Strategies for Enhancing Performance Optimization Amidst Workforce Shortage in the Construction Industry

Rebecca Kassa[1]*, Ibilola Ogundare[1], Brian Lines[2], Jake Smithwick[3], and Kenneth Sullivan[4]
[1]Ph.D. Student, University of Kansas, Civil, Environmental and Architectural Engineering Department
[2]Associate Professor, University of Kansas, Civil, Environmental and Architectural Engineering Department
[3]Associate Professor, University of North Carolina at Charlotte, The William States Lee College of Engineering Department of Engineering Technology and Construction Management
[4]Professor, Arizona State University, Ira A. Fulton Schools of Engineering School of Sustainable Engineering & the Built Environment
**Corresponding Author*

Abstract

The construction industry confronts a critical workforce shortage that significantly impacts project performance and productivity. Traditional project performance metrics such as time, cost, quality, safety, and client satisfaction rely on skilled professionals' competence. However, the prevailing labor gap necessitates targeted talent development strategies. Construction organizations' investment in effective talent-development programs is a pivotal approach for attracting, developing, and retaining staff. This paper proposes a performance measurement approach tailored for construction companies in facilitating focused talent development programs. The study assessed performance data from the direct supervisors of 187 project managers (PMs) and 80 field leaders (FLs) across general and specialty contractors in the United States. Utilizing Principal Component Analysis, performance measuring criteria were established for both roles. These criteria were then used to categorize project managers and field leaders into different performance tiers including top-performers, above average performers and blow average performers. Notably, top-performing project managers and field leaders exhibit well-rounded skills in leadership, communication, technical proficiency, and overall job knowledge. This study equips construction organizations with a comprehensive framework for refining talent-development programs, emphasizing on the skills most associated with top performing project managers and field leaders. The study lays a foundational understanding of performance dynamics across diverse construction professions, offering valuable insights for future investigations.

Key Words: Performance, Project Manager, Field Leader, Talent Development, Workforce Shortage

Introduction

The construction industry, a sector heavily reliant on human resources across the project lifecycle, faces a critical shortage of skilled individuals, posing substantial challenges. Contributing factors encompass the retirement of the experienced baby boomer generation possessing requisite construction skills with no commensurate influx of a qualified younger generation to fill these vacancies [1]. A survey conducted jointly by the Associated General Contractors of America and

Autodesk [2] underscored the profound labor shortage in the U.S. construction domain. Remarkably, 93% of construction firms grapple with open position vacancies, with 91% encountering difficulties in filling specific roles. A transformative demographic shift further compounds the issue, as a significant cohort of adept professionals near retirement, revealing a scarcity of midcareer personnel to assume leadership positions, while the younger workforce remains yet unqualified for such roles [3][4]. Labor scarcities magnify supply chain disruptions, escalating construction material costs, and inducing uncertain delivery timelines and availability, thereby engendering substantial project delays [5][2].

The employment landscape within the construction industry has become notably complicated due to the ramifications of the COVID-19 pandemic [6]. The effects of the pandemic on employment in the U.S. construction sector during the period spanning February 2020 to August 2021 are outlined in an additional study by the Associated General Contractors of America [5]. This research underscores that construction employment witnessed a decline of up to 16.6% in 39 states. Furthermore, [7] underscore the substantial influence of the COVID-19 pandemic on the diversity of the construction workforce in the U.S. The authors observe a reduction in the participation of women, minorities, and foreign-born workers within the construction industry since the pandemic's inception. This decline is attributed to multifaceted factors, including the pandemic's disproportionate impact on marginalized and low-income communities, reduced construction opportunities, and heightened job competition from individuals in alternative sectors.

Construction firms point to the lack of requisite skills among job applicants and potential hires as a leading factor in the ongoing labor shortage, as highlighted by the Associated General Contractors of America's report (Simonson, 2022). Without substantial investment in training programs, the situation could worsen, potentially exacerbating the issue. While certain construction firms have taken steps to establish in-house training initiatives aimed at refining the skills of their workforce [8], the efficacy of these skill development endeavors hinges upon the accurate identification of performance metrics that exert direct influence on construction projects. Addressing labor shortages and bolstering productivity within the construction industry demands the formulation of strategies dedicated to retaining and enhancing the skill set of the existing workforce, especially given the limited availability of qualified potential workers. This endeavor involves pinpointing the fundamental competencies that underpin performance and instituting upskilling interventions for individuals performing at average or below-average levels. Such efforts hold the promise of elevating the overall productivity of the industry's current workforce [9].

