

Mobile ICT support for construction process improvement

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Abstract

This paper brings together the visions for information and communications technologies (ICT) in construction and the changing requirements of the construction industry. Drawing on case studies, previous research and future scenarios outlined by research road mapping projects, it illustrates how the areas identified as having potential for improvement can be addressed through the use of mobile IT. This vision is then developed into a scenario for communicating to industry professionals the construction site of the future. Their feedback on this scenario is used to assess the viability of the research propositions within mainstream construction. Finally, the paper examines the implications for the construction industry should the vision for the future be adopted; the potential for new islands of automation; the effects on our human resources; and the potential impact on knowledge management initiatives.

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1. Introduction

Global economic competition has compelled many organisations to explore all possible options for improving the delivery of their products or services [1]. This trend has also become apparent in the construction industry, with clients expecting a better service and projects that meet their requirements more closely. This has challenged the industry to become more efficient, integrated and more attractive, both in the eyes of society and its potential workforce. In response, government, industry or research-led construction change initiatives have emerged in most developed countries [2].

In parallel with, and to serve, these initiatives there has been a concerted effort, within the research and academic sector, to explore and implement existing and emerging information technologies that facilitate the improvements required to modernise the construction industry.

Progress has been driven by a combination of technology push and demand pull. Several authors have argued that construction typically lags behind other industries in its use of IT and hence one could deduce that the primary driver is

technology push. However, more recently many would argue that the reason the construction industry has been slow to adopt new technologies is that they have not yet been developed to suit the needs of the industry, hence there is a strong demand pull which is yet to be satisfied. For example, it is relatively easy to implement new technologies in a manufacturing production line where it is a clean, stable environment and the work travels to the worker. However, on a construction site the worker has to travel to the work and take the technology with him/her and is subject to the natural elements.

The continuing development of affordable mobile technologies such as handheld computers, SmartPhones and Tablet PCs alongside the latest generation communications infrastructure (3G, WLAN and GPRS) could provide the ‘last mile’; connection to the point-of activity and hence provide the missing link to help address the ongoing drive for process improvement and re-valuing construction.

2. What needs to change?

The construction change initiatives have all set out a vision of where the industry should head to. Some have set specific targets; for example, Rethinking Construction [3] and US National Construction Goals [4]. Others have simply defined

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the way they want to work in broader terms, for example, through integrating the supply chain, industrialisation of the building process and increased technological innovation and use of ICT [5–7]. Sought after improvements, common to most of the initiatives, include:

- reduction in construction time;
- reduction in capital cost of construction;
- reduction in defects;
- reduction in accidents;
- increase in predictability;
- reduction in waste;
- increase in productivity;
- reduction in operation and maintenance costs.

3. ICT road mapping initiatives

In recent years there have been several road mapping projects that have set out to determine how ICT could influence the future of the construction industry. These visions have been formulated taking account of industrial requirements and the opportunities offered by evolving ICT. This section provides an overview of several of these initiatives which made reference to the application of mobile technologies.

3.1. CIB W78

Information technology has become a major research topic in the construction industry for the last 20 to 30 years. In 1983, the International Council for Research and Innovation in Building and Construction, also known as the CIB, formed the W78 Working Commission focusing initially on computer aided design. This has now been broadened to IT in Construction. The W78 work programme commissioned three related activities: a review of W78 work to date [8]; a short to medium term vision for construction IT [9]; and a longer term research agenda examining the future IT support required for construction projects [10].

The three main themes covered in W78 conferences have been: computer-integrated construction; IT supported process improvement; and decision support knowledge based systems and artificial intelligence. The conference programmes in 2002 and 2003 included papers on the use of Mobile IT.

Sarshar et al. [9] conducted a literature review supplemented by academic and industry workshops. This resulted in the formulation of seven themes describing their vision for construction IT 2005–2010:

- model driven, as opposed to document driven, information management on projects;
- life cycle thinking and seamless transition of information and processes between life cycle phases;
- use of past project knowledge (/information) in new developments;
- dramatic changes in procurement philosophies, as a result of the Internet;

- improved communications at all life cycle phases, through visualisation;
- increased opportunities for simulation and what-if analysis;
- increased capabilities for change management and process improvement.

These themes were then used to shape a scenario around the phases of a construction life cycle; conception of need; tendering and team selection; design and briefing; construction and facilities management. Example uses of mobile technologies highlighted were:

- *Buildability*-staff can use 3rd generation mobile phones and visualisation to zoom into different areas of buildings and check how to assemble components;
- *Material delivery and tracking*-Auto-ID tags will be a prominent technology for tracking material movement;
- *Progress monitoring and programming*-as construction progresses, staff update the programming information. Any problems or changes are recorded on the model. This will allow virtual progress monitoring;
- *As-built information*-if the design is changed, due to last minute considerations, as-built information can be captured and handed over to the client.

Froese's [10] survey of academia and industry concluded that the overriding role of IT will be to provide ready access to all information at all times, and to support much richer forms of communication and information sharing. The respondents indicated that they expected that the types of computers they would be using in 2020 would be predominantly wirelessly networked and there would be a definite shift towards laptop and palmtop computing alongside embedded computers in tools, vehicles etc. An increase in the use of voice input and output was expected, with the accompanying demise of the use of paper printouts.

3.2. EU's framework programme

The European Commission has also funded several road mapping activities under their fifth and sixth framework programmes within Information Society Technologies (IST). The ICCI (Innovation co-ordination, transfer and deployment through networked Co-operation in the Construction Industry) project brought together the results from six IST projects for the construction industry. Future needs, RTD and plans for ICT in construction were identified from a literature review and enquiry among the ICCI partners [11]. The themes for the future were summarised as:

- value orientation and sustainability;
- virtual organisations;
- life cycle integration;
- reuse of information and knowledge;
- IFC-based or model-based ICT;
- advanced Internet technologies (based on XML, SOAP etc.);

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