

**Berkeley-Stanford CE&M Workshop:
Defining a Research Agenda for AEC Process/Product
Development in 2000 and Beyond**

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Günther Grass (June 1990) stated that we already have the statistics for the future.... The future is already in place. This is indeed the case. New technology will continue to transform the construction industry, generating cost-saving innovation as well as new products and processes, faster delivery systems and a new construction industry image.

This brief discourse will address the needs and opportunities of the construction industry in some of the areas that appear likely to have the greatest impact. Addressed will be the opportunities as they relate to information systems, alternative materials, education of professionals, productivity, and construction research.

Information Systems

Both in the near and the long-term future, information technology will dramatically affect the construction industry. The information systems of the future will be based on real-time communication between the parties involved in the construction process. All communication will be incorporated into the computer, thus creating a database of design, project planning and control, and communication between participants. Communication is often a problem on a construction project where delays and errors can occur frequently. Internet and computer enabled communication and management offers tremendous promise. Project participants, regardless of the location, have real-time access to the same information with real-time turnaround. Designs and field changes can be done in collaboration, rather than isolation.

It is clear from the number of new software offerings and the number of projects at the A/E/C Systems show in Los Angeles this year, that much of the new technology is aimed at taking better advantage of the Web's inexpensive and instantaneous connectivity. Companies are now exchanging design and project management information at modem-accessible sites. Many companies are now offering new software and services. Web interface will improve project information access and speed delivery.

Company and project information systems will provide a more integrated and instantaneous view of all aspects of the project to all partners of the construction project. Computer aided information systems will be common place for the construction industry in the near future. New technologies in telepresence and virtual reality will lead to new working methods.

¹ Assistant Professor, University of Washington, Department of Construction Management, 116 Architecture Hall, Box 351610, Seattle, WA. 98195-1610, (206) 616-1915, Fax: (206) 685-1976, pacec@u.washington.edu. Professor Pace was president of Applied Designs Construction Company for ten years prior to entering academia. One of his main areas of research is in the area of managing new technology development. Currently at the UW, the CM department is developing a 35,000-sq. ft. laboratory dedicated to the development, testing and use of alternative building materials. As part of his duties as Undergraduate Program Coordinator, he was instrumental in developing the first Design/Build dual degree in any major university in an effort to address the segregation of future construction participants in the university setting. Similar programs are in the planning stages to combine both mechanical and electrical engineering with construction management.

The construction industry will face specific challenges in implementing this new technology. Reeducation and training will be necessary to promote wide acceptance of this technology. Hardware and software improvements will be needed. Designers will face the pressure of reacting more quickly to contractors' requests for information, and contractors' jobsite operations will fall under increased scrutiny because of its visibility via onsite Webcams. While in the future, information systems will continue to transform the construction industry, it will also create a division between those companies who can afford the change, and those who can't. Because of new technology, companies will either become "megacompanies" or niche companies that work in a small arena.

Alternative Materials

New technology affecting managerial, organizational and design disciplines will exist in the future with new technology within the core disciplines, materials and structural engineering. New technology developments in the areas of materials and structures will occur only through the integration managerial, organizational and design disciplines. As the construction industry has seen for many years, development of new materials and structures will happen mainly by specialized suppliers. Contractors will continue to provide the connection between the owner and the project through planning and management, optimization and decision making.

New basic knowledge in materials and structures will be needed in the areas of thermal behavior, durability and service life. Standards and formal guidelines will be necessary in order to put these new technologies into practice. A revolution of both strong and soft materials as well as types of structures will rapidly replace the existing technology depending on the specific life cycle requirements in each application. Effective recycling and demolition of building materials, and the effective reuse of recycled materials, will continue to be an increasing challenge for the construction industry. As a major consumer of materials, the construction industry will have amazing opportunities to apply the by-products and recycled materials of industry and general consumption to the development of new innovations and applications. The use of waste materials, the new applications of materials like composites and laminates will have major consequences to the future construction industry.

Productivity

There has been a great deal of discussion and very good research over the last several years addressing jobsite productivity. However, in the future, we will be looking at productivity in the light of an entirely new building technology/process. Many believe that the "smart" office building can increase worker productivity upward to 30%. So what does that mean to the construction industry of the future?

The clearest, most easily understood way of understanding the affects of the smart building is to consider the affects of increased integration of technology that combines communications, computers, electronic controls, et cetera. This introduction of new technology at the least will conceivably result in the displacement of certain people in the firm. A more dramatic change that will have a great affect on the construction industry as a result of these new technologies

will be the possibilities of the displacement of buildings that are not 'smart' buildings. This will represent the opportunity for the creation of new markets specifically aimed at upgrading performance in these older structures if they are to remain viable in the near future. Developments of the technologies behind smart buildings are likely to bring the most dramatic change in the performance characteristics of buildings since before the turn of the century.

Education of Professionals

For many years the construction industry has been told that those involved need to learn to work differently. Architects, engineers, and contractors will need to work together to be effective and the results of the variety of efforts attempting to address this challenge have been mixed, depending on the areas of application. So why are we still faced with so little integration at the university level? Most schools and programs educating mechanical and electrical engineers provide little information on the building process as part of the students' education. It is clear that these problems are not easily addressed. The architects are concerned primarily with design and aesthetic aspects, not the technical or cost aspects of the building. While in some cases the architects and the civil engineers may occupy the same building, there is little or no interaction even though the engineers develop most of the structural design. The future provides us with increased opportunities to educate, as we have never done in the past, by looking at ways of educating building professionals as a whole, without sacrificing the skills of the individual. There are enormous potential benefits in studying and improving the way the university system educates the future leaders of the construction industry.

Construction Research and Transfer of Information

For years, some have argued that there needs to be more money allocated to research while others have argued that money is available and is proportioned out as justified by the financial opportunity. Few disagree that there needs to be more money spent directly on research that benefits the industry as a whole. Other countries, as well as other industries within this country, are spending more money and providing incentives for private interests to support research. Those same countries are doing more to transfer the results of current research into practice. The Department of Agriculture spends about \$1 billion a year on research and the National Institute of Health gets four times that amount from congress. While the construction industry is about the same size as those two industries, at a national level the appropriations to it are between \$8-\$9 million. In the future, the more funding and research that takes place, the more excellent construction research opportunities will exist and the more they will need support.

The construction industry in this country can only improve its competitive position if it continues to develop new materials, products and processes and transfers them into the construction practice. There is a need for increased support for a national research program that supports every university in every state and there needs to be technology transfer specialists that move the results of this research into the construction industry.

For the first time in 100 years, revolution will take place in construction industry. The first, and perhaps the most important step in leading the way to the future, is acknowledging that the forces that will define the future are already in place and we need only recognize them.