

WORKtoZERO

an nsc program



Certification in Crane Operations: Impacts on Safety and Performance



Executive Summary

Certification is widely viewed as an important element of crane safety, yet evidence linking it to reductions in serious incidents and fatalities (SIFs) remains challenging due to the influence of training, experience and other jobsite factors. To better explore this relationship, the [Work to Zero](#) program at the National Safety Council (NSC) partnered with the [NCCCCO Foundation](#) to assess the impact of formal certification on crane safety outcomes. This study draws on existing research and analysis of national fatality data to explore the impacts of the 2010 OSHA Cranes and Derricks in Construction rule – a significant overhaul of federal crane regulations that introduced certification requirements for operators. Survey data and interviews with crane personnel were also used to supplement the analysis and provide additional context into how certification influences work in the field.

Key Findings



Crane fatalities are declining alongside long-term improvements in certification, training and safety practices. Since 1997, fatalities have declined at an average rate of 4% per year, reflecting sustained industry progress. While the analysis did not identify a distinct effect attributable solely to the 2010 Cranes and Derricks rule, the decline is consistent with the cumulative impact of certification, training, regulatory improvements and broader safety initiatives that have evolved over several decades.



Industry support for certification is overwhelmingly strong. Nearly nine in ten respondents say working with certified personnel improves jobsite safety, technical competence and overall career prospects, and 85% believe that certification helps reduce near-misses, incidents and delays.



Respondents broadly support extending certification to riggers and signalpersons. Nearly three in four agreed that certification for riggers and signalpersons should be required for critical lifts, with certified personnel rated as more effective than non-certified peers across most safety-critical competencies.



Certified personnel were consistently viewed as safer and more effective than their non-certified peers. Across rigging and signaling activities, respondents reported that certified personnel demonstrated stronger competency across most safety-critical responsibilities, supporting the value of certification as a tool for promoting safe and consistent work practices. Operators also reported meaningful increases in confidence following certification, particularly in hazard identification, load chart interpretation and crane setup, suggesting certification strengthens both perceived competency and workforce readiness.



Certification establishes a critical baseline for safe crane operations. Respondents emphasized that while experience, mentorship and ongoing training remain essential, particularly for complex and situational work, standardization plays an important role in promoting consistency, communication and shared expectations across the workforce.



Certification adds the most value with standardized, knowledge-based tasks. Respondents reported the largest gains in hazard identification, load chart interpretation, crane setup and the use of standard signals, indicating that certification is especially effective at strengthening foundational skills that support safe crane operations.

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Crane Safety, Training and Certification: A Review of the Evidence

Crane Safety: Injury and Fatality Trends

Crane operations are inherently high risk, where heavy loads, suspended materials, blind spots and active jobsites can quickly turn even small errors into serious incidents. According to data from the Bureau of Labor Statistics (2025), cranes were involved in 405 incidents between 2015 and 2024, or roughly 41 fatalities per year. Construction accounted for the largest share (42%) of these incidents. Notably, crane and tower operators accounted for only 29% of these fatalities, underscoring that risk extends well beyond the cab to riggers, signalpersons, and other personnel working near suspended loads and moving equipment. An earlier review of OSHA crane fatality cases found that 90% of those killed were laborers or other personnel working near the load or within the crane's swing radius, underscoring the risk that extends beyond the cab (Beavers et al., 2006).

Patterns in how these incidents occur are well established in the literature. In the United States, the most common fatal events involve electrocution and struck-by incidents, particularly those involving swinging loads, equipment contact or falling objects (Beavers et al., 2006; McCann et al., 2009). Other common causes include crushing or caught-between incidents (Beavers et al., 2006), as well as transportation-related incidents and falls to a lower level (BLS, 2019). Importantly, studies show that crane incidents are rarely the result of a single mechanical failure.

Rather, incident investigations routinely identify breakdowns in planning, worker preparedness, supervision and communication as contributing factors (McCann et al., 2009; Lingard et al., 2018), highlighting the need for a shared baseline of competency across personnel involved in crane operations.

However, following sustained efforts by industry groups, employers and regulators to improve crane safety practices, crane-related fatalities have steadily declined since the late 1990s (see Figure 1). Fatality trends were examined beginning in 1997 to capture the broader evolution of crane safety over time, including the period during which voluntary third-party certification programs became increasingly adopted across the industry. This longer period allows for evaluation of whether improvements observed after the 2010 OSHA rule represented a distinct shift or reflected safety gains that had already emerged through earlier certification, training and safety initiatives. In addition, 1997 represents the earliest year for which crane involvement was consistently coded within the BLS data, allowing for a comparable analysis across the full study period.

During this period, annual crane-related fatalities across all industries declined from 94 deaths in 1997 to 42 in 2024. In construction specifically, crane fatality rates fell by 71% (from 0.79 to 0.23 per 100,000 workers), compared to a 26% decline in the overall occupational fatality rate during the same period. This suggests that improvements in crane safety outpaced broader reductions in workplace fatalities. As fatality rates have declined, increasing attention has focused on operator competency and the role standardized certification and quality training may play in supporting further safety improvements.

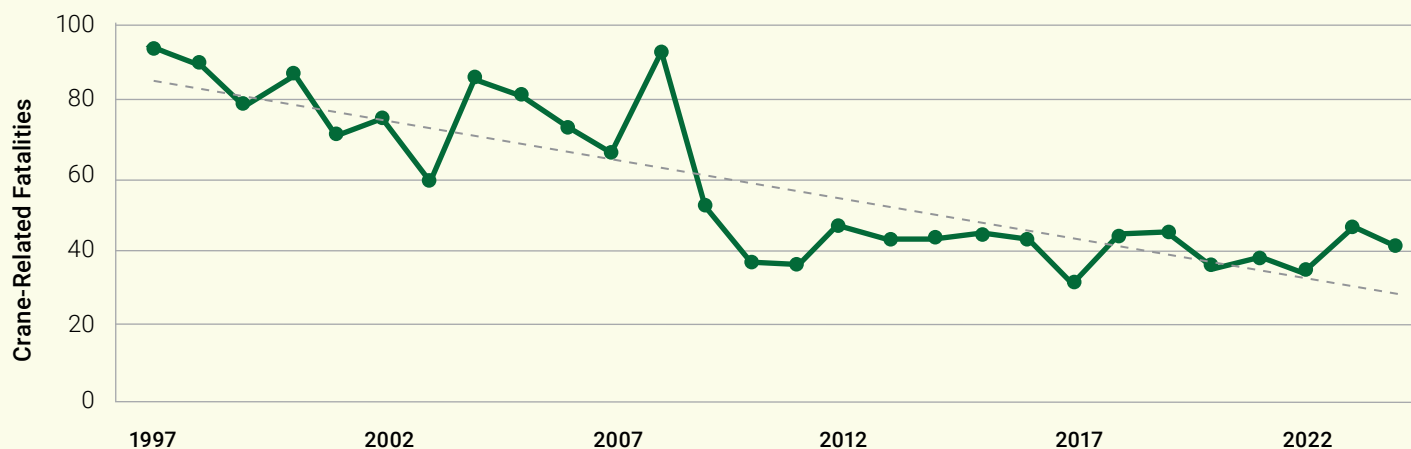


Figure 1. Fatal Work Injuries Involving Cranes (All Industries), 1997-2024 (BLS, 2025)

Evolution of Crane Operator Certification Requirements

Before 2010, OSHA required crane operators to be “qualified” but did not mandate formal testing or third-party certification. Instead, employers determined competency through a mix of training, experience and internal qualification processes, resulting in varying levels of operator preparation across organizations and jobsites.

During this period, crane-related fatalities averaged 78 deaths per year (BLS, 2019), with investigations frequently citing gaps in training, knowledge and experience as contributing factors (McCann et al., 2009; OSHA, 2008).

In the 1990s, the crane industry began developing more standardized approaches to operator training. In 1996, the National Commission for the Certification of Crane Operators (NCCCO) introduced the first nationally accredited certification program in the United States, providing written and practical examinations to assess operator competency. Over time, third-party certification gained broader adoption and helped establish a more consistent framework for evaluating operator qualifications.

