

# Strategic Management of Human Resources in Construction

Stefanie G. Brandenburg<sup>1</sup>; Carl T. Haas, F.ASCE<sup>2</sup>; and Keith Byrom<sup>3</sup>

**Abstract:** Human resource management in construction has typically been an emergent rather than a strategic or deliberate process. This has resulted in the infrequent use of comprehensive workforce management strategies in the industry. Researchers at the Center for Construction Industry Studies (CCIS) have proposed a Two-Tier Approach to workforce management. The Tier I strategy is designed to improve the effectiveness and productivity of the construction workforce through effective supervision and project management. This paper presents the concepts behind the Tier I strategy and discusses the metrics and the procedures needed to implement this strategy. An analysis of 19 on-site project visits of industrial construction projects, including surveys collected from over 900 journey-level craft workers and supervisors, is also presented in order to validate the feasibility and potential of the Tier I strategy. It is anticipated that increased productivity, reduced absenteeism, and reduced turnover will be results of the strategy. It is not a revolutionary strategy in itself, but the concepts and elements of the strategy may serve as building blocks for more complex and extensive structured workforce development programs in the construction industry.

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## Introduction

The relationship between strategic human resource management (HRM) and a firm's performance has been extensively studied in human resource journals and literature, while very little information is available on its application to the construction industry. Shepeck and Militello (2000) explain the relationship between strategic human resource (HR) configurations and an organization's performance. They found that, once HRM strategies have been established, those configurations guide employee behavior and are associated with differing levels of organization effectiveness. Shepeck and Militello also describe other studies where strategic HRM practices used with other business strategies were related to reduced employee turnover (Arthur 1994), higher productivity (Arthur 1994; MacDuffie 1995; Wright et al. 1996), and greater financial performance (Huselid 1998).

The construction industry has not been as diligent in implementing strategic HRM 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, including higher productivity, greater cost effectiveness, and greater overall efficiency. Maloney (1997) found that, in most construction companies, the strategies that receive the least formalized consider-

ation 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 by 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.

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 et al. 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 that "simultaneously exploit the potential for complementarities or synergies among such practices and help to implement a firm's competitive strategy" (Huselid 1998).

Metrics are important in facilitating the implementation of an HRM strategy that effectively represents the goals and objectives of the firm. Researchers at The University of Texas at Austin's Center for Construction Industry Studies (CCIS), in cooperation with the Construction Industry Institute (CII), have developed metrics that outline the fundamentals of a construction workforce management strategy. The Two-Tier Approach 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

<sup>1</sup>Assistant Professor, Dept. of Building Construction, Virginia Polytechnic Institute and State Univ., Blacksburg, VA 24061.

<sup>2</sup>Professor, Dept. of Civil Engineering, Univ. of Waterloo, Waterloo, Ontario, Canada.

<sup>3</sup>General Manager of Employees, Zachry Construction Corp., 527 Logwood, San Antonio, TX 78221.

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**Table 1.** Tier I and Tier II Characteristics

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	Multicrafted 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	Proactive, 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 crew level (for key crafts)

of its skill level. The emphasis is on organization, communication, and utilization of field management. Both of these strategies emphasize the development of human capital as part of an overall human resource management approach. The basic characteristics of Tier I and Tier II are listed in Table 1.

The Tier I strategy is not new or revolutionary, yet it is a comprehensive management strategy that focuses workforce management at the supervisory level. 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.

The Tier II strategy is described in greater detail by Castañeda-Maza (2002) and Chang (2002). 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 for implementation as well as a guide for targeting training efforts.

## Research Objectives, Scope, and Methodology

The Tier I Workforce Management Strategy emphasizes the proficiency and training of front-line supervisors as well as management, communication, and technology utilization at all levels of the project. A benchmark of the status of the industry at this time with regard to current workforce management strategies was established to determine the effectiveness of the Tier I strategy.

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 were volunteered by owners or construction companies that 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 (Fig. 1). The data includes projects from most of the major sectors within industrial construction such as chemical process, food processing,

manufacturing, petrochemical, pharmaceutical, and power generation and transmission. Thus, the data is representative of the projects in the industrial sector of the construction industry.

The Two-Tier approach has been evolving since its inception in early 2000. To facilitate its development and to capitalize on the expertise and experience of industry representatives, a work force steering committee was established and workshops were held to begin development of the Tier II metrics. The topics discussed included training and certification, craft management skills, necessary metrics, craft utilization, information technology utilization and its impact, and work structure. The purpose of the workshop was to gain “executive-level” feedback on the strategy as well as to determine its feasibility in the construction industry (Howard 2001). The product generated from this workshop became the basis for the current Tier II strategy and metrics. A CII Research Team (PT 182) was given the task of investigating the Tier I strategy. A group of industry representatives from CII and researchers from The University of Texas at Austin (UT) met to discuss the feasibility of the Tier I strategy and what the strategy would encompass. The Tier I metrics were developed in the fall of 2001 through the collaboration of the CII Research Team and UT researchers. Upon completion of both the Tier II and Tier I metrics, baseline data was collected.

