SMEs who own most of the skills and knowledge but cannot afford to invest individually into research and development (R&D).

In March 2007, Prof Eamonn Murphy of University of Limerick said the future competitiveness of Irish SMEs would be determined by the amount of resources they invested in R&D; *"SMEs must innovate or die"* (The Irish Times, 2007). However, traditionally the Irish construction industry at best has a low level of research and development. Table 1 below summarizes the overall statistics for gross expenditure on R&D (GERD) as a percentage of GDP / GNP for Ireland and selected countries in 2006. It illustrates the well-documented fact that R&D in Ireland is below both the EU 25<sup>(1)</sup> and the OECD <sup>(2)</sup> averages for R&D investment. This highlights the fact that if Ireland is to be a skilled knowledge based economy in the future it needs to invest heavy in R&D throughout the economic sectors, including construction and SMEs.

**Table 1:** Gross Expenditure on R&D as a percentage of GDP / GNP, 2006 (Forfas, 2006)

<b>Country:</b>	<b>% of GDP/GNP in 2006</b>
Sweden	3.86
Finland	3.51
United States	2.68
OECD average	2.25
Netherlands	1.78
EU 25 average	1.77
United Kingdom	1.73
Ireland (GNP)	1.56
Portugal	0.81

If Ireland is to be a knowledge based economy, the innovation and effective use of ICT is a fundamental feature of knowledge based economies and considered to be an important driver of current and future productivity improvements (Eurostat, 2006). Table 2 below illustrates IT and telecommunication expenditures as a percentage of GDP, 2004 and comparable figures for EU-25 and other leading countries. In 2004, Ireland's expenditure in these areas was below the EU-25 average which highlights the well-documented fact that Ireland's ICT infrastructure is behind that of other European countries. This disappointing statistic is a restriction to economic development including that of the Irish construction industry and its SMEs.

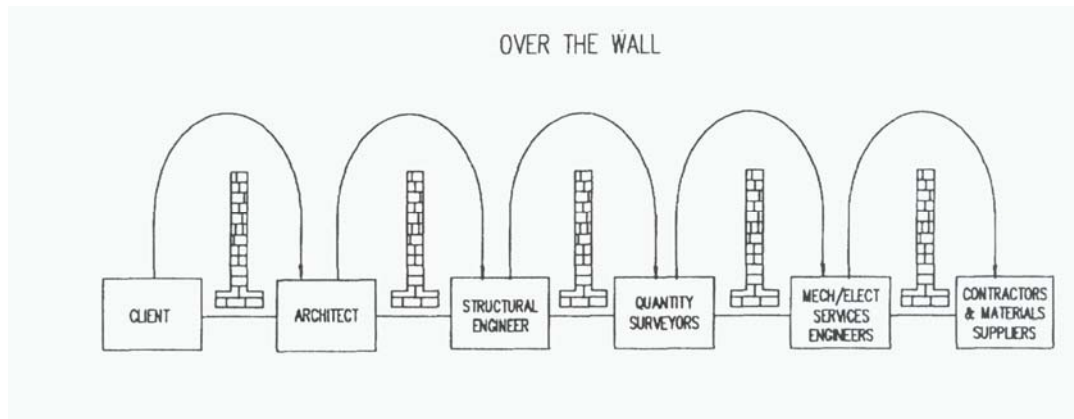
**Table 2:** IT and Telecommunications Expenditure, (Eurostat, 2006)

<b>Country:</b>	<b>IT Expenditure % of GDP in 2004</b>	<b>Telecommunications Expenditure % of GDP in 2004</b>
EU-25	3	3.4
Germany	3.1	3.1
Ireland	2.1	3.3
Finland	3.7	3.4
Sweden	4.3	4.2
United Kingdom	4.1	3.7
United States	4.6	3.1

## CONSTRUCTION, COLLABORATION AND SMES

*“Collaboration is a creative process undertaken by two or more interested individuals, sharing their collective skills, expertise, understanding and knowledge in an atmosphere of openness, honest, trust and mutual respect, to jointly deliver the best solution that meets their common goal.”*  
(Wilkinson 2005:3)

Traditionally, the construction industry is characterized by dynamic partnerships between different disciplines from different organizations. The industry is almost unique in its dependence on SMEs to communicate successfully between the disciplines; this is a critical success factor to any project (van Nederveen and Tolman, 2001). The problems associated with this fragmentation of the construction process have been well documented in the past. This fragmentation of the various functional disciplines communicating and exchanging specialized information at different times and locations along a supply chain approach has been referred to as the ‘over the wall syndrome’, see Figure 1 (Evbuomwan and Anumba, 1997). Although the increased use of ICT in the industry in recent years has changed some aspects of collaboration, in many cases the traditional method of distributing and receiving information alluded to in Figure 1 is still common practice in today's industry.



