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THE TIER I WORKFORCE
MANAGEMENT STRATEGY:
CONCEPT AND APPLICATION

THE UNIVERSITY OF TEXAS AT AUSTIN

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Research Report 182-11

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THE TIER I WORKFORCE MANAGEMENT STRATEGY:
CONCEPT AND APPLICATION

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

Under the Guidance of
CII Project Team 182
Addressing the Shortage of Skilled Craft Workers

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Executive Summary

Shortages of skilled craft workers continue to plague the construction industry. Employers have attempted to identify the root causes and to develop strategies to overcome these shortages. The Construction Industry Institute (CII) and others have funded research on the problem and generated potential solutions. The industry now uses, although sporadically, a number of initiatives including craft and supervisory training, multi-skilling, and self-directed work teams as well as productivity enhancements utilizing technology, constructability, and prefabrication. Efforts to quantify or qualify the resulting benefits, however, have been unsatisfactory.

Despite this research and the efforts to stem the problem, the construction industry's skilled worker pool continues to shrink. The decreasing number of young people entering the work force and the failure to recruit from non-traditional labor pools both contribute to this troublesome trend. Over the past thirty years, real wages of construction workers have declined relative to those of other workers. Poor industry image, tough working conditions, and the industry's perceived poor safety record (despite the stellar performance in safety by CII members) also have contributed to the decline in the number of people willing to enter and remain in the industry.

In 2001, CII commissioned PT182-Addressing the Shortage of Skilled Craft Workers in the U.S. to conduct a study on recruiting and retaining qualified craft workers. Based upon its examination of the industry, the project team concluded that:

- The journey-level work force includes as many high school graduates as the rest of the U.S. population.
- The construction industry is failing to attract women and minorities.
- The construction work force can be characterized as two divergent work forces: one that is satisfied with the work and is willing to participate and improve skill levels; and a second that is transient, unsatisfied, and will quickly leave the industry when other opportunities arise. These two work forces have vastly different characteristics and need to be managed accordingly, thus there is a need for two different work force management strategies.
- The skilled workforce shortage must be addressed as both a supply and a demand problem.
- Currently the industry is not utilizing any formal, structured work force management strategies, nor does it have a way to measure the success of its current management practices.

PT 182 found a particular interest in a recent collaboration between CII and the Center for Construction Industry Studies (CCIS). That study produced a theoretical model for a revolutionary new way to address the issue in a more comprehensive manner. Although the method, called “Tier II,” is new and future-oriented, it may have a considerable impact on the construction work force and industry.

PT 182 developed a complimentary strategy to Tier II to address the work force shortage: Tier I. It is based on the concept that productivity gains from optimal management of the work force will relieve pressure on demand and will encourage workers to remain on a project and in the industry. These productivity gains will be achieved by applying training, collaboration, and the use of technology in a systematic

way to maximize the effectiveness of the front-line supervisors. Tier I proposes that the cohesive, structured implementation of industry accepted best practices will improve the management and utilization of the work force. It is anticipated that this will lead to improved productivity, reduced absenteeism and turnover, and eventually to overall project success.

It is important to note that the focus for Tier I is on the management and supervision of the work force on a project. Explicitly choosing a work force management strategy in early project planning stages should allow for systems to be put into place, recruitment to be focused, and crews to be structured in a way that will result in better project performance.

As pointed out, the Tier I Strategy is not new and it is not revolutionary. It is, however, a comprehensive combination of many of the construction industry's best practices associated with workforce management. It is important for the industry to move away from emergent strategies and adopt more deliberate, structured strategies.

This research has the potential to increase awareness in the industrial construction industry for the need for a workforce assessment process that drives a workforce development strategy. It is probable that the metrics developed in this research could be used as the forerunners for workforce management metrics that drive industry improvement the way safety metrics have driven improvements in safety in many CII member companies in the last 15 years.

This research also presents one of the most thorough examinations of the characteristics of the journey-level and supervisory workforce in the construction industry. This information should help to dispel some of the common assumptions of the workforce, assisting industry leaders in the recognition of strategies that will best address the realities of that workforce.

Implementing a Tier I or Tier II Work Force Management Strategy will require management commitment. Part of this commitment is the utilization of the Tier I and Tier II Metrics that help to evaluate the implementation of these strategies. Implementation guidelines and a Work Force Assessment Package have been developed and are discussed in this document.

Acknowledgements

The completion of this report is due to the collaboration of many people in the industrial construction industry, in academia, and through CII. We would like to thank those who have been the forerunners in the pioneering of the Two-Tier Strategy: Dr. Richard Tucker, Dr. John Borcharding, and the other members of the CCIS Workforce Research Team. We would also like to thank the other students that have been involved in this research effort particularly Jorge Castañeda, Mike Pappas and Issam Srour.

We are thankful for all of the companies that participated in the research effort and whose contributions to the Construction Industry Institute have made this effort possible. Last, but certainly not least, we would like to thank the members of Project Team 182 for their continued support, input, and participation in this research effort. Through this unique combination of individuals and corporations, this research was able to evolve into the tool that it now has become.

Table of Contents

List of Tables	x
List of Figures	xii
Chapter 1: Introduction	1
1.1 Introduction to the Tier I Strategy	1
1.2 Research Objectives and Hypothesis	3
1.2.1 Research Objectives	3
1.2.2 Hypothesis	4
1.3 Research Scope	4
1.4 Research Methodology	5
1.5 Document Organization	6
Chapter 2: Background	8
2.1 The Construction Industry	8
2.2 The Construction Labor Market	9
2.2.1 Construction Employment	9
2.2.2 Demographics	11
2.2.3 Employment Projections	13
2.2.4 The Labor Shortage	13
2.3 Related Previous Studies	15
2.3.1 The Construction Industry Cost Effectiveness Project	15
2.3.2 Determining the Root Causes of the Shortage	17
2.3.3 Recruiting and Training the Workforce	17
2.3.4 Employment Linkage Programs	18
2.4 Strategic Management of Human Resources	19
2.4.1 Human Capital Programs	20
2.4.2 Supervisors as Human Capital	23
2.4.3 Human Capital and the Construction Industry	24

Chapter 3: Methodology	26
3.1 Research Design.....	26
3.2 Development of the Tier I Workforce Strategy Metrics	26
3.2.1 The Tier I Metrics	27
3.2.2 Project Average Work Skills Index	27
3.2.3 Information Technology Utilization Index	28
3.2.4 Craft Utilization Index	29
3.2.5 Project Communication Index	30
3.2.6 Management Structures Index	30
3.2.7 Tier I Project Index Score	31
3.3 Data Collection Methods	32
3.3.1 Survey Instruments	32
3.3.2 Fieldwork Procedures	33
3.3.3 The Microsoft Access© Database	35
Chapter 4: Baseline Data Analysis	38
4.1 Description of Projects Studied	38
4.1.1 Brief Description of Projects	39
4.1.2 Project Scores.....	43
4.2 Worker Demographics	47
4.3 Competency of Supervisors	57
4.3.1 Continuous Training and Education	60
4.3.2 Computer Skills	64
4.3.3 Planning Skills	66
4.3.4 Job Management Skills	67
4.3.5 Willingness and Receptiveness of Supervisors.....	68
4.4 Construction Phase Success Indicators	69
4.4.1 Construction Phase Success Index.....	70
4.4.2 Interim Success Indicators	71
Chapter 5: Implementation of the Tier I Strategy	73
5.1 The Tier I Project Baseline	73