This study proposes a performance measurement strategy that construction companies can use as input to design talent development programs. This holistic performance-measuring construct identifies the skills most strongly associated with top performing PMs and FLs. The strategy intends to assess the performance of PMs and FLs to develop criteria that define different categories of their performance, including the top, above average and below average performer category. This enables construction organizations to provide their project managers (PMs) and field leaders (FLs) with individualized trainings that address areas of weakness so that they have skills that correspond to being top performers. The investment of construction organizations in effective talent development programs is a key strategy for attracting, developing, and retaining staff. Such programs are especially important given the current challenges in the construction workforce, including labor shortages, an aging workforce, generational differences in the

workforce, supply chain disruptions, and the need to effectively train staff on skills that are essential in a constrained labor environment.

Literature Review

Construction Project Managers

The construction project management domain is one of the prominent areas bearing employee shortages arising from a lack of qualified candidates [10]. A comprehensive examination into this context was undertaken by Fails Management Institute [11], a consulting firm that publishes industry insights within the United States and Canada. The examination encompassed the exploration of methodologies adopted by engineering and construction firms in cultivating their workforce, spanning training and development initiatives, employee engagement endeavors, and performance management strategies. According to the survey findings, 89% of the participating firms faced staff shortages. Only a few were strategically addressing the issue by prioritizing talent development as a countermeasure.

Construction contractors devote substantial resources exploring methodologies for assessing PMs' experties, knowledge, and effectiveness in overseeing projects [12][9]. In a study by Mir and Pinnington [13], the Project Management Performance Assessment model, originally developed by Bryde [14], was employed to examine the potential correlation between project management performance and overall project success. The study findings underscore that proper utilization of project management performance measures corresponds to enhanced project outcomes. Notably, of the examined factors contributing to project management performance, the alignment of appropriate key performance indicators and capable PMs exhibited the most robust positive associations with project success [13]. Given the pivotal role of PMs in driving overall project achievements [12][10][13], Mir and Pinnington [13] advocate for organizational employee evaluation systems to be tailored to prioritize PMs' performance in project-related activities.

Organizations in the construction industry need to assess the performance of PMs before assigning them new projects. This assessment will serve as a decisive factor in ascertaining the most suitable PM for a given project, thereby strengthening the prospects of organizational success [15]. The process of Measuring PMs' performance not only facilitates the identification of areas necessitating enhancement but also offers insights into tailored training provisions to bolster competence in those domains [3]. Cheah et al. [16] noted that the details of measuring a PM's performance may vary contingent up on the distinct responsibilities and requirements incumbent upon each PM within the organizational context [16].

Various studies have identified skills that PMs need to be considered as high performers in the construction industry and other industries. Table I summarizes some of these skills and competencies of PMs identified by previous researchers.

Table 1 PM Competencies Identified by Previous Researchers

PM Competencies	Literature
Technical Knowledge	[17][18][19] [10][20]
Communication Skills	[17][18][19] [10][21][20]
Team Leadership	[22][23][24][25][17][18][19][10][21][20]

Problem Solving	[24][17][18] [21]
Decision Making	[22][17][18]
Taking Initiative	[26][22][19]
Conflict Resolution	[17][18]
Emotional Intelligence	[27]
Self-Control	[26] [25][10]
Planning and Scheduling	[22][17][18][19] [21][20]
Social Competence	[23][24][21]
Supervising and Coordination	[26][22][18][19][21]
Orientation	[27][24]
Risk, Quality, and Safety Management	[17][18][19]

