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METRIC-BASED IMPLEMENTATION OF TIER II WORK FORCE STRATEGY

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Foreword

This report is brief. Its purpose is to introduce the Two-Tier Work Force concept and to provide a metric for guidance in implementation of the Tier II strategy. The Tier I strategy and measurement of project success will be addressed in other studies. Similarly, details of the Tier II approach will evolve as implementation progresses and more knowledge is obtained. This publication is intended to provide a framework for utilization by those companies who wish to begin immediate implementation of the Tier II strategy.

The Two-Tier Work Force concept has evolved over a number of years, with considerable input from many individuals and organizations. It is based upon numerous earlier research studies, conferences and initiatives. In recent months, the concept has crystallized and deliberate input has been solicited from knowledgeable industry personnel. A list of individuals, who contributed information and participated in particular workshops, is given in the Appendix.

We are grateful to the members of the Center for Construction Industry Studies (CCIS) Work Force Steering Committee who have provided guidance to this effort and have provided constructive reviews and input to the metrics presented in this document.

The 40 attendees at a February 2001 Tier II Workshop were instrumental in developing the parameters that led to the metrics presented in this document. An additional workshop, involving about 20 craft workers, was held in July 2001 and added meaningful input.

Finally, but not least important, are the Graduate Research Assistants in the Construction Engineering and Project Management Program, Department of Civil Engineering, University of Texas at Austin whom we sincerely thank for their efforts in developing the material presented in this document. The students include Nicole Balli, Erin Cannon, Jorge Castañeda Maza, Soon-Woong Chang, Derek Edward, Lizabeth Howard, Alexander Oey, Kamel Saidi, Julien Saillard, and David Shields. Their theses and dissertations will expand some of the elements of this Metric.

Executive Summary

The shortage of skilled construction workers has been considered a major industry challenge for decades. The shortage has become more acute in recent years due to declining wages, changing work force demographics, and the changing economic and educational climate in the world's industrialized nations. Many initiatives and new organizations have been created, some with limited success, but the challenges of work force related issues still remain. A "step-change" approach is needed to address the worker related issues in a substantive fashion. Such an approach is proposed as a Two-Tier Work Force Strategy which, if successful, should provide a structure for long-term evolution of an improved work force.

The basic concept of the Two-Tier Strategy is simple. A Tier I project will be built by a relatively less skilled construction work force than for a Tier II project. The workers on the Tier I projects will be paid less, on average, than will workers on Tier II projects, consistent with their lower skill levels. Tier I workers will, on average, not only have limited technical skills and experience, but will also have limited management skills. Tier I projects will require a high level of task training and a detailed management system appropriate to the lower skills of most workers. Even so, it should be possible to realize highly successful Tier I projects, and the Tier I worker category provides a convenient entry level for construction. The Tier I strategy will be developed by the Construction Industry Institute (CII Research Team 182) over the next several months and is not included as part of this report.

A Tier II project will be the other extreme. It will contain fewer, but better, workers who are expected to produce improved safety, quality, schedule and cost results than through the current system. Although a Tier II project will have a variety of worker skills, it will have a high percentage of certified "Tier II Workers", who will have both superior technical skills and some lower-management skills. A Tier II project will be organized and executed to exploit those advanced worker skills through use of information technology, worker utilization and a high performance work structure. The current attention, and focus of this report, is on the Tier II strategy.

A critical success factor in the Tier II strategy is the development of metrics. Two metrics are needed, one to measure construction success and one to measure the level of Tier II implementation. The metric to measure construction phase success is being developed through the CII Benchmarking and Metrics program and will be utilized for both the Tier I and Tier II strategies. This report will focus on the metric to measure the level of implementation of the Tier II strategy. That metric, called a Tier II Project Index, and measured on a scale of 0-10, will provide not only a measurement system but also criteria for Tier II strategy implementation.

The Tier II Project Index contains five components, composed of sixteen separate elements. Two of the five components, Craft Technical Skills and Craft Management Skills, relate to the quality of the workers available to a project. Those two components comprise 40% of the Tier II Project Index score, and contain nine of the sixteen elements for measurement. Thus, to have a Tier II Project, it is necessary to first have an adequate number of Tier II workers.