In November 2010, OSHA finalized the Cranes and Derricks in Construction rule, the most comprehensive update to crane safety regulations in nearly four decades. The rule strengthened requirements related to ground conditions, assembly and disassembly, inspections and powerline safety (OSHA, 2010), and introduced mandatory crane operator certification, requiring operators to pass standardized written and practical examinations administered by accredited third-party organizations (OSHA, 2010). While the original rule required certification by both crane type and capacity, industry stakeholders raised concerns about the added cost and administrative burden without clear safety benefits. In response, following the rule’s original introduction in 2010, OSHA (2018) officially issued a revised rule that removed the capacity requirement while retaining certification by crane type (OSHA, 2018), reflecting a broader shift toward recognizing operator competency as a key factor in crane safety.

Notably, by the time OSHA introduced and finalized the rule in the 2010s, certification was already becoming increasingly common across portions of the industry. Adoption was driven not only by certifying bodies, but also by state requirements, owner and contractor specifications, insurance considerations, and employer-led safety initiatives. As a result, many crane operators were already obtaining third-party certification prior to the federal mandate, suggesting that improvements associated with certification may have begun emerging before the rule was formally implemented.

How Training Supports Safety

Safety training is one of the most widely used strategies for preventing workplace incidents and equipping workers with the knowledge and skills needed to identify hazards and work safely (Bisbey et al., 2025). Core training programs typically cover hazard recognition, safe work practices, use of personal protective equipment (PPE) and emergency response procedures. In crane operations, training extends to more specialized topics, including crane-specific hazards (e.g., powerline contact, tipping risks and ground instability), load handling, signaling and communication protocols, rigging practices and load chart interpretation. **Studies consistently point to deficiencies in training (Beavers et al., 2006; McCann et al., 2008; Kumar & Thatoad, 2023; Raviv et al., 2025) and limited opportunities for hands-on experience (Lingard et al., 2021) as underlying contributors to crane incidents.**

A large body of research supports the positive role of training in workplace safety, contributing to improvements in safety knowledge, hazard recognition and use of controls (Bisbey et al., 2025; Burke et al., 2006; Hutchinson et al., 2022; Robson et al., 2012), as well as safety attitudes and climate (Hutchinson et al., 2022). Notably, these changes often translate into improvements in skill acquisition (Blume et al., 2010), performance (Bisbey et al., 2025) and use of safe work practices (Burke et al., 2006; Robson et al., 2012). Some studies have also linked training directly to reductions in workplace injuries (Boini, Colin, & Grzebyk, 2017), including a 24% reduction observed across a large sample of U.S. organizations (Waehrer & Miller, 2009).

Despite these notable research findings, other evidence on the effectiveness of training on workplace safety remains mixed. Systematic reviews have found that training alone often produces limited or inconclusive improvements on safety outcomes (Dyreborg et al., 2022; Robson et al., 2012). Poorly delivered or excessive training can lead to worker frustration and reduced autonomy, potentially undermining the credibility of both management and the training program (Blair & Seo, 2007). Outcomes also depend on how training is delivered, with more hands-on and engaging approaches consistently outperforming passive formats (e.g., classroom or e-learning) in terms of knowledge retention and skill development (Burke et al., 2006; 2011). By combining written and practical testing, crane certification programs aim to verify knowledge, skills and abilities through multiple training modalities, representing an important mechanism for strengthening worker competency and supporting improving safe operations.

Existing Evidence on Certification and Crane Safety

Certification is commonly used to verify worker competency and establish standardized qualifications across organizations and jobsites. Unlike employer-determined training programs, certification requires workers to pass written and practical examinations administered by accredited third-party organizations. In crane operations, where work is high-risk and requires coordination across multiple roles, regulators and industry groups have increasingly turned to certification to establish a consistent baseline of operator knowledge and skill (McCann et al., 2009; OSHA, 2010).

Some studies have found a positive relationship between certification requirements and crane safety outcomes. A 34-year longitudinal study in Ontario (1969-2002) documented a nearly 81% reduction in fatalities following the implementation of a mandatory, government-backed training and licensing system for crane operators that became standardized beginning in 1979 and fully required for new operators by 1982 (Construction Safety Association of Ontario, 2007). This report later became a foundational argument for proponents of the 2010 Cranes and Derricks rule. Similar trends have been observed in California, where analysis reported significant declines in both fatalities (80%) and injuries (57%) in the three years following introduction of mandatory operator certification (Cal-OSHA Reporter, 2008).



A separate evaluation of the 2010 OSHA rule similarly identified reductions in certain accident categories, including struck-by and crushing incidents, although it did not find a statistically significant change in the overall frequency of crane accidents, which they attribute in part to the small sample size and the decline in construction activities during the 2008 recession (Cho et al., 2016).

Additional industry evidence has reported similar associations between certification and safety performance. For example, the National Wireless Safety Alliance (NWSA) reported that crew-related incidents in the telecommunications industry were approximately three times less likely to occur on jobsites where NWSA-certified technicians were present, including a sample of 243 audited jobsites with no reported incidents when advanced-level certified technicians were present (National Wireless Safety Alliance, 2021). Likewise, reports from NCCCO have cited reductions in crane-related fatalities and injuries in jurisdictions that adopted certification requirements and have highlighted employer perceptions that certification contributes to safer crane operations (Brent, 2016). While these findings are not based on academic research and should be interpreted cautiously, they provide additional industry-based evidence supporting the potential value of certification as part of a broader safety system.

However, other research suggests the relationship between certification and safety outcomes in crane operations is more complex than an easily measured cause-and-effect relationship. For example, a systematic review examining certification as a form of “soft regulation” found little evidence that certification alone leads to measurable reductions in injury rates (Dyregborg et al., 2022). This is attributed in part to data limitations, such as incomplete certification records in incident investigations, which make it difficult to evaluate certification impacts directly (Beavers et al., 2006). As a result, certification should be viewed as a foundational component of a broader safety system that includes quality training, operator experience and management practices (Lingard et al., 2018; Skiba, 2020), providing a more holistic approach to improving crane safety than any single intervention alone.

Taken together, existing research suggests that certification may contribute to improved safety performance in some contexts, but its overall impact on incident outcomes is difficult to isolate. This reflects both limitations in available data and the influence of broader jobsite conditions that shape how work is performed. To address this gap, the present study draws on multiple sources of evidence to evaluate how certification influences safety outcomes in practice.

Research Methodology

This study used a mixed-methods approach to examine the role of certification in crane safety, drawing on an analysis of national fatality data, an industry survey and supplementary interviews. Data from the Census of Fatal Occupational Injuries (1997-2024) were analyzed to compare trends before and after the 2010 OSHA Cranes and Derricks in Construction rule to assess whether mandatory operator certification was associated with any changes in crane-related incidents. A pre-post comparison using a Mann-Whitney U test was conducted, followed by interrupted time series analyses to evaluate whether observed changes reflected the rule itself, pre-existing temporal trends or broader economic conditions.

Next, to capture perspectives on certification, training and jobsite practices, an industry-wide survey was distributed to an NCCCCO mailing list (approximately 42,500 certified recipients) and promoted through NSC email lists, NSC Communities and LinkedIn, including an NCCCCOF crane safety group. To qualify, participants were required to be actively involved in crane operations and based in the United States and had to pass an attention check to ensure data quality. In total, 376 responses were included in the final sample. Respondents were also entered to win one of six \$25 gift cards as incentive to complete the survey. Survey data were analyzed using descriptive statistics and ordinal logistic regression to examine relationships between certification, experience and perceived impacts on safety and jobsite performance.

In addition to the survey, in depth interviews were conducted with five experienced crane professionals highly engaged with the NCCCCO Foundation to provide qualitative context for the survey findings. Collectively, interview participants represented more than 90 years of experience across crane operations, training and supervision. While not intended to be representative of the broader workforce, these interviews were used to surface recurring themes, explain patterns observed in the survey data, and illustrate how certification and training play out in real world jobsites.

