Interwoven Threads:
Trends in the Use of Information Technologies for the Construction Industry

A White Paper prepared for the Berkeley-Stanford CE&M Workshop, August 1999

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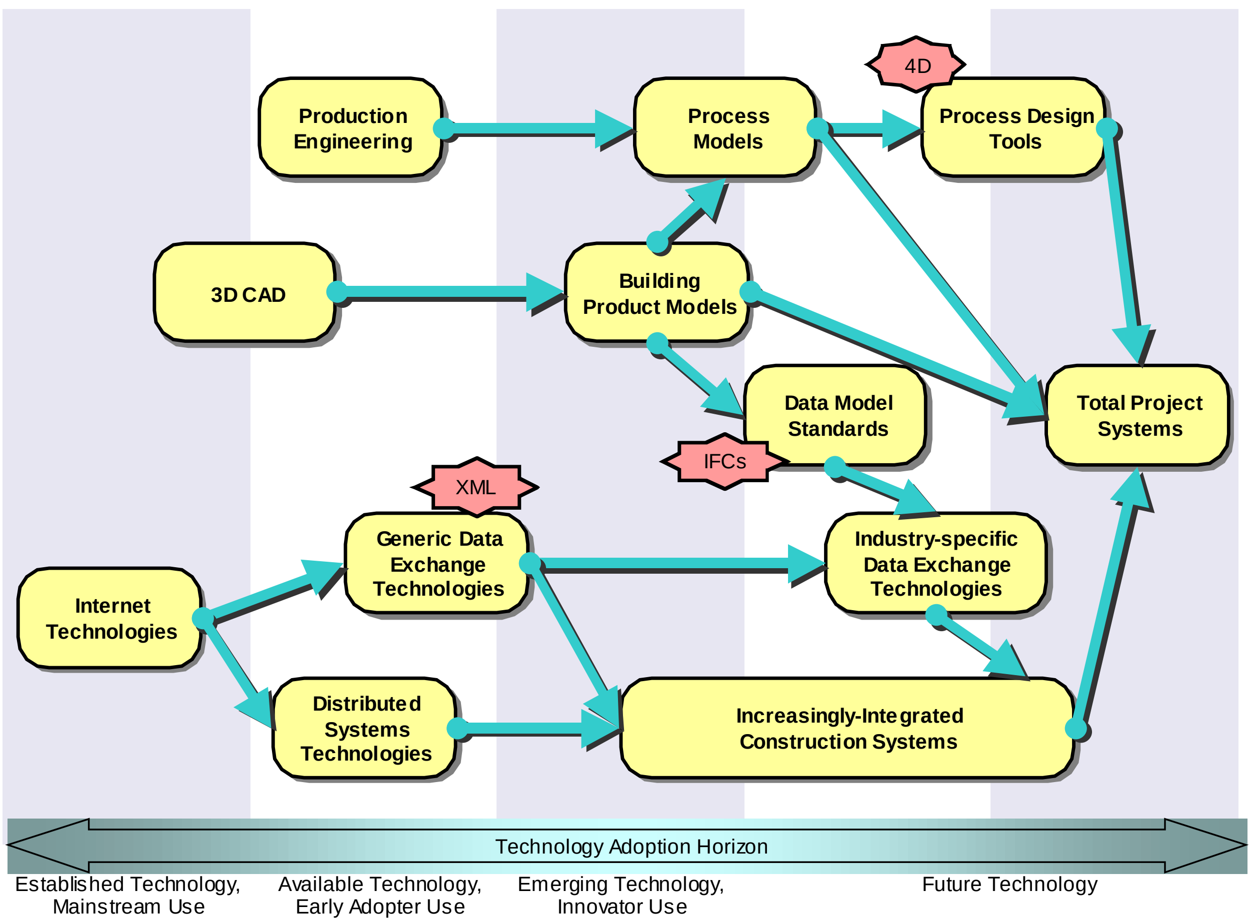


Figure 1: Information Technology Trends in the Construction Industry

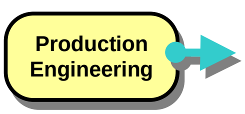
Introduction

Information technologies (IT) will continue to be predominant agents of change within the construction industry. IT as a whole is advancing at a faster rate than any other major area of technology and it is increasingly pervasive in its influence over work practices. The construction industry, though it may lag other industries in its rate of IT adoption, is heavily information-based, and IT offers great potential for improving management practices, communication, and overall productivity in the industry.

IT is not a single technology but a wide range of technical approaches to a variety of problems. Many IT threads could influence the construction industry, and while each thread comprises a distinct body of technology, they all inter-relate to provide a complex tapestry of technical solutions. This paper follows the linkages between some of these IT threads and discusses their potential influence on the construction industry.