5.2	Level of Effort Required For Implementation of Tier I.....	74
5.2.1	Project Average Work Skills	75
5.2.2	Information Technology Utilization Index	76
5.2.3	Craft Utilization Index	78
5.2.4	Project Communication Index	79
5.2.5	Management Structures Index	80
5.3	Return on Investment- A Benefit/Cost Analysis	82
5.3.1	Estimation of Program Costs	82
5.3.2	Estimation of Program Benefits.....	87
5.3.3	The Benefit-Cost Ratio and Return on Investment.....	90
5.4	Basic Implementation Guidelines	91
5.4.1	Stage 1: Clarification	94
5.4.2	Stage 2: Assessment.....	95
5.4.3	Stage 3: Design	96
5.4.4	Stage 4: Implementation	96
5.4.5	Stage 5: Monitoring	97
Chapter 6:	Conclusions and Recommendations	99
6.1	Review of Research Objectives and Conclusions.....	99
6.2	Recommendations.....	100
6.3	Contributions.....	101

Appendix A: Tier I Workforce Management Strategy Metrics	103
Appendix B: Survey Tools Used in Data Collection Process.....	108
Appendix C: Sample Project Report.....	119
Appendix D: Regression Analyses for Supervisor Competency	128
Appendix E: Tier I Project Baseline Scores	132
Appendix F: Sample Foreman Delay Survey and Report.....	134
Appendix G: Workforce Assessment Package	138
Appendix H: Suitability Chart	145
References.....	147
Project Team Participants	153

List of Tables

Table 1.1:	Basic Characteristics of the Tier I and Tier II Strategies.....	2
Table 2.1:	Occupational Classification and Distribution in Construction	10
Table 2.2:	Top Challenges Facing Owners (Percent of Respondents).....	14
Table 2.3:	The Human Capital Appraisal™ Process.....	21
Table 3.1:	Tier I Index Score	31
Table 3.2:	Time Commitments for Each Project Visit.....	34
Table 4.1:	Project Descriptions	39
Table 4.2:	Tier I Project Scores and Averages.....	45
Table 4.3:	Highest Education Level Attained (Percent of Respondents).....	50
Table 4.4:	Training Participation	55
Table 4.5:	Average Supervisor Score on Tier I Supervisory Skills Metric	60
Table 4.6:	Highest Education Level Attained (Percent of Respondents).....	63
Table 4.7:	Types of Computer Training Received.....	64
Table 4.8:	Percent of Supervisors with Proficiency in Computer Skills.....	65
Table 4.9:	Training, Certification, and Proficiency in Planning Skills.....	66
Table 4.10:	Job Management Skills Training, Certification, and Proficiency.....	67
Table 4.11:	Willingness of Supervisors to Receive Training	69
Table 4.12:	Construction Phase Success Score Components.....	71
Table 5.1:	The Tier I Project Baseline	74
Table 5.2:	Staffing Levels for BCR Analysis	84
Table 5.3:	Training and Proficiency Testing Cost Estimates.....	85
Table 5.4:	Information Technology Cost Estimate	86
Table 5.5:	Program Administration Estimate.....	86

Table 5.6:	Total Estimated Benefits.....	88
Table 5.7:	Productivity, Absenteeism, and Turnover Savings Estimates	88
Table 5.8:	Other Savings Estimates	88
Table 5.9:	Benefit-Cost Ratio and ROI Calculations.....	90
Table C.1:	Regression Statistics for Craft Training.....	129
Table C.2:	Regression Statistics for Planning Skills Training.....	130
Table C.3:	Regression Statistics for Management Skills Training.....	131
Table D.1:	Tier I Project Baseline Scores.....	133

List of Figures

Figure 1.1: Locations of Volunteered Projects.....	5
Figure 2.1: Average Age of Workers 1980-2000	11
Figure 2.2: Distribution of Female Construction Workers.....	13
Figure 2.3: Strategy Relationships	24
Figure 3.1: Project Average Work Skills Index	28
Figure 3.2: Information Technology Utilization Index	29
Figure 3.3: Craft Utilization Index	29
Figure 3.4: Project Communication Index	30
Figure 3.5: Management Structures Index	31
Figure 3.6: Individual Skills Assessment Form	36
Figure 3.7: Background Questionnaire Form.....	36
Figure 3.8: Project Management Practices Questionnaire Form.....	37
Figure 4.1: Industry Sectors	38
Figure 4.2: Box Plot of Two-Tier Project Indices	46
Figure 4.3: Tier I Index Scores by Project ID	47
Figure 4.4: Respondents' Country of Origin.....	49
Figure 4.5: Age of Workers Interviewed by Position.....	51
Figure 4.6: Satisfaction Rating Responses (in Percent of Respondents).....	52
Figure 4.7: Salary Earned in Construction Last Year by Position	53
Figure 4.8: Hours of Craft Skills Training Received Each Year.....	54
Figure 4.9: Box-and-Whisker Plot of Craft Experience by Position.....	56
Figure 4.10: Percentage of Rehired Employees	57
Figure 4.11: Tier I Supervisory Skills Score Metric	59

Figure 4.12: Histogram of Supervisors Receiving Craft Training	61
Figure 4.13: Histogram of Supervisors Receiving Planning Skills Training	62
Figure 4.14: Supervisors Receiving Management Skills Training.....	62
Figure 4.15: The Construction Phase Success Index Concept.....	70
Figure 4.16: Absenteeism and the Tier I Project Score.....	72
Figure 5.1: Flow Diagram for Implementation of Tier I on a Project.....	93
Figure 5.2: Flow Diagram for Implementation of Tier I on a Pilot Project	94
Figure C.1: Regression Plot of Craft Experience and Craft Training.....	129
Figure C.2: Regression Plot of Planning Skills Training and Experience	130
Figure C.3: Regression Plot of Management Training and Craft Experience ...	131

Chapter 1: Introduction

1.1 INTRODUCTION TO THE TIER I STRATEGY

The construction industry in the United States has been plagued with shortages of skilled labor for at least the last thirty years. While the problem may be alleviated at times by economic recessions, the framework behind the shortage has not changed and will continue to impact the industry if the status quo remains. The impact and severity of the shortage is cyclical and may be limited to certain regions and crafts. The reasons behind the shortage are numerous, ranging from a poor image of the industry, to declining real wages, to poor work environments and the lack of a stable worker career path. Incentives and wage increases represent some of the solutions used to address the situation but are difficult to sustain without a comprehensive, long-term strategy to support them. Many organizations such as the National Center for Construction Education and Research (NCCER), the Construction Industry Institute (CII), the Center to Protect Workers' Rights (CPWR), and the Construction Users Roundtable have recognized the shortage as a critical problem and are promoting the need for immediate action.

There are two primary ways to address the skilled shortage problem: supply versus demand. The first method involves increasing the supply of skilled workers through improving the image of construction, recruitment, and training. This has been the traditional approach to the problem of the shortage. Another means of addressing the shortage, however, has not been extensively explored in any coordinated manner and involves reducing the demand for the skilled labor by improving the productivity and retention of the current workforce. Either attempt at addressing such a large, complicated problem must involve a long-term comprehensive strategy.

A revolutionary workforce management approach is needed within the construction industry to address the underlying issues of the skilled workforce shortage

while encompassing management strategies at all project levels. The Center for Construction Industry Studies (CCIS) at the University of Texas at Austin has proposed a Two-Tier Workforce Management Strategy. It is comprised of two workforce management strategies: Tier II, which was developed by CCIS; and Tier I, which was developed through CII. Tier II is revolutionary and future oriented, designed to improve workers' skills and productivity creating a situation where the value of the workers is increased (Borcherding et al 2001). The goal of this increased value is increased wages and longer careers in the industry. It utilizes workers with some management skills and responsibilities, High Performance Work Teams, and increased utilization of Information Technology. The other strategy, Tier I, is designed to efficiently manage the existing workforce, regardless of its skill level. The focus is on organization, communication, and utilization of field management. Both of these strategies focus on reducing the demand for the skilled labor by improving overall productivity on the site and retaining the current workforce. The basic characteristics of Tier I and Tier II are listed in Table 1.1.