Findings and Results

Demographics

Table 1. Primary Role of Respondents

Primary Role	Percent
Operator	71%
Site Supervisor or Lift Supervisor	10.4%
Rigger	5.6%
Safety Professional	4.5%
Trainer or Instructor	3.2%
Signal person	2.7%
A/D Director	1.3%
Other	1.3%

Crane operators made up a majority of the sample (71%), followed by site supervisors or lift directors (10%), riggers (6%), safety professionals (5%), trainers and instructors (3%) and signalpersons (3%). The most common certification held was Mobile Crane Operator (78%), followed by Rigger (Level I or II) and Signalperson certifications, each held by approximately 44% of respondents. Over 72% held multiple certifications, averaging three each.

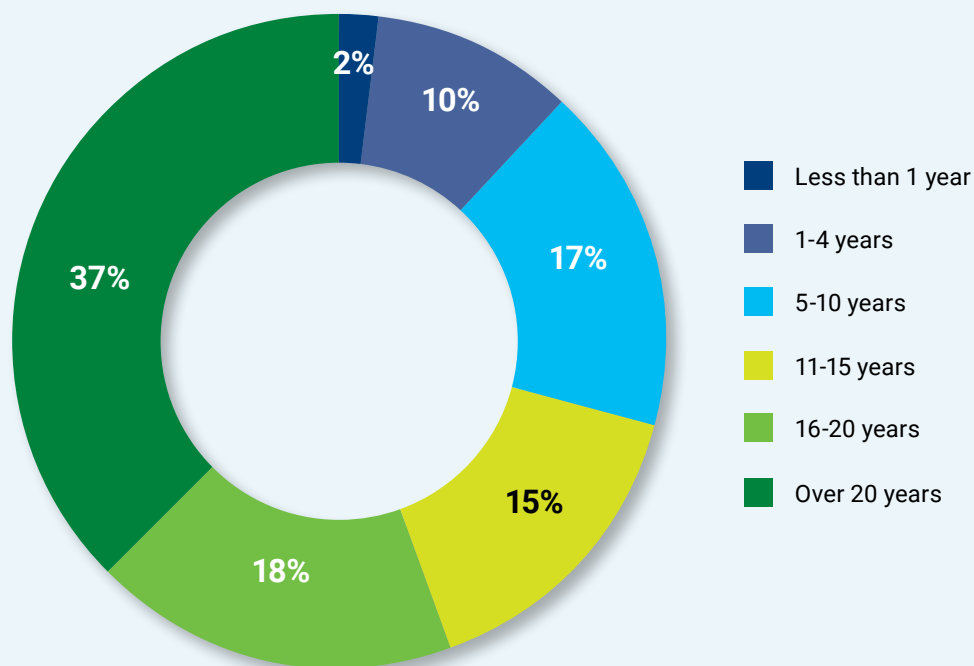


Figure 2. *Respondent Experience in the Crane Industry*

Respondents were highly experienced, with 37% reporting more than 20 years of experience and over 70% of respondents reporting 10 years or more. Notably, 75% of respondents worked in crane operations prior to November 2018, when OSHA's Cranes and Derricks rule took full effect, meaning most of the respondents had a direct reference point for evaluating the impacts of the rule.

Construction was the most represented industry in the sample (67%), followed by utilities (9%) and manufacturing (5%). An additional 13% reported working in other industries, including oil and gas, government and public sector, and general-industry crane rental services. Respondents represented organizations of varying sizes, with 41% employed by organizations with 200 or more employees, 27% by mid-sized organizations with 51–200 employees and 30% by organizations with 50 or fewer employees.

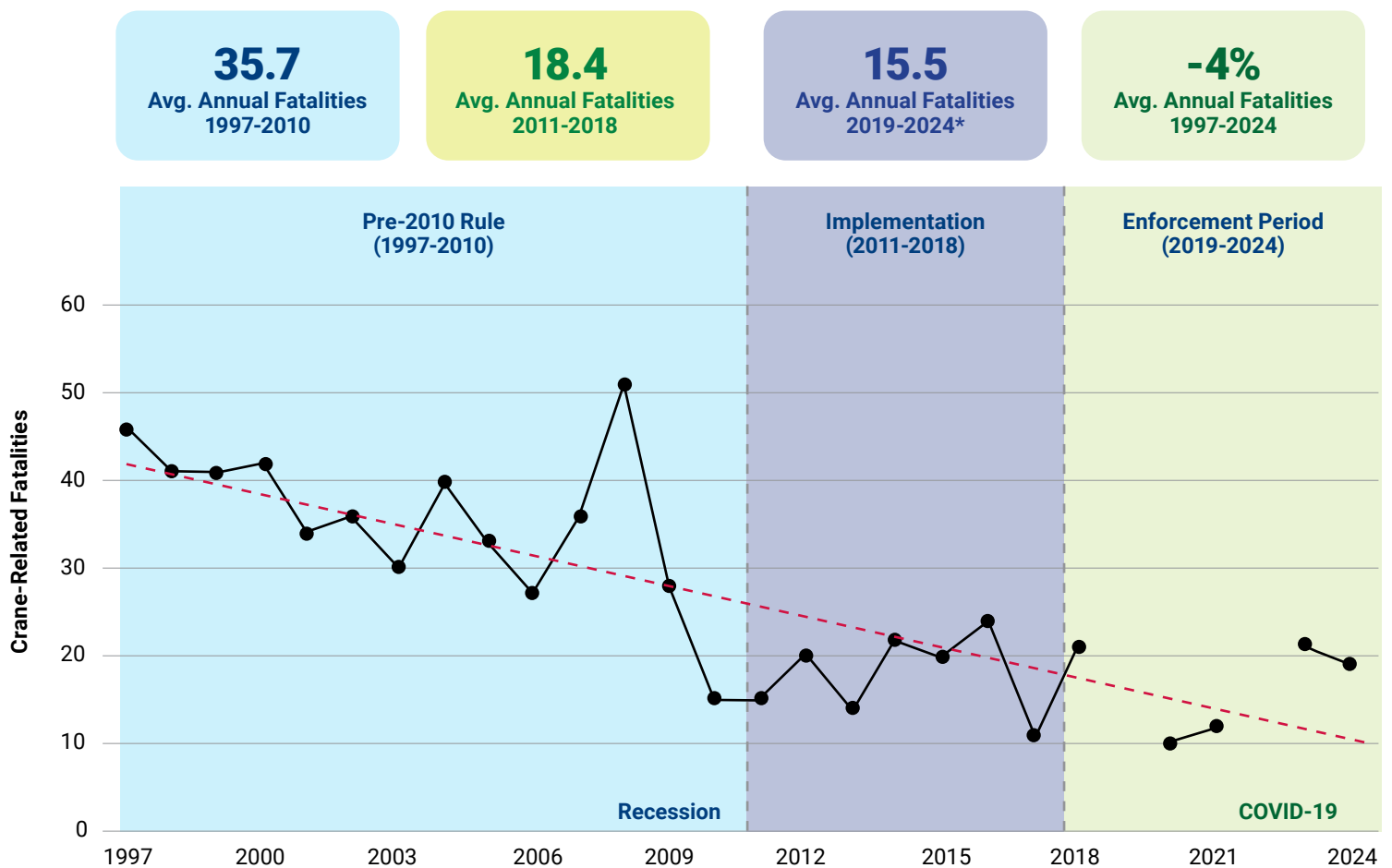
Fatality Trends After the 2010 OSHA Rule

To assess whether the 2010 OSHA Cranes and Derricks rule impacted crane-related fatalities, 28 years of national fatality data (1997-2024) were analyzed. The analysis begins in 1997 because it represents the earliest year for which crane involvement was consistently coded within the BLS dataset and captures the period during which voluntary third-party certification programs began gaining broader adoption across the industry. Because certification expanded gradually throughout the late 1990s and 2000s before becoming federally required, examining a longer timeframe allows for evaluation of whether safety improvements emerged incrementally over time or were associated with a distinct change following the 2010 OSHA rule. Because the rule applies specifically to construction, the analysis was limited to incidents within the industry to better isolate its impact. Data from 2019 and 2022 were suppressed by BLS and were therefore unavailable for analysis, resulting in a final sample spanning 26 years.

Crane-related fatalities in construction averaged 36 deaths per year prior to the rule (1997-2010). Following the rule's introduction in 2010, the average declined to 17.4 deaths, a 51% reduction overall. Fatality rates showed a similar pattern, decreasing from 0.53 to 0.26 incidents per 100,000 workers. Notably, fatalities also became less variable in this time, suggesting more consistent safety outcomes that are characteristic of long-term, industry-wide improvements.

