Research Statement

A Questioned Field--

Construction Engineering and Management (CEM) is perhaps the most poorly understood research area among the disciplines of Civil Engineering. On the one hand, a colleague of mine in Civil Engineering asked me: "What is your core research?" An NSF program director challenged a group of Construction researchers at a workshop: "Can you show me your basic research?" On the other hand, I have often heard contractors plead: "My project is in trouble; Im behind schedule and over budget. What went wrong?" As a construction researcher, I too seek definitive answers to these questions.

Motivation--

Construction was not my choice of career at first. After graduating with a B.S. degree in Structural Engineering, I worked for a prestigious engineering firm designing mid-rise buildings. Soon I was in charge of design projects. Rarely did I visit the sites because everything seemed to go smoothly for most of my projects. Out of curiosity, I stopped by a building site that I had proudly designed. I observed, and was surprised, how tasks were being conducted in the field. Later I discussed the project with workers, foremen, and superintendents who worked on the project. To my surprise, I received an earful of complaints and new ideas about how to improve the design so that it would be easier to construct. Humbled, I realized the importance of construction and how it ultimately defines the quality, cost, and performance of a facility. Soon afterwards, I decided to pursue graduate degrees in CEM.

Research Areas--

Before joining the faculty of UIUC, I spent many years managing construction projects in industry. After being an outsider, a practitioner, and a researcher in the Construction area, I realized why people asked the three questions above. CEM, as a whole, is still trying to establish its identity. Compared to other fields of Civil Engineering, CEM is relatively young, considering that most Construction graduate programs were established after the 1960's. The main theories in CEM, such as Critical Path Methods, originated from Industrial Engineering and Management Sciences. Construction researchers are still working on establishing a theoretical foundation for the field, similar

to what the pioneers in Structural and Geotechnical Engineering had done 50-100 years ago. In my view, Construction research needs theories and quality data. We need theories to help us understand, analyze, and improve construction projects. Equally important is the need for quality data to verify, validate, and improve the theories. Throughout the years, my research has been focusing on automating field data collection and developing new theories for project planning and controls.

1. Automation of field data collection

Accomplishments:

- Invention of a field data collection device, the Digital Hard Hat system, for collecting multimedia (digital) construction data to support productivity analysis and improvement. The project was a joint effort with two researchers from Electrical Engineering. Initially funded by UIUC Critical Research Initiative, the project later received funding from the government, engineering/construction companies, and technology firms.

- Development of an information framework that supports the storage, analysis, and retrieval of project data throughout the life cycle of a facility. With the framework, we can better manage and improve the design of a facility.

Current and Future Work:

- Investigation of using sensors and information technologies for collecting construction field data, collaborating with researchers from Electrical Engineering (wireless communications, sensor technologies, and image processing), Computer Science (smart space), and Mechanical/Industrial Engineering (robotics and automation)

2. Developing new theories for construction project planning and controls

Accomplishments:

- Project time and cost trade-off analysis: development of a series of analytical and optimization models for project time and cost tradeoff analysis, including linear/integer programming method, genetic algorithms, and simulation.

- Design and construction integration: development of a predictive model for project performance based on project personnel interactions.

- Project financing: creation of an option-pricing model for analyzing DBOT (Design-Build-Operate-Transfer) projects.

Current and Future Work:

- Multi-project resource optimization

- Theoretical models for analyzing construction claims (collaboration with researchers from Law School and Labor & Industrial Relationships)

Vision and Future Plan--

I envision myself pursuing future research with the overall goals of (1) balancing basic and applied research and (2) integrating research, practice, and education. I believe that basic research is useful only if it leads to applied areas so that the industry can ultimately benefit. I'm also convinced that research activities must be integrated with education and practice, so that the seeds of Construction research can spread to the industry through students. The development of theoretical models that are validated by a large body of data is an ultimate aim of my research. Of course, theoretical considerations must also determine what the important data are. Perhaps during my career, the three questions at the start of the statement will be answered as readily in Construction Engineering and Management as they are in other disciplines of Civil Engineering.

Research Interests

- Lighting in Construction Work Zone
- Construction Work Zone Safety
- Field Data Collection
- Productivity
- Simulation
- Risk Analysis and Management
- Cost Engineering
- Schedule Analysis
- Construction Management Information Systems
- Construction Inspections