**Fig. 1.** Location of volunteered project

**Table 2.** Project Average Work Skills Index

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

### Tier I Metrics

Tier I is a structured management strategy that is designed to focus workforce management in a cohesive way. It emphasizes worker proficiency, training, supervision, and communication at all levels. Five indices comprise the metrics: (1) Project Average Work Skills; (2) Information Technology Utilization; (3) Craft Utilization; (4) Project Communication; and (5) Management Structures.

The Project Average Work Skills index is defined by two sub-metrics: the Tier I Worker's Score and the Supervisor's Score. Although the emphasis of the Tier I strategy is the supervisor, it is important to understand the skill level of the workers who will be under his or her supervision. 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 Supervisor's Skills Score is used to evaluate the skill level of the current supervisory workforce on a project and is based on eight elements determined to be important for a supervisor's performance:

1. Technical experience at the certified level;
2. Continuous training and education;
3. Administrative skills—cost management, scheduling, material management, requests for information (RFIs), 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 requests, short-term planning and scheduling;
6. Job management skills—crew coordination, inter- and intracraft coordination, selection of work packages, and leadership;
7. Task training—the ability to train unskilled workers in tasks as an instructor or proctor; and
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. Table 2 shows the combination of these two metrics into the Project Average Work Skills 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; therefore, access to information via computers is necessary to utilize those field management skills. The IT Utilization Index is shown in Table 3. 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 utilization of these computers to become widespread.

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 the optimum 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 being evaluated. The Craft Utilization Index is shown in Table 4.

Critical to the success of any business operation, communication is also an important aspect of the Tier I strategy. 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 the upper project management; therefore, communication between the supervisors and craft workers should be regular and allow for two-way information flow, as illustrated in the Project Communication Index in Table 5.

The Management Structures Index is comprised of three elements: (1) work packages, materials, and tools; (2) planning; and (3) metrics-based controls (Table 6). The work packages element

**Table 3.** Information Technology Utilization Index

Elements	Weight	Evaluation criteria	Score	Maximum score
Integrated information access	6.0	All information is stored, integrated, continuously updated, and accessed by field supervisors electronically	10	60
		Three 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	

**Table 4.** Craft Utilization Index

Elements	Weight	Evaluation criteria	Score	Maximum score
Crew mix [ <i>crew to supervisor (CS) ratio</i> ]	5.0	CS ratio between 8 and 12 to 1	10	50
		CS ratio between 13 and 17 to 1 or between 5 and 7 to 1	5	
		CS ratio greater than 18 to 1 or less than 4 to 1	0	
Worker retention ( <i>of planned workforce</i> )	5.0	90% retention of planned workforce	10	50
		60% retention of planned workforce	5	
		30% retention of planned workforce	0	

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 other factors.

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 7. 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. It is important to note that the metrics were developed with input from industry professionals and are designed to represent goals for the implementation of a workforce management strategy. The weights are based on the opinion and experience of these industry professionals and are not intended to be statistically validated metrics.

### Data Collection Process

The data collection process for this research involved on-site interviews with workers from volunteered projects. There were three questionnaires used in the data collection process. The Individual Skills Assessment surveyed the skill level and experience of the journey-level workforce, asking questions about craft certifications, technical training, and administrative/job management skills. The Background Questionnaire gathered information on

the background (education, language, age, etc.) of the workers. The third survey form 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. The questionnaire forms and other documents used in the data collection process can be found in Brandenburg (2004).

Projects were volunteered for the data collection effort by owner and contractor organizations and therefore were not randomly selected by the researchers. The site representative for each project 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. 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 explanation. Literacy was required of all of the workers surveyed and, although a Spanish form was available, it was only used for clarification of terminology. This process was repeated for each of the groups of journey-level workers and for each of the groups of supervisors.

To collect the project-level information, a meeting with the project management team was held at each site. Although the attendance varied from project to project, there was usually at least one project manager, a superintendent, and a human resources representative at this meeting. The entire data collection process for one project required a time commitment of approximately four to six hours from the site.