The remaining three components of the Tier II Project Index relate to the use of the highly skilled workers in executing the project. The third component, Information Technology Utilization, assumes that Tier II workers are computer literate and relates to the ease of their utilization of appropriate information through electronic media. It contains two elements and represents 20% of the Tier II Project Index. The fourth component, Worker Utilization, also represents 20% of the Index. It contains three elements associated with crew mix, multiskilling and worker turnover. The last component, Organization, also worth 20% of the Index, addresses the important issues of communications and creation of a high performance work place.

The Tier II strategy has evolved through considerable effort and input over the past several months, and captures much of the earlier work performed by CII and other organizations. It is now considered to be adequately developed for pilot project implementation. As data are gathered from initial project implementation, the strategy can be refined and developed for wide-spread use.

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Metric-Based Implementation of Tier II Work Force Strategy

I. Background

The construction industry is presently facing tremendous challenges in work force related issues. Many initiatives have been undertaken to address the basic problem of shortages of skilled workers. A “*step-change*” strategy is proposed to provide a structured Two-Tier approach to projects. The Tier I strategy uses less skilled and task trained craft workers, and has a larger administrative site management presence than for the Tier II strategy. Tier II projects would utilize fewer, better-educated and higher skilled workers who perform craft functions and some lower-management functions and receive higher compensation, while delivering improved project results in safety, quality, and schedule at comparable or improved costs. The Tier II work place appears to be a good candidate to accomplish this “*step-change.*” The present efforts surrounding the Tier II strategy are *focused exclusively on the construction phase of projects.*

II. A Two-Tier Craft System

It is anticipated that the Two-Tier approach will eventually replace the current approach. The two-tier craft system will probably be phased in over the next several years, as depicted in Figure 1. The industry will hopefully move from the current state that has few Tier II workers to a state that has only Tier I and Tier II workers. It is hoped that Tier II will be the common method and that the Tier I approach will be mostly used to accommodate the cyclic nature of the construction industry while maintaining a stable number of Tier II workers. It is expected that fewer construction workers will be required due to the higher quality of the Tier II work force.

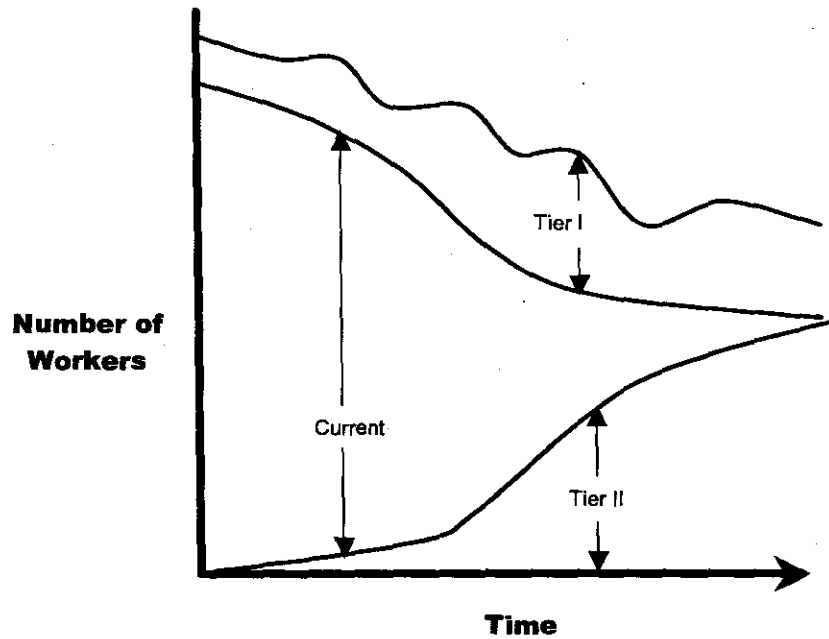


Figure 1. Change in work force composition due to introduction of Tier I and Tier II strategies.

The Two-Tier strategy addresses industry problems such as the declining number of skilled workers, lack of career paths, poor industry image, and declining wages. Many factors will govern the choice of whether to use the Tier I or Tier II strategy on a project, and the decision will be very project specific. As shown in Figure 1, the Tier I and Tier II strategies are to be phased in over time.