Table 1.1: Basic Characteristics of the Tier I and Tier II Strategies

Tier I	Tier II
Highly skilled front-line supervisors in all crafts	Highly skilled journey-level workers in key crafts
Single-craft journey-level workers	Multi-crafted journey-level workers
No pay differential to workers for skill	Workers are paid a higher wage for their higher skill level
Traditional, top-down management structure	Pro-active, horizontal management structure
Strong communication between supervisors and project managers	Strong communication between journey-level workers and project managers
Information Technology used extensively at supervisor and project management level	Information Technology used extensively at all levels
Large labor pool available (possibly unskilled)	Skilled labor pool available
Management, Computer, Planning training available to supervisors only	Management, Computer, Planning training available to journey-level workers
Task training available to all workers	Craft training available to workers
Traditional hierarchical work environment at crew level in all crafts	High Performance Work Teams utilized at the crew level (for key crafts)

The Tier I Strategy is not new or revolutionary, yet it is a comprehensive management strategy that focuses workforce management. The focus for the Tier I strategy is on the management and supervision of the project. Supervisors (foremen, general foremen and superintendents) are required to have strong management abilities to effectively coordinate and manage their crews. Upper-level management must focus on comprehensive planning, procurement, and scheduling to maximize the opportunity for success. The goal of the Tier I strategy is to improve short-interval planning, improve workforce retention, and improve the overall productivity and success of the project. Explicitly choosing a workforce management strategy in the early project planning stages should allow for systems to be put into place, recruitment to be focused, and crews to be structured in a way that will result in better project performance.

Metrics must be developed to effectively facilitate and measure the implementation of the Tier I Strategy. This research will propose the metrics for the implementation of the Tier I Workforce Management Strategy as well as analyze the feasibility of the strategy from baseline data collected as part of this study. The key motivation of this research is to provide potential implementers of this strategy with the knowledge of the level of effort required and a guide for targeting training efforts.

1.2 RESEARCH OBJECTIVES AND HYPOTHESIS

1.2.1 Research Objectives

The Tier I Workforce Management Strategy emphasizes the proficiency and training of front line supervisors as well as the management, communication, and technology utilization at all levels of the project. This research effort focuses on gathering and analyzing the skills of the supervisors (foremen, general foremen, and superintendents) as well as their profile data to provide information on the current level

of competence of the supervisory workforce. This research also seeks to benchmark the current status of the industry with regards to current workforce management strategies and to determine the effectiveness of the Tier I strategy and its ability to address the construction workforce shortage. The three primary objectives of this research are proposed as follows:

1. Develop a database for the facilitation of the baseline data collection and analysis.
2. Determine the current level of competence of the construction workforce and the competence of the front-line supervisors through descriptive analysis of baseline data.
3. Evaluate the current status of workforce management strategies and the feasibility, validity, and possible effectiveness of the Tier I Strategy.

1.2.2 Hypothesis

To adequately achieve the objectives outlined above, a hypothesis summarizing the intent of the research was needed. In this case, it was anticipated that a structured workforce management strategy is better than no strategy at all. The structured strategy must be feasible and it must be practical to implement in the field. Therefore the hypothesis for this research endeavor is as follows:

Hypothesis: A structured construction workforce management system can be developed that will be feasible, practical to implement, and will produce measurable benefits to the project.

1.3 RESEARCH SCOPE

This research study is limited to the industrial sector of the construction industry within the United States and the crafts related to that industry. The projects visited for the baseline data collection process are volunteered by owners or construction companies

which are members of the CII or whose participants serve on the Steering Committee of the CCIS. The baseline data includes 19 maintenance, capital facility, and grass-roots construction projects in Arizona, Alabama, Florida, Ohio, South Carolina, Tennessee, Texas, Virginia, and West Virginia (Figure 1.1).

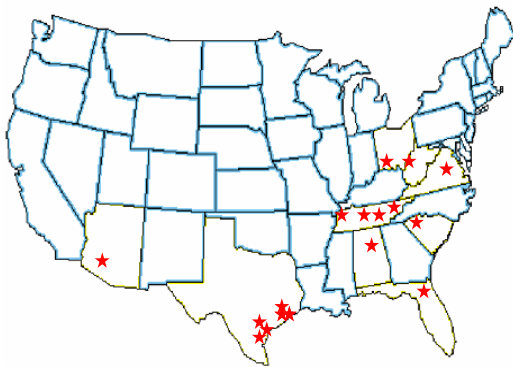


Figure 1.1: Locations of Volunteered Projects

The data includes projects from most of the major industry sectors within industrial construction such as chemical process, food processing, manufacturing, petrochemical, pharmaceutical, and power generation and transmission. The data is considered to be representative of the projects in the industrial sector of the construction industry.

This baseline data has been collected for the use of the Two-Tier Workforce Thrust at the University of Texas at Austin. This research will focus on the development and feasibility analysis of the Tier I Strategy as defined by the research objectives. There is much more possible analysis of the data gathered, which will be used for other theses and reports and will not be attempted in this research.

1.4 RESEARCH METHODOLOGY

The Tier I Strategy is defined by metrics that represent the ideal goal of the strategy without prescribing the methods of implementation. The Tier I Strategy Metrics

are based on those that were developed for the Tier II Strategy (Chang 2002). With the input of industry leaders from CII, the Tier I Metrics were formulated and refined.

To validate the metrics and analyze their feasibility and effectiveness on a project, data needed to be collected. For the baseline data collection, convenience sampling is used to survey the workforce from volunteered projects. The process is not a random sampling process, but can be considered similar to data obtained through cluster sampling (Castañeda-Maza 2002).

Three separate survey tools are used in the collection of baseline data. Two collect data at the worker and front-line supervisor level while the third is used to collect data from the project and field managers. All of this data is then entered into a Microsoft Access[®] database developed specifically for this purpose. The database utilizes queries and macros based on the Tier I Metrics to calculate the worker level Tier I scores as well as provide information to be used in the calculation of project level Tier I scores.

1.5 DOCUMENT ORGANIZATION

This report has six chapters. The current chapter provides an introduction to the document and the Tier I Strategy. Chapter Two presents the relevant background information regarding the construction industry, the construction labor market, other studies that have analyzed the construction workforce, and the basic elements of a strategic human resource program and provides a summary of the literature for each of those areas. Next, in Chapter Three, the methodology for collecting and analyzing the research data is presented. Then, Chapter Four summarizes the data analysis that was done based on the baseline data collected for the current construction workforce as well as the description and analysis of the projects visited in the study. Chapter Five presents the implementation factors necessary for implementation of the Tier I Workforce Management Strategy including the level of effort required for implementation, the feasibility of the strategy, a benefit-cost analysis, and identifies the basic implementation

guidelines. Finally, Chapter 6 summarizes the conclusions and recommendations of this research and describes the potential impact that this research may have on the industrial construction workforce and industry.