A basic pre-post comparison confirms that pre-rule fatalities were significantly higher than in the post-rule years (Mann-Whitney $U=7.50$, $p<.001$). An interrupted time series analysis was then used to determine whether the post-2010 decline was the result of the rule itself, a pre-existing downward trend or attributable to larger economic factors such as the 2008 recession. Results show that fatalities were already declining at a rate of 4% per year ($B = -0.040$, $p = .015$). The model did not identify a statistically significant change in fatality levels at the point of the rule's implementation in 2010, nor at the 2018 finalization. These results were consistent across alternative model specifications, suggesting that findings were robust to modeling approach. The absence of a statistically significant change following the OSHA rule should not be interpreted as evidence that certification had no effect on safety. **Rather, the findings suggest that any safety benefits associated with certification likely emerged gradually alongside broader industry improvements largely emerging in the 1990s and on, making them difficult to separate from broader trends.**

Taken together, crane-related fatalities were already declining before the 2010 OSHA Cranes and Derricks rule. After accounting for workforce size and temporal trends, no distinct change in fatalities was observed following the rule's introduction. While the analysis was limited by the small number of observations, the observed decline appears to reflect the cumulative effect of improvements since the 1990s, including the expansion of third-party certification programs, improvements in training and competency verification, regulatory activity, technological advances and broader improvements in jobsite safety culture. Importantly, many of these changes, including the growth of voluntary third-party certification programs and employer-driven certification requirements, began before the OSHA rule was enacted. As a result, any safety benefits associated with certification may have emerged gradually over time, making them difficult to distinguish from other concurrent industry improvements. To complement the fatality data, the following section draws on survey and interview findings to understand how certification influences safety in practice.



*Data from 2019 and 2022 data were suppressed by BLS and unavailable for analysis.

**Declines likely reflect long-term trends; analysis did not identify a statistically significant change following the 2010 rule.

Figure 3. Annual Crane-Related Fatalities in Construction, 1997-2024

Workforce Perspectives on Certification and Crane Safety

Industry Attitudes on Certifications Across Roles

Respondents to the industry-wide survey distributed by NCCCO and NSC were first asked about their experiences working with certified crane personnel. Survey responses revealed wide variation in certification practices for non-operator roles. About one-third of respondents reported that fewer than 10% of their non-operator lift crew held current certification, while another 32% reported that at least three-quarters of their crew were certified. This variability suggests a lack of consistency in how certification is applied across crews, potentially limiting its effectiveness as a shared safety baseline.

Despite this variation, overall support for third-party certification was strong (see Figure 4). A vast majority of respondents agreed that working with certified personnel improves jobsite safety (91%) and technical competence (89%). Most also believe certification helps reduce near-misses, incidents, and delays (85%) and improves overall jobsite efficiency (85%). Certification was also widely viewed as beneficial for career advancement, with 91% agreeing that it improves career prospects.

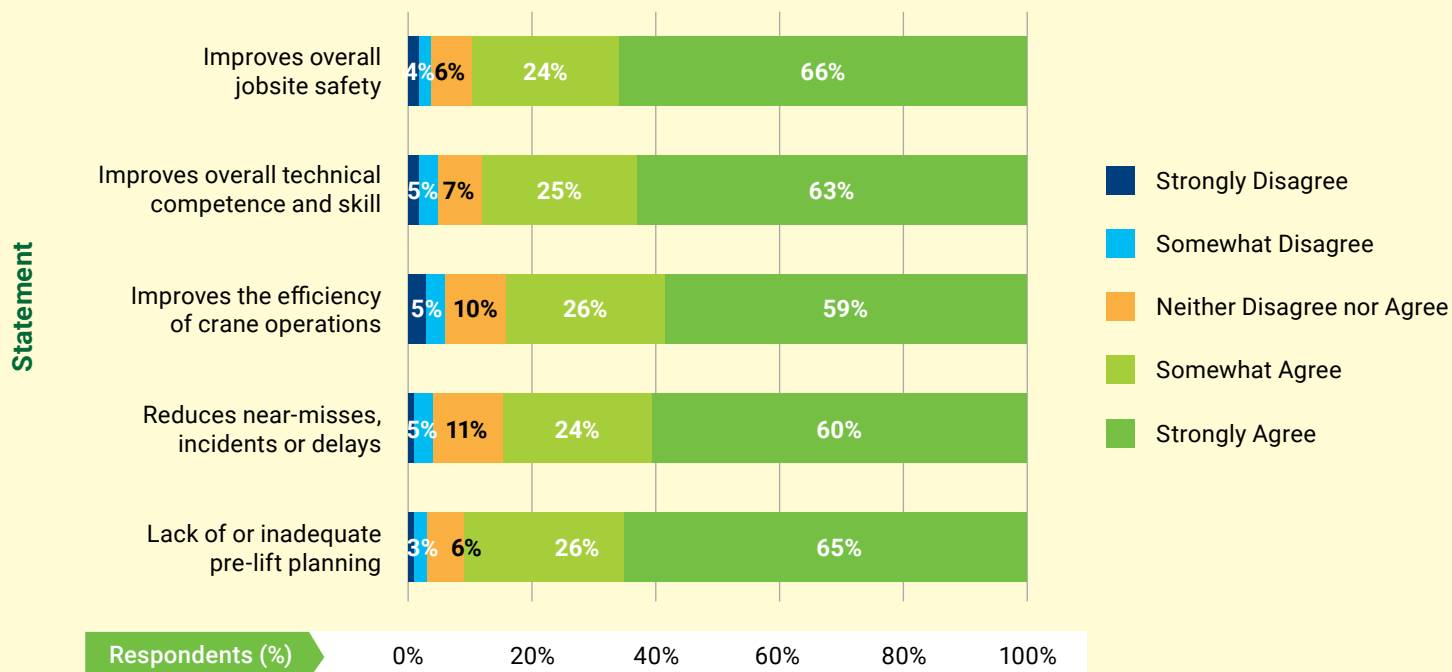


Figure 4. Attitudes Toward Working with Certified Personnel

Qualitative interviews helped explain why certification is valued beyond just immediate safety outcomes. Several participants noted that certification has increasingly become a practical requirement for access to higher-paying positions and larger or more complex projects, including for non-operator roles. One experienced training director also pointed to the role certification plays in supporting professionalism and ethical standards, citing formal codes of conduct and the ability of certifying bodies to suspend or revoke credentials for unsafe or unethical behavior.

Importantly, although certification was not viewed as a substitute for experience or training, support for certification itself remained overwhelmingly positive. Across operators, supervisors, riggers, trainers and safety professionals, respondents consistently reported that certification improves jobsite safety, technical competence and overall workforce preparedness. More than 90% agreed that working with certified personnel improves jobsite safety, while 85% reported that certification helps reduce near-misses, incidents and delays. Taken together, these findings suggest that certification is widely viewed by industry personnel as an important contributor to safe crane operations, particularly when paired with ongoing training, mentorship and field experience.

“Certification is a great foundation to start, but that doesn’t make you an operator or signalperson. You start off at a level and you grow throughout the years, from experience, from learning, and from certain mistakes you make.”

– Apprenticeship Director/Former Operator



Operator Certification Perspectives

Industry Attitudes on Certifications Across Roles

Over 75% of respondents reported working in the crane industry before November 2018, when the OSHA Cranes and Derricks rule became fully effective. To further explore the impact of the rule, this subgroup was asked to share their perceptions of how mandatory operator certification in particular affected safety, efficiency and technical competency on the jobsite.

Overall, respondents reported largely positive changes following the introduction of mandatory operator certification (see Figure 5). **Nearly seven in ten rated overall jobsite safety as somewhat or significantly better (68%), followed by incident frequency (63%), operator competence and skill (62%) and near-miss frequency (60%).** Operational efficiency showed the smallest perceived change, with just over half of respondents reporting improvement and one-third reporting no discernible difference.

