INFORMATION TECHNOLOGY AND SUPPORT SYSTEMS: HOW DO SMES APPROACH THEIR IMPLEMENTATION?

Allan S. Douglas¹ David J. Greenwood² and David W. Wainwright³

¹,² School of the Built Environment, Northumbria University, Ellison Building, Newcastle upon Tyne, NE1 8ST, UK
³ School of Computing, Engineering & Information Sciences, Northumbria University, Pandon Building Camden Street, Newcastle upon Tyne, NE2 1XE, UK

Small and Medium Enterprises (SMEs) within the Construction Industry are not very innovative or active in terms of developing, implementing, adopting and diffusing new information and communications technologies. Any research to date has mainly focused on, and benefited, large construction enterprises who are developing complex distributed computer systems for co-ordination and management of project activities across diverse geographical locations. However, SMEs also need systems that co-ordinate and manage activities across different locations. Building sites tend not to be side by side. But SMEs, due to their very nature, need to see any new system’s added value to existing manual systems before making any commitment to bring in new technology. The only way to measure added value is to know what value the existing systems have. Again, there is little meaningful writing in this field as most studies need to have a high level of confidentiality. This paper highlights some of the real issues facing SMEs in their pursuit of systems that add value. Human and financial resources, time, previous experience and relationships, both formal and informal, all weave an intricate pattern that dictate SMEs approach to IT implementation. The issues highlighted are based upon an Action Research-based case study currently underway in a SME in the construction industry.

Keywords: information management, information technology, management information systems, research methods, SMEs.

INTRODUCTION

The work reported in this paper is part of a research project that is monitoring the attempts of a construction SME to adopt an ICT-based Management Information System (MIS). In keeping with an action-research approach the researchers are confronted with a hybrid: a project-within-a-project. First there is the 'practical' desire of the SME to adopt the new system and within this lies the 'academic' project that is involved with monitoring, interpreting, analysing, discussing and generalising from the experience. The thrust of the academic part of the project is to exploit the rich and plentiful evidence that comes from the immersion of the researcher and to explore ICT adoption by Construction SMEs in general. The remit of this paper however, is narrower, as the work is in its early stages. Its aim is to review some previous studies of ICT-uptake in SMEs and compare their findings with results regarding adoption that are emerging from the present project.

¹ a.douglas@unn.ac.uk
ICT, SMES AND THE CONSTRUCTION INDUSTRY

In terms of their numbers at least, SMEs constitute the most important section of the national economy with over 90% of companies in the U.K. employing less than 250 people. Whilst the adoption of Information and Communication Technology (ICT) is seen as a key to the modern corporate goals of innovation, agility, knowledge management, e-business and organisational learning, managing its adoption can be problematic in smaller organisations, which do not have large budgets or the time to invest in appropriate resources. In the Construction Industry, in particular, where the proportion of SMEs is so high, there are problems related to adopting ICT innovations. Most companies simply do not do it.

Brock (2000) found that comparatively little research exists in the area of ICT within small business (as opposed to large organisations). In the SME context, he cites major concerns including; the importance of the unavailability of internal IT skills, that top management support is moderated by the owner-manager relationship and centralised decision making, lack of user participation and, in many cases, a total reliance on the external support of IT vendors and consultants. Most small firms restrict IT usage to administrative tasks; mainly their accounts. Brock (2000) concludes by stating that there is a crucial need to develop internal ICT knowledge, skills and consequences (both owners’ and employees’) and not to have total reliance on external vendors. This must be combined with better user-training and greater participation in the adoption and implementation process.

Research into the strategic and operational management of ICT within SMEs is also surprisingly under-developed (Cragg 2002). Innovation and agility within organisations are increasingly cited as desired core competences which often depend on effective and creative use of ICT (Fraser et al. 2003). This is an area of developing research which focuses on people, organisation and culture as the important variables that enable or inhibit effective ICT adoption, implementation and use. More rigorous research studies such as that undertaken by Caldeira and Ward (2003) utilise in-depth case study research methods. Caldeira and Ward studied twelve Portuguese manufacturing SMEs to consider how resource-based theory could be used to explain success with the adoption and use of ICT. They used the concept of core competences which involves viewing the assets and resources of a firm from a knowledge-based perspective. This is combined with a framework comprised of four dimensions: internal context, external context, process and content. These key determinant factors are linked to 3 sets of associated skills and competences; technical IS/IT skills, managerial IS/IT skills and business and general management skills.