Construction Field Leaders

Field leaders, such as site supervisors, are crucial to the success of construction projects. Diamant and Debo [28] describe FLs' responsibilities as coordinating labor, materials, equipment, and other resources for on-time and within-budget completion of construction projects. Their role in upholding timeliness and workmanship underscores the influence of their quality, expertise, and experience on project outcomes [29]. While leadership remains a crucial attribute for FLs, their supervisory efficacy and adept project management necessitate a broader array of essential competencies. In addition to leadership skills, Cline [29] emphasized the importance of job performance, communication skills, proactive initiative, decision-making, and seamless collaborating with fellow project team members. Lacking these competencies can hinder project and organizational goals. Gunderson and Gloeckner [30] highlighted the significance of a comprehensive understanding of estimating, scheduling, and cost control for site superintendents to be better field/site leaders. Furthermore, the work of Soemardi and Pribadi [31] demonstrated the indispensable role of initiative as a critical skill empowering site supervisors to improve work effectiveness, create a conducive environment for site workers, and foster the growth of their subordinates.

Koch et al. [32] delineated field supervision skills into two distinct competencies: technical and behavioral. FLs require technical proficiencies encompassing the ability to plan, understanding of work and sequencing, estimating, organization skills, knowledge of efficient construction methods, ability to manage tools, and a strong emphasis on safety [30][32][33][31]. Complementary to this technical facets, behavioral competencies, such as leadership, communication, mentoring, and negotiation skills, are crucial for field leaders' effective interaction with other project team members and crews. Given the paramount role of field leaders as primary supervisors at construction sites, their capacity to inspire and guide crew members significantly influences project success [34].

Certain behaviors and personality characteristics have been linked with the acquisition of soft skills that contribute to the successful completion of a project. Soft skills such as teamwork, leadership, communication, conflict management, motivation, and trust building are indispensable to effectively manage construction projects [35]. Some of these soft skills are correlated with personality traits. For example, Payne [36] highlighted that trait like agreeableness, characterized by being friendly, considerate, and trustworthy, has a positive influence on team performance. For

project managers, Sunindijo et al [37] indicated that those with high emotional intelligence are more likely to communicate effectively and in their leadership.

While previous studies and literature reviews have identified the necessary skills and competencies for success among PMs and FLs in the construction industry, there is a knowledge gap regarding the quantification of their performance in these areas. Although some studies have developed PM competency evaluations, contractor PMs are notably underrepresented in these studies. Similarly, while some studies explored the performance assessment of FLs, they are mostly restricted to qualitative methodologies. This gap highlights the need for a comprehensive that elucidates the utilization of a single construct to gauge performance, accommodating the diverse array of skill categories requisite for contractor PMs and FLs.

In light of this gap, this study addresses the aforementioned limitations inherent in prior research, with a primary emphasis on construction contractor PMs and FLs. This research focuses on the examination of project- and job-level outcomes pertaining to contractor PMs and FLs.

Methodology

Research Approach

This pilot study, following a review of the literature on the competencies and skills of high-performing PMs and FLs, identified skills that apply to contractor PMs and specialty FLs. These are key attributes that have frequently been cited in previous studies and are essential for PMs and FLs in their day-to-day tasks. Once the skills were identified in the literature, two performance measurement surveys were developed using these skills. These surveys are described below.

The first survey consists of seven questions representing the seven competencies chosen to serve as performance evaluation criteria for construction PMs.

- **Quality of work**: The PM's skills in consistently delivering excellent work on projects, including bringing profit to the company and satisfying supervisors and customers.
- **Overall job knowledge**: The PM's technical skills, including the ability to identify and mitigate design errors and omissions, comply with safety policies and procedures, maintain a strong safety record, estimate competently, and proficiently use tools.
- **Leadership and management skills**: The PM's leadership and managerial skills include coordinating team members' work, assisting team members in being successful, and fostering teamwork.
- **Ability to meet deadlines**: The PM's ability to ensure that projects are completed within the intended timeframe.
- **Communication skills**: The PM's ability to communicate effectively with owners, designers, and general contractors, and motivate others to achieve organizational goals.
- **Ability to take initiative**: The PM's capacity and self-confidence to take action.
- **Overall satisfaction rating for the employee**: The supervisor's evaluation of the PM's overall performance in comparison with peers.

The second survey comprised of 22 questions to measure FLs performance. These identified questions were categorized into four areas described below.