Chapter 2: Background

Understanding the circumstances that lead to the development of the Tier I workforce management strategies, its current status, and the elements of its metrics are important in grasping the contribution of this research and the impact of the Tier I Strategy in addressing the workforce shortage. Howard (2001) and Chang (2002) present documentation on the background of the Tier II research program from which the Tier I Strategy originated. Those documents also present related previous efforts addressing the problems of the industry's poor image, the lack of a worker career path, and low real wages. The focus of this research is to present the current indicators of the construction industry, the construction workforce and its current shortages, and other strategies that are relevant to the Tier I Workforce Strategy and its implementation.

2.1 THE CONSTRUCTION INDUSTRY

The construction industry is a large and growing part of the United States economy. In 2000, construction produced 4.7% of the Gross Domestic Product (GDP). This is the highest in almost a decade and an increase from 4.1% in 1997. The total dollar value of construction establishments in 1997 (the latest published Economic Census) was \$945.7 billion. This is an increase of 63% from \$581.6 billion in 1992, not adjusted for inflation (CPWR 2002). Between 1976 and 2001, the annual value of total construction put in place as measured in real dollars increased by almost 62%, representing an approximate annual compounded rate of improvement of two percent (Goodrum 2003).

The total number of establishments increased over 30% from 1992 to 1997, now totaling 2.55 million (CPWR 2002). Most of these companies are small. Construction establishments with 1 to 9 employees comprise 81% of all establishments, yet they only

employ 27% of the workforce. The establishments employing the greatest percentage of the workforce, 33.9%, employ 20 to 99 people.

2.2 THE CONSTRUCTION LABOR MARKET

Understanding the demographic, employment, and industry specific characteristics of the current labor market is critical to any effort to address the shortage of skilled labor within that industry. The Center to Protect Worker Rights (2002) compiled much of this information from sources such as the US Bureau of Labor Statistics (BLS), the US Bureau of Commerce, and the Census 2000.

2.2.1 Construction Employment

The construction industry currently employs 9.4 million people (Jacobs 2001) including all positions within the industry and all sectors of the industry. Over 7.3 million people are employed in production occupations (Jacobs 2001) as seen in Table 2.1. Construction employment represents approximately 7% of the over 135 million employed civilians over the age of 16 in the United States (Jacobs 2001).

Table 2.1: Occupational Classification and Distribution in Construction¹

Label	Descriptions	Number (thousand)	Percent
Manager	General manager, supervisor & professional	1,299	16.0
Carpenter	Carpenter & apprentice	1,287	13.8
Laborer/helper	Laborer, helper, mechanic/repair, freight, stock handler, material handler/bagger	1,078	11.5
Foreman	Supervisor who can't be classified by occupation	750	8.0
Electrical	Electrician, electrical worker, incl. supervisor/apprentice	643	6.9
Painter	Painter, paperhanger, plasterer, incl. supervisor/apprentice	620	6.6
Adm. support	Support staff	591	6.3
Plumber	Plumber & pipe fitter, steamfitter apprentice	431	4.6
Op. engineer	Operating engineer, including supervisor	378	4.0
Heat A/C mech.	Heat & air conditioning mechanic	231	2.5
Bricklayer, mason	Bricklayer, stone mason, including supervisor & apprentice	230	2.5
Drywall	Drywall installer & taper	209	2.2
Roofer	Roofer	196	2.1
Truck driver	Truck driver/motor transport, including supervisor	182	2.0
Const. nec.	Construction trades except supervisor	172	1.8
Repair	Repair & mechanic	169	1.8
Concrete	Concrete & terrazzo finisher	90	1.0
Carpet layer	Carpet layer	97	0.9
Welder	Welder, cutter, solderer & brazer	84	0.9
Tile	Tile setter	82	9.9
Ironworker	Structural metal worker	69	0.7
Sheet metal	Sheet metal worker & sheet metal duct installer	58	0.6
Insulation	Insulation worker	40	0.4
Glazier	Glazier	26	0.3
Elev. constructor	Elevator installation construction	17	0.2
Boilermaker	Boilermaker	8	0.1
Other	Includes extraction, driller, millwright, rail/water trans., machine, plant/sys op.	110	1.2
Total		9,351	100.0

¹ Based on workers 16 years of age or older, Source: The Construction Chart Book (CPWR 2002)

2.2.2 Demographics

The average age for the construction workforce is 37.2 years according to the Center to Protect Worker Rights (2002). This is slightly less than the average for all industries, 38.6 years, although both averages have been steadily increasing since the late 1980s as indicated in Figure 2.1. The average age of the US population has also been increasing, changing the demographics of the total workforce. The basic effects of this change include a “sharp reduction in the traditional entry-level workforce (eighteen to twenty-five years of age) lasting through 2005 and probably beyond and an increase in the proportion of workers in their mid-career years” (Greller and Nee 1990).

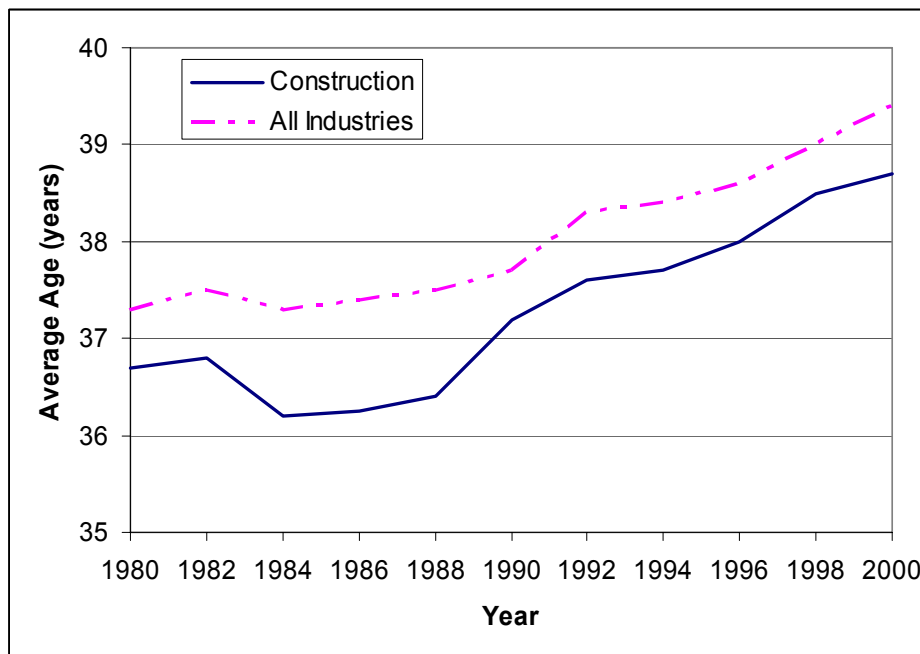


Figure 2.1: Average Age of Workers 1980-2000²

The average age within the construction industry varies from trade to trade with managers being the oldest and drywall installers being the youngest. Hispanic workers, who make up 17% of the construction workforce, also tend to be younger than non-

² Source: The Construction Chart Book (CPWR 2002)

Hispanic workers. They are, on average, 5 years younger than non-Hispanic workers with an average age of 33 years (CPWR 2002). The Center to Protect Worker Rights (2002) found that members of racial minorities (all racial groups except “white”) were underrepresented in the construction industry. The percentage of racial minorities in construction is only 10%, which is less than the percentage for all industries, 17%. It is important to note that the Current Population Survey, the source of this information, characterizes “race” (based on physical characteristics) separately from ethnicity (cultural, linguistic, or national-origin traits). So, people of Hispanic origin may or may not be included in racial minorities. The BLS projects that the Hispanic labor force will increase faster than other groups, at a rate of 36 percent due to high immigration and fertility (BLS 2001). The black labor force is expected to increase 21% by 2010, more than twice as fast as the 9% growth rate for the white labor force.