Tier I Strategy

The Tier I strategy is essentially based on an assumption of less-skilled workers (on average) on a construction project. This strategy may be particularly applicable to projects in developing countries, on U.S. projects that have a high proportion of immigrant or resident alien workers who are low skilled, and on projects where owners cannot be convinced of the merits of the Tier II strategy. The characteristics of this strategy are:

- Skills training at today's level (or lower)
- More task training
- More (less skilled) workers needed
- Relatively low journeyman wages

- Limited craft flexibility
- Shorter individual craft time on a project (more turnover)
- More detailed supervision
- “White Collar” administration (planning, purchasing, scheduling, etc.)
- Outside inspection
- Minimal worker loyalty to company/project

The Construction Industry Institute Research Team 182 (CII RT 182) will address details of the Tier I strategy and metrics for implementation of the Tier I strategy. The Productivity Measurements initiative of the CII Benchmarking and Metrics (CII BM&M) Committee will address metrics for construction success.

Tier II Strategy

The Tier II strategy is viewed as a “*step-change*” in the way the construction industry presently organizes and performs the construction phase of projects. It is hoped that the results of the implementation of the Tier II strategy will achieve the following at the project level:

- Comparable or better project costs
- Better quality – less rework because of better workers and improved planning
- Better safety – due to better workers and increased tenure on a project
- Better schedule – resulting from less rework and improved productivity
- Better productivity – due to better workers, improved planning and scheduling, less rework, better materials management, and improved communication
- More predictability/less chaos – because of better planning and scheduling at the crew level
- Less administration/supervision – reduction in field administrative personnel because more tasks are handled at crew and craft level
- Fewer workers/less turnover on a project – increased use of multiskilled workers who are able to stay on the project longer and achieve increased performance

- Higher project loyalty – due to increased durations of employment and improved compensation

At the company and industry level the following results are expected:

- Less attrition of workers as a result of an available career path
- Higher company loyalty – resulting from increased durations of employment and improved compensation

One of the key characteristics of the Tier II strategy is that the workers are trained and certified in multiple craft skills, administrative skills, computer skills and management skills.

At present the Tier II strategy characteristics are envisioned as follows:

- Higher compensation for workers – resulting from improved wages and longer duration on project sites
- Fewer workers on site – smaller peak work force due to productivity of more highly skilled and multiskilled craft workers and reduced turnover
- Different journeymen/helper mix – appropriate use of helpers to assist the highly skilled Tier II craft workers
- Higher worker craft skills – greater use of craft workers who are trained and certified
- Multiskilled workers – more workers who are trained and certified in multiple skills
- Administration-skilled workers (certified) – in computers, planning, scheduling, controls, etc.
- Less supervision/higher worker autonomy – crews/teams will take on an increased role in self-management, i.e. self-managed work teams, and be empowered to make appropriate decisions
- Higher worker project/company loyalty – due to improved wages, increased duration of employment and better management, workers will develop loyalties to both projects and companies
- Career path opportunities – workers will be able to progress from apprentices/helpers and journeymen to Tier II workers due to increased emphasis in training and certification of technical skills, administrative skills, and management skills
- Appropriate management approach (certified), to utilize the broader worker skills

In order to achieve the Tier II strategy there are necessary steps along the path forward which must be addressed. These include but are not limited to the following:

- Phase in over time
- Establish criteria/agencies for training and certification
- Pilot projects for Tier I and Tier II strategies
- Assessment/monitoring

The overall Two-Tier strategy is wide-ranging and will require considerable development. An overriding requirement will be that of metrics, for both measuring the level of implementation for a Tier I or Tier II strategy and for measuring the success of the construction phase of a project. Three different groups are addressing the metrics and other details, and are listed below.

- CII Research Team 182 – Tier I Strategy and Metrics
- CII BM&M Committee – Construction Success Metrics
- CCIS – Tier II Strategy and Metrics

The basic assumption for the Tier II strategy is that better workers, properly utilized, will produce a more successful construction effort. That assumption is illustrated in Figure 2. Development is under way for metrics to measure construction success. The focus of the remainder of this paper is on metrics to measure the level of Tier II implementation on a specific project. It is intended that the metric itself will also provide a guide to implementation of the Tier II strategy. Both the Project Construction Phase Success metric and the Level of Tier II Implementation Index (Tier II Project Index) will be on a 0-10 scale.