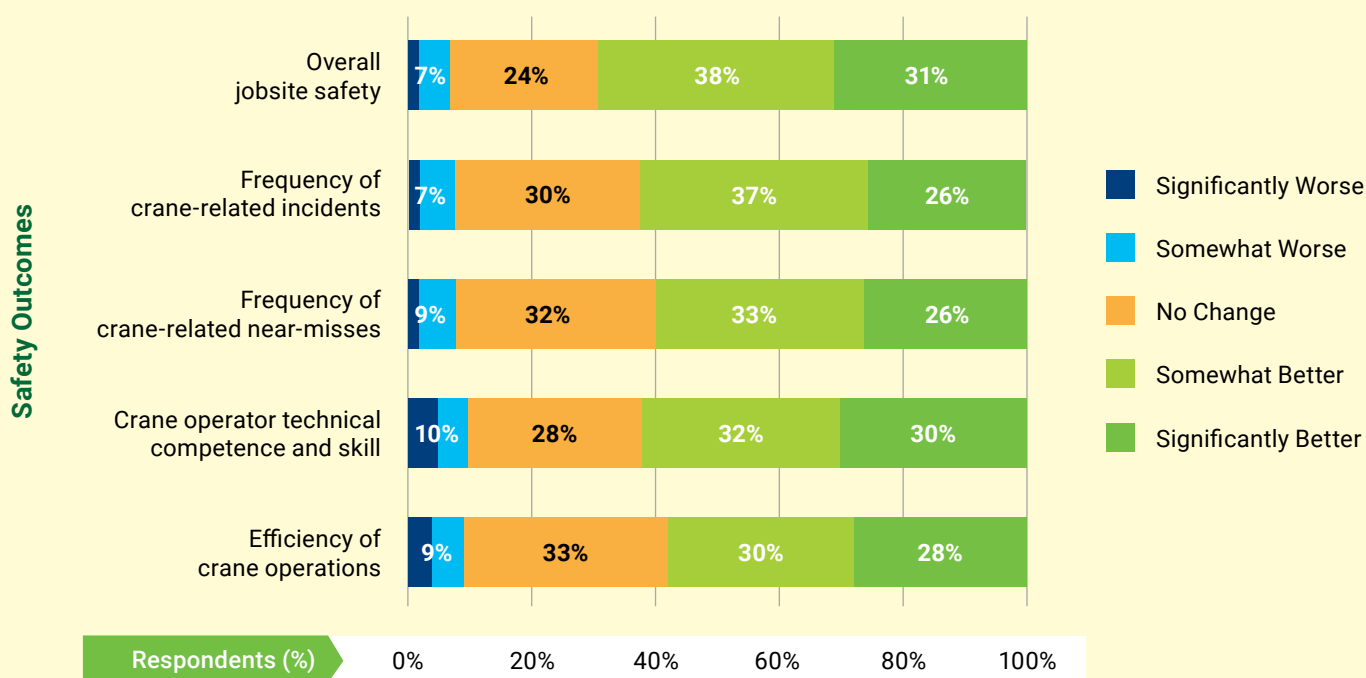


Figure 5. Perceived Outcomes Following Mandatory Operator Certification

Interviews and qualitative feedback from those who worked in the industry before 2018 described an operator landscape that was largely inconsistent. Without a federal standard, qualification ranged from structured training programs and apprenticeships to informal or inconsistent on-the-job assessments. Several respondents described how many skilled operators came up through the industry after decades without formal credentials, learning entirely through experience. Notably, by the time the Cranes and Derricks rule took effect, certification was already gaining popularity in many parts of the country, driven by state-level mandates, contract requirements and employer demand rather than federal regulation. This supports a broader shift in crane safety that was already underway in much of the industry.



Interviewees described the shift after mandatory certification as meaningful, if uneven. As one industry trainer reflected: “[Certification] was majorly meaningful. That’s what it is, really: it’s to prove that you have the knowledge, skills and ability to do this job.” Participants emphasized that while certification establishes a shared foundation, full competency is developed through experience, mentorship and hands-on learning. This reinforces the finding above that credentials and field experience function together as complementary elements of crane safety.

Operator Confidence Following Certification

Operators were also asked whether their level of confidence changed before and after certification across seven core responsibilities outlined in ASME B30.5 guidelines (see Figure 6). Overall, respondents reported increases in confidence across all areas assessed, with a mean score of 4.06 on a five point scale, falling between “somewhat increased” and “significantly increased,” indicating a meaningful improvement in perceived competency following certification.

Confidence gains were strongest in areas that rely heavily on standardized knowledge and formal instruction. The largest reported increases were in hazard identification (74%), interpreting and applying load charts (73%), and proper crane setup and site evaluation (69%). These are competencies that certification programs directly target through classroom instruction, written examinations and standardized assessment, suggesting that certification is particularly effective at strengthening knowledge-based skills and reinforcing consistent decision-making frameworks.

By contrast, more modest increases were reported for safely handling loads (61%) and coordinating with riggers and signalpersons (63%). These tasks are highly situational and depend on judgment, communication and coordination across roles, skills that tend to develop through repeated field exposure rather than formal testing alone. The smaller gains in these areas align with respondents’ broader emphasis on the importance of hands-on experience and mentorship, and reinforce the finding that certification establishes foundational knowledge but does not fully capture the complexity of real-world crane operations.

Regression analysis further illustrates the relationship between certification, confidence and experience. More experienced operators reported significantly smaller increases in confidence following certification (OR = .78, $p < .001$), indicating that certification had the greatest perceived impact among newer or less experienced operators. In practical terms, certification appears to provide newer operators with a structured foundation that accelerates early competency development, while experienced operators, who have already built confidence through years in the field, experience comparatively smaller marginal gains.