Women comprise approximately 47% of employees in all industries in the United States. They account for only 9% of construction occupations, however, and only 2.5% of all production occupations. In 2000, of the women who were employed in the construction industry, approximately 47% held clerical or support positions as shown in Figure 2.2. The labor force participation rates of women in almost all age groups are projected to increase and the total share of women in the labor force is projected to grow to 48% in 2010 (BLS 2001).

Women and minority groups represent a large labor pool from which the construction industry is not adequately drawing. “Unless there is a fantastic increase in productivity, construction will have to recruit workers from outside its traditional labor pool” (Grogan 2000).



Figure 2.2: Distribution of Female Construction Workers³

2.2.3 Employment Projections

The Monthly Labor Review (2001) estimates that employment in construction trades will increase 13.3% from 2000 to 2010, representing a total of 2.1 million job openings due to growth and net replacements. The BLS predicts that total employment over the same period (2000-2010) is projected to increase 15%, slightly less than the 17% growth during the previous decade (BLS 2001). In a press release on December 3, 2001 the BLS indicated, “The service-producing sector will continue to be the dominant employment generator in the economy, adding 20.5 million jobs by 2010. Within the goods-producing sector, construction and durable manufacturing will contribute relatively modest employment gains.”

2.2.4 The Labor Shortage

The shortage of skilled labor is not unique to the construction industry. It is a cyclical process that has affected many, if not all, industries at some point in time. In 1865, the Central Pacific Railroad Company experienced a labor shortage when many of its skilled workers left for Nevada during a silver rush (Emord et al 2003). In the early part of last century the answer to skilled worker shortages was to attract more European immigrants with their Old World training and experience (Fiori 2003). The current

³ Source: The Construction Chart Book (CPWR 2002)

shortage will continue to affect the industry for many years to come as well. The Bureau of Labor Statistics (2002) projects that by the 2010 there will be a need to replace 1,469,000 construction trade worker jobs. There were not enough children born between 1990 and 1995 to fill these voids and since 1967, there has been a zero-growth birth rate in the United States.

A 1997 study conducted by the National Center for Construction Education and Research (NCCER) found that 92% of national construction firms reported shortages of skilled labor. Of the firms reporting shortages, 85% felt as if their current workforce was not as skilled as it should have been (Shelar 1998). An FMI report (2002) surveyed owners in the construction industry and found that 43% of respondents indicated “overcoming labor shortages” as the most difficult of the top challenges facing owners (Table 2.2).

Table 2.2: Top Challenges Facing Owners (Percent of Respondents)⁴

Top Challenges	Least Difficult (1)	(2)	(3)	Most Difficult (4)
Meeting budgets	0	14	14	71
Meeting Schedules	0	35	21	43
Overcoming labor shortages	7	21	36	43
Finding the right construction managers/general contractors	7	21	36	36
Finding the right architects/engineers	7	64	14	14
Achieving a quality end product	7	57	21	14
Satisfying end users	7	43	43	7

Engineering News Record (ENR) published an article in October of 2000 entitled “The Dilemma of Good Times: More Work, Fewer Workers.” It was written during a period of economic growth for both the U.S. economy and the construction industry. During this time, young people were no longer forced to take a job because they had to; they were able to go for the jobs that they wanted. “That makes it construction’s

⁴ Source: The 2002-2003 U.S. Markets Construction Overview

challenge to encourage these young people to consider work in [the] industry” (Grogan 2000). Traditionally, the group of 16 to 24 year olds has been the source of new workers for the construction industry. This group is shrinking and employers will have to reach into the ranks of the non-traditional workers and those who may be less qualified to find their entry-level workforce (Carnevale 1990).

2.3 RELATED PREVIOUS STUDIES

The construction industry’s skilled labor shortage is a topic that has been well documented in the literature and many attempts to address the supply side of the problem have been discussed. William Maloney is one of the experts in documenting the shortage and analyzing its root causes. Maloney has examined the shortage from the perspective of the decline of the unions (1995) and in terms of strategic planning for human resource management (1997). A study published in March of 1993 by Federle et al predicted the current issues in the construction workforce shortage that are being experienced today. This study cited research by Johnston and Packer (1987) that by the year 2000, “The workforce will be growing more slowly, the average age of the workforce will rise, the pool of young workers entering the labor market will shrink, more women will enter the workforce, minorities will be a larger share of the workforce, and immigrants will increase in number.”

2.3.1 The Construction Industry Cost Effectiveness Project

The Business Round Table conducted a series of studies in the early 1980s on improving the cost effectiveness of the construction industry. The construction workforce was a significant part of those studies. The Construction Industry Cost Effectiveness Project (1983) indicated that under-trained supervisors and de-motivated workers were two major problems in the construction industry.

The CICE project found that for supervisors the missing element was not technical skills but “too little schooling in such supervisory techniques as communicating with workers and planning their work.” The common subjects that were determined necessary for supervisory training include: planning, organizing the work, scheduling, safety, quality control, directing and coordinating, material control, human relations, motivation, leadership, effective communication, and problem solving/ method improvement. The report indicated that training programs for supervisors could be reasonably expected to generate a return on the investment of at least three to one. The importance of supervisors’ training is reflected in their ability to impact the productivity of their crews. “Foremen (and their supervisors, general foremen) control, influence, or have the greatest impact on most of the ingredients of productivity.” The report found that the inability of supervisors to plan work, communicate with workers and direct work activities adequately was an “important contributor to declining cost effectiveness in construction.”

The de-motivation of construction workers was also found to be a significant contributor to decreasing productivity in construction. This is evident through absenteeism and turnover, two endemic causes of poor productivity. In a survey of over 1000 craft workers on 8 large industrial construction projects, the reasons for missing work that were most often recorded were: unsafe working conditions, excessive rework, lengthy travel to and from the job site, and poor craft supervision. The most frequent reasons for quitting a job were: relationship with boss, overtime availability at another job, poor craft supervision, and sloppy overall job management. The CICE report did suggest ways that these problems could be combated: “We have a bright, well-educated an independent workforce. This new workforce demands reforms in the traditional rigidities of construction organization and changes in levels of responsibility and authority, supervisory roles, communication networks, interpersonal relationships and

reward systems.” These concepts are at the heart of the Tier I workforce management system that is presented in this research.

2.3.2 Determining the Root Causes of the Shortage

There have been numerous studies by CII, CCIS, and NCCER on the causes of the shortage and many have attempted to discuss solutions to the shortage. This research will not focus on the results of these studies but does recognize that the causes of the shortage are important in developing a strategy to address the shortage. Some of the reasons for the shortage are summarized in this literature review and have been incorporated into the elements of the Tier I Strategy.

A study conducted at the University of Florida summarized many of the causes of the shortage and proposed a solution to that shortage (Chini et al 1999). This study indicated that the shortage of skilled labor was due primarily to changes in vocational education and technology as well as a shift toward open shop contracting. The solution suggested included a strategy to retain the workers currently employed in the industry and to improve the education and training system within the industry.

2.3.3 Recruiting and Training the Workforce

Recruiting workers to the industry and providing training are major components of NCCER’s strategy as well as those of other organizations. Arthur Coia (1997) of the Laborers’ International Union of North America (LIUNA) described the efforts of LIUNA to recruit and train its members and provide them with a “safe, secure, and prosperous future in construction.” According to Coia, LIUNA has established 69 training centers and trains approximately 50,000 workers each year. Those workers have the opportunity to learn about every aspect of the construction industry from building bridges or tunnels, to supervising workers or planning projects. Their mantra is “We help build careers.”

