

Following up with Foremen



Meetings

Work Package Development

Planning and Prioritizing Tasks
and Fallback Work

Completing Progress/Timesheets

Constraint Management

Communicating with Field Engineers

Safety-related Activities

Improving Frontline Supervision in Industrial Construction

Coordinating

Planning and Prioritizing

Receiving and Verifying

Meetings

Supervise/Motivate/Execute

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Future Work

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Improving Frontline Supervision in Industrial Construction

Prepared by

Construction Industry Institute

Research Team 330, The Role of Frontline Supervision
in Improving Construction Productivity and Performance

Final Report 330

December 2018

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Executive Summary

Frontline supervisors – foremen and general foremen – are the managers who translate construction execution plans into productive action. Despite their importance, they have been comparatively understudied. Recent productivity research has focused on new techniques, such as Advanced Work Packaging (AWP), or worker shortages and the lessening of craft skills. However, to implement any productivity improvement initiatives or to address worker skills, it is imperative to focus on the capabilities of foremen and general foremen. In order to conduct this research, limited to industrial construction, Research Team 330, The Role of Frontline Supervision in Improving Construction Productivity and Performance (RT-330), addressed frontline supervision in two ways:

1. **The competencies of foremen and general foremen** – RT-330 identified 10 core competencies, composed of a host of specific skills. These competencies are uniform across productivity regimes, varying only in detail. The 10 core competencies, in no specific order, encompassed the following specific skills:

- | | |
|-----------------------------------|-------------------------------|
| 1. General Construction Knowledge | 6. Problem Solving |
| 2. Trade-specific Knowledge | 7. Ethical Value System |
| 3. Verbal Communications | 8. People Management |
| 4. Written Communications | 9. Leadership |
| 5. Pre-Planning | 10. Proactive and Goal-driven |

This research validated the importance of these 10 competencies. The assessment of foremen and general foremen indicates that their levels of competency are lower than desired. Industry investment in frontline supervisor skills – for foremen in particular – is seen as one of the biggest opportunities for the industry to improve productivity and performance. This assessment is supported by low levels of training self-reported by both foremen and general foremen.

2. **How frontline supervisors allocate their time across common tasks** – RT-330 members identified specific tasks with reference to the common activities – from field leadership to administration – undertaken by foremen and general foremen during a typical day. The team developed a target time per activity – a range that reflects the most productive allocation to each task, considering the variety of activities that frontline supervisors must perform.

The team's principal research findings were that foremen and general foremen, in aggregate, spend time on tasks in ways that are not productive compared to a target allocation. At an industry level, this indicates an enormous opportunity for improvement. The researchers discovered that training in AWP techniques improved foremen and general foremen's time allocation on many tasks. This research provides added support for investment in AWP by the industrial sector.

The RT-330 research identified significant opportunities to enhance frontline supervisor skills and, thus, ways to improve how foremen and general foremen allocate their time every day. An overarching recommendation is that the industry must collectively invest in frontline supervisor skills. For individual firms, this report concludes with recommendations around screening, onboarding, development, and retention that may help readers to realize sizeable improvements. A summary recommendation around these activities is that firms need to take a deliberate approach to ensure that they select and develop their best talent.

Contents

Executive Summary	iii
1. Introduction	1
2. Methodology	5
3. The Competencies of Frontline Supervisors	11
4. Training and Frontline Supervision	23
5. Conclusions and Recommendations	35
Appendix A: General Foreman Competency Level Ratings	41
Appendix B: Foreman and General Foreman Time Allocation to Tasks	43
Appendix C: Foreman and General Foreman Competencies in Detail	51
Bibliography	59

Chapter 1

Introduction

Context and the Need for Improvement in Frontline Supervision

Frontline supervisors – foremen and general foremen – are responsible for translating construction plans into productive practice. In spite of the centrality of these roles to project success, the experience and research of Research Team 330, *The Role of Frontline Supervision in Improving Construction Productivity and Performance*, (RT-330) show a pervasive weakness in frontline supervision. The construction industry has many opportunities to improve, and its challenges are particularly acute for foremen.