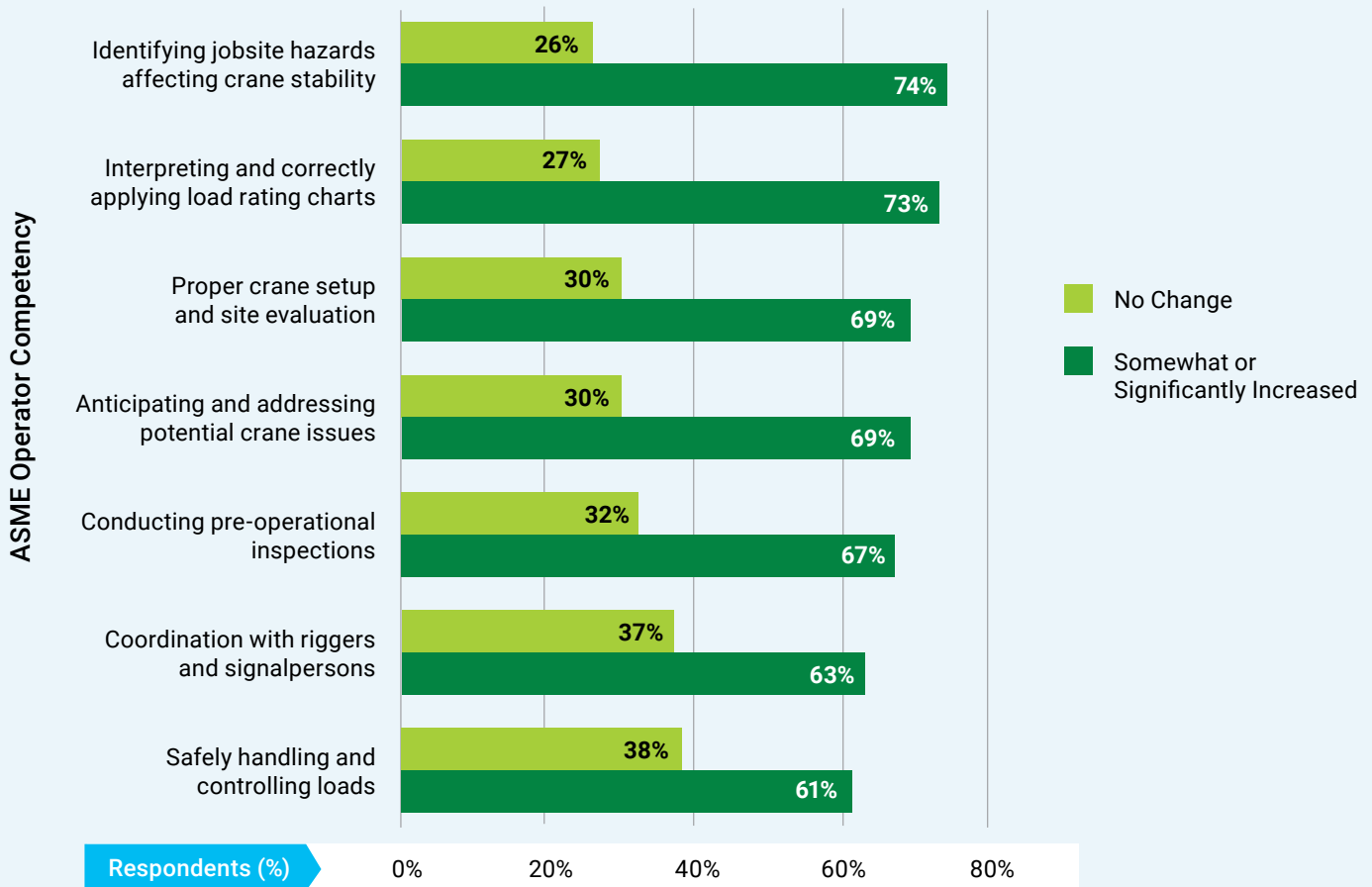


Figure 6. Operator Confidence Following Certification

Rigger Certification Perspectives

Perceived Effectiveness of Certified Riggers

Next, respondents were asked about their support for certification for riggers and signalpersons, who are currently not subject to federal certification requirements. Attitudes toward rigger certification were consistently strong (see Figure 7). A large majority “somewhat” or “strongly” agreed that certified riggers are more knowledgeable about their responsibilities and crane dynamics (85%), representing the highest level of agreement across role-specific certification questions. Most also agreed that certified riggers improve lift safety (80%) and reduce rigging-related near-misses and incidents (76%). Notably, nearly three-quarters (73%) agreed that certification should be required for all crane lifts involving rigging (73%). Among respondents who identified primarily as riggers, support was even stronger, with 86% favoring mandatory certification and the remainder expressing neutral views.

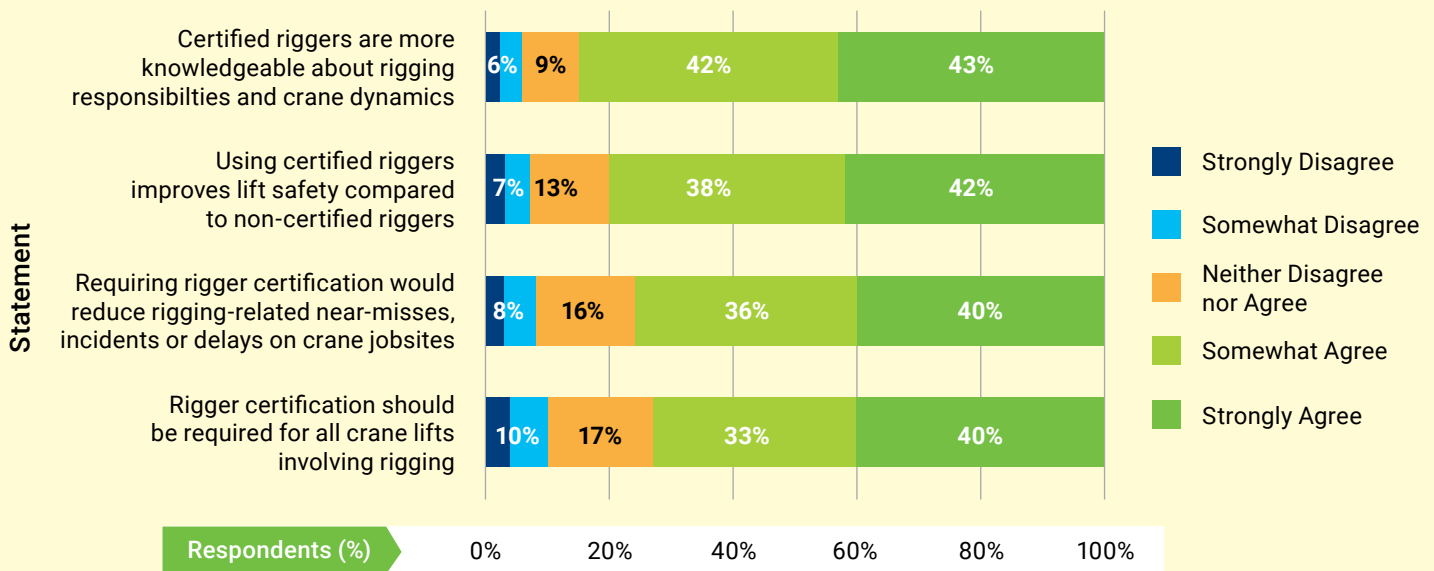


Figure 7. Attitudes Toward Working with Certified Riggers

Next, respondents were asked to compare certified and noncertified riggers across eight core competencies aligned with the ASME B30.5 framework for rigging practices. Certified riggers were consistently rated as more effective than their noncertified counterparts across all competencies (Table 2). **Roughly three in four respondents rated certified riggers as more effective across inspection, hazard recognition, equipment selection, load estimation and application of standard rigging methods.** The lack of variation across competencies suggests that certification was believed to reinforce consistent knowledge and judgment across tasks rather than improving only discrete skills.

Interviews helped clarify why certified riggers may have an advantage over non-certified personnel. Participants described a qualification environment that remains highly variable, ranging from rigorous, hands on programs to minimal classroom instruction that results in a qualification card with limited practical preparation. As a result, individuals with the same “qualified rigger” designation may demonstrate very different levels of actual competency, with few reliable signals for coworkers to distinguish between them.

Interviewees also emphasized the complexity of rigging work and the narrow margin for error involved. Safe rigs depend on correct equipment selection, load configuration and component orientation, whereas small deviations from proper practices can significantly reduce system capacity or compromise lift safety. They also highlighted that complacency could emerge when rigging knowledge is uneven or gained informally, with a few participants sharing situations where repeated exposure to equipment created a false sense of confidence, leading workers to overlook why certain requirements exist or how conditions can change from one lift to the next. Together, these perspectives reinforce the survey findings that certification supports more consistent baseline competence in a high-risk role, while experience and reinforcement remain essential to safe performance over time.

“There’s a million and one ways to rig something. People don’t realize how much you lose by placing one piece completely wrong, where a shackle is supposed to face one way and it’s now used sideways for whatever reason, and now you’ve lost 60% of your capacity.”

– Apprenticeship Director/Former Operator



Table 2. Effectiveness of Certified Compared to Non-Certified Riggers

Competency	Less Effective	About the Same	More Effective
Proper selection and use of rigging hardware	4%	18%	78%
Inspection requirements for rigging components	4%	19%	77%
Anticipating and addressing rigging issues/unsafe conditions	5%	18%	77%
Proper selection and use of slings	5%	18%	77%
Effect of sling angles on rigging loads	6%	18%	77%
Proper selection and use of below-the-hook lifting devices	5%	20%	75%
Application of standard hitches (e.g., vertical, choker, basket)	4%	22%	73%
Estimation of load weight and center of gravity	6%	22%	73%

Rigger Training and Perceived Confidence

Respondents who primarily work as riggers were also asked to evaluate the quality of their training and their confidence across the same eight core rigging competencies. All 21 rigger respondents held a third-party Rigger I or II certification. Overall, reported training levels were strong, with most respondents indicating moderate to extensive training across competencies.

Training was most extensive for routine, standardized tasks, including application of standard hitches (81%), followed by rigging hardware selection (76%) and sling selection and inspection practices (71% each). By contrast, respondents reported more limited training for technical or calculation-based competencies, including load weight and center of gravity estimation (57%), use of below-the-hook lifting devices (55%), and understanding the effects of sling angles on rigging loads (55%). These areas also had a higher share of respondents reporting only moderate training, reflecting their complexity and the need for applied judgment developed through hands-on experience rather than formal instruction alone. Notably, no respondents reported minimal or no training in any area, indicating a consistent baseline exposure across all competencies.