This links more generally with research into the strategic management practices of small firms. Stonehouse and Pemberton (2002), in their survey of over one-hundred and fifty SMEs, found that the main method of business planning in use within small firms was internal financial analysis. There was little evidence of any other methods, techniques or practices associated with strategic planning (including ICT). This is despite a lot of research evidence suggesting a strong positive relationship between overall performance of SMEs and the degree of long term planning undertaken.

Southern and Tilley (2000) also comment on the dearth of research on small firm adoption of ICT, despite its fundamental importance to the global economy and major government policy initiatives. They state that a common cause of problems is the lack of understanding of small firm context and culture: many approaches attempt to apply standard IT management methods, systems analysis and development techniques
within a context for which they were not originally designed. Such technologically
deterministic approaches may be inapplicable to loose and unstructured organisations
where there are low levels of IT skills and experience and which are highly centralised
in terms of decision making – usually with power vested in the owner-manager. There
is evidence that the managers of smaller firms are more concerned with operational
issues than the managers of larger organisations (see, for example, Rivard, et al.1988):
intuitively, this is quite understandable.

The issues and problems highlighted in this general research on ICT adoption,
implementation and use in SMEs are further amplified by studies carried-out in a
construction-specific context. Aranda-Mena and Stewart (2004) in their review of the
Australian Construction industry found that adoption of e-business technologies
significantly lagged behind other service and product industries. This was due to
impediments that were emphasised by the particular nature of construction. Twenty-
three such ‘impediments’ were identified and these related to specific organisational
types and cultures associated with construction SMEs. They included: privacy, trust,
uncertainty of financial returns, lack of reliable measurement, fraud, and lack of
support and systems maintenance. Löfgren (2007) also investigated e-business
technology adoption focusing on mobile computing in the Construction Industry. His
findings also supported the case that in the Construction Industry, despite massive
efforts to improve processes with ICT, firms have not increased productivity to the
same extent as other business fields. The use of ICT by contractors and site workers is
seen as surprisingly low.

To summarise: the literature on SMEs generally and Construction SMEs specifically,
indicates that there are significant problems associated with the management,
adoption, implementation and use of ICT. These are associated with the culture,
context and operational practices of small businesses – especially those with a strong
owner-manager structure. New levels of ICT user knowledge, skills, competencies
and technical support linked to the introduction of new production practices are
essential for successful business transformation.

METHODOLOGY

The present study forms part of an EPSRC CASE studentship whose aim is explore
models for ICT adoption within Construction SMEs. The vehicle for the study is a
construction company with thirty employees based in the Northeast of England. The
researcher has been partly based in the company for the duration of the project to-date,
and is involved with the company’s attempts to adopt an electronic document control
and management information system. This involves operational meetings, informal
and formal interviews as well as diary entries. In view of the particular circumstances
an ‘action research’ approach was considered to be the most appropriate for the
situation within an overall qualitative and interpretivist research-based inquiry.

Action Research method

Action Research (AR) as an approach, attempts to find ways of eliminating the gap
452) states that AR is a method based upon ‘a collaborative problem-solving
relationship between researcher and client, which aims at both solving a problem and
generating new knowledge.’ This emphasises the strong relationship between the
researcher and the practitioner. It is fundamentally different from, as an extreme,
laboratory research, where the interaction between researcher and researched is rigorously minimised by careful design.

Figure 1: The Action-reflection Cycle (NcNiff & Whitehead 2006)

AR involves the community throughout the project and is often driven by an issue from the community itself. It is a method that can be driven by a group of people requiring change whilst working with a researcher to focus on a solution to the problem. Indeed, it actually ‘favours consensual and participatory procedures that enable people (a) to investigate systematically their problems and issues, (b) to formulate powerful and sophisticated accounts of their situations, and (c) to devise plans to deal with the problems at hand’(Curry 2005: p.2). Somewhat confusingly, practitioners may use different terms to describe it: AR is also referred to as Participatory Action Research, Participatory Research, Participatory Evaluation, Emancipatory Action Research, Action Science, Action Learning, Action Inquiry, Mutual Inquiry and Empowerment Evaluation. (Whitehead et al. 2003: p.7).

However, within these definitions, there are four basic themes: empowerment of participants; collaboration through participation; acquisition of knowledge; and social/organisational change.

THE CASE STUDY BACKGROUND

The name SMEcon has been adopted to retain the anonymity of the real company. Extracts from the company’s former and current websites remain unreferenced for the same reason.

