



Construction Industry Institute®

Enhancing Innovation in the EPC Industry: Industry Implementation Studies

Construction Industry Institute

Abbott	AMEC
Air Liquide	AZCO
Air Products and Chemicals	Aker Solutions
Ameren Corporation	Alstom Power
American Transmission Company	Apex Engineering, Inc.
Anheuser-Busch InBev	BIS Frucon Industrial Services
Aramco Services Company	Baker Concrete Construction
Archer Daniels Midland Company	Bateman Engineering
BP America	Bechtel Group
Barrick Gold Corporation	Bentley Systems
Bristol-Myers Squibb Company	Black & Veatch
CITGO Petroleum Corporation	Burns & McDonnell
Cargill	CB&I
Chevron	CCC Group
ConocoPhillips	CDI Engineering Solutions
The Dow Chemical Company	CH2M HILL
DuPont	CSA Group
Eastman Chemical Company	Coreworx
ExxonMobil Corporation	Day & Zimmermann
GlaxoSmithKline	Dresser-Rand Company
Hovensa	eProject Management, LLC
International Paper	Emerson Process Management
Irving Oil Limited	Faithful+Gould
Kaiser Permanente	Flad & Associates
Eli Lilly and Company	Fluor Corporation
Marathon Oil Corporation	Foster Wheeler USA Corporation
National Aeronautics & Space Administration	GS Engineering & Construction Corporation
NOVA Chemicals Corporation	Grinaker-LTA/E+PC
Occidental Petroleum Corporation	Gross Mechanical Contractors
Ontario Power Generation	Hargrove Engineers + Constructors
Petroleo Brasileiro S/A - Petrobras	Hilti Corporation
Praxair	JMJ Associates
The Procter & Gamble Company	Jacobs
SABIC - Saudi Basic Industries Corporation	KBR
Sasol Technology	Lauren Engineers & Constructors
Shell Global Solutions US	McDermott International
Smithsonian Institution	M. A. Mortenson Company
Southern Company	Mustang
Teck Resources Limited	Omniware
Tennessee Valley Authority	Oracle USA
TransCanada Corporation	Parsons
U.S. Architect of the Capitol	Pathfinder
U.S. Army Corps of Engineers	Pegasus Global Holdings
U.S. Department of Commerce/NIST/ Building and Fire Research Laboratory	S&B Engineers and Constructors
U.S. Department of Energy	SNC-Lavalin
U.S. Department of Health and Human Services	The Shaw Group
U.S. Department of State	Siemens Energy
U.S. General Services Administration	Technip
	URS Corporation
	Victaulic Company
	Walbridge
	Wanzek Construction
	WorleyParsons
	Zachry
	Zurich

Enhancing Innovation in the EPC Industry: Industry Implementation Studies

**Prepared by
Construction Industry Institute
Enhancing Innovation Research Team
with additional funding from the
Charles Pankow Foundation**

**Research Summary 243-1a
December 2010**

© 2010 Construction Industry Institute™

The University of Texas at Austin

CII members may reproduce and distribute this work internally in any medium at no cost to internal recipients. CII members are permitted to revise and adapt this work for their internal use, provided an informational copy is furnished to CII.

Available to non-members by purchase; however, no copies may be made or distributed and no modifications may be made without prior written permission from CII. Contact CII at <http://construction-institute.org/catalog.htm> to purchase copies. Volume discounts may be available.

All CII members, current students, and faculty at a college or university are eligible to purchase CII products at member prices. Faculty and students at a college or university may reproduce and distribute this work without modification for educational use.

Printed in the United States of America.

Contents

<i>Chapter</i>	<i>Page</i>
Executive Summary	v
1. Introduction	1
2. Research Process and Methodology	3
3. Literature Review	7
4. The Innovation Maturity Model	11
5. Data Analysis	15
6. Case Study A	19
7. Case Study B	21
8. Case Study C	23
9. Case Study D	25
10. Conclusions	27
References	31

Executive Summary

This report summarizes the Phase II research on innovation performed by RT 243—the work performed during the team’s one-year extension beyond its initial two-year assignment. While the research methodology, data, and conclusions are new, the report summarizes some of the literature from the first research summary. This second, less exhaustive summary will ensure that the reader understands the body of literature on the importance of innovation in all industries.