2D CAD is now pervasive. **3D CAD** is a well estabilished technology that is beginning to enter mainstream use. One significant effect of 3D CAD is that it has established the role of using computer-based "building models" for design and communication in building projects (although users currently may not think of the 3D models in this sense). This introduces a natural progression towards increasing semantic information (i.e., CAD entities modeled as specific building components rather than generic shapes) and increasing non-geometric information in the CAD models—that is, towards the use of **Building Product Models.**

Building product models, and industry **data model standards** for product models such as the Industry Foundation Classes (IFC's)[1] have been an emerging technology for some time now. On one hand, the technologies to create and work with product models has matured significantly and product models are successfully used to support some applications in some industries. On the other hand, product model-based applications and data exchange have not entered mainstream use and many unresolved technical difficulties remain[2].



Several trends within the construction industry—Process Re-Engineering, Total Quality Mangement, and Lean Construction[3,4], to name a few—focus on better "engineering" of construction processes. These are not information technologies, but their **production engineering** perspective emphasises a more formalized treatment of construction processes. A focus on construction processes also arises as a result of extending the data modeling technologies used in building product modeling to project management application areas such as estimating, scheduling, etc.[5,6] These threads all lead to

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[1] <http://www.interoperability.com>

[2] Eastman, C.M., "Information Exchange Architectures For Building Models, Information Exchange Architectures", Durability of Building Materials and Components 8. Institute for Research in Construction, National Research Council Canada, Ottawa Canada. 1999. pp. 2139-2156.

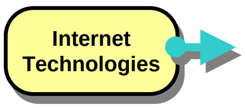
[3] <http://www.leanconstruction.org>

[4] <http://www.vti.fi/rte/lean/>

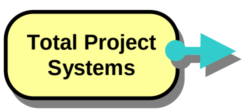
[5] <http://www.civil.ubc.ca/~tfroese/pubs/fro95b_process_models/fro95b_abstract.html>

process modeling, a range of technologies for representing and working with information about construction work processes[7].

Product and process modeling technologies, combined with the attitudes embodied in production engineering, could lead to an exciting new application area: **Process Design Tools**. Currently, scheduling software probably comes closest to a tool for helping to plan construction processes. However, construction process design involves detailed knowledge of the building being constructed, information about available construction methods, and many other types of information that are not included in any scheduling software but that are central to integrated product and process model approaches. A new type of process design tool would allow users to explore and interlink a wide variety of construction project information, together with process design and analysis tools such as 4D CAD (3D geometry plus time)[8], to engineer efficient construction process plans. These new process design tools could be incorporated within scheduling tools, estimating tools, CAD tools, or they could form a whole new application class.



The **Internet** changes everything. It profoundly influences information technologies and, perhaps more significantly, perspectives and attitudes towards information technologies. Our expectation of access to shared information and communication is drastically different from what it was a few short years ago. Currently, communication via e-mail and document sharing via the WWW predominate the Internet. Increasingly, the internet will be used for **distributed systems** and **generic data exchange** (for example, XML is a notable technolgy[9,10]). These technologies, in conjunction with data model standards, will lead to richer, more **industry-specific data exchange technologies**. All these will result in ever-increasing levels of **integration among construction sofware**.



At present, the “collective body” of information about a construction project is represented and communicated via paper documents, individual computer files from a wide range of applications, and in the minds of the project participants. Many of the technologies discussed here improve the interoperability between these data sources without changing this basic premise. At some point, as integration capabilities continue to improve, the collected integrated systems reach a critical mass where they can form the primary mechanism or media used to develop, record, work with, and communicate the overall body of project information. We have called such systems **Total Project Systems**[11], which are defined by the following characteristics:

1. Comprehensiveness: they include a suite of applications that support a broad range of CM functions.
2. Integration: all applications contribute to and draw from a shared pool of project information.

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[6] Froese, T.M., and Yu, K.Q., “Industry Foundation Class Modeling For Estimating And Scheduling, Industry Foundation Class Modelling”, Durability of Building Materials and Components 8. Institute for Research in Construction, National Research Council Canada, Ottawa Canada. 1999. pp. 2825-2835.

[7] <http://www.mopo.org>

[8] <http://www.stanford.edu/group/4D/4D-home/htm>

[9] <http://www.w3.org/xml/>

[10] <http://msdn.microsoft.com/xml>

[11] <http://www.civil.ubc.ca/~tfroese/pubs/fro97a_tops/fro97a_abstract.html>

3. Flexibility: they operate in a highly modular, open, flexible, and distributed framework, rather than in a restrictive and prescriptive manner.