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Charting the Future of RTD in Construction IT: the ROADCON Roadmap

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Abstract
This paper presents the main findings from the recently concluded ROADCON project that was funded by the European Commission to define a vision and roadmap for future RTD in construction IT. Findings indicate a paradigm shift towards research in the areas of total life cycle management, knowledge re-use, ambient access, model based ICT, flexible interoperability, performance driven processes, virtual teams, etc. A high level roadmap is presented followed by a presentation of a specific sub-roadmap in the priority area of knowledge sharing covering use, take-up, development, research, and exploration of new emerging technologies.

Keywords
Construction IT, Roadmap, Vision, Knowledge Re-use

1. Introduction

The ROADCON project (see www.roadcon.org) was launched in the summer of 2002, with funding from the European Commission to develop a strategic roadmap towards knowledge-driven sustainable construction. This roadmap was to serve as the underlying basis for future research and technology development (RTD) in the construction sector. With a main focus on new and emerging information and communications technologies (ICTs), the roadmap was to furthermore identify existing ICTs for immediate industrial take-up. The considered issues centred on industry-wide collaboration between various industrial actors in a typical project setting rather than the internal activities of a single organisation.

2. Background

2.1 Characteristics of the construction sector

The construction section has key characteristics that differentiate it from other industrial sectors (Hannus, et al, 2003, ROADCON consortium, 2003, Kazi and Charoenngam, 2004). Some of these characteristics are:

- The sector is heterogeneous and highly fragmented, depending on a large number of very different professions and firms, which are mostly small in size, tend to respond to local market needs and control only one element of the overall building process.
- Construction is one of the most geographically dispersed sectors with marked regional differences.
- Construction is highly project oriented. Any ICT used within a project must be deployable and profitable to all / several partners.
- Each construction project, whether to create a new facility or a renovation/repair project is typically unique. The final product tends to be very durable, lasting 25-50 years and longer, and represents one of the few non-transportable industrial products.
- When construction facilities become obsolete they are most often repaired, modernised and sometimes radically transformed to suit new requirements rather than disposed of and replaced with new, which is more typical for manufactured products.
- The sector is highly regulated. Regulations and standards are more rigorous in construction than in most other sectors of economy, with the involvement of several levels of governments (local, provincial, national).
- The sector is very labour intensive, with high mobility of the workforce and growing skills needs as construction technology becomes more sophisticated. The duration of contracts is often linked to the length of the site construction phase.
- Business relationships are temporary and often short-term, bringing together partners who may never work together again.

2.2 Current state of ICT usage in construction

ICT usage in the construction sector is limited when compared with other industries such as manufacturing. While in part this may be due to the unique characteristics of the construction industry ,there is a tendency for late take-up of ICT solutions, or when no appropriate solution exits, construction organisations develop closed proprietary solutions. Through a series of consultations and analysis the current state of ICT usage trends in the construction industry were identified (Kazi, et al. 2003, Zarli et al., 2003) as illustrated in Fig.1.

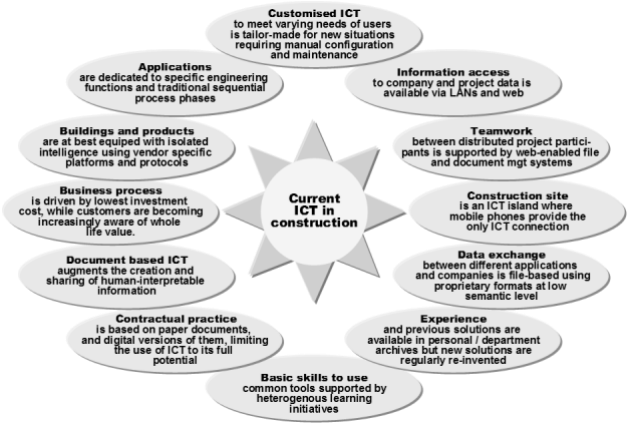

Figure 1: Current ICT Usage Trends

3. Vision for ICT in Construction

The vision for ICT in construction was defined in ROADCON as: *Construction sector is driven by total product life cycle performance and supported by knowledge-intensive and model based ICT enabling holistic support and decision making throughout the process by all stakeholders*. When compared with the current state (Fig. 1), it in essence promotes a paradigm shift from customised ICT to adaptive systems, from information access to ambient access, from teamwork to collaborative virtual teams, from construction

site to digital site, from data exchange to flexible interoperability, from experience to knowledge sharing, from basic skills to ICT skills and awareness, from contractual practice to legal/contractual governance, from document based ICT to model based ICT, from business processes to performance driven processes, from buildings and products to smart buildings and products, and from applications to total life cycle support (Fig. 2).