For decades, EPC organizations have acknowledged that innovation is important but have pointed at a plethora of external factors that have kept them from being innovative. But EPC organizations can no longer afford to ignore opportunities for innovation, given the volatility of the global market, the ever-increasing complexity of capital projects, and the emerging realities of the construction workforce. CII members who continue to focus solely on achieving short-term project goals at the expense of long-term capabilities for managing innovation and change will find themselves following the same path of the U.S. shipbuilding industry: decreasing productivity, decreasing profit margins, and decreasing market share.

The findings presented in this research summary illustrate the significant opportunity the EPC industry has to improve innovation performance. Taking advantage of this opportunity will depend on the commitment the leaders of EPC organizations take to the following measures:

- changing the industry’s perspective on innovation from a single-project focus to one that considers project portfolios
- establishing repeatable processes for implementing innovation
- dedicating resources to innovation.

The Innovation Maturity Model (IMM) developed by RT 243 evaluates innovation and makes recommendations for increasing innovation.

The findings from the four case studies of organizations that pilot-tested the IMM provide evidence for the following conclusions:

1. An EPC organization's responses to the IMM questions provide a representative characterization of its innovative capacity across several dimensions.
2. The IMM's recommendations are straightforward, clear, and can be integrated with other performance improvement initiatives.
3. Implementation of the recommendations leads to improvement in the targeted attributes.

The Phase II results suggest that there is a great level of consistency in the strengths and weaknesses among the four case study firms. Moreover, the overall conclusion of both phases of this research is that enhancing innovation is an achievable goal for any EPC organization. However, every organization must challenge its existing assumptions regarding specific areas of operations. For most organizations, the following five sets of strategic actions should be aggressively pursued:

- **Build a learning culture.** A key element of fostering innovation is building a learning environment in which every member of the organization can embrace the core value of continually acquiring new knowledge.
- **Focus on the customer.** Continuous innovation must be viewed as a means to achieve continuous improvement and better meeting the changing needs of customers.
- **Establish supportive processes.** Management must establish processes that encourage and reward innovative ideas; such processes reassure employees that management takes all suggestions for innovations seriously.
- **Change the perspective.** Organizations must tolerate the inherent risk associated with the introduction of innovative ideas and adopt a multi-project perspective for syndicating innovation risks.
- **Focus on specific initiatives.** Organizations should focus on the recommendations identified by the Innovation Maturity Model as having the highest potential for increasing innovation within that organization.

Introduction

Although the ability to innovate is acknowledged as fundamental to 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 industries such as aerospace and manufacturing in its investment in, adoption of, and development of innovative practices and technologies. Given that the industry is undergoing significant changes as it addresses major challenges—e.g., the introduction of advanced field and office technologies, the aging of the construction workforce, increasing globalization, economic integration, and international partnering—its underperformance in innovation is becoming a crisis. While the industry is beginning to understand the urgent need for innovation, recognition of the problem is only the first step to solving it. Beyond recognition are the challenges of fostering and implementing innovation within EPC organizations; completing daily requirements while concurrently looking ahead at an innovative future can be daunting for most organizations.

In response to this need to foster and enhance innovation, the Construction Industry Institute (CII) established RT 243, first to explore and document current levels of innovation in the EPC industry and then to identify opportunities and best practices for increased innovation. Working with leaders from the Charles Pankow Foundation, the project's co-sponsor, CII formed the research team in November 2006.

The research was divided into two phases. The first phase ran from November 2006 until October 2008 and was documented in RS 243-1. The second phase, documented in this research summary, ran from October 2008 until October 2009. The focus of this second phase was to conduct case studies through which to test the effectiveness of the Innovation Maturity Model, the tool the team developed during the first phase. As stated above, the difficulty of fostering and implementing

innovation within an EPC organization is the industry's primary challenge. This research summary gives an overview of how four organizations were able to use the Innovation Maturity Model to develop an innovation culture and to initiate innovation activities. The lessons from these implementations are offered as a point of departure for any organization interested in embracing and implementing innovation.