The transient nature of the industrial construction foreman position makes it difficult for contractors to justify the cost of investing in developmental training. RT-330 observed that most contractors select new foremen from the “best” of an increasingly inexperienced craft labor pool, mostly based upon the recommendations of general foremen and superintendents. These new foremen generally assume their roles with minimal onboarding support and rely on daily guidance from their peers and supervisors to help them transition into their new responsibilities.

Typically, over time, individual foremen succeed or fail through their personal efforts. They have work opportunities with a variety of companies, each with its different culture and support structure. Some continue as foremen; some fall back to working with their tools; and a few advance to the general foreman level. Very few are ever formally evaluated to determine their strengths and weaknesses, and even fewer are provided with the training and developmental opportunities that they need to reach their full performance potential. The result is that most foremen are never given their best opportunity to do well and, consequently, the performance of craft labor on many projects is much less than optimal.

The challenges and opportunities facing frontline supervision are important to framing the productivity challenge facing the construction industry. In addition to the addressing the shortage of skilled workers, improving the skills of foremen and general foremen is an essential challenge for the industry. It is important not just in a broad sense, but also to support the implementation of productivity-enhancing practices such as Advanced Work Packaging (AWP) or new technologies (CII 2013a; CII 2013b).

Despite RT-330’s observations of weakness – particularly among foremen – the team’s research has a positive message. A common set of competencies for foremen and general foremen spans the different practices and regimes. This common set

can support screening, training, and retention efforts at both the firm and industry level. Investments in building these competencies should have positive effects for the industry, both in terms of improving the skills of frontline supervisors and in supporting more directed efforts in improving productivity, such as AWP.

Definitions

The research team defines frontline supervision as foremen and general foremen. The team found, at least within industrial construction, that the following understanding of the roles of foremen and general foremen was broadly similar across projects and companies:

- The **general foreman** is the top level of frontline supervision, supervising between three to six foremen, typically within a specific craft discipline. It is the general foreman's responsibility to plan out work several days to a few weeks in advance of the foremen, and ensure that each foreman and crew has necessary resources, such as equipment, materials, cranes, and scaffolding. Additionally, the general foreman will verify completed progress and assist in forecasting labor needs.
- The **foreman** is the immediate frontline supervisor for each crew, typically supervising a crew of eight to 12 people, depending on the discipline. The foreman's primary responsibilities are the safety, quality, and productivity of the crew. The foreman works on tasks assigned by the general foreman and plans daily production for the crew. On smaller jobs, the foreman may take on some of the general foreman's role (especially when the general foreman's position is gone and replaced by discipline superintendent).
- The work of the general foremen and foremen is typically overseen by a **superintendent**, who fills the top level of supervision for a specific craft or area of work. Superintendents typically lead between three to five general foremen and have ultimate responsibility for the safe and productive execution of required work. Larger projects can have multiple levels of superintendents; however, superintendents do not directly supervise workers and hence are not considered frontline supervisors.

Related Literature

Foremen and general foremen have long been considered important to productive work across industries. Their roles' ongoing challenge to translate management plans into action has also long been recognized as a difficult one. Indeed, a 1949 paper describes foremen as "the marginal men of industry" and describes their challenge of translating management plans to action without necessarily sharing in the planning process (Wray 1949). While the literature on foremen and general foremen has existed for decades, in many respects these roles are understudied. The studies that

do address frontline supervision emphasize the importance of construction foremen in motivating workers, assuring safety and quality, and efficiently conducting work (Senior 1996).

Some studies have established the foreman's role as a crucial link between management and the workforce (Uwakweh 2005), while other, related work has been performed to understand the influence of frontline supervisors and their influence on performance (Lemna et al. 1986; Uwakweh 2005; Shohet and Laufer 1991). For example, Shohet and Laufer studied the behavioral patterns of construction foremen and their influence on construction productivity. They concluded that the role of a foreman as a manager or supervisor is very important, and foremen can adequately replace re-planning with pre-planning to increase construction performance and productivity. Shohet and Laufer further identified a correlation between how foremen spent their time during a workday and the performance of their crews (Shohet and Laufer 1991).