The “Construction Career Days” program was created in 1999 by four men from Lewisville, Texas (Fiori 2003). It introduced about 1,300 students and their parents to the careers available in the construction industry. In 2001, the program had reached 26,000 students at sixteen events in seven states.

The United Brotherhood of Carpenters trains 100,000 craft workers each year and has 180 training centers across the United States (ENR 2001). Babbock and Wilcox developed a training development strategy called ADDIE (Buzzard 1997). ADDIE stands for Analyze, Design, Develop, Implement, and Evaluate and addressed training as an investment for the company.

Dan Bennett (2003) one of the founders of NCCER, has begun a training program for workers based on the idea of “earn while you learn.” Six schools are currently operational and more are scheduled to open. The program is comprised of two parts. The first, “boot camp,” is an intensive eight hours a day training session for one month. Once the students have completed boot camp they receive assistance in finding employment and begin working in the trade for which they have been trained. After the program is completed, the student will be working at a level just under journey-level and, with on the job training, would be able to advance quickly to journey-level positions.

These are just a few of the many training and recruiting programs and initiatives that have been developed across the country. There is still a problem, however, of sustaining these programs and encouraging workers to participate in them. There seems to be an underutilization of the programs and an underinvestment by the workers in their own training. For more people to participate and benefit from these programs, there needs to be a reward system in place that encourages participation in training and workforce development programs.

2.3.4 Employment Linkage Programs

Linking workers with employers is an important aspect of any strategy attempting to address the skilled workforce shortage. “Linkage [programs] are formal contractual

relationships between employers and training providers that exist for the purpose of providing job-specific training to a targeted group of employees” (Carneval et al 1990). The Casey Jobs Initiative is an eight year, \$30 million effort to reform the labor market of poor neighborhoods in six cities: Milwaukee, New Orleans, Philadelphia, St. Louis, and Seattle (Hinds 1997). The poor, often inner city, neighborhoods in the United States have much higher unemployment rates and represent a pool of workers from which the construction industry can draw. In fact, there are construction training centers that have emerged from the Casey Initiative in Milwaukee and St. Louis. These centers provide training; help job seekers meet contractors and union officials; offer pre-apprenticeship and apprenticeship programs; and offer mentoring and other special support services for workers. The U.S. Department of Labor through its Employment and Training Administration has investigated the importance of linkages to all industries. These types of programs give workers “the ability to learn a higher level skill and to continually update and learn new skills to match rapid technological changes” (Molina 1998). The construction industry has the opportunity to draw from these linkage programs and implement some of the training and employment strategies that are suggested in these documents.

2.4 STRATEGIC MANAGEMENT OF HUMAN RESOURCES

Strategic management has been widely studied in the field of Human Resources while very little has been found on its application to the construction industry. Human Resource planning is described as “an effort to anticipate future business and environmental demands on an organization and to meet the personnel requirements dictated by these conditions” (Cascio 1991). This process has four fundamental steps: forecasting labor demand and supply, setting human resource objectives, designing and implementing programs to achieve the objectives, and program evaluation and control (Duane 1996). People and people processes are a source of competitive advantage for

any company. Their skills and motivations result from an entire portfolio of “people policies, procedures, and processes which serve to train, develop and retain” (Gratton 1999). To create strong links between business strategies and human resource management, the emphasis must be on metrics that evaluate all aspects of the business strategy, not just the financial targets. Sustained competitive advantage is only achieved with effective systems of human resource management practices which “simultaneously exploit the potential for complementarities or synergies among such practices and help to implement a firm’s competitive strategy” (Huselid 1998). Research indicated that employee skills and organizational structures were negatively related to turnover and were positively related to productivity and corporate financial performance. That is to say that increased employee skills and improved organizational structures reduced turnover and increased productivity and cost effectiveness. Any human resource strategy must address the need for “changes in recruitment, education and training, teamwork and technology transfer, organizational and staffing changes, project management and cross-discipline integration, and assessment of individual skills and development needs” (Walker 1990).

2.4.1 Human Capital Programs

The field of Human Resources is rich with information on attracting and retaining human capital as well as in training and utilizing supervisors. The Human Capital Appraisal™ Process developed by three men from Arthur Andersen in *Delivering on the Promise: How to Attract, Manage, and Retain Human Capital* (Friedman et al 1998) is one tool that is very helpful in understanding the elements necessary in developing a workforce development and management strategy. Many of these elements are also a part of the Tier I process and are important in understanding the overall components of any human capital process. The Human Capital Appraisal™ Process has five primary stages: 1) Clarification, 2) Assessment, 3) Design, 4) Implementation, and 5) Monitoring. Within each stage there are five areas of human capital management: 1) Recruitment,

Retention, and Retirement; 2) Rewards and Performance Management; 3) Career Development, Succession Planning, and Training; 4) Organizational Structure; and 5) Human Capital Enablers. These are illustrated in Table 2.3. The concept behind the process is that by having an “overall sequence for measuring and enhancing human capital, and by including a full range of human capital areas in this process, companies can improve their returns on investment in this area” (Friedman et al 1998).

Table 2.3: The Human Capital Appraisal™ Process⁵

	Stage 1 Clarify	Stage 2 Assess	Stage 3 Design	Stage 4 Implement	Stage 5 Monitor
Recruitment, Retention, and Retirement					
Rewards and Performance Management					
Career Development, Succession Planning, and Training					
Organizational Structure					
Human Capital Enablers					

The Clarification stage involves an assessment of the business context and the integration of Human Resources (HR) issues in that context while beginning a company-wide communication and involvement process. The Assessment stage requires a thorough measurement of the fit, the cost, and the value of the human capital programs in the company. The cost analysis should include all direct costs in implementing and running the programs, the indirect costs created as a result of the program, and the

⁵ Source: Delivering on the Promise (Friedman et al 1988)

opportunity costs associated with the programs. The value of the programs should consider all of the impacts on performance, retention and morale, productivity, career development and succession planning, and turnover or absenteeism. The Design stage is a multiple step process that involves the assessment of needs and readiness for the program, the designation of a design team with the necessary expertise and/ or experience, and a design based on the future requirements of the company with regards to performance measurements, terms of the program, duration and structure of the program. The Implement stage involves “turning paper goals into real-time results” (Friedman et al 1998) and is where the majority of change initiatives fail. Having the right tools in place for implementation is critical to the success of the program. There must be a key sustaining sponsor, a pilot program to test the feasibility and potential of the program, training links, policy and process links, feedback, written documentation, and communication throughout the entire process. Finally, the Monitoring stage is where the new program is measured against the original goals that it was meant to accomplish. This is the stage that is most often forgotten but is the true measure of the success of a program. If the program is not meeting the goals it was intended to address, then the program must be reevaluated or discontinued.

An effective Human Resources or human capital program must have three elements: a mission and strategy, a formal structure, and human resources systems in place to facilitate the program. “People are recruited and developed to do jobs defined by the organization’s formal structure. Their performance must be monitored and rewards allocated to maintain productivity” (Fombrun et al 1984). The performance of any system is a function of all of the human resource components. The right people for the job must be selected, the employees must be adequately motivated and rewarded for their accomplishments, and those employees should be developed to enhance current performance as well as prepare them for positions they may hold in the future. The rewards that are deemed to be the most important for workers are: pay (salary, bonuses,

stock options, benefits, etc.), promotions, career opportunities, positive feedback, a personal sense of well-being for doing a job well, opportunity to learn, job securities, responsibility, and respect from co-workers (Fombrun et al 1984). Too often, companies only look at the financial costs associated with a program and do not consider all of the intransigent benefits that the employees may perceive as rewards.