**Table 5.** Project Communication Index

Elements	Weight	Evaluation criteria	Score	Maximum score
Project management communication with supervisors	7.0	Proactive information flow to and from supervisors, established formal and 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	

**Table 6.** Management Structures Index

Elements	Weight	Evaluation criteria	Score	Maximum score
Work packages/materials and 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 10% 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	

## Project Baseline

Implementation of any strategy is the “turning of paper goals into real-time results” (Friedman et al. 1998). The “paper goals” for the Tier I Workforce Management Strategy are the metrics. The metrics have been developed to set guidelines for the development of a strategy to effectively manage a construction workforce, regardless of its skill level. Before implementation can even begin, a company must assess where it stands in regard to the established goal, or the Tier I metrics. From the 19 projects that were assessed in this research effort, a Tier I Project Baseline was established. This is the average score for each element within the Tier I metrics. There is variation from project to project for each element, but the baseline can give owners and contractors an idea of where the industrial construction industry stands on these elements and how far the industry has to go to achieve a maximum score and thus fully implement the Tier I strategy.

General information from each of those projects can be found in Table 8. All company and individual participant information will be held as confidential. Project IDs 00 and 16 represent two project visits to the same project, ID 00 as a beta test for the surveys and ID 16 as a follow-up visit. Also, project level information was not released for IDs 02 and 09; thus, those projects were not used in the baseline calculations.

## Project Scores

Each project for which information was available was scored using the Tier I metrics. Each category has a maximum score of 100 points and, when summed, the maximum Tier I Project Score is 10.0. The average project score on the Tier I index is 6.98 out of 10.0. This is a relatively high score but is not surprising,

**Table 7.** Tier I Score

Index	Maximum 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 = ( <i>sum</i> /50)	10

considering that the Tier I strategy is based on current industry best practices. Also, the majority of these projects involve CII companies that pride themselves on achieving higher than industry average performance. These companies may therefore have higher Tier I scores than might be found on other industrial construction projects. The scores do, however, highlight the fact that few, if any, companies are utilizing all aspects of a formal, structured workforce management strategy. If this was the case, then there would be more projects scoring in the 8 to 10 point range.

It is important to know in which areas the projects are experiencing the lowest scores and in which areas they are scoring the highest. Knowing the areas of greatest concern can help those projects make modifications that will provide the greatest return. Fig. 2 compares each project to the other project scores by each of the five categories: Project Average Work Skills, Information Technology (IT) Utilization, Craft Utilization, Project Communication, and Management Structures. The figure also shows how each of the five categories contributes to the overall Tier I index for that project.

It is evident from this figure that the area with the largest room for improvement is in IT utilization. The average score in this category is 44.8 out of a maximum of 100 points. This means that very few projects are fully utilizing computers and other information technology with their supervisors. The construction industry, as a whole, has been slow to implement these kinds of IT innovations at the site level. The Tier I strategy, however, is designed to take advantage of the productivity enhancements that can be achieved through the use of computers and other technologies. The other project categories have varying scores, and there are components within each category that warrant further investigation.

## Tier I Project Baseline

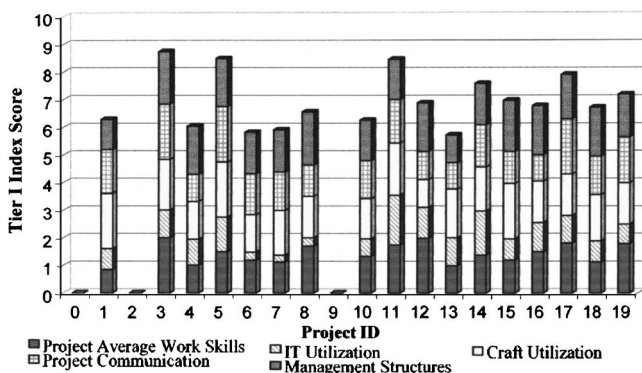
The Tier I Project Baseline has been established through on-site project visits of a limited number of projects. It can be used to generalize the industrial construction industry but must not be seen as an absolute measurement of the industry as a whole. Every project will be different, and every company will have different ways of assessing and evaluating the elements below. The metrics are designed to allow for this flexibility and individual customization. It is this flexibility that will allow each project to adapt the elements of the metrics to fit in with company and project-specific objectives and thus customize the implemen-