Despite the importance of frontline supervisors to project performance, evidence indicates that their skills are lacking. Hewage et al. researched on-site construction professionals in Alberta building construction projects. They identified weak supervisory skills among foremen and an urgent need for training programs so field managers could improve their skill levels (Hewage et al. 2011). Maloney and McFillen suggested that journeymen were being made foremen with little or no supervisory training, and hence concentrated on their craft more than focusing on supervising and motivating their crews (Maloney and McFillen 1987). Fayek et al. identified the importance of frontline supervisors in the construction industry and the need to train them to effectively undertake their supervisory responsibilities (Fayek et al. 2006).

Another stream of research relates to needed or suggested supervisory skills and competencies. CII's research on supervisory education (CII 1996a, 1996b) considered the importance of investing in education and training, outlining sets of competencies in skills and abilities, prerequisite knowledge, and desirable personality traits (CII 1996b). The CII research also suggested that the selection of supervisors should be based on their competencies. However, this research focused broadly on supervisors, including superintendents instead of focusing more narrowly on frontline supervisors (foremen and general foremen).

Various other authors have produced assessments or recommendations that were more limited or focused than the CII research. Rojas provided a 360° assessment of field supervisors and project managers within a unionized electrical contracting company and identified 12 pillars of successful supervision (Rojas 2013). Hinze and Kuechenmeister investigated the characteristics and common traits of productive industrial foremen (Hinze and Kuechenmeister 1981). Lemna et al. identified characteristics of industrial foremen and their effect on construction productivity

(Lemna et al. 1986). Maloney and McFillen identified five dimensions of foreman performance and their relationships with worker motivation, performance, and satisfaction (Maloney and McFillen 1987). Senior elaborated on foreman planning behind short-term task scheduling (Senior 1996). Uwakweh identified seven foreman scales to establish their relationship with the motivation and performance of construction apprentices (Uwakweh 2005).

Some related research focused on the specifics and efficacy of training. Goodrum et al. suggested that formal training lowers the cognitive load on workers and potentially improves their performance (Goodrum et al. 2016). Kumaraswamy illustrated the importance of integrated training programs to uplift the knowledge, skills, and attitudes of construction workers and managers (Kumaraswamy 1997). Serpell and Ferrada proposed a labor competency management framework to train, develop, and certify construction supervisors in Chile and other developing countries (Serpell and Ferrada 2007). These studies established the importance of developmental training in ensuring that frontline supervisors effectively perform their responsibilities in labor-intensive and dynamic construction environments.

Reader's Guide

This report documents the principal findings and recommendations of the RT-330 research. Chapter 2 describes the research methodology and includes a discussion of the principal data collection instruments and their development. Chapter 3 provides an assessment of the current state of competencies of foremen and general foremen as well as an assessment of how they spend their time on typical tasks. Its principal findings are that foremen, in particular, lack a variety of beneficial competencies, and that both foremen and general foremen, in aggregate, spend their time across tasks in ways that deviate from recommendations. Chapter 4 extends the research findings to report on what training foremen and general foremen have received, and to relate the finding that, apart from a few specific topics, training is lacking. Chapter 4 continues to explore the impact that training in one area – Advanced Work Packaging – has on how foremen and general foremen spend their time. Chapter 5 draws conclusions and makes recommendations, and the appendices add details and more complete data on various aspects of the study.

Chapter 2

Methodology

CII initially chartered this research with an essential question: “What are the cognitive and practical competencies of field supervisors to implement productivity-enhancing practices effectively?” From its first meeting, Research Team 330 quickly understood that this was a large topic and that a narrower scope was needed. The team focused on frontline supervisors – foremen and general foremen – because these are the personnel who are most involved with supervising craft. The team also decided to limit its focus to industrial construction. In terms of productivity-enhancing practices, the team focused on Lean and Workface Planning (as part of Advanced Work Packaging) where the focus is on more advanced crew planning, rather than examining other techniques that may or may not directly involve field supervisor competencies, such as consultant-led observational techniques or incentives.

At the same time RT-330 was tightening the focus of its work, during its initial discussions the team decided to expand the essential question. In particular, the group decided to focus on which cognitive skills and competencies needed to be broadened. The industry team members observed that the skills and competencies of foremen and general foremen were lacking in general, and hence they wanted a better definition of what competencies were needed and which the industry lacked. (This observation was supported by the literature review noted in the previous chapter.)