**Figure 1:** Over the Wall Syndrome (Evbuomwan and Anumba, 1997)

This lack of change among certain stakeholders in the industry, many of whom are SMEs, contrasts with research which identifies that ICT when used properly can improve the exchange and communication of information (Christiansson P, 2004 and Christiansson *et al.*, 2002). It is the construction industry's acknowledgement of the fact that it is not just important to encourage product innovation and research but also innovation and research in management systems that is leaning itself to the transformation of the industry to a knowledge driven industry. Such management systems would open the industry up to considerable improvements, (Miyatake and Kangari, 1993) reduce the administration burden (Mitev *et al.* 1996; Anumba and Duke 1997; Deng *et al.* 2001) and benefit the project life cycle in terms of time, cost and quality (Bouchlaghem, Kimmance and Anumba, 2004).

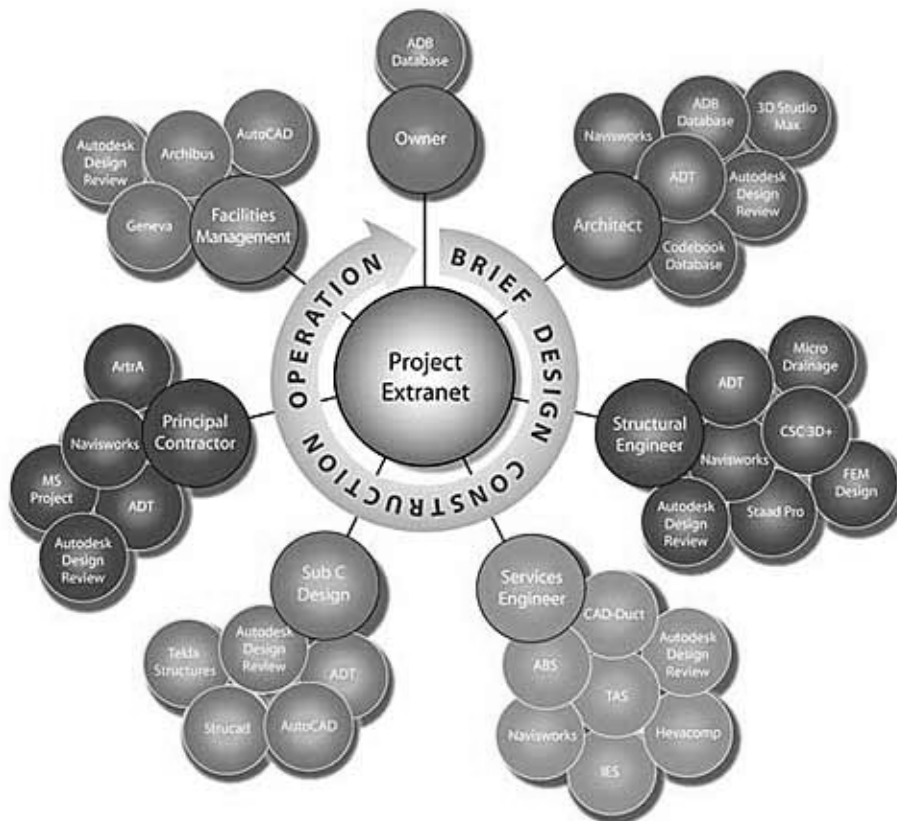
This transformation from the traditional method to a more modern approach of exchanging information and communication (Construction Collaboration Technologies – CCT) in construction processes could open up opportunities for construction business to operate more productively, with greater profits and a possibility of operating on a global basis.

## **CONSTRUCTION COLLABORATION TECHNOLOGIES (CCT)**

A number of national and international organizations have been established over the past 10 to 15 years to address the need for improved use of ICT (including CCT) in the construction industry. The Network for Construction Collaboration Technology Providers (NCCTP) was established in December 2003 with the specific mission “*to promote the benefits and use of collaborative technology in the construction and related industries*”. It should be noted that the CCT provided by the NCCTP member organizations are often referred to as Project Extranets but in reality they are a “*combination of technologies that together create a single shared interface between multiple participants*” (Wilkinson, 2005:7). The NCCTP (2006) identify that the industry “*is highly dependent on information*” and that “*successful projects require timely exchange of the latest and most accurate information between project team members – the right information needs to go in the right form to the right person at the right time.*” Not only does this statement apply to the leading and larger organizations in the construction industry, but also the vast number of SMEs.

The primary objective of CCT is to replace the traditional cumbersome and primarily paper-based exchange of information and communication system. Traditional administration systems meant that for every document issued, there is a need to copy,

whether in part or whole, that document for circulation through a supply chain for exchange of information, action, comment, review or contractual obligations. CCT can potentially eliminate this administrative burden and financial cost to benefit the project. This is achieved by developing a process whereby all documentation in a project is digital, so as it can be centrally stored in a secure repository provided by a CCT supplier (e.g. Aconex, 4Projects, Sarcophagus). The CCT or Project Extranet allows authorized members of the project team to access information when required and also circulate information to all project team members online – see Figure 2 below.



**Figure 2:** Collaborative Communication (Gonchar, 2007)

A recent survey (NCCTP, 2006) that consisted of 272 telephone interviews with end users of CCT concluded that “96% of people that have made use of CCT are happy that it has benefited their business and that they are likely to re-use the technology on future projects”. Although these results are both impressive and encouraging for the industry, the extent of SME involvement in this survey, and indeed the extent of SMEs using CCT in general, are not clear.