2.4.2 Supervisors as Human Capital

“The key to success for any organization is good management, and the key [person] in good management is the supervisor” (George 1977). The supervisor of any group is the one responsible for the planning, organizing, staffing, and direction of that group. The supervisor must then have the skills and abilities to undertake those responsibilities. Too often, however, a supervisor is given little or no training outside of the technical training required for the work. There are other human and conceptual skills that are critical to the performance of a good supervisor. The supervisor must be able to understand and communicate with the people in the group, motivate them, be a good planner and allocator of work and able to serve as a liaison between the group and upper management.

The skills needed to be a good supervisor are different from those required of a proficient worker. Often, the best worker is the person selected to be a supervisor. This may work in some cases, but people should be placed in supervisory positions based on their skills that would enable them to effectively engage in the activities of management (Imundo 1980). Training and development of supervisors is important to their success. Training emphasizes the learning of skills and knowledge necessary to achieve a certain level of performance. It is very short-term and specific in its orientation. Development, however, is more long-term and general. It goes beyond training to “focus on growth and improvement of employees as members of the organization and as human beings” (Imundo 1980). Supervisors should therefore be chosen based on their skills and

potential as managers and then given both training and development opportunities to further enhance those skills and increase their performance.

2.4.3 Human Capital and the Construction Industry

The construction industry has not been as diligent in implementing strategic human resource management programs as other industries in the United States. Ferris et al (1990) found that construction firms with higher levels of strategic, including human resource, planning have achieved higher organizational performance. Maloney (1997) found that in most construction companies, however, the strategies that receive the least formalized consideration are those involving human resources: “There is a very strong tendency to do what everyone else does, or simply, to continue using emergent [rather than deliberate] strategies that have evolved over time.” Maloney defines strategic planning as a process whereby the objectives of an organization are developed and the actions required to meet those objectives are identified. The process must culminate in the allocation of resources to carry out those actions (Figure 2.3).

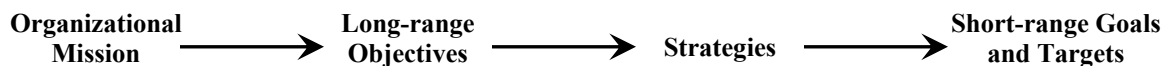


Figure 2.3: Strategy Relationships⁶

According to Maloney, a construction firm must attempt to develop deliberate human resource management strategies. Some of the issues that need to be addressed in an HR strategy include strategic vision, view of human resources, management versus worker orientation, short-term versus long-term orientation, production technologies, workforce diversity, and the availability of a skilled workforce. Maloney identified two distinct types of human resource management strategies in construction. The first involves craft-trained workers in self-managed work teams that receive performance-based pay. This strategy utilizes a broad education system, in-house training programs,

⁶ Source: Maloney 1997

and offers workers a formal career path and development program. This is very similar to the concepts embodied in the Tier II Strategy. The second strategy involves workers that receive skill-based training, has a strict hierarchical organizational structure, and pays workers based on the market rate. This is similar to the concepts of the Tier I Strategy. The researchers with CII and CCIS have taken these two strategies and incorporated other project-level management elements and other workforce management practices into the Two-Tier Strategy to help facilitate the maximum utilization of the workers on a project. It is this expanded strategy that will be the focus of this report.

Chapter 3: Methodology

3.1 RESEARCH DESIGN

The design of the study presented in this report has multiple elements and involves exploratory and descriptive research. The objective of the study is to *describe* the current proficiency of the supervisory level workforce in construction and to *explore* the potential feasibility of a workforce management system designed to better utilize those supervisors.

3.2 DEVELOPMENT OF THE TIER I WORKFORCE STRATEGY METRICS

The Tier I Workforce Management Strategy is part of the Two-Tier Workforce Management Strategy System and is aimed at providing a strategy that will better utilize highly trained supervisors to improve the productivity and efficiency of a workforce that may be less skilled. The Tier II Metrics were developed in 2001 and are described in more detail by Chang (2001) and Castañeda-Maza (2002). The Tier I Metrics were developed based on the Tier II Metrics.

The Tier I Strategy is not a prescriptive strategy for effective workforce management but it gives guidelines or goals for implementation of the basic elements of the strategy. These guidelines are described by metrics. The metrics for the Tier I Strategy were developed by industry representatives from both owner and contractor companies through a CII research team. They evaluate the level of implementation of the critical factors that have been identified for a successful Tier I workforce development strategy. These factors include the characteristics and skill level of the supervisory personnel, the characteristics of the general workforce, the utilization of technology, the utilization of the craft workforce, increased communication on the project, and the management structures in place on the project. It is important to note that these metrics may not represent all of the factors necessary for a successful workforce development

program, but they do present a list of some of the most important elements and provide a starting point for further strategy development.

3.2.1 The Tier I Metrics

Tier I is a structured management strategy that focuses workforce management in a cohesive way. It emphasizes worker proficiency, training, supervision, and communication at all levels. The strategy is defined by metrics that measure the degree of implementation of certain aspects of the strategy but do not prescriptively define the methods of implementation. Five indices comprise the metrics: Project Average Work Skills, Information Technology Utilization, Craft Utilization, Project Communication, and Management Structures. A comprehensive list of all of the metrics and the calculation of the overall Tier I Project Score can be found in Appendix A.

3.2.2 Project Average Work Skills Index

The Project Average Work Skills Index is defined by two metrics: the Tier I Worker's Score and the Supervisor's Score. The elements of the Tier I Worker's Score are proficiency (the average score of an employer administered craft evaluation test) and the percentage of rehired employees. The Supervisors' Skills Score rates all craft workers on their ability to perform the functions associated with a Tier I supervisor (foremen, general foremen, craft/area superintendent) and is based on eight elements:

1. Technical experience at the certified level
2. Continuous training and education
3. Administrative skills — cost management, scheduling, material management, Request for Information (RFI) and estimating
4. Computer skills — e-mail/internet, word processing, spreadsheet, scheduling, estimating, access to drawings, and material management
5. Planning skills — material, equipment, tools and information request, short-term planning and scheduling

6. Job management skills — crew coordination, inter- and intra- craft coordination, selection of work packages, and leadership
7. Task training — the ability to train unskilled workers in tasks as an instructor or proctor
8. Work record — safety, attendance/truancy, quality, productivity, and initiative.

Each element is scored on a scale of 0 to 10 and multiplied by respective weights to determine the overall score for that element. The weights for each element were determined based upon the inputs of industry representatives. Figure 3.1 shows the combination of these two metrics into the Project Average Work Skills Index.

Elements	Weight	Evaluation Criteria	Score	Max Score
Average Score from Tier I Worker's Score	7.0	Greater than 75 points 50 Points Less than 25 points	10 5 0	70
Average Score from Supervisor's Skills Score	3.0	Greater than 75 points 50 Points Less than 25 points	10 5 0	30

Figure 3.1: Project Average Work Skills Index

3.2.3 Information Technology Utilization Index

The importance of information technology (IT) use to a Tier I workforce management strategy lies in integration of and access to information. Computer and administrative skills comprise part of the Supervisor's Skills Score, and therefore access to computers is necessary to utilize those field management skills. The IT Utilization Index is shown in Figure 3.2. The use of wireless, wearable computers is a future-oriented goal. Some limited use of hand-held computers has been reported in the industry, but the durability and quality of the technology must improve for the utilization of these computers to become widespread.