It is important to note that the research team was composed of individuals with direct responsibility for field production. Many worked with craft supervision on a daily or weekly basis, and the majority had gained direct experience as craft workers and field supervisors before they had moved to the management positions they held as they conducted this research. Several team members also had experience with implementing Lean or Workface Planning concepts on their projects. Thus, the team was very knowledgeable of the current conditions and challenges facing the industry.

Research Approach

After initial deliberation over the course of three team meetings, the team choose to investigate three hypotheses:

1. **Frontline supervisors have a common set of core competencies, and these competencies are weaker than desired to effect productive construction.** A sub-hypothesis is that the competencies needed for implementing productivity-enhancing practices do not vary significantly from the broader competencies needed by foremen and general foremen.

2. **Foremen and general foremen spend their time in ways that deviate from desirable allocations.** These deviations may be seen as evidence of several issues, but at some level they probably correlate with a lack of skills.
3. **Foremen and general foremen do not receive enough training or education about the desired competencies.** As with the second hypothesis regarding time on tasks, the thought was that lower levels of training likely correlate with the deficiencies in supervisor competencies.

Testing these research hypotheses required RT-330 to conduct a variety of investigations into the competencies of frontline supervisors and how they spend their time. To this end, the team adopted a mixed-methods approach that combined team deliberations, surveys, and interviews (Creswell and Plano Clark 2017). The team considered this approach to be the best way to gather data with the breadth and depth necessary to substantively address the essential question that drove this research.

Figure 1 shows the structure and sequence of the research. The team first addressed the research with a literature review and team deliberations to refine the topics and the research questions. After defining the study's scope, the team's next focus was on identifying and defining the competencies of foremen and general foremen. The team generated these competencies through a literature review and a review of documents internal to team members' companies, and by drawing on the members' personal experiences. The team gathered the skills and competencies in a lengthy list, ordered and grouped the list's contents, and then refined the list through repeated discussions that broadly followed the Delphi method for generating consensus among experts (Hallowell and Gambatese 2010).

Once the team had defined the competencies and grouped them into 10 broad areas or categories, it moved on to assessing the importance of foremen and general foremen's skill levels within these categories. As Figure 1 shows, at this point the research split into two parallel tracks:

1. How frontline supervisors spend their time
2. Foremen and general foremen's levels of training

After the split, the primary data collection effort surveyed large numbers of foremen and general foremen, asking how they spent their time and other related topics. At the same time, the team pursued a more detailed assessment of the skills and competencies of foremen and general foremen by conducting interviews. The team piloted and refined both the survey and interview portions of the research before it engaged larger groups of respondents.