**Table 8.** Description of Projects

Project ID	Date of visit	Industry sector	Location	Number of surveys	Merit or union
00	November 2001	Power generation	Southeast	27	Merit
01	February 2002	Petrochemical	Gulf Coast	17	Merit
02	February 2002	Power generation	Gulf Coast	124	Union
03	April 2002	Power transmission	Southeast	23	Union
04	May 2002	Food processing	Southeast	73	Merit
05	June 2002	Petrochemical	Mid-Atlantic	36	Union
06	July 2002	Power generation	West	59	Merit
07	July 2002	Manufacturing	Southeast	57	Merit
08	July 2002	Power generation	Southeast	23	Merit
09	August 2002	Petrochemical	Gulf Coast	22	Merit
10	August 2002	Petrochemical	Gulf Coast	58	Merit
11	September 2002	Pharmaceutical	Southeast	28	Merit
12	September 2002	Power transmission	Southeast	30	Union
13	October 2002	Chemical process	Gulf Coast	28	Merit
14	October 2002	Petrochemical	Gulf Coast	115	Merit
15	October 2002	Manufacturing	Mid-Atlantic	35	Merit
16	October 2002	Power generation	Southeast	41	Merit
17	October 2002	Manufacturing	Midwest	25	Merit
18	October 2002	Petrochemical	Gulf Coast	64	Merit
19	December 2002	Chemical process	Gulf Coast	30	Merit
			Total	915	

tation of the Tier I strategy. The Project Baseline averages for each element of the metric as well as the percent deficit from the maximum score are shown in Table 9.

This baseline indicates that there is very little information technology being utilized on industrial construction projects from the supervisor level to the project level. At the supervisor level, there is a 70% deficit in computer skills, and at the project level there are 56 and 54% deficits in integrated information access and hardware utilization, respectively. There are also significant areas of improvement that can be made in terms of project management communication and metrics based controls (Brandenburg 2004). This baseline also indicates that, although Tier I is based on current management strategies, those strategies are not being utilized in a comprehensive way and in conjunction with other strategies to produce the best possible results.

**Fig. 2.** Tier I scores by project ID

## Conclusion and Recommendations

Currently in the construction industry, there are very few structured workforce management programs. If any human resource development is conducted on a project, it is usually in the form of on-the-job training, with very few resources available at the project level for further training and development of the workforce. There are extensive strategies and programs available in the Human Resource Development industry. There is a need for a structured workforce management strategy in construction that can be used to effectively manage a workforce regardless of its skill level. The construction industry has experienced a shortage of skilled craft workers and will continue to experience the shortage unless revolutionary methods are put in place to address the problem.

This research effort resulted in the collection of thousands of data points on individual workers and a significant amount of information on the participating projects. Because only 19 projects were visited in this research effort, it is recommended that additional project level data be collected to facilitate the determination of construction success indicators. A natural progression of this research, especially in terms of facilitating widespread implementation of the Tier I strategy, is the generation of an Implementation Manual. This manual, which is currently being developed, will provide all of the forms, assessment procedures, and detailed instructions for the development of a Tier I Workforce Management Strategy on a specific project or for a specific company. An interactive, dynamic Web application is currently in progress that will make the workforce database available via the Internet on a secure website, allowing companies to store their data and compare their workers and projects with the others in the database. This could also allow for continued data collection without the need or expense of sending researchers to each site to conduct on-site evaluations. Also in progress is an optimization

**Table 9.** Tier I Baseline

Element	Average score (maximum=10)	Percent deficit
<i>Tier I worker's score (A)</i>		
Proficiency (average score of craft evaluation test)	7.1	-29
Percentage of rehired employees	4.6	-54
<i>Tier I supervisor's skills score (B)</i>		
Technical experience	8.5	-14
Continuous training and education	5.9	-41
Administrative	6.2	-38
Computer	3.0	-70
Planning	5.8	-42
Job management	6.2	-38
Technical experience	5.6	-44
Task training	8.3	-17
<i>Project Average Work Skills index</i>		
Average score (A)	7.5	-25
Average score (B)	7.0	-30
<i>Information Technology Utilization index</i>		
Integrated information access	4.4	-56
Hardware	4.6	-54
<i>Craft Utilization index</i>		
Crew mix	7.9	-21
Worker retention	8.2	-18
<i>Project Communication index</i>		
Project management communication with supervisors	6.9	-31
Supervisors communication with workers	8.4	-16
<i>Management Structures index</i>		
Work packages materials and tools	6.4	-37
Planning	9.5	-5.0
Metrics based controls	6.1	-39

tool that should allow potential users of the Two-Tier approach to optimize their allocation of workforce development resources.

Potential users of the Tier I metrics should be aware that, although the metrics were developed with industry involvement, the weights have not been statistically verified. With additional data collection and even reports from pilot project implementations of the strategy, these weights can be validated, or changed if necessary to reflect the factors' actual impacts on a project.

A final recommendation for potential implementers of the Tier I strategy is that deliberate attention needs to be focused on how the strategy fits in with the company and project goals, culture, and environment. For successful implementation of the strategy and effective maximization of its potential benefits, the strategy must become a part of the overall corporate and project structure. It cannot stand alone if it is to be successful. The benefits of the strategy must also match the goals and objectives for the project as well as the overall corporate goals.

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