Research Process and Methodology

The purpose of the second phase of the RT 243 research was to validate and refine the Innovation Maturity Model. The team developed a case study methodology to accomplish these objectives and invited five firms to pilot test the IMM. In addition, one CPF member company identified by the CPF Board was asked to participate. Each case study firm was asked to perform the following actions:

1. Have a small set of employees review the format, overall content, and specific wording of the IMM evaluation questions and provide the team with constructive criticism.
2. Have a larger set of employees (25–100) complete the IMM evaluation tool, adding demographic questions as appropriate to allow the organization to identify statistically significant differences in data from different groups within the organization (e.g., supervisory versus non-supervisory personnel and geographic locations).
3. Allow the research team to analyze the results and provide recommendations for improving the organizational characteristics that are identified as having the highest potential for promoting innovation within the organization.
4. Implement the recommendations within at least one portion of the organization and share the outcomes with the research team.
5. Provide any feedback regarding the effectiveness of the IMM.

The identities of the six organizations that agreed to participate in the case study process are being kept confidential due to the sensitive nature of the data recorded for each firm. The firms are described using

a generic alphabetical naming pattern that will be retained throughout this discussion.

- **Company A** – A multi-national engineering firm working in the heavy civil and industrial sectors. A leader in all sectors, with a growing construction presence in the industry. Company A reviewed the IMM evaluation questions and had no criticisms of the overall content or of any specific questions. Company A had 50 employees in two groups use CII's SelectSurvey program to complete the IMM evaluation tool.
- **Company B** – A national mechanical engineering and construction firm with a heavy focus on commercial and hospitality projects. Company B reviewed the IMM evaluation questions and had no criticisms of the overall content or of any specific questions. Company B had 26 employees use CII's SelectSurvey program to complete the IMM evaluation.
- **Company C** – A multi-national engineering-construction firm with a significant presence in all geographic regions of the world. The company works in all sectors, but is considered a leader in the industrial sector. Company C reviewed IMM evaluation questions and had no criticisms of the overall content or of any specific questions. Company C had 90 employees complete the evaluation using CII's SelectSurvey.
- **Company D** – A multi-national engineering-construction firm focused on the industrial sector, with significant clients in the energy sector. Company D reviewed IMM evaluation questions and had no criticisms of the overall content or of any specific questions. Company D had 83 employees complete the IMM survey using Surveymonkey.com.
- **Company E** – A regional engineering firm with a focus on the industrial sector and a presence in the commercial sector. Company E had 26 employees, representing two distinct geographic regions, take the survey.
- **Company F** – A national owner agency focused on supporting engineering and construction operations throughout the

country. Company F decided to use the IMM as a key part of the organization's multi-year strategic plan for improving innovation within the organization. Twenty-three members of the organization's innovation improvement team completed the IMM evaluation tool, using CII's SelectSurvey. These participants identified demographic variables that were to be included in a wider, subsequent survey. The innovation team members reviewed the wording of each IMM question and recommended minor changes to approximately one-third of the questions to better fit their organizational context.

The responses from the participants in Companies A, B, C, and D ranged from 20 to 90 responses from a single organization. The selection of the respondents was left up to each organization. In each case, the organization focused on a particular segment of its operations, although this focus was different for each organization. Companies E and F took the survey after the research team had revised it according to the feedback from the initial four companies. These last two pilot tests were designed to enable the research team to determine if the final version of the IMM tool was ready for release. However, the research team was not able to schedule subsequent surveys of larger groups of employees or to identify specific actions to pursue to enhance innovation in these organizations. Thus, the team was unable to include these last two firms' participation in the case study results.

Once the surveys were completed by Companies A, B, C, and D, the following four-step process was followed for each case study:

1. Analyze the results to determine the ten attributes with the highest potential for innovation improvement within the organization.
2. Highlight and report the results of this analysis to the firm, along with the specific recommendations for improvement.
3. Allow individual companies to implement recommendations independently. (After agreeing on the specific recommendations to adopt, the implementation process was placed under the

direction of the individual companies. The RT 243 team stayed in contact with the company to provide advice, but remained outside the direct process to ensure that the implementation remained independent.)

4. Revisit the companies to determine progress on the suggested implementations. In the case of Company B, the IMM survey was redistributed to the employee population to detect any changes in innovation perceptions. The results of this second round survey were then compared to those of the previous round to measure any improvements of the targeted attributes.

During this process, the team created a website and a set of spreadsheets to make it easy for the participants to use the IMM without the direct involvement of the CII/CPF research team.