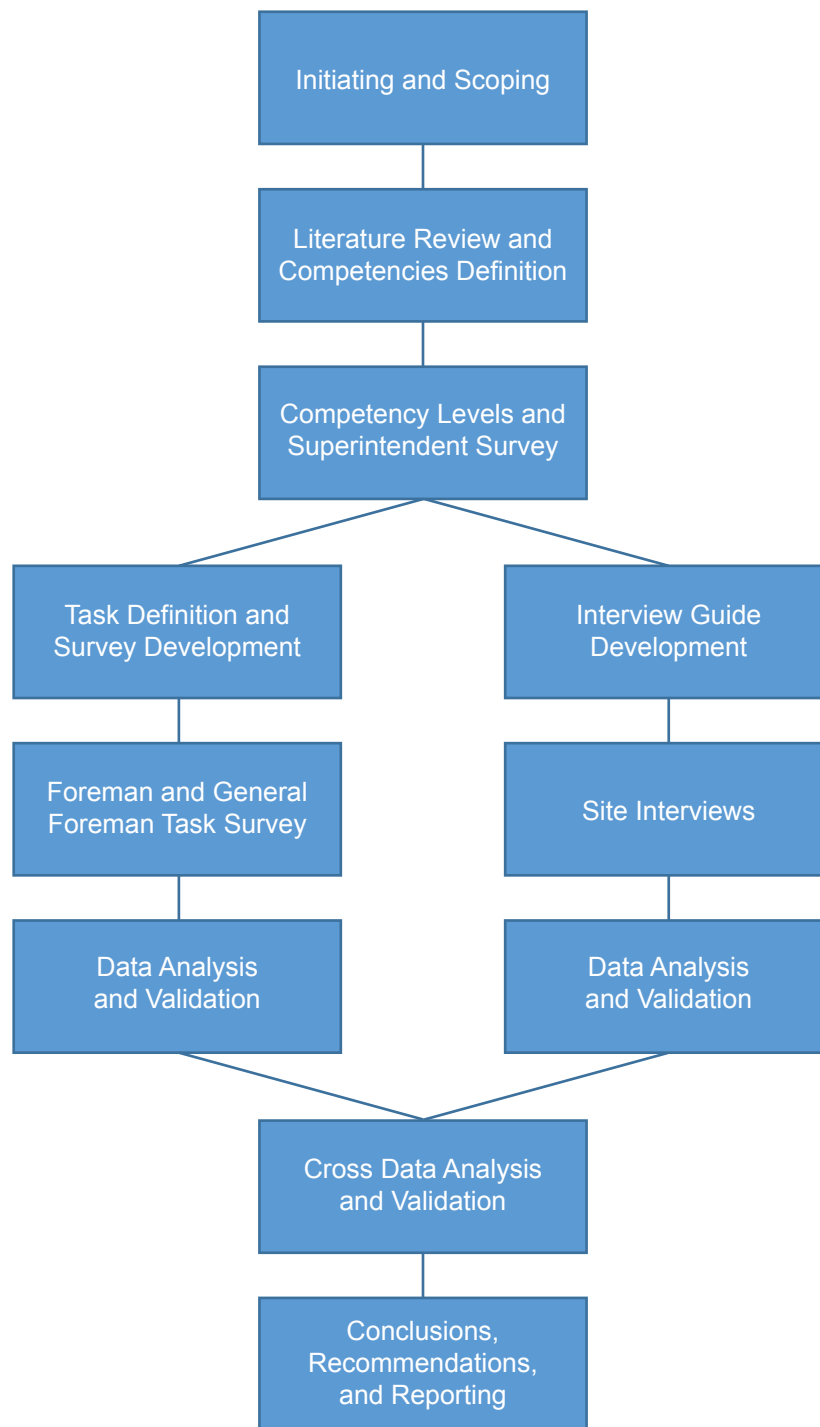


Figure 1. RT-330 Research Approach and Tasks

The survey portion of the research principally sought to understand how foremen and general foremen allocate their time on projects. In order to do this, the research team defined which common tasks frontline supervisors devote time to (apart from personal time and breaks). The team developed an online survey, then piloted and refined it with the help of respondents from team members' companies. This initial pilot of the survey instruments demonstrated that foremen and general foremen were generally unable to record how they allocated their time, whether precisely or by percentages. (Their allocations were incomplete or did not add up.) As a result, the team adjusted its survey to allow respondents to indicate ranges of time for each task.

The ranges of time that the research team developed represented the realistic quantities of time that frontline supervisors could be expected to spend on various tasks. After defining a target or ideal range, the team established additional ranges that represented less-desirable allocations of time for each task. These target ranges sought to offer likely alternates for how foremen and general foremen could spend their time on tasks. A pilot of the revised survey found that it allowed rapid and accurate responses.

The team broadly distributed its final survey to CII member companies with the specific request that it be answered by superintendents or personnel with direct experience or responsibility for craft production. The survey reached frontline supervisors working on project sites at industrial projects of various types, including maintenance projects. Responses came from across North America, ranging from the U.S. Gulf Coast to Canada, and both union and open-shop projects were surveyed. The survey collected data from 812 foremen and 323 general foremen. The team felt that the answers to this survey broadly validated the importance of the 10 areas of foremen and general foremen competencies it had identified, and also supported its hypothesis that frontline supervision skills are below desirable levels. (The survey results are reported in greater detail in Chapter 3.)

RT-330 developed the interview portion of the research to address specific aspects of the skills and competencies of foremen and general foremen which interested the team. The researchers developed an interview guide to ask frontline supervisors about the skills and competencies necessary for their jobs. This interview research also sought to determine in greater detail whether frontline supervisors required different skills or competencies if their projects used productivity-enhancing practices, such as Advanced Work Packaging and Workface Planning.

