



Construction Industry Institute®

## Owner and Contractor Job Site Organizations

James T. O'Connor

Chong Yao Wang

Daren T. Goldin

The University of Texas at Austin

## Construction Industry Institute

Abbott	AMEC
Air Products and Chemicals	AZCO
Ameren Corporation	Alstom Power
American Transmission Company	Audubon Engineering Company
Anheuser-Busch InBev	Aveng Group
Aramco Services Company	BIS Industrial Services
ArcelorMittal	Baker Concrete Construction
Archer Daniels Midland Company	Bateman Engineering
Architect of the Capitol	Bechtel Group
BP America	Bentley Systems
Barrick Gold Corporation	Black & Veatch
Bristol-Myers Squibb Company	Burns & McDonnell
CITGO Petroleum Corporation	CB&I
Cameco Corporation	CCC Group
Cargill	CDI Engineering Solutions
Chevron	CH2M HILL
ConocoPhillips	CSA Group
DTE Energy	Coreworx
The Dow Chemical Company	Day & Zimmermann
DuPont	Dresser-Rand Company
Eastman Chemical Company	eProject Management
Ecopetrol	ENGlobal Corporation
Eskom Holdings	Emerson Process Management
ExxonMobil Corporation	Faithful+Gould
General Electric Company	Flad & Associates
General Motors Corporation	Flint Energy Services
GlaxoSmithKline	Fluor Corporation
Hovensa	Foster Wheeler USA Corporation
International Paper	GS Engineering & Construction Corporation
Irving Oil Limited	Gross Mechanical Contractors
Kaiser Permanente	Hargrove Engineers + Constructors
Kinross Gold Corporation	Hilti Corporation
Koch Industries	Industrial Contractors
Eli Lilly and Company	Innovative Design Engineering Associates
LyondellBasell	JMJ Associates
Marathon Oil Corporation	JV Driver Projects
National Aeronautics & Space Administration	Jacobs
NOVA Chemicals Corporation	KBR
Occidental Petroleum Corporation	Kvaerner North American Construction
Ontario Power Generation	Lauren Engineers & Constructors
Petroleo Brasileiro S/A - Petrobras	Matrix Service Company
Petroleos Mexicanos	McDermott International
Praxair	Midwest Steel
The Procter & Gamble Company	M. A. Mortenson Company
SABIC - Saudi Basic Industries Corporation	Parsons
Sasol Technology	Pathfinder
Shell Global Solutions US	Quality Execution
Smithsonian Institution	S&B Engineers and Constructors
Southern Company	SAIC Constructors
Statoil ASA	SKEC USA
Teck Resources Limited	SNC-Lavalin
Tennessee Valley Authority	SOG – Óleo e Gás S/A – SETAL
TransCanada Corporation	The Shaw Group
U.S. Army Corps of Engineers	Siemens Energy
U.S. Department of Commerce/NIST/ Engineering Laboratory	Technip
U.S. Department of Defense/Tricare Management Activity	URS Corporation
U.S. Department of Energy	Victaulic Company
U.S. Department of Health and Human Services	Walbridge
U.S. Department of State	Wanzek Construction
U.S. Department of Veterans Affairs	Wood Group Mustang
U.S. General Services Administration	WorleyParsons
	Yates Construction
	Zachry Holdings
	Zurich

# OWNER AND CONTRACTOR JOB SITE ORGANIZATIONS

by

James T. O'Connor, P.E., Ph.D.  
Chong Yao Wang  
Daren T. Goldin  
The University of Texas at Austin

A Report to  
Construction Industry Institute  
The University of Texas at Austin

Under the Guidance of  
CII Research Team 261  
Optimizing Job Site Organizations

CII Research Report 261-11  
February 2012

© 2012 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 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.

## Table of Contents

Executive Summary .....	vii
CH 1. Introduction.....	1
1.1 Background.....	1
1.2 Purpose and Hypotheses of the Research .....	1
1.3 Research Scope Limitations.....	2
1.4 Structure of the Research Report .....	2
CH 2. Literature Review.....	3
2.1 Overview of Literature Review .....	3
2.2 Job Site Organizations .....	5
2.3 Owner’s Role and Work Structure .....	11
2.4 Integrated Project Teams.....	13
2.5 Owner-Contractor Trust .....	16
2.6 High Performance Teams.....	17
2.7 Organization Design and Organization Chart.....	19
2.8 Summary .....	20
CH 3. Research Methodology and Data Sample .....	21
3.1 Methodology Overview .....	21
3.2 Study Preparation.....	21
3.3 Data Collection .....	24
3.4 Characteristics of Data Sample.....	25
3.5 Data Analyses.....	27
3.6 Statistical Tests.....	29
CH 4. Findings: Descriptive Statistics.....	34
4.1 Norms for Entire Sample .....	34
4.2 Norms for Sample Subsets.....	35
4.3 Owner/Contractor Core Roles.....	39
4.4 Owner’s Involvement.....	46
4.5 Owner Outsourcing of Job Site Staff .....	47
4.6 Organizational Learnings from Project Managers .....	48
CH 5. Findings: Inferential Statistics and Associations .....	51
5.1 Quantitative Correlations .....	51
5.2 Contractor Core Roles and Craft Work Hours .....	54