## PROPOSED RESEARCH

To the overall aim of the proposed research is as “to assess the potential for CCT use by SMEs involved in the Irish construction industry.”

Prior to carrying)( out the primary research, a more detailed review of the relevant literature will be completed. This review will not only reflect on the issues relating to the use of CCT in the construction industry, but in particular how these issues are further compounded by the more specific context of SMEs. The primary research

element will focus on an in-depth case study of a current construction project in Ireland where the lead project management responsibility and associated activities are being carried out by an SME without the use of CCT.

This study will include structured interviews with the relevant staff in the project management SME and also with the other SME stakeholder organizations involved in the project. Each interview will include reference to their current use of ICT, their potential for adopting CCT and barriers to such adoption.

The underlying hypothesis to this research study is as follows:

*“The communication between SMEs in the Irish construction industry can be significantly improved by the proper use of construction collaboration technologies (CCT).”*

## **EXPECTED OUTCOMES**

It is expected that a key outcome of the research shall be a proposed framework for the implementation of CCT in SMEs engaged in construction project management. While the study will be carried out in Ireland, the results and the proposed framework should be useful to construction industries in other countries, all of which contain significant numbers of SME organizations.

## **REFERENCES**

- Anumba, C.J. and Duke, A. (1997): ‘Internet and Intranet usage in communications infrastructure for virtual construction project teams’. Proceedings of the Sixth IEEE workshops on Enabling Technologies: Infrastructure for Collaborative Enterprises, Massachusetts, USA, Cambridge. 56-61 .
- Bouchlaghem, D. Kimmance, A.G. Anumba, C.J. (2004) ‘Integrating product and process information in the construction sector’ *Industrial Management and Data Systems*, 104 (3), 218-233.
- Christiansson, P. (2004) ‘ICT supported learning prospects (editorial)’, *ITcon Vol. 9, Special Issue ICT Supported Learning in Architecture and Civil Engineering*, 175-194.
- CIF, (2006), ‘Construction activity report autumn 2006’, October 2006.
- Cornick, T. (1990) ‘Quality Management for building design’ Butterworth Architecture Management Guides, Butterworth, New York.
- Davy, Kelleher, R. (2006), ‘Update on the Irish Economy / Equity Market’, October 2006 .
- Deng, Z.M. Li, H. Tam, C.M. Shen, Q.P. Love P.E.D. (2001) ‘An application of the Internet-based project management system’ *Automation in Construction*, 10, 239-246.
- Dulaimi, M, Ling, F. and Ofori, G. (2004) ‘Engines for change in Singapore’s construction industry: an industry view of Singapore’s Construction 21 report’, *Building and Environment*, 39, 699-711.
- Eurostat: European Statistics Office, (2006) ‘Key figures on Europe: Statistical Pocket book 2006’.
- Evbuomwan, N.F.O. and Anumba, C.J. (1997) ‘An integrated framework for concurrent lifecycle design and construction’ *Advances in Engineering Software*, 29(7-9), 587-597.
- Gonchar J. (2006) ‘Transformative Tools Start to Take Hold’, *Architectural Record*, US [archrecord.construction.com/CE/archives/0704edit-2.asp](http://archrecord.construction.com/CE/archives/0704edit-2.asp).

- Kajewski, S., Mohamed, S., Tilley, P., Crawford, J., Chen, S., Lenard, D., Brewer, G., Gameson, R., Kolomy, R., Martins, R., Sher. W., Weippert. A., Caldwell. G. and Hung. M. (2001) 'A Brief Synopsis in the Use of ICT and ICPM in the Construction Industry' Report Nr. 2001-008-C-02, Queensland University of Technology.
- Mitev, N.V., Wilson, F.A. and Wood-Harper, A.T. (1996) 'An information system model for concurrent construction project partnership environments' *The Organization and Management of Construction: Shaping theory and practice*. Langford D.A. and A. Retik 3, 226-235.
- Miyatake, Y. and Kangari, R. (1993) 'Experiencing computer integrated construction' *Journal of Construction Engineering and Management*, ASCE, 119(2), 307-322.
- NCCTP (2006) *Proving Collaboration Pays – Study Report*, NCCTP, [www.ncctp.net](http://www.ncctp.net) .
- Rowlinson, S. and Croker, N. (2006) 'IT sophistication, performance and progress towards formal electronic communication in the Hong Kong construction industry', *Engineering, Construction and Architectural Management*, 13(2), 154-170 .
- The Irish Times, (2007) 'Call on small firms to innovate' March 10th, 16.
- Van Nederveen, S. and Tolman, F. (2001) 'Neutral Object Tree Support For Inter-Discipline Communication In Large-Scale Construction', *ITCON* 6, 35-44.
- Wilkinson, P. (2005) *Construction Collaboration Technologies: The extranet revolution*, Taylor & Francis, UK.