A graduate research assistant conducted the interviews at nine team member project sites, either in the field or, more typically, in trailers nearby. The sites were in Texas, Louisiana, and Alabama, and they included new capital projects, renovation projects,

and maintenance projects. Both AWP and traditional sites were identified, and 113 interviews were conducted: 62 with foremen, 43 with general foremen, and eight with other personnel (e.g., workplace planners).

The researchers used the initial round of interviews to refine the interview guide. A principal finding from the initial interviews was that the interview guide was too long to be completed in the time generally allowed per interviewee, so subsequent interviews focused on only a portion of the full guide. The specific portion chosen changed with each interview, so that for any given site there were multiple responses to each portion of the guide. The team determined that this approach was able to deliver adequate depth and breadth.

After the surveys and the interviews, the research team reviewed the findings to look for internal consistencies and to generate initial research findings. Finally, the survey and interview data were cross-checked, to compare the results captured by the different data collection methods. The principal findings from this research supported the hypotheses, and the results are presented in the following chapters. In short, the interview findings support the quantitative data and, as such, are not reported in detail in this volume (although key interview results are presented in Chapter 4). For a more detailed discussion of the team's findings and methodologies for analysis, review Gurpreet Kaur's master's thesis (Kaur 2017).

Chapter 3

The Competencies of Frontline Supervisors

The initial hypotheses of the RT-330 research were that frontline supervisors have core skills, and these skills are weaker than desired to effect productive construction. This chapter focuses on this hypothesis, presenting the following information:

- The research team's definition of the core skills or competencies required by frontline supervisors
- Superintendents' assessments of the importance of these skills
- The skill levels of foremen and general foremen as assessed by superintendents and related personnel (with support from interviews)

The team found the core skills were both important and below desirable levels. Since skill levels influence, at least in part, how foremen and general foremen spend their time, this study presents data from detailed surveys that document how frontline supervisors allocate their time to common tasks across the day. When the researchers compared these allocations with the ideal times, they found that foremen and general foremen spend their time on a wide range of tasks, and in ways that vary both from one other and from the ideal ranges. Collectively, RT-330 sees great opportunities for enhancing performance by improving frontline supervisor skills and addressing how these supervisors allocate their time.

Required Competencies of Frontline Supervisors

The researchers' intensive review of both literature and the training and assessment guides provided by research team members identified a broad range of skills required of foremen and general foremen. Through a Delphi-style process, the team categorized these skills and consolidated them into 10 core competencies. The team considered the following skills and competencies to build from basic skills and knowledge to more advanced capabilities. (They are listed in the order the skills will be summarized, rather than ranked by their importance.)

- | | |
|-----------------------------------|-------------------------------|
| 1. General Construction Knowledge | 6. Problem Solving |
| 2. Trade-specific Knowledge | 7. Ethical Value System |
| 3. Verbal Communications | 8. People Management |
| 4. Written Communications | 9. Leadership |
| 5. Pre-Planning | 10. Proactive and Goal-driven |

Each competency contains a range of sub-skills. The broad categories are seen as equally applicable to foremen and general foremen, but the emphasis placed on a particular sub-skill may change across roles. For example, Pre-Planning has a sub-skill of Planning and Schedule Production. For foremen, this sub-skill focuses more on setting a crew's goals for daily production, while for general foremen it considers how well they understand productivity rates to set crew sizes for multiple weeks of work.

The team related the 10 skills or core competencies of foremen and general foremen to over 100 sub-skills, but it found that a smaller set of these sub-skills was particularly important to productivity practices. Appendix C lists the most important sub-skills for each of the 10 core skills. These sub-skills define the core skills and can be used as a resource for assessing and screening foremen and general foremen. (See RT-330's recommendations in Chapter 5).

Competencies Assessment

The team identified 10 competencies that are important to both foremen and general foremen, then confirmed them through its survey research. RT-330 widely distributed a survey of construction management (superintendents and similar knowledgeable personnel) through CII and research team contacts, and received 86 responses from the United States and Canada. This management survey asked respondents both to rate the importance of the 10 competencies to foremen and general foremen, and to assess the current skill levels of foremen and general foremen.