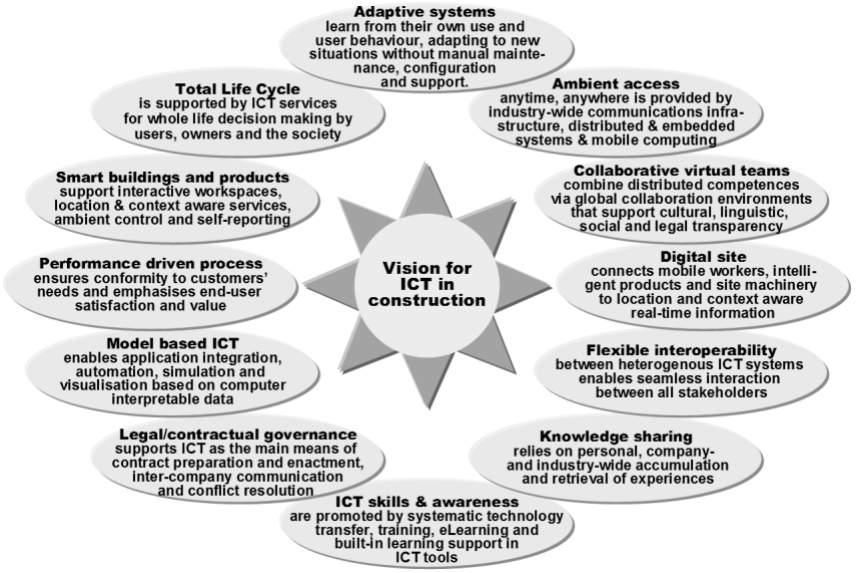

Figure 2: Vision for Construction ICT

4. ROADMAP for ICT in Construction

A high-level roadmap (Fig. 3) was developed to illustrate the migration from the current state (Fig. 1) to the vision (Fig. 2). All elements combine to achieving the vision and there is naturally the possibility of interdependencies between the various paths illustrated (lines in Fig. 3).

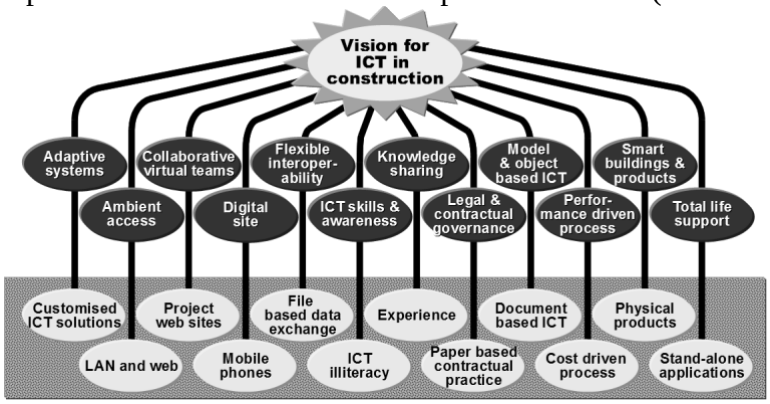

Figure 3: High Level Roadmap

The roadmap was broken down into a series of sub-roadmaps. These sub-roadmaps were intended to provide directions and provide alternate routes (e.g. from experience to knowledge sharing) connecting different technological elements required to achieve the vision. They furthermore, provide a view at a given point of time (now): mature ICTs can be deployed immediately; application development is needed for exploitation of available technologies; research is needed on new technologies; and, the potential of emerging technologies need to be explored. The tentative time for exploitation (industrial use) of the various elements was identified as follows:

- Take-up: Adopt, deploy and demonstrate mainly existing technologies (0-2 years)

- Development: Clearly defined RTD to achieve exploitable results (3-5 years)
- Research: Protoyping is required to find the way forward (6-10 years)
- Emerging: Exploring RTD needs and opportunities for potential solutions (6-10 years)

As an illustrative example, the sub-roadmap for knowledge sharing is presented as shown in Fig.4.