- **Technical Skills**: This category consisted of nine questions related to specific technical skills required for site operations. It evaluated the FL's proficiency in the ability to identify and mitigate design errors, comply with safety policies, ability to plan and manage a project schedule, estimating expertise, and demonstrate overall job knowledge, among others.
- **Leadership and Communication Skills**: This category assessed the FL's capabilities in taking initiative, influencing others, communicating effectively, and working with the owner's representative and other project stakeholders, etc. There were a total of eight questions in this category.
- **Ability to Change and Adapt**: This criterion aimed to gauge the FL's readiness and willingness to embrace changes, including new technologies, skills, and procedures. This category only had a single question.
- **Overall Job Performance**: This category comprehensively evaluated the FL's ability to meet project timelines, consistently deliver profitable outcomes, and maintain high-quality work standards. There were four performance questions in this category.

Direct supervisors of PMs were asked to rate their PMs and FLs on a scale of 1 to 10 for each criterion (1 = lowest possible satisfaction; 10 = greatest possible satisfaction)

Data Collection

A nationwide data-collection initiative was conducted to collect performance data from the direct supervisors of PMs and FLs. Several large general contractors and specialty contractors were invited to participate. The survey instrument was distributed online to volunteer contractor groups, who enlisted supervisors to rate the performance of PMs and FLs using the provided surveys. Therefore, a non-random snowball approach was adopted to expand data collection across various contractor groups. Participants were encouraged to invite other PM and FL supervisors within their own companies and from other contractor organizations. In total, the study received ratings for 187 PMs from general and specialty contractors across the United States and 80 specialty FLs as rated by their direct supervisors. Participation in the survey was voluntary, and all responses were kept strictly confidential to protect the privacy of the participants. The insights gathered from this data were intended to offer valuable information on the performance of contractor PMs and identify potential performance improvement strategies applicable to contractors in the U.S.

Data Analysis

The primary objective of this pilot study was to create a measurement construct that assesses the performance of PMs and FLs.

Once the survey instruments were developed and data was collected, descriptive statistics were calculated to analyze the central tendency, dispersion, and overall structure of the study data. Subsequently, principal component analysis (PCA) was used to determine if the criteria could be condensed into a smaller set of factors, known as principal components, which account for majority of the variance in the original variables. PCA, as explained by Fellows and Liu [38], offers a valuable advantage by revealing underlying dimensions that explain the relationships among the given variables. By quantifying the importance of each dimension in characterizing the variability, PCA provides a means to assess the relative significance of each dimension [39]. For this purpose, summarizing data from a limited number of variables and identifying patterns and relationships within the dataset, PCA provides an excellent choice [40]. In this study, PCA was

utilized to visually represent the entire dataset using the variance across a reduced number of principal components (fewer than the number of measurement types).

Prior to running PCA, several preliminary checks were performed to ensure the data's suitability. First, internal reliability and factorization requirements were assessed. To evaluate the internal consistency and reliability of the given variables, Cronbach's alpha, a widely used measure, was used to determine whether or not the given variables measure the same underlying dimension [41][42]. Cronbach's alpha values range between 0 and 1, with higher values indicating a greater level of internal consistency reliability[43].

Furthermore, a correlation matrix was examined to understand the relationships between each criterion. The Kaiser-Meyer-Olkin test was applied to assess sampling adequacy for PCA. Moreover, Bartlett's test of sphericity was used to determine whether the correlation matrix exhibited an identity matrix structure. Other statistical tests—namely, one-way ANOVA, the nonparametric Kruskal-Wallis test, the Games-Howell post hoc test, and Pearson's correlation—were used to determine whether differences in the mean scores for PM performance categories were statistically significant.

Results

Project Managers' Performance Evaluation

This statistic indicates a high level of internal consistency reliability among the seven criteria in terms of measuring PMs' performance. The principal component analysis resulted in the retention of a single component that represents the seven performance rating criteria. The extracted component was given the name Project Manager Performance Construct (PMPC).