Self-reported confidence followed a similar pattern, with ratings generally high across all eight competencies. At least 71% rated themselves as very or extremely confident about every task assessed, and confidence reached 90% or above for rigging hardware selection, inspection requirements and application of standard hitches. Confidence was somewhat more distributed, though generally still high, for selection and use of below-the-hook lifting devices, load weight estimation and sling angle effects. The close alignment between training depth and confidence suggests that areas receiving more extensive training also produce greater perceived readiness. At the same time, the high experience level of this subsample (57% reporting more than 10 years in the crane industry) suggests that confidence likely reflects a combination of both formal certification and field experience. Together, these findings reinforce the broader theme of the study: certification supports baseline competence and early confidence, while sustained experience remains essential for mastering complex rigging decisions over time.

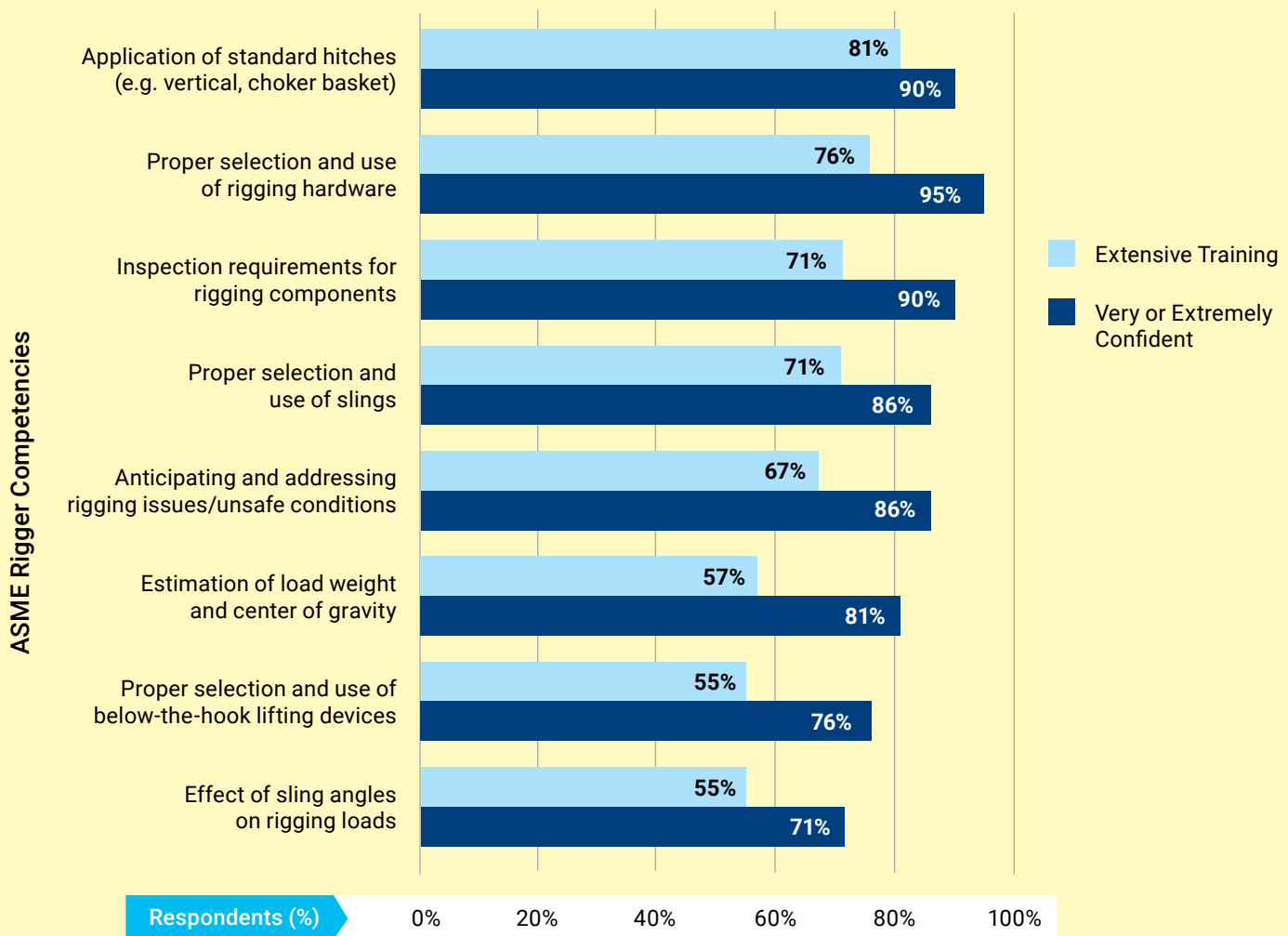


Figure 8. *Rigger Training Experience and Confidence*

Signalperson Certification Perspectives

Perceived Effectiveness of Certified Signalpersons

Attitudes toward signalperson certification were generally positive, though support was less uniform than observed for riggers (see Figure 9). Across all respondents, a majority agreed that certified signalpersons are more knowledgeable about signaling responsibilities and crane dynamics (80%) and improve lift safety compared to non-certified peers (76%). In addition, 71% agreed that requiring certification would reduce communication-related near-misses and incidents.

Support for mandatory signalperson certification, however, varied by role. While 73% of respondents overall agreed certification should be required for all crane lifts involving signaling, support was lower among signalpersons themselves: only 60% of signalpersons agreed, while the remaining 40% disagreed. Although this subsample is small (n=10) and should be interpreted with caution, this pattern may reflect differences in how signalpersons perceive certification in practice. Given the reliance on real-time communication, coordination and jobsite-specific conditions, signalpersons may view experience and crew familiarity as more critical than formal certification, which may not fully capture the variability of signaling in the field.

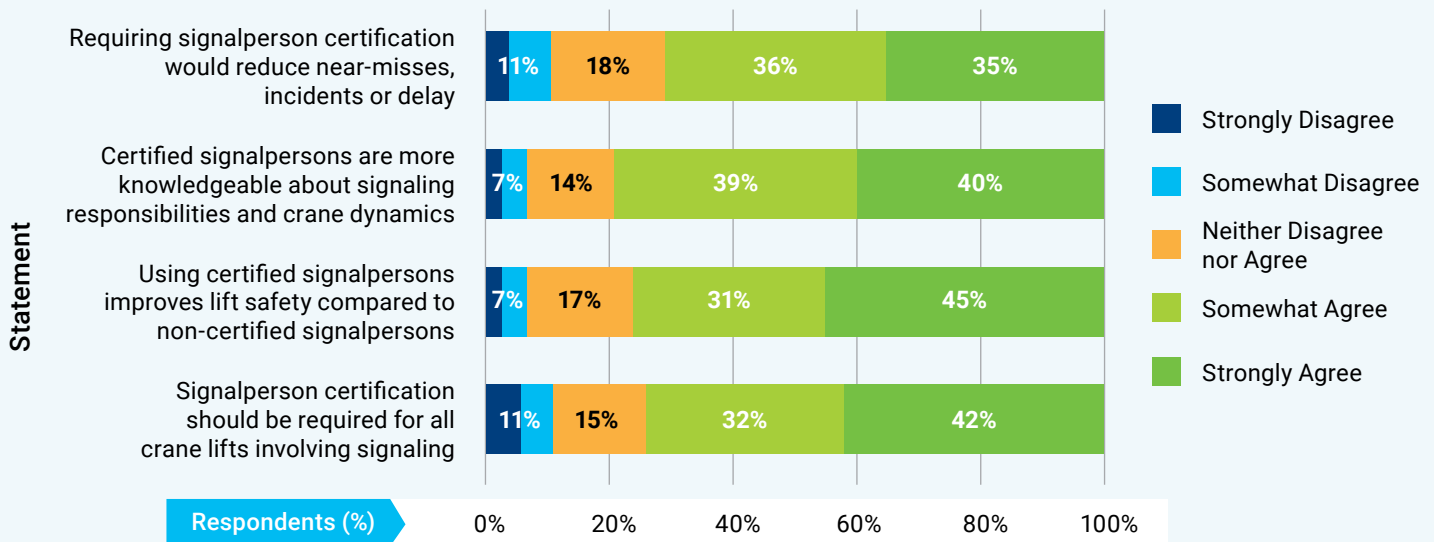


Figure 9. Attitudes Toward Working with Certified Signalpersons

Respondents were asked to compare certified and non-certified signalpersons across six core competencies aligned with ASME B30.5 standards (see Table 3). For five of the six competencies, certified signalpersons were consistently rated as more effective by a clear majority. The strongest perceived advantages were in anticipating and communicating potential hazards (79%) and maintaining clear communication with operators (78%). Certified signalpersons were also rated as more effective at stopping crane movement when communication breaks down and providing accurate, unambiguous signals, with fewer than 6% of respondents rating certified personnel as less effective in any of these areas.