The **importance ratings** from the survey (shown in Table 1) used the following scale:

- | | |
|-----------------------|------------------------------|
| 1. No Importance | 4. Moderate Importance |
| 2. Limited Importance | 5. High Importance |
| 3. Slight Importance | 6. Extremely High Importance |

The average importance ratings of the 10 competencies are seen to be high for both foremen and general foremen; in most cases between high and extremely high importance. The lowest score is 4.45, or halfway between moderate and high importance. In all cases, the general foreman importance scores were slightly higher on average than the foreman scores.

The same competencies were also observed in the interviews conducted by the research team, and they were found to be broadly applicable to all project types (i.e., maintenance, AWP, and traditional). The 10 competencies are also seen to be comprehensive: interviews did not identify any new categories or indicate any substantive differences among the 10 competencies in terms of their application. While some specific skills are more particularly needed for a given application (e.g.,

the ability to read and utilize an Installation Work Package document in AWP), all of the skills were considered to be instances of the broader 10 competencies.

Table 1. Construction Management Importance Ratings of Foreman and General Foreman Competencies (1-6 Scale) (n = 86)

Competencies	Foremen	General Foremen
1. General Construction Knowledge	4.73	5.32
2. Trade-specific Knowledge	5.29	5.58
3. Verbal Communication	5.17	5.43
4. Written Communication	4.45	4.93
5. Pre-Planning	5.12	5.57
6. Problem Solving	4.87	5.37
7. Ethical Value System	5.46	5.58
8. People Management	5.15	5.53
9. Leadership	5.28	5.57
10. Proactive and Goal-driven	5.24	5.53

The construction manager survey respondents assessed the **competency levels** of frontline supervisors (see Table 2) based on the following scale:

- | | |
|---------------|--------------|
| 1. Inadequate | 4. Good |
| 2. Fair | 5. Very Good |
| 3. Adequate | 6. Excellent |

Table 2. Construction Management Assessment of the Competency of Foremen and General Foremen (1-6 Scale) (n=86)

Competencies	Foremen	General Foremen
1. General Construction Knowledge	3.64	4.28
2. Trade-specific Knowledge	4.05	4.53
3. Verbal Communication	3.75	4.21
4. Written Communication	3.29	3.92
5. Pre-Planning	3.56	4.20
6. Problem Solving	3.56	4.17
7. Ethical Value System	4.15	4.45
8. People Management	3.76	4.32
9. Leadership	3.85	4.38
10. Proactive and Goal-driven	3.81	4.24

A significant finding was that construction managers assessed the skills of foremen and general foremen to be below the desired levels. The respondents scored foremen in a range between adequate and good, and rated general foremen as good to very good. These ratings are consistent with the industry's general approach of promoting talented foremen to be general foremen. It is notable that several general foremen interviewed by the team commented that foremen's skills have been declining. RT-330 also observed that firms may more routinely invest in general foremen. Foremen are often transient across projects and thus less likely to receive investment in their skills.

The survey indicates that written communication was the weakest rated competency for both foremen and general foremen. Rankings for foremen are also consistent with the research team's observation that foremen competencies, particularly interpersonal skills, are below desired levels.

While ratings for foremen and general foremen averaged between adequate to very good (skewed lower for foremen), the team considers an improvement in the skill levels for foremen and general foremen to be a tremendous opportunity for the industry. At the same time, the current skills levels are seen as a barrier to improving productivity. The problems caused by the current skill levels and the opportunities for improvement from training and education are discussed in the analysis that follows.

To provide more insight into the assessments, Table 3 shows the distribution of answers in each rating level for the 10 competencies for foremen. (Appendix A provides the same data for general foremen.) As can be seen in the table, most of the 10 skills have a significant percentage of ratings in the inadequate and fair levels (1 and 2). Similarly, only two competencies have 10% or more of the ratings in the excellent level (Level 6). Interviews with general foremen also reveal broad agreement that foremen skills have room for improvement. The research team views the data as broadly representative of the industry, including maintenance and new capital construction projects. It is the opinion of the team that these averages are regionally worse in certain areas, particularly among the traveling workforce employed on large-scale capital projects.