The PMPC scores were used to establish criteria for grouping the PMs into three categories: top performers, above-average performers, and below-average performers. Because PMPC is a standardized score that can range from negative infinity to positive infinity, PMPC has a mean of 0. Therefore, PMPC scores below zero were considered to represent PMs who were below-average performers; 43.3% of the PMs received negative PMPC scores and were therefore assigned to this category. To establish the criteria for the above-average performers and top performers, PMPC scores for the remaining 56.7% of the PMs were closely examined. This examination revealed that there was a considerable gap (10.7%) between the PMPC scores of the top 5.9% PMs and the other 50.8% of PMs not in the below-average category. Therefore, it was determined that the top-performers category would consist of the top 6% of the PMs.

Table 2 PMPC Scores by PM Performance Category

Performance category	*n*	Percent of *N*
Top performers	11	5.9%
Above-average performers	95	50.8%
Below-average performers	81	43.3%

PMs in the top performers category have the highest scores for all seven performance criteria that compose the PMPC. This means they tend to consistently deliver excellent work on projects while

bringing profit to the company. Top performing PMs, compared to average and below average performing PMs, have exceptional technical skills with adequate proficiency to use tools. They also are well equipped in leadership and managerial skills that include coordinating and assisting team members towards project success. Top performing PMs work hard to ensure timely completion of their projects, they communicate effectively with owners, designers and GCs. They have the capacity and self-confidence to take actions while satisfying their supervisors in their jobs.

Field Leaders' Performance Evaluation

In a similar evaluation process to the PMs' performance, the data encompassing supervisor ratings for FLs was examined. There was high level of internal consistency reliability among the 22 questions representing the four performance measuring areas used to evaluate FLs. A single component was retained from the principal component analysis. The extracted component was named Field Leader Performance Construct (FLPC). Due to the limited number of data, this construct was used to categorize FLs into two groups. FLs with FLPC scores below zero (negative FLPC scores) were classified as Average Performers. The average performers were 65 (81%). Whereas 15 FLs (19%) with positive FLPC scores were classified as Top Performers. The FLs in this category had exceptional performance based on the extent of disparity observed in their positive FLPC scores. The results from the analysis showed that there were significant differences between the mean scores of top performers and average performers in the four performance measuring areas listed in the methodology section. Top-performing FLs exhibit a well-rounded skillset, surpassing the average-performing FLs in all four performance measuring areas.

Table 3 FLPC Scores by FL Performance Category

Performance category	*n*	Percent of *N*
Top performers	15	19%
Average performers	65	81%

The results in the technical skills category revealed that top performing FLs are proficient in working efficiently to control costs, adhere to schedules, and achieve a favorable profit margin as compared to average performing FLs. Furthermore, in the leadership and communication skills category, top performing FLs outclassed average performing FLs in leveraging established interpersonal relationships to address issues with project team members in a timely manner, thereby preventing any negative impact on the project. Within the same category top performing FLs showed a strong "political" skill that they can take advantage of leveraging relationships to motivate and encourage crew members toward achieving desired project outcomes. They also tend to anticipate unforeseen challenges and develop contingency plans to efficiently resolve problems. In the adaptability category, compared to average performing FLs, top performing FLs showed inclination to lead their teams in navigating through dynamic and evolving construction environments. They are better prepared to tackle unforeseen challenges and capitalize on emerging opportunities (e.g., new methods, tools, and technologies), ultimately contributing to the successful execution of construction projects.

Discussion

The shortage of skilled professionals, the aging workforce, and the loss of a substantial number of employees because of the COVID-19 pandemic have forced construction organizations to look for effective strategies to recruit and retain skilled employees [9]. One of these strategies is to increase employee wages [8]. However, continually increasing wages is not a sustainable solution. A more sustainable solution to attract new employees and retain the existing ones is to provide talent-development opportunities, including training and mentorship programs [11]. An added benefit of these opportunities is they will help young professionals to develop essential PM skills more quickly.