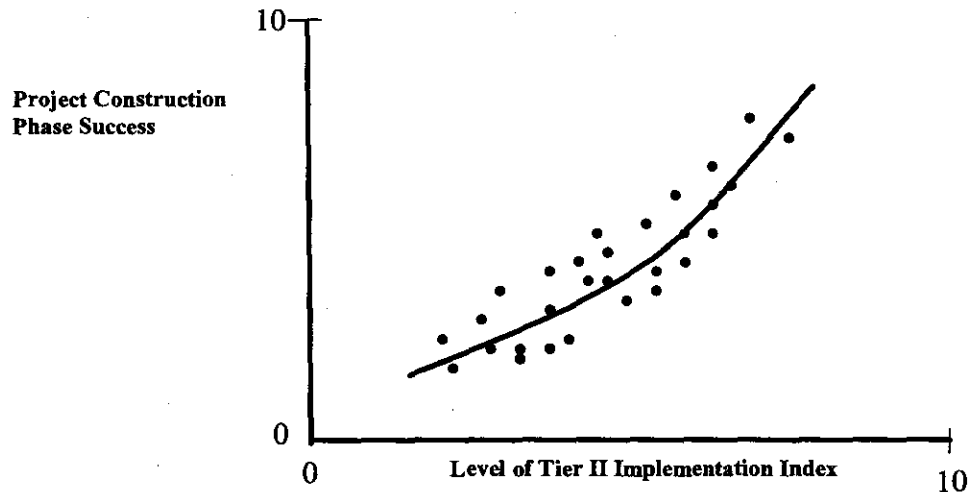


Figure 2. Relationship between level of Tier II implementation and project success.

The basis for a Tier II Project is having high quality workers, and utilizing them in an optimum fashion. Section III describes the necessary worker attributes and provides a means of individual worker assessment. Section IV then assesses both the Workers' Characteristics in the project and the Project Execution to utilize those workers' characteristics.

III. Individual Worker Skills Score

A Tier II worker must have both superior technical and management skills. The inclusion of management skills is, in itself, a "step-change" in worker expectations and represents a potential career path for ambitious workers. The elements of Individual Tier II Worker Skills are listed below and are described in the following paragraphs.

Individual worker skills include both technical and management components. Two scores are provided to characterize those components. The scores and their elements are:

1. Individual's Technical Skills Score (3 elements)
 - a) Craft certification, including multiskilling
 - b) Technical experience
 - c) Continuous training and education

2. Individual's Management Skills Score (5 elements)

- a) Administrative – cost management, scheduling, material management, RFI's, and estimating
- b) Computer – email/internet, word processing, spreadsheets, scheduling, estimating, CAD, and material management
- c) Planning – materials, equipment, tools, information requests, short-term planning and scheduling
- d) Job management – crew/team coordination, inter- and intra-craft coordination, means and methods and leadership
- e) Work record – safety, attendance/truancy, quality, productivity, and initiative

Particular details for evaluation of an Individual's Technical Skills Score are shown in Figure 3. Each of the three elements is measured on a scale of 0 – 10, and weighted such that a maximum score of 100 points is possible. Guidelines are given for some of the measures and interpolation should be used for intermediate values.

Elements	Weights	Evaluation Criteria	Score	Max Score = 10 x Weight
Craft Certification	4.0	Certified in 3 crafts	10	40
		Certified in 2 crafts	5	
		No certification	0	
Technical Experience	4.0	More than 10 years of experience at the certified craft level	10	40
		5 years of experience at the certified craft level	5	
		Less than 1 year of experience at the certified craft level	0	
Continuous Training and Education	2.0	More than 200 hours of training and skill updating in the last 3 years	10	20
		100 hours of training and skill updating in the last 3 years	5	
		No training or skills updating since first craft certification	0	
	10.0			Total = 100

Figure 3. Individual's Technical Skills Score

A similar set of criteria, and scoring, is used to complete an Individual's Management Skills Score and is shown in Figure 4. The five elements are weighted to give a maximum Individual's Management Skills Score of 100 points, as for the Individual's Technical Skills Score.

Elements	Weights	Evaluation Criteria	Score	Max Score = 10 x Weight
Administrative (<i>cost management, scheduling, material management, RFI, and estimating</i>)	1.0	Certified in at least 4 administrative skills Certified in 2 administrative skills No certified administrative skills	10 5 0	10
Computer (<i>e-mail / internet, word processing, spreadsheet, scheduling, estimating, CAD, and material management</i>)	1.0	Certified in at least 5 computer skills Certified in 3 computer skills No certified computer skills	10 5 0	10
Planning (<i>material, equipment, tools and information request, short-term planning, and scheduling</i>)	3.0	Certified in planning skills 160 hours of training but not certified in planning skills No training and certification	10 5 0	30
Job Management (<i>crew coordination, inter- and intra- craft coordination, selection of work means and methods, and leadership</i>)	2.0	Certified in job management functions 160 hours of training but not certified in job management functions No training and certification	10 5 0	20
Work Record (<i>safety, attendance / truancy, quality, productivity, and initiative</i>)	3.0	Superior in all categories Superior in some, modest in others Weak in most categories	10 5 0	30
	10.0			Total = 100

Figure 4. Individual's Management Skills Score

The combined score of Technical Skills and Management Skills has a maximum value of 200 points. A minimum combined score of 150 points is necessary to qualify as a Tier II Worker. Thus, to qualify as a Tier II Worker, it is necessary to have both technical and management skills.