The construction company SMEcon has thirty employees (this varies slightly, depending upon current projects) with its head office in an industrial estate in the Northeast of England. The company provides ‘professional services to the construction and property industries … [and works] …. with individuals, companies and organisations, providing a complete service’ [original website]. They conceive the ‘Property Cycle’ being split five sections; Develop, Design, Build, Maintain and Manage, and each of these ‘divisions’ can stand alone as a service or be combined in a manner that suits the client. The three owner-directors of the company each has around 20 years’ experience in the industry and they formerly operated as the regional management team of a major national construction and property company. They describe themselves as having ‘a wealth of experience in managing a successful regional business for a major multi-national organisation.’ However, ‘the team decided to rid itself of the shackles of the plc to concentrate on using its skills and experience for the direct benefit for the people who really matter – employees and customers!’ [original website]. Their feeling was that large companies can’t change quickly enough to suit client demands and other industry developments due to
bureaucracy, complex reporting mechanisms and a ‘lack of direct contact’ with the clients, suppliers and other stakeholders [Interview with Commercial Director, 19/03/07].

The company’s structure is based upon a framework that was introduced to the team in the late 1990s. This framework, along with their individual and group experiences, gave them a clear goal as to the direction the company would go along with a clear method of accomplishing this. They are committed to the ‘change agendas’ of Latham (1994) and Egan (1998), as well as other more recent developments, to adopt a new way of working within the construction industry. They feel that this should give them a real competitive advantage in the industry. [Interview with Commercial Director, 19/03/07]. These changes include the implementation of a co-ordinated project information system, quality-based tendering, committed leadership, a focus on the customer, integrated processes / teams, a quality driven agenda and commitment to people. The company policy is described as providing ‘maximum value for money to customers by combining a relaxed, friendly and flexible approach with a wealth of experience, expertise and professionalism. Our approach is to work closely with our customers to fully understand their requirements, aspirations and priorities. Information is openly shared and we encourage customers to pass responsibility to us to manage their property and construction projects, using our in-house experience and expertise.’ [original website].

The company's use of technology has been limited to date. They currently use the ubiquitous laptops/desktops with Microsoft operating and Office systems and a few specialist software packages: Asta PowerProject, AutoCAD and Sage Accounts. There has been little or no formal training in any of these systems to date.

THE RESEARCH ‘PROBLEM’

As noted above, Action Research (AR) is about problem-solving through a collaborative relationship between the researcher and client. The ‘problem’ here is two-fold. First is the academic goal of the CASE PhD; to contribute to theoretical understanding of ICT adoption and implementation issues in Construction SMEs. The second, more pragmatic goal, involves the desire by the client, SMEcon, to support its radical business aims with the development of a modern Management Information System. The company needs information to be: readily available; in a useful format; to all that are involved; and, in a timely manner. The main purpose of the Action Research study is to begin by creating a robust new paper-based system with a view to developing it into an ICT-based system with the ability to use the incumbent systems available. Fundamental to this is the company’s adoption, implementation and use of ICT.

ICT ADOPTION ISSUES

There are many issues that can influence and affect the adoption of ICT in SMEs in particular, some briefly mentioned earlier. These include:

- Internal organisation knowledge and experience of ICT vs. External ICT resource suppliers,
- SME resources vs. Large firms' resources,
- SME business planning informed by financial measures,
- The basic understanding of SMEs and their work practices,
- Operational management approaches vs. Strategic management approaches
This paper will briefly discuss three of those listed; ICT Knowledge, Resources and Communications, bringing them together into the overall usefulness of ICT.

ICT Knowledge
The WestFocus Project Team (2006) makes some observations on specific matters relating to ICT expertise. They state that many SMEs find themselves in a difficult situation as they may not be large enough to afford to employ a dedicated ICT expert, or may lack the money even to buy advice. This, allied to their lack of experience, which in turn leads to a lack of confidence in the reliability of the advice given, exacerbates the situation that arises from their limited experience in selecting, implementing and evaluating suggested ICT solutions. Indeed, SMEcon has relied upon the research project, and in particular the researcher, as a resource for meeting some of its ICT aspirations.

Resources
The next issue to be discussed is that larger firms have dedicated ICT resources, internal or external, and existing procurement processes. This is not the case in SMEs and “the deployment of ICT typically depends on a single individual with vision who takes full responsibility for ICT initiatives, as well as continuing with their regular activities. They often have to rely on their own self-taught expertise and feel ill-equipped to carry out the implementation tasks required of them. They make little use of the formal methods of ICT, project management, or evaluation.” (WestFocus Project Team 2006: p2). In SMEcon, one person is the driving force behind the overall project and the idea of bringing in a researcher to aid the project and take an academic view of actual processes. It has also been observed that this person does not have a deep IT understanding and does not have the knowledge or experience to deal with some of the more technical issues that arise in such a project.