This pilot study developed two single constructs, PMPC and FLPC, from identified PM and FL performance evaluating criteria respectively. The PMPC and FLPC were developed and tested by collecting data from the direct supervisors of 187 PMs and 80 FLs respectively. These PMs and FLs worked for general and specialty contractors who were willing to contribute to this study. These constructs were used to measure the performance of the PMs and FLs. Statistical analysis indicated that the PMPC and FLPC are reliable tools for measuring construction PMs' and FLs' performance. For construction PMs and FLs to be high performers and become more successful leaders, they should pursue consistent improvement in all these identified areas. These constructs explain the greatest amount of total variance in all the performance evaluation criteria.

The PMPC and FLPC are consistent with previous studies that indicate high-performing PMs have technical, leadership, and communication skills [30][22][23][32][44][13][33][17][19][18][31][10][21][20]. Using the PMPC and FLPC can provide a well-rounded assessment of a construction PM's performance.

By grouping PMs and FLs into the identified performance categories, organizations can help their employees understand their current performance levels. Further, comparing employees to their peers can reveal areas in which they need to improve, motivating them to address these areas [40][45]. Furthermore, hiring managers can use the PMPC and FLPC to evaluate job candidates and determine whom to hire for PM and FL positions [12][46].

Organizations can also benefit in selecting suitable PMs and FLs for specific projects. Additionally, they may develop personalized trainings that meet the needs of individual PMs and FLs. Providing customized training can help organizations efficiently improve PMs' and FLs' performance and thereby improve project performance and organizational success. By incorporating performance evaluation into staff development initiatives, employers can assess the job performance of their workers and identify skill deficiencies and needs within the workforce [9]. This enables them to design targeted training programs that address these gaps and enhance the overall talent development and retention efforts. This approach is more efficient than offering one-size-fits-all training programs [3]. In addition, prioritizing the development of employees demonstrates that companies value their employees. In response, employees may be more motivated to develop crucial skills and to remain at their companies rather than taking jobs at other companies [47].

Hiring managers can use the PMPC and FLPC to evaluate job candidates and determine whom to hire for PM and FL positions. Furthermore, by consistently evaluating and monitoring employee performance, organizations can identify high-potential individuals who demonstrate the skills and potential to assume higher-level positions in the future. Recognizing and nurturing these individuals through tailored development programs prepares them to fill leadership roles as the

older workforce retires. This proactive approach helps mitigate the impact of labor shortages and ensures a smooth transition of responsibilities within the organization.

Conclusion

In this study, the PMPC and FLPC were developed to provide single job-level constructs for measuring construction PMs' and FLs' performance respectively. The constructs were developed and tested by collecting data from the immediate supervisors of 187 PMs and 80 FLs working for general and specialty contractors. PCA was used to extract the PMPC from seven criteria regarding leadership, communication, technical proficiency, and overall job knowledge. The PMPC was used to establish criteria for grouping the PMs into top, above-average, and below-average performance categories. Similarly, PCA was used to extract FLPC from four FL performance measuring areas which in total had 22 questions. FLPC was then used to categorize FLs into top and average performing groups.

The results of this study indicate that top-performing PMs and top-performing FLs have well-rounded skills because they received high scores for each of the evaluation criteria that composed the respective performance constructs. These constructs can be used to identify construction PMs' and FLs' areas of weakness and then to develop personalized training that meet the needs of individual PMs and FLs. Providing customized training can help organizations efficiently improve PMs' performance and thereby improve project performance and organizational success.

This study's results can be used as a foundation for researchers to further understand how performance is related to various construction professions. The construction industry can also benefit considerably from the results of this study. Construction firms can use the PMPC and FLPC to increase the accuracy of employee reviews and to identify PMs' and FLs' areas of weakness. Companies can use the results to develop personalized training to cost-effectively increase the skills of PMs and FLs.

Limitation and Recommendation

The first limitation of this study is that it was restricted to construction PMs and FLs. Research is needed on other construction roles, such as engineers, architects, estimators, detailers, procurement professionals, and craft laborers. Second, the constructs were not customized based on external characteristics such as culture, environment, geography, company size, and so on. The only group performance difference assessed by this pilot study was between PM and FL jobs (general and specialty contractors). The authors, encourage that a group difference be performed depending on company size, area, and other cultural and demographic characteristics. Third, the data was limited, especially for the FLs category. Collecting more data may show more relationships and differences between the different categories.

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