CH 6.	Findings: Associations with Project Performance .....	56
6.1	Job site Organization Characteristics vs. Project Performance.....	56
6.2	Smaller-effective and Leaner-effective Project Teams .....	57
6.3	Other Analyses Conducted.....	60
CH 7.	Conclusions and Recommendations .....	62
7.1	Conclusions.....	62
7.2	Recommendations.....	64
Appendix A: Interview Guide for Owners.....		65
Appendix B: Interview Guide for Contractors.....		92
Appendix C: Questions for Owner-managed Projects .....		120
Appendix D: Follow-up Interview Guide for Small-effective and Efficient-effective Projects ..		124
Appendix E: References .....		125

## List of Tables

Table 2.1: Key Terms for Searching Relevant Material for Literature Review .....	4
Table 2.2: Shifting of Owner Competencies to Contractor (CII 1996).....	11
Table 2.3: Identified and Defined Core Competencies (CII 1996).....	11
Table 2.4: Competencies Performed by Owner, Contractor, and Requiring Structural Alignment (CII 1996) .....	12
Table 2.5: High Performance Team Themes (Ammeter and Dukerich 2002) .....	18
Table 3.1: Sample RT 261 Contingency Table.....	30
Table 4.1: FTE Norms for Sample.....	34
Table 4.2: CSR Norms from Sample .....	35
Table 4.3: FTE Norms for Sample Subsets.....	36
Table 4.4: FTE Variability.....	36
Table 4.5: CSR Norms for Sample Subsets .....	37
Table 4.6: CSR Variability .....	38
Table 4.7: Owner Core Role Summary .....	39
Table 4.8: Owner Core Role Variability.....	40
Table 4.9: Owner Core Role Shifts by Project Cost .....	41
Table 4.10: Contractor Core Role Summary.....	42
Table 4.11: Contractor Core Role Variability .....	43
Table 4.12: Contractor Core Role Shifts by Project Cost .....	44
Table 4.13: CSR Mean Values for Scalable Contractor Roles.....	45
Table 4.14: Owner Outsourced Staff by Role Frequency .....	48
Table 4.15: Project Manager Learnings on Job site Organization .....	48
Table 4.16: Owners' Learning on Increasing Staff .....	49
Table 4.17: Contractors' Learning on Increasing Staff .....	50
Table 5.1: Contractor CSR vs. Union or Open/Merit Shop Labor.....	54
Table 5.2: Tabular Data for Regression of Contractor Role FTE vs. Work Hour .....	55
Table 6.1: Safety Performance vs. Owner Staff FTE.....	56
Table 6.2: Safety Performance vs. Contractor Staff FTE .....	56
Table 6.3: Productivity Performance vs. Owner-to-Contractor Staff Ratio.....	57
Table 6.4: Core Role Differences for SE/LE Projects .....	59
Table 6.5: Results Summary of Interviews about Effective Projects.....	60
Table 6.6: Other Potential Associations Examined by RT 261 .....	61

## List of Figures

Figure 2.1: The Relationship between Level of Authority and Organization (Randolph et al. 1984) .....	7
Figure 2.2: Typical ‘Field Based Project Management Team’ Organization Chart (Anderson and Woodhead 1981) .....	8
Figure 2.3: Typical ‘Total Field Autonomy Project Management Team’ Organization Chart (Anderson and Woodhead 1981) .....	9
Figure 2.4: A Model of the Integrated Project Team (Anumba et al. 2002) .....	15
Figure 4.1: FTE Box-Whisker Plot for Owner and Contractor Teams .....	34
Figure 4.2: CSR Box-Whisker Plot for Owner and Contractor Teams .....	35
Figure 4.3: Owner-Contractor Staff Balance .....	46
Figure 5.1: Regression of Contractor FTE vs. Craft Work Hours .....	51
Figure 5.2: Regression of Contractor FTE vs. Project Capital Cost .....	52
Figure 5.3: Non-linear Regression: Owner FTE vs. Ln of Project Capital Cost .....	52
Figure 5.4: Non-linear Regression: Ln of Owner FTE vs. Ln of Project Capital Cost .....	53
Figure 5.5: Contractor Role FTE vs. Craft Work Hours (million WH) .....	54
Figure 6.1: Owner FTE vs. Project Composite Performance .....	58
Figure 6.2: Contractor FTE vs. Project Composite Performance .....	58



## **Executive Summary**

Job site management functions and associated staffing levels among both Owners and Contractors have increased in number and complexity over the past 30 years in response to the demands for greater levels of job site planning, resource management, and performance oversight. However, there is little published guidance or clarity on job site organization metrics or approaches. The primary purpose of this research was to identify and describe industry norms pertaining to Owner and Contractor job site organizational functions and staffing levels, especially those that provide the best value for different types of projects under different circumstances.

