



Construction Industry Institute®

Enhancing Innovation in the EPC Industry

Construction Industry Institute

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Executive Summary

To stay competitive, engineering, procurement, and construction (EPC) organizations must approach innovation with a focus on internal investment and industry-wide adoption. To motivate the EPC industry to move robustly in this direction, industry leaders must challenge the tradition-bound elements of construction culture and manage the adoption of innovation. Fundamental to this shift is the need for an economic perspective that grasps innovation as offering more financial benefit than risk, when managed properly. Taking such a total innovation perspective is crucial to expanding innovation within the EPC industry and within the key areas addressed in this research.

Through a literature search, a structured interview process, and a survey of nearly 200 EPC professionals, this research—co-sponsored by the Charles Pankow Foundation (CPF)—provides empirical evidence that a significant gap exists between an effective approach to innovation and the industry's current approach (even that of the most progressive EPC-based firms). This gap includes the following elements of innovation management: mindset, resources, processes and structure, and changed project environments. Below are the research team's findings on these elements:

- **Mindset:** While EPC firms have a culture that generally affirms the importance of innovation, managers apparently enable innovation only on a project-by-project basis. They tend not to adopt the long-term, multiple-project, risk-tolerant perspective that enables innovation on an organization-wide basis.
- **Resources:** The majority of respondents indicated that their companies lack the resources necessary to identify, nurture, track, and apply innovations. These resources would include expense budgets as well as managing staff to ensure that sufficient time could be devoted to nurturing innovation.
- **Processes and Structure:** The innovation literature makes it clear that innovation will rarely happen when managers' leadership on innovation is passive. Rather, innovation requires active leader

commitment and formalized processes within the organization. This organizational structure should allow employees to methodically identify and evaluate potential innovations. Once identified and assessed, the organization's structured processes should promote to effective implementation of the innovations on appropriate projects.

- **Changed Project Environments:** Successful innovation requires real and sustained commitment from all project entities. Project delivery and contract methods that inhibit collaboration between entities during design and construction, and that prevent risk-taking, are not conducive to the creative integration needed for innovation.

In response to these findings, the research team developed two processes to help advance innovation within EPC organizations: 1) an innovation maturity model and 2) an economic model that demonstrates the value of innovation investment. The Innovation Maturity Model is an evaluation tool that measures the current state of an organization's innovation and provides recommendations for advancing innovation. The economic model developed by the team supports these recommendations by illustrating and communicating the long-term benefits of innovation investment. The challenge for EPC organizations is determining how and where to start on the path to innovation; this progress entails identifying the areas of the organization that need investment to encourage innovation.

Introduction

Although the ability to innovate is recognized as a fundamental requirement for long-term business success in nearly all industries, the need for innovation has been overlooked and undervalued within the engineering, procurement, and construction (EPC) industry. The EPC industry is noticeably lagging behind other industries—e.g., aerospace and manufacturing—in terms of investment in, adoption of, and development of innovative practices and technologies. Given that the industry is changing significantly as it addresses the introduction of advanced technologies, the aging workforce, globalization, economic integration, and international partnering, its underperformance in the area of innovation is becoming a crisis. Although individual exceptions exist, research of the EPC industry has demonstrated that there are significant economic, organizational, and structural barriers to innovation within construction organizations of all sizes (Toole 1998, Toole 2001, Chinowsky 2001). This body of research suggests that it is critical to identifying how the EPC industry can accomplish the following innovation goals:

1. Develop greater emphasis on the economic and competitive benefits of innovation given the structural constraints of the industry.
2. Implement processes that drive innovation as a normal part of business functions.
3. Change the culture to view innovation as key to improving project delivery and to creating the long-term success of EPC organizations and the EPC industry.

In response to this need to enhance innovation within organizations and across the industry, the Construction Industry Institute (CII) established Research Team 243 to explore and document the current levels of innovation in the EPC industry, identify opportunities for enhanced levels of innovation, and develop best practices for becoming

more innovative. In collaboration with leaders from the Charles Pankow Foundation (CPF), the study's co-sponsor, CII formed the research team and charged it with developing a framework for analyzing, adopting, and fostering innovations. This effort is aimed at enhancing project operations, processes, and, ultimately, long-term competitiveness.

With these research goals in mind, the team developed its scope, process, and objectives. The team set out to review the relevant literature, conduct interviews and surveys to determine existing attitudes and management practices relating to innovation, and to identify ways to increase innovation in the EPC industry. The team also chose to analyze innovation management best practices in other industries to determine whether any can be applied to the EPC industry. The research was to answer the following research questions:

1. Is innovation perceived to lead to higher profit margins? If so, what metrics do contractors use, or can they use, to measure the direct and indirect benefits of innovation?
2. What are the key perceived drivers of innovation? Can and do managers apply microeconomic and financial concepts and tools to their decisions on innovation?
3. What are the key perceived barriers to innovation?
4. What organizational cultures, staffing, structure, and processes enable innovation?
5. What market segments/niches are most conducive to innovation?
6. Do perceptions vary between types of entities (i.e., owners, designers, general contractors, sub-contractors, and suppliers), market segments, and type of innovation (product or process)?
7. What economic scenarios make it imperative for an organization to aggressively adopt innovation as a core competitive principle?