IV. Tier II Project Index

A Tier II project, inherently, must have an adequate number of Tier II workers. However, the execution of the project must utilize the Tier II workers and their capabilities. The level of implementation of the Tier II Strategy is expressed as the **Tier II Project Index**. The calculation of the Tier II Project Index has five components; each has a maximum index value of 2.0.

Project Worker Characteristics: Project Craft Technical Skills Index 2.0

Project Craft Management Skills Index 2.0

Project Execution: Information Technology Utilization Index 2.0

Craft Utilization Index 2.0

Organization Index 2.0

Maximum Tier II Project Index 10.0

For each element, only three possible scores are illustrated and judgment must be utilized for interpolation. A score of '10' represents an ideal, probably future, state. A score of '5' represents the current best possible, and a score of '0' represents an unacceptable state for that element. The scoring system is consistent for all five indices.

Details of the five components are given in Figures 5 through 9. The first two components, represented in Figures 5 and 6, are derived from the scores of the Individual's Technical Skills and Management Skills scores, but represent all of the workers in key craft crews on a project. Thus, for example, a major element of the Project Craft Technical Skills Index is the average value of the Individual's Technical Skills scores for key crafts. (The project leadership must define the project's key crafts). The other element of the Project Craft Technical Skills Index is the percentage of Tier II workers on the project. The Project Craft Management Skills Index is based upon the average of the Individual's Management Skills scores for the key craft's workers. The calculation of each Index score is made by dividing the total score by 50, and has a maximum index value of 2.0 points.

Elements	Weights	Evaluation Criteria	Score	Max Score = 10 x Weight
Average Score from Individual Evaluation on Technical Skills *	7.0	Greater than 75 points	10	70
		50 points	5	
		Less than 25 points	0	
Percentage of Tier II workers*	3.0	40% or more of journeymen are certified as Tier II workers	10	30
		20% of journeymen are certified as Tier II workers	5	
		Less than 10 % of journeymen are certified as Tier II workers	0	
	10.0			100

Max Total Score = 100

Max Index value = 100 / 50 = 2.0

** for project's key crafts*

Figure 5. Project Craft Technical Skills Index

Elements	Weights	Evaluation Criteria	Score	Max Score = 10 x Weight
Average Score from Individual Evaluation on Management Skills *	10.0	Greater than 75 points	10	100
		50 points	5	
		Less than 25 points	0	
	10.0			100

Max Total Score = 100

Max Index value = 100 / 50 = 2.0

** for project's key crafts*

Figure 6. Project Craft Management Skills Index

Figures 7, 8 and 9 exhibit the Execution components of a Tier II project. Thus, if a project has an adequate number of Tier II workers, with excellent technical and management skills, it is necessary to utilize those skills through Information Technology Utilization, Craft Utilization and Organization. Each of these components is described below.

The Information Technology Index is presented in Figure 7 and consists of two elements. The first element is the direct access of Tier II workers to necessary project management information. The second element is the ease of access, through modern hardware, by the Tier II workers to necessary project information. As with the other components, a maximum score of 100 points is possible and, after dividing by 50, yields a potential Information Technology Utilization Index of 2.0.

Elements	Weights	Evaluation Criteria	Score	Max Score = 10 x Weight
Integrated Information Access	6.0	All information* is stored, integrated, continuously updated, and accessed by Tier II workers electronically	10	60
		3 types of information* are stored, integrated, continuously updated, and accessed by Tier II workers electronically	5	
		Information* is not directly accessed by Tier II workers	0	
Hardware	4.0	Tier II workers have wireless, wearable computers	10	40
		Hardware is nearby and shared among crews	5	
		No hardware is available to Tier II workers	0	
	10.0			

Max Total Score = **100**
Max Index value = 100 / 50 = **2.0**

* Information includes schedule, costs, materials and equipment management, safety, drawings, and worker skills

Figure 7. Information Technology Utilization Index

The Craft Utilization Index is presented in Figure 8. It consists of three elements: the percentage of Tier II workers on key-craft crews, the percentage of multiskilled workers on key craft crews, and the worker turnover on the project. In essence, the Craft Utilization Index is a measurement of the distribution of the advanced worker skills on a project. As with the other components, it has a maximum Index value of 2.0.

