

INFORMATION TECHNOLOGY FOR CONSTRUCTION

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1 INTRODUCTION

This paper sets a vision of how research and innovation in construction information technology (IT) is converging. It outlines how current activities can be categorised and classified and how gaps and overlaps can be identified. It suggests innovation priorities for the future and how research and implementation can be brought more closely together. It is based on the author's involvement with W78 and work carried out within the UK for the Construct IT Centre of Excellence.

2. BACKGROUND

The field of construction IT has traditionally been approached from a dominant technological perspective. The focus has been on the detail, design and mechanics of the technology in itself. The emergence of the early systems of Computer Aided Design (CAD) were a major trigger to this and much of the early work in our discipline focused on the integration of CAD systems. This naturally drew the focus for research into the search for a model of the product of construction which as a physical representation would enable analysis of its physical attributes for the purpose of design. Alternative product modeling methodologies and notations became the dominant language of the field. The real gains from such a product modeling approach were felt to lie in associated standardisation and much of the work of the research community in this field has become inextricably linked with standardisation efforts.

3. TRENDS AND FUTURE PERSPECTIVES

Recent times have seen major new developments in the field away from such a narrow, product-based, technologically-oriented, design-driven approach. Recent developments in the research community have seen the emergence of a broader process-based perspective of part of the problem, and the further emergence of a broader range of technologies which are now converging. These trends and the current future perspectives that they leave us with can be described in the following way.

Process and Product Models

A dominant issue for construction IT research remains the search for a means of integrating information. Different levels and types of integration form the focus for such work for different groups but integration of project and industry-wide information are priority issues. This search for integration at the project level has been led by the search for a means of modeling the product of construction. Alternative representation methodologies and more recently, alternative technologies have seen substantial progress in this area of work.

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More recently has been a recognition of the need to model the processes that are undertaken throughout the design and production stages of construction. New representation methodologies are being applied to attempts to model the activities and tasks that make up the construction process with a view initially to model the information flow through the process, and more recently to redesign and improve the process from an information management and integration point of view. A recent trend has also seen the two approaches of product and process modeling begin to overlap.

Other Managerial Issues

The emergence of process modeling as a key part of the modeling approach reflects a greater concern more recently with the managerial and organisational dimension of IT for construction. It could be argued that the level of technological advancement is already far in advance of our ability to be able to apply and implement effectively. With this in mind, an increasing research concern has been to better understand how IT is managed in construction and to overcome the managerial and organisational prerequisites to integrated systems.

Important aspects of this managerial dimension have included process re-engineering research, issues of business strategy, the economics of IT, the implementation process, the value and benefits of IT, change management, innovation processes in construction, and legal issues of IT application. Other important management related subjects include concepts behind teamworking, partnering, human interaction, and the influence of alternative learning styles on man machine interfaces.

Emerging Technologies

Much research in the field adopts a technology push paradigm and is pure experimentation and exploratory examination of new technologies. The goal for such research is often a proof-of-concept demonstrator of the way emerging technologies from other fields can apply to a particular construction domain.

One way of classifying these emerging technologies is to adopt the VICI acronym. This can be used to classify the key categories of technologies of visualisation, intelligence, communications and integration.

Visualisation technologies have been greatly enhanced by the emergence of virtual reality as a serious technology with enormous potential application. It builds from the previous work in CAD. The emergence of multi-media technologies is also key.

Intelligent technologies were greatly stimulated by the knowledge-based expert system explosion of the late 1980's. Their subsequent more rational and more considered examination has seen many systems developed to practical application, new methodologies emerge for their production, and new key intelligent technologies such as case-based reasoning, neural networks, genetic algorithms and the like have genuine research potential.

Communication technologies were traditionally seen as discrete from IT but are rapidly becoming more closely integrated. The possibilities offered by tele, video and desk top

conferencing technologies to a concurrent engineering paradigm that our early product modeling work had investigated is providing a major stimulus. However, the communication technology aspect of construction IT research is being revolutionised by the emergence of Internet and Intranet as major technological advances.

Integration technologies have advanced considerably from the representational methodologies of our early product modeling work. The emergence of the object-oriented paradigm is placing realisable integration within grasp and is forming a major bridge between this and the other technologies.

Current Major Thrusts

From the above review of the range of new research issues it is possible to abstract three key issues that form a combination of many of these perspectives and appear to dominate our current work.

- Integration
- Communications and the Information Superhighway
- Process Change

4. INTERNATIONAL RESEARCH

Up to this point, this overview paper has mainly commented on the subject of our international research. Such issues develop on the basis of our knowledge and understanding and the way we choose to interact with our business need and associated technologies. However, the political, economic and organisational context within which our research is conducted is also of major influence. In this regard most countries have their own set of drivers and influences. However, it is possible to perceive some general trends that appear to be exerting a strong influence on the work of many groups.

Interdisciplinary, collaborative and industrial participation

Increasingly, research is being seen as an activity that can make the best progress when drawing from a range of discipline perspectives. More of the exciting developments and breakthroughs in science and technology generally appear to be occurring at the interface between core technologies and disciplines. The implication for us in construction IT is that we should look even more closely at what the traditional sciences of computing, information systems, engineering, management and economics have to offer in a construction IT context. We should seek to more actively engage skilled researchers from these fields in our work.

Secondly, research is becoming more likely to be collaborative between two or more institutions. This brings its own problems of organisation and management but also offers possibilities of exploiting complementary skills.

Finally, many research environments are seeing an increasingly active role being played by industrial collaborators. This is of enormous potential for our research community. It is far more challenging and sometimes difficult to maintain a long-term and scientific approach, but the opportunity it offers for practical issues to be included, for real

experimentation, for considered assessment of impact and for subsequent implementation is the major opportunity we have to respond to.

Research coordination

Related to some of the above issues is the emergence of a number of attempts by some research funders, industry groups and even some groups of researchers, to try to bring about some measure of coordination in research. The opportunities here are to broker research ability with research need, identify gaps and overlaps, develop shared long-term visions, prioritise future activities and develop complementary relationships between current outputs and future intentions.

Incremental research

Linked to the issue of coordination is the ever more pressing need for us to build some level of continuity and incrementalism in our work. There is always the danger that this decade's research priorities and major activities will completely ignore the progress of the past when terminologies and perceptions go out of fashion. The danger with this for us all is that we fail to move forward as much as we could, we revisit old problems that have already been solved and we fail to build a body of knowledge that moves ever forward.

Measuring and monitoring the impact of research

A key way of seeking to achieve incrementalism, which is related to the issues of collaboration and coordination, is to seek to more objectively measure and monitor the benefits and impact of our work. Very few metrics have been developed for construction IT both in practice and research. As such we are very poorly informed of the relative contribution of different research advances and unable to prioritise future research opportunities by lacking estimates of improvement potential. This is a major challenge to the research community to develop, adopt and apply performance measuring and monitoring metrics to our work..