This research summary discusses the team's research process and methodology, the data it collected, its findings, and its recommendations for individual organizations.

Research Process and Methodology

The team collaborated on the research through face-to-face meetings, phone calls, and emails. After two face-to-face meetings on the CII research process, the scope and goals of the research project, and the creation of a preliminary research plan, the team conducted a literature review and developed the Innovation Maturity Model. The team's research process was comprised of the following steps, described below: literature review, Charles Pankow Foundation (CPF) research, interviews, online survey, development of an economic model, development of an innovation maturity model.

Literature review: The team reviewed the literature on innovation within the (EPC) industry and in other industries. The review included literature on innovation in both domestic and international firms. The team searched academic journal articles, practitioner journal and magazine articles, academic books, and popular press books. Copies and references from some of the literature were obtained through the courtesy of Professor John Gambatese and his graduate assistant, Matthew Hallowell, at Oregon State University (OSU). Both were completing a research project on construction innovation for the Charles Pankow Foundation. All of the literature was reviewed and summarized by RT 243. This step provided valuable background to current industry thinking on innovation.

Charles Pankow Foundation research: The OSU research on innovation sponsored by the Charles Pankow Foundation was studied closely by members of the RT 243 team to prevent any duplication of effort. One difference between the two teams' research lies in their respective definitions of innovation. The OSU-CPF researchers' defined innovation as the "actual use of a non-trivial change and improvement in

a process, product, or system that is novel to the institution developing the change.” The RT 243 team adopted the following, slightly narrower, definition:

Innovation is the act of introducing a significant improvement in a process, product, or system that is novel to the organization, may cause individuals to view things differently, and results in competitive advantage, increased value for the client, or benefit to stockholders.

One other difference in approach was that a significant portion of the CPF research involved case studies of specific innovations and/or organizations, while the RT 243 research effort involved surveying a large number of individuals and organizations.

Interviews: Drawing from the literature review, the team drafted a script for structured interviews. For the initial set of interviews, all team members interviewed one or two managers within their respective organizations; the team conducted approximately 15 of these initial interviews. After this initial round of interviews, the script was modified slightly, and the team conducted approximately ten additional interviews of managers at EPC and non-EPC firms thought to be innovative.

One key finding of the interviews proved to be the most critical methodological challenge for the research team: EPC firms do not measure or manage to the innovation-related metrics identified in the literature review. The team therefore reluctantly concluded that it would be impossible to empirically demonstrate the relationship between innovation investment and business success. Moreover, it was clear that it would not be possible to identify innovation best practices with any objective metrics on the innovation-related activities of innovative firms. Given this absence of objective innovation metrics, the team chose to identify innovative firms by asking survey participants whether they considered their respective organizations innovative relative to the rest of the EPC industry.

Online Survey: Once the literature review and interviews were completed, the team developed and distributed an online survey to a number of CII members and non-members. The survey consisted of five closed-ended demographic questions, eight closed-ended innovation-related questions, and 34 Likert-scale questions associated with eight innovation topic questions. (For example, there were 11 Likert-scale questions associated with innovation culture.) The team first analyzed the survey data using Microsoft Excel to develop some descriptive statistics and then used Minitab for the remaining descriptive statistics and all inferential statistics.

Economic Model: The team developed an economic model to illustrate the benefits of investing in innovation and adopting a broader risk perspective. Utilizing economic theory that was originally applied to such diverse market sectors as agriculture and manufacturing, the team established a risk analysis perspective that validates the benefit of innovation investment when viewed over iterative generations of innovation investment.

Innovation Maturity Model: Finally, RT 243 developed the Innovation Maturity Model. By correlating organizational attributes and economic metrics, this tool evaluates an organization's current innovation status and generates a set of recommendations for improving its innovation status. The model is currently being tested in several CII member organizations to validate its structure and recommendations.

Background

As a starting point for its innovation research, RT 243 reviewed the current literature regarding innovation. As noted above, this review included literature focused on innovation in the EPC industry as well on innovation in all industries. A bibliography of the most useful items found in the review is provided in Appendix B. Ultimately, many of these items were summarized and shared with the team through a spreadsheet of “literature gems.” Some key themes emerged from the literature review, themes that guided the preparation of the team’s survey and the Innovation Maturity Model. The brief summary below of these key themes is organized by the research questions the team set out to answer.

1. Is innovation perceived to lead to higher profit margins? If so, what metrics do contractors use, or can they use, to measure the direct and indirect benefits of innovation?

The team did not identify any studies or articles that addressed these questions for the EPC industry, but did find many articles on the perceptions of economists, policy makers, and researchers that innovation is critical for business success in all industries.

- Innovation-related metrics and statistics are limited and can be misleading because they focus on Research & Development expenditures and patents, which are only a small subset of innovation activities (Seaden and Manseau 2001).
- The construction industry’s low investment in innovation has contributed to the EPC’s very low growth in productivity since 1964 (25 percent compared to 250 percent for other industries). Given that productivity directly affects the bottom line, this statistic implies that EPC leaders should invest more in innovation to improve their firms’ financial success (LePatner 2007).