This is the first job site organization benchmarking study of its kind. The study targeted recent industrial projects with total installed cost between \$50 million and \$800 million. The study examined thirty-one projects under construction over the last two years in terms of job site organization parameters, project characteristics, execution parameters, and project success parameters. Benchmark metrics derived from this research pertain to Owner and Contractor job site organization size and constituent roles. Organization size is reported and analyzed in terms of both staff full-time equivalent (FTE) and craft-to-staff ratio (CSR).

For the sample of projects examined, job site organization team sizes and CSR metrics vary significantly. These values range from three to 69 FTE for Owners and from five to 143 FTE for Contractors. The mean Craft-to-Staff ratio for Owners is 13.0 and 4.3 for Contractor teams. From an FTE perspective, Petro-chemical projects have the largest Owner teams, while Construction-only projects have the smallest Owner teams. EPC/Design-build projects have the largest Contractor teams, while Construction-only projects have the smallest Contractor teams.

High CSR values translate to smaller job site management teams. Power utility and Construction-only projects have the largest Owner CSR values, while Cost-reimbursable and EPC/Design-build projects have the smallest Owner CSR values. Lump sum projects have the largest Contractor CSR values, while Petro-chemical, Power utility, and EPC/Design-build projects have the smallest Contractor CSR values. CSR variability is quite large for Owners, but much less so for Contractors. Regression analyses indicate strong correlations between Contractor staff size (FTE) and either Project capital cost or Construction craft work hours.

The sampled projects suggest that there are six core job site organization roles with FTE > 1.0 for Owners, and 16 such roles for Contractors. Owner job site staffs are dominated by the management functions of quality, coordination, and commissioning; while Contractor job site staffs are dominated by the functions of field engineering, quality, materials management, safety, craft superintendents, procurement/supplier coordination, and area superintendents. Staff support for the four Contractor roles of area superintendent, craft superintendent, HSE management, and QA/QC management are generally scalable – or correlated with project size.

Two-thirds of the projects examined entail the outsourcing of job site staff functions by Owners, and this approach appears to be a growing trend. The amount of outsourcing for these projects ranged from seven percent to 92 percent. Contractor project managers have a mixed opinion on their level of satisfaction with outsourced Owner staff.

Projects with larger Owner and Contractor job site staffs appear to be safer than those projects with smaller staffs. Both Owners and Contractors should ensure that their management staffs are sufficient to promote worker safety.

Association trends have been analyzed for those projects that perform better-than-average with smaller-than-average job site teams. Success-enabling factors appear to be trust growth between Owner and Contractor, thoroughness of definition of team roles, higher quality of technical documents, thoroughness of change management, thoroughness of start-up planning, thoroughness of constructability planning, and thoroughness of front-end planning, among others. Thus, there appear to be links between team effectiveness and implementation of CII best practices.

It is believed that job site organization approach can play a key role in helping achieve project success – at a time when there's little tolerance for underperformance. Thus, it is important to understand both quantitative and qualitative dimensions of job site organizations and their links with project performance.

# **CH 1. Introduction**

## **1.1. Background**

Job site management functions and associated staffing levels among both Owners and Contractors have increased in number and complexity over the past 30 years in response to the demands for greater levels of job site planning and performance oversight. For example, there's much greater effort directed now toward safety management, and cost and schedule controls efforts have grown in complexity. Such changes have been influencing the structure and makeup of job site management teams.

Job site management teams are being structured in a wide variety of ways – with different implications on performance. For example, there's growing use of the Owner-managed approach, and Owners are involving greater numbers of contract personnel to supplement their management staffs at the job site.

However, there is little published guidance or clarity on job site organization metrics or approaches. In fact, job site organization benchmark information remains mostly closely held at the company level. As a result, this information is generally not well understood at either the project or industry levels.

It is believed that job site organization approach can play a key role in helping achieve project success – at a time when there's little tolerance for underperformance. Thus, it is important to better understand quantitative and qualitative dimensions of job site organizations, their links with project performance, and the mechanics of improving project performance by better job site organization staffing strategies.

## **1.2. Purpose and Hypotheses of the Research**

The primary purpose of this research was to better understand why and how some approaches to job site organization are more effective—or more responsive to project needs and objectives. Therefore, it is crucial that industry norms pertaining to job site management functions and staffing levels should be identified, especially those norms that provide the best value for different types of projects under different circumstances.