Elements	Weights	Evaluation Criteria	Score	Max Score = 10 x Weight
Crew Mix	4.0	Key crafts' crews (on avg.) have at least 40% of Tier II workers	10	40
		Key crafts' crews (on avg.) have at least 20% of Tier II workers	5	
		Less than 50% of key crafts' crews have Tier II workers	0	
Use of Multiskilled Workers	2.0	Key crafts' crews (on avg.) have at least 40% multiskilled workers	10	20
		Key crafts' crews (on avg.) have at least 20% multiskilled workers	5	
		Less than 50% of key crafts' crews have multiskilled workers	0	
Worker Turnover (Total Hires / Peak Workforce)	4.0	Less than 2	10	40
		Equal to 3	5	
		Greater than 4	0	
	10.0			

Max Total Score = 100
Max Index value = 100 / 50 = 2.0

Figure 8. Craft Utilization Index

The final component, Organization Index, is presented in Figure 9 and consists of two elements. The first element relates to communications and stresses the importance of good communications for project success. The second element is that of a High Performance Work Place and is intended to reflect the necessity of utilizing the management skills of the Tier II workers.

Elements	Weights	Evaluation Criteria	Score	Max Score = 10 x Weight
Communications	6.0	Proactive information flow to and from workers about the project, established formal & informal channels, open access to management, frequent meetings with workers, all workers are familiar with all aspects of the project	10	60
		Informal communication channels, regular meetings with workers, workers can receive project information requested, open door policy	5	
		Rigid hierarchical structure for communication, only information that management deems necessary to workers is provided.	0	
High Performance Work Place	4.0	Delegation of appropriate authority and accountability to High Performance Work Teams (HPWT). Clear definition of authority, accountability and expectations to each team. Training of all teams in HPWT approach. Expected utilization by crews of management skills and IT information available thru Tier II workers	10	40
		Hierarchical structure, but with 2-way information & idea flow between crews and management	5	
		Rigid hierarchical structure	0	
	10.0			

Max Total Score = 100
Max Index value = 100 / 50 = 2.0

Figure 9. Organization Index

V. Tier II Project Index Calculation

The Tier II Index for a project is the combined total index of the five components: Project Craft Technical Skills, Project Craft Management Skills, Information Technology Utilization, Craft Utilization and Organization. Each component has a maximum score of 100 points, which divided by 50 yields a maximum potential Index score of 2.0 points. Thus, the Tier II Project Index is merely the sum of the five Index scores.

Project Craft Technical Skills Index	2.0	Max
Project Craft Management Skills Index	2.0	Max
Information Technology Utilization Index	2.0	Max
Craft Utilization Index	2.0	Max
Organization Index	<u>2.0</u>	<u>Max</u>
Tier II Project Index	10.0	Max

VI. Summary and Discussion

The Tier II Index not only provides a method of evaluating the level of Tier II implementation on a project, but it also provides a road map to successful implementation of the Tier II Strategy. It contains five major components:

- **Project Craft Technical Skills**
- **Project Craft Management Skills**
- **Information Technology Utilization**
- **Craft Utilization**
- **Organization**

The five components, which are equally weighted, consist of a total of 16 different elements. At this time, the weights and criteria for measuring each element are based upon input from industry experts. Thus, the Metric is available for immediate use. As data are gathered, it will be possible to add new elements and adjust weights based upon statistical analyses and experience.

Two major issues have intentionally been omitted from this document. The first is that of compensation for Tier II workers, including incentives. The market place will allow the compensation issue to be appropriately addressed as results from Tier II projects are obtained.

The second major omission is that of training and certification. The Tier II metric does not prescribe "how to accomplish training and certification" but assumes that both will be necessary. For some elements, such as those for an individual's technical skills, excellent training and certification programs are currently available at project, company, and national levels. For other elements, such programs must be developed. It is assumed that, if a contractor (or contractor and client) wishes to implement a Tier II strategy on a project, it will be necessary to score each of the elements on a "planned" basis and then identify and implement the necessary training activities to achieve that score. At the project's completion, it will be possible to assess the level of success in achieving the planned goals.

Appendix
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