Communications
The third issue involves mobile communications. As the Construction industry is often characterised by a central 'management structure' with remote sites, the use of mobile technology is a key factor in any successful implementation.

Löfgren's work in Sweden and the USA in 2007 on available technologies and their use gives very useful insights to issues that may affect the author's current project. Construction projects are, as all projects including ICT, dependent on reliable and updated information through a number systems and communication tools. Currently SMEcon use some laptops (limited by connectivity and training issues), facsimile machines and mobile phones. As there is a need for quick access to necessary information on sites, management personnel have to physically run back and forth between the construction site and computer access at the office. "This leads to inefficient use of managerial resources due to that the production management team is occupied at their computers a large part of their working hours." (Löfgren 2007: 2) Also, most of the available 'project oriented ICT tools' are meant for office use. These tools only give modest support to the mobile environment that the site personnel work in.

Summary - Overall usefulness.
Apart from the infrastructure required for 'site-based ICT, such as broadband connection, etc, is the notion of usefulness. This must not be confused with ease-of-
use of any system. Usefulness includes both utility and usability aspects and is about making the technology fit the organisation, activities and routines (as shown in Fig. 2).

**Figure 2: Cause and effects of system usefulness (Löfgren 2007:7)**

The involvement of the end-users in technical development and the implementation process was seen as critical for achieving long term usefulness of mobile computing tools for the mobile workforce out in the field according to Löfgren (2007).

Löfgren went on to highlight four key points to be investigated in any future research:

- "A bottom-up technology pull process where the end-users are strongly influencing the technological configuration and its areas of use.
- Authorisation and encouragement from top corporate management, including global coordination connecting the pilot projects together for experience sharing.
- A strong focus on usefulness and its resulting benefit of the technology for the mobile workforce in the field.
- An overall development process that is more characterised by trial and error than a linear accumulation of incremental improvements. This learning by trying development is a social collaborative process in the search of improved understanding of how to get the technology to fit the dynamic and mobile construction work environment." (Löfgren 2007:10)

These issues are very relevant to the current study in SMEcon. For example, some of the building sites are so remote that the mobile phone carriers do not guarantee service. This is a huge problem if the organisation is to implement a web-based system. The notion of 'trial and error' through 'a social collaborative process' is currently underway in SMEcon.

**CONCLUSIONS**

The literature shows a common consensus, that SMEs, despite accounting for over half of UK employment and company turnover (and well over that proportion in terms of firms' population) nevertheless command very little research attention in terms of their ICT uptake. The importance is noted in the literature of an individual that drives innovation in ICT take-up. This has been clearly borne-out by the case study to date. However, that individual is not necessarily sufficiently 'au fait' with the technology to ensure the correct decisions as to its use. He/she relies heavily on personal recommendations, even (in the case of SMEcon mentioned earlier) where the recommendation comes from a contact whose own performance has been less than satisfactory.

Another area of concern involves how project management achieves the flexibility of organisation and method of work needed to enable the project members to handle the
many unexpected situations. "Can a project organisation and method of work be
designed that would support a combination of real-time, interactive, ICT-supported
problem-solving and strict, quality-assured information deliveries?" (Wikforss &
Löfgren 2007:343)

Designing mobile ICT involves giving people the same possibilities in the field as
they would have at their 'bases'. This view on mobility poses some challenges in
understanding what ICT is supposed to deliver in various job settings, as well as
appropriate system design and use of the technology for different mobile work
contexts. The usefulness of the technology and system is also key as it covers both
utility and usability aspects and is about making the technology fit the organisation,
activities and routines. The socio-technical gap of what is required socially within a
work group and what can be done technically is important. The introduction of new
ICT systems must not deteriorate and distort the working collaboration process and
social interaction. For implementation management, collaboration, communication
and feedback between users, researchers and developers are often critical in achieving
the proper fit between technology, organization and users.

The opportunity to engage with a single company in such depth has been welcome,
though it necessarily precludes a wider study at this stage. The authors' future research
will be focused on prototyping an intranet system that integrates with a Management
Information System focused upon SMEcon's requirements. The academic part of the
CASE PhD will evaluate adoption and implementation models in SMEs and evaluate
them within the research field. In order to aid the contribution to theoretical
understanding of ICT adoption and implementation issues in Construction SMEs. The
design of the necessary codification as well as the organisation of data to create
generalisable issues that can be modelled and checked will also be undertaken. To
complete the AR cycles in SMEcon, structured and semi-structured feedback will be
investigates once issues have been identified in order to check initial model design.

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