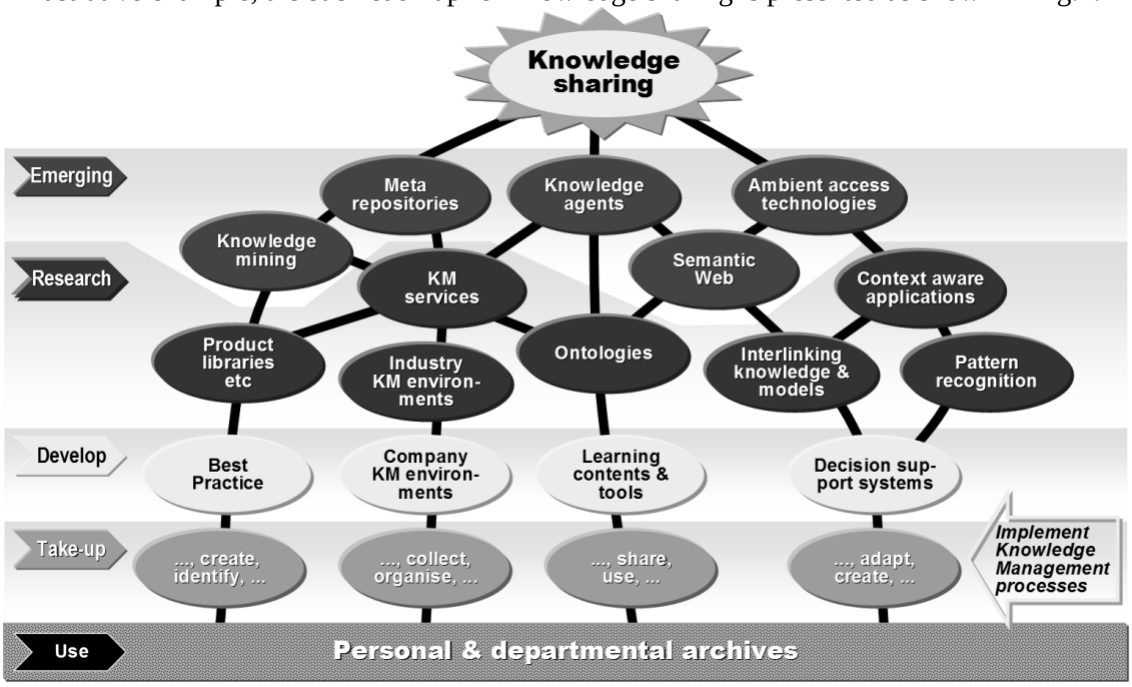

Figure 4: Sub-roadmap on Knowledge Sharing

Current state: Experience and previous solutions are available in personal and departmental archives but new solutions are regularly re-invented in every project.

Vision: Sharing previous experiences, best practice and knowledge within and, increasingly, between organisations. The aim is to have (transparently) immediate access to the right information, at the right time, in the right format, and from the right sources (both internal to an organisation and external).

Scenario: An individual faces a problem (e.g. leakage through the roof of a concrete basement due to excessive rainfall). His/her KM environment will be able to search across multiple data repositories, mine the relevant information (e.g. from potential similar problems or occurrences) and return the potential solution(s) and relevant contact people. At the same time, it will have the capability through a combination of ontologies (or a meta-ontology) to exploit relevant content for identification through the semantic web and retrieval of the same into end-user applications using intelligent knowledge agents. The retrieved content may come from a different domain (e.g. aerospace) and relate to a different problem whose solution may yet be relevant and adaptable to the problem in context.

More detailed information on the knowledge sharing sub-roadmap and all others is available in Hannus et al. (2003).

5. Conclusions

This paper has presented some of the findings of the ROADCON project aiming at identifying future opportunities and needs for ICT in construction. The work achieved was on the basis of an identification of industry needs, and those enabling ICTs that can support the needs. A high level roadmap was identified consisting of a number of sub-roadmaps offering various paths to achieving the vision for ICT in construction.

To build a momentum for change, support from relevant key stakeholders is necessary. Even more so, if the actions defined in a roadmap are to be undertaken. One of the main assets of ROADCON is its accumulated and still under enhancement, critical mass of stakeholders (ROADCON support group). This has been built early on even before ROADCON formally started. Most members have actively contributed towards providing requirements, and RTD action proposals. The ROADCON support group (http://cic.vtt.fi/projects/roadcon/support/) today contains 293 organisations from 30 countries supported by national contact points in more than 20 countries. Some of these support group organisations are in fact industry organisations (associations) that represent tens if not hundreds of organisations under them.

4. References

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