Elements	Weight	Evaluation Criteria	Score	Max Score
Integrated Information Access	6.0	All information is stored, integrated, continuously updated, and accessed by Field Supervisors electronically	10	60
		3 types of information are stored, integrated, continuously updated, and accessed by Field Supervisors electronically	5	
		Information is not directly accessed by Field Supervisors	0	
Hardware	4.0	Field Supervisors have wireless, wearable computers	10	40
		Hardware is nearby and shared among crews	5	
		No hardware is available to Field Supervisors	0	

Figure 3.2: Information Technology Utilization Index

3.2.4 Craft Utilization Index

The Tier I workforce management strategy emphasizes skilled supervisors and field supervisors and recognizes that the crews with which they work can limit the ability of supervisors to plan and coordinate tasks successfully. For optimization of the skills of the field supervisors, it is important to have a balance of crew members and supervisors. This allows a definable level of control and communication. It is also important to retain the workforce currently employed on the site. This allows for continuity and reduces the productivity losses associated with the learning curve of new hires. Worker retention represents the retention of the planned workforce and requires minimizing losses due to workers either being fired or quitting. Both elements are based on averages for the project. The Craft Utilization Index is shown in Figure 3.3.

Elements	Weight	Evaluation Criteria	Score	Max Score
Crew Mix (Crew to Supervisor (CS) ratio)	5.0	CS ratio between 8 and 12 to 1 CS ratio between 13 and 17 to 1 or between 5 and 7 to 1 CS ratio greater than 18 to 1 or less than 4 to 1	10 5 0	50
Worker Retention (Of planned workforce)	5.0	90 percent retention of planned workforce 60 percent retention of planned workforce 30 percent retention of planned workforce	10 5 0	50

Figure 3.3: Craft Utilization Index

3.2.5 Project Communication Index

An important aspect of Tier I is communication. Establishing communication channels, especially between the project management and the field supervisors, can increase the productivity and reliability of the crews. The Tier I hierarchy recognizes the supervisor as the link between the craft workers and upper project management, therefore, communication between the supervisors and craft workers should be regular and allow for two-way information flow, illustrated in Figure 3.4.

Elements	Weight	Evaluation Criteria	Score	Max Score
Project Management Communication with Supervisors	7.0	Proactive information flow to and from supervisors, established formal & informal channels, open access to management, frequent meetings with supervisors, all supervisors are familiar with all aspects of the project	10	70
		Informal communication channels, regular meetings with supervisors, supervisors can receive project information requested	5	
		Rigid hierarchical structure for communication, only information that management deems necessary to supervisors is provided	0	
Communication with Workers	3.0	Frequent organized project meetings with workers, regular queries to workers and anonymous channels to voice concerns or suggestions	10	30
		Regular organized project meetings with workers and regular queries to workers about concerns or suggestions	5	
		No organized regular meetings with workers and feedback is discouraged	0	

Figure 3.4: Project Communication Index

3.2.6 Management Structures Index

This index is comprised of three elements: (1) work packages, materials and tools; (2) planning; and (3) metrics-based controls (see Figure 3.5). The work packages element measures the availability of materials and tools and the use of organized work packages for crews. The delays are measured through the use of Foremen Delay Surveys, which identify both the areas experiencing the greatest amount of delay and the causes of the delay. The planning element is intended to encourage formal and regular short-interval planning as well as regularly updated CPM schedules. The third element, metrics-based

controls, is intended to encourage regular reporting of the measured progress of a project in terms of cost, schedule, safety, and others.

Elements	Weight	Evaluation Criteria	Score	Max Score
Work Packages/ Materials & Tools	4.0	Materials, equipment, information and directions available without delays	10	40
		Requested information and drawings available with delays due to lack of needed items greater than 10percent of crew time	5	
		Supervisor and crew responsible for getting all necessary items	0	
Planning	5.0	Formal short interval planning and regular CPM updates	10	50
		Informal short interval planning and no regular CPM updates	5	
		No formal schedule	0	
Metrics Based Controls	1.0	Daily reports (<i>cost, time, etc.</i>)	10	10
		Weekly reports (<i>cost, time, etc.</i>)	5	
		Monthly reports (<i>cost, time, etc.</i>)	0	

Figure 3.5: Management Structures Index

3.2.7 Tier I Project Index Score

The score from each of the five indices is totaled and divided by 50 to produce a total Tier I Index score that ranges from 0 to 10, as shown in Table 3.1. The purpose of this score is to measure the degree of implementation with the ultimate goal of comparing the degree of implementation to project success.

Table 3.1: Tier I Index Score

	Max Score
Project Average Work Skills Index	100
IT Utilization Index	100
Craft Utilization Index	100
Project Communication Index	100
Management Structures Index	100
Sum	500
Tier I Index = (Sum/50)	10

3.3 DATA COLLECTION METHODS

The primary objects of this study were supervisors (or anyone with the title “foreman”, “general foreman”, or “superintendent”) and the projects for which these supervisors worked. Data was collected on the journey-level workers of these same projects, but this data is the focus of other research areas and only some descriptive information from this set will be included in this report.

The type of sampling technique utilized in this research effort is convenience sampling (Castañeda-Maza 2002). It is a non-probabilistic sampling method that was utilized more for the convenience of the site rather than the researcher. Each of the individuals chosen to participate in the data collection was chosen by his or her employer on a somewhat random basis. The researchers in this study were not aware of the exact procedures for including individuals in the study as they changed from project to project and were based on the preferences of the managers for that project.

The data gathered in this research effort can be, however, considered to be equivalent to data obtained using cluster sampling. In this research effort, each project represents a cluster from which a sample of workers was analyzed. Each cluster is intended to be “representative of the entire population” (Berenson et al 2002). This is dependent on the limitation that the population represents industrial construction projects in the United States.

3.3.1 Survey Instruments

To facilitate the data collection process and enable the analysis of that data, a set of survey instruments were created. These survey forms enabled the collection of data that could then be input into a database that would calculate implementation scores (Tier I and Tier II Individual and Project Scores) based on the metrics developed. These forms were intended to be used in on-site survey and interview sessions with the craft- and supervisor-level workforce. There were two forms that collected this information: the Individual Skills Assessment and the Background Questionnaire. The Individual Skills

Assessment surveys the skill level and experience of the journey-level workforce asking questions about craft certifications, technical training, and administrative skills. The Background Questionnaire gathers information on the background (education, language, age, etc.) of the workers. There is a third survey form that was used to collect information on the project level management practices, the Management Practices Questionnaire. All of the forms were created with the input of senior industry advisors and tested on a pilot project to ensure their feasibility. A copy of these forms can be found in Appendix B.

3.3.2 Fieldwork Procedures

Standardized procedures were developed for use on each of the project visits used in this data collection effort. After initial contact was made for the project visit, either through a contractor or an owner organization, the procedures governed the type and timing of the information gathered. The major steps of the procedure are described in sequential order in the following paragraphs.

Projects were volunteered for the data collection effort by owner and contractor organizations and therefore were not randomly selected by the researchers. Prior to the site visit, a list of questions intended to facilitate the data collection process were sent to the site representative. Some of these questions involved the actual logistics of the visit, maps, hotels, on-site facilities, etc. while the rest of the questions were intended to gather preliminary project level information. The site representative was asked to select three to four groups of journey-level craft workers and one to two groups of supervisors to participate in the surveys. Each group would take approximately 30 minutes to complete the surveys.

Once on site, the researchers met with each group of workers in a conference room or other large room. A short, five-minute introduction was given to the workers about the research effort and the reason for the researchers' presence. Then each of the two worker surveys was administered with each question receiving a detailed