One competency stood apart from this pattern: use of nonstandard or site-specific signals. While OSHA generally requires standard signals for most lift scenarios, nonstandard or site-specific signals may be used in limited, pre-defined circumstances where use of standard signals is infeasible. However, results show that in practice, inconsistent signaling practices were identified by 60% of respondents as a common jobsite challenge. When asked, only 37% rated certified signalpersons as more effective in the use of nonstandard hand and voice signals compared to non-certified peers. A sizable share of respondents rated certified and non-certified signalpersons as equally effective (43%), while one in five rated certified personnel as less effective.

Importantly, this finding likely reflects the intended focus of certification programs, which emphasize the consistent use of standardized signals rather than informal or site-specific alternatives. As a result, certified signalpersons would be expected to demonstrate the greatest advantage in environments where standard signaling practices are followed, while differences in performance may be less apparent when communication relies on nonstandard methods that fall outside established training and assessment standards.

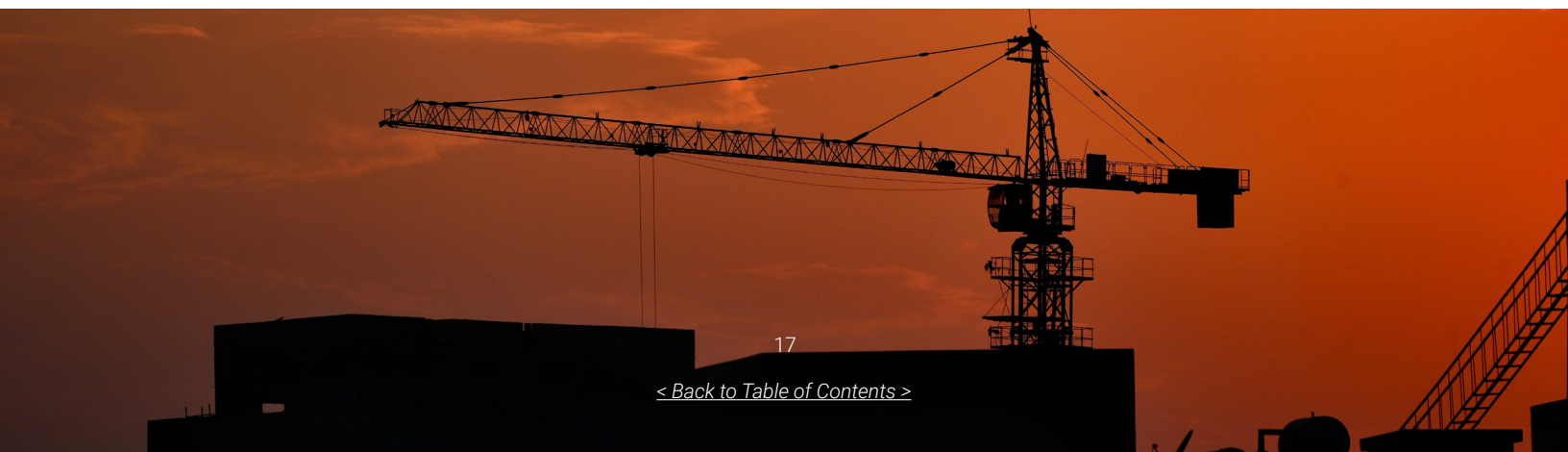


Table 3. Effectiveness of Certified Signalpersons Compared to Non-Certified

Competency	Less Effective	About the Same	More Effective
Anticipating and communicating potential unsafe movements or hazards	5%	17%	78%
Maintaining continuous and clear communication with the operator	4%	19%	77%
Providing accurate and unambiguous signals that result in the intended crane movement	5%	21%	74%
Stopping or pausing crane movements if communication is lost or unclear	4%	21%	74%
Using standard hand and voice signals per ASME B30.5 standards	6%	25%	69%
Using nonstandard hand and voice signals per ASME B30.5 standards	20%	43%	37%

Interview participants offered an explanation for this pattern, describing an environment in which newly certified signalpersons are trained in standard signal protocols, but often encounter informal practices used in the field. As one industry trainer observed: *“You teach them properly and they understand what the signal means, and then they get on the jobsite and they’re dealing with a crane operator who’s been in the seat for 20, 25 years... next thing you know, they’re just doing it the way the crane operator wants them to do it.”* In such settings, signalpersons may defer to more experienced operators or supervisors who favor site-specific signals, limiting opportunities to apply formal training consistently. Further, because certification programs are intentionally focused on standardized signals, this creates a practical gap when work moves into nonstandard or informal signaling and performance depends more on pre-lift coordination than on formal credentials alone.

In practice, departures from standard signaling can introduce risk by shifting communication from a shared crew responsibility to individual interpretations. Interviewees described scenarios where operators are forced to either proceed using their best judgment of the signal, or to stop or slow the lift, both of which can create time pressures and friction between crews. Taken together, these findings suggest that signalperson certification effectively strengthens standardized signaling and hazard communication, but its influence is diminished when informal practices override formal training.

Addressing this gap requires a dual approach that recognizes both the value and the limits of certification. First, standardized signals must be reinforced as the consistent baseline across crane operations. Certification establishes this common language, but its safety value is realized only when standard signals are actively used, reinforced and protected from being eroded by informal practices. When operators or other personnel default to informal norms, even well-trained signalpersons may feel pressure to defer to experience rather than adhere to standardized protocols. In this context, certification alone cannot ensure consistent signaling behavior; supervisory reinforcement and clear expectations are essential. Without that reinforcement, informal practices can override formal training, allowing variability to persist and introducing additional risk into the lifting process.

At the same time, training programs should more explicitly prepare signalpersons for the limited but legitimate situations in which nonstandard signals are necessary. Training should reinforce the use of standardized signals as the preferred method of communication and emphasize that deviations are appropriate only in rare situations where standard signals are genuinely infeasible. Interview findings suggest that many challenges arise when nonstandard signals are introduced without clear communication, pre-lift alignment or shared understanding among crew members. Accordingly, training should emphasize signal clarification, stop-work authority and the importance of re-establishing a common communication framework whenever uncertainty exists.

Signalperson Training and Perceived Confidence

Respondents who identified primarily as signalpersons were also asked to assess the quality of their training and their confidence across role-specific signaling competencies. Given the small subsample (n=10), these findings should be interpreted with caution but help explain patterns observed in the broader survey results. Notably, all signalperson respondents held a current certification from a third-party certifying body.

Reported training levels were high for competencies tied to standardized signaling practices. Most signalpersons indicated extensive training in maintaining clear communication with operators (80%), using standard ASME B30.5 signals (77%), anticipating and communicating hazards (70%), and stopping crane movement when communication fails (70%). In contrast, training related to the use of nonstandard or site-specific signals was more limited, with only 40% reporting extensive training and 20% reporting little to no formal instruction.

Self-reported confidence was similarly high for standard signaling tasks. All respondents rated themselves as very or extremely confident in maintaining communication, providing accurate signals, anticipating hazards and stopping movement when needed. Confidence was more variable for nonstandard signaling, where most respondents still rated themselves as confident, but a small number reported only moderate or no confidence. Despite greater variability, most respondents remained confident in their ability to manage nonstandard signaling situations, indicating that certification provides a meaningful foundation even for tasks that extend beyond standardized protocols.

These findings suggest that signalperson certification establishes a strong baseline of competency and confidence for standard crane signaling. At the same time, the gap in training and confidence for nonstandard signaling can help explain why certification is perceived as less beneficial in this area. As with other roles examined in this study, certification provides an important foundation, but its full impact depends on how well training aligns with the realities of jobsite practice and how consistently standardized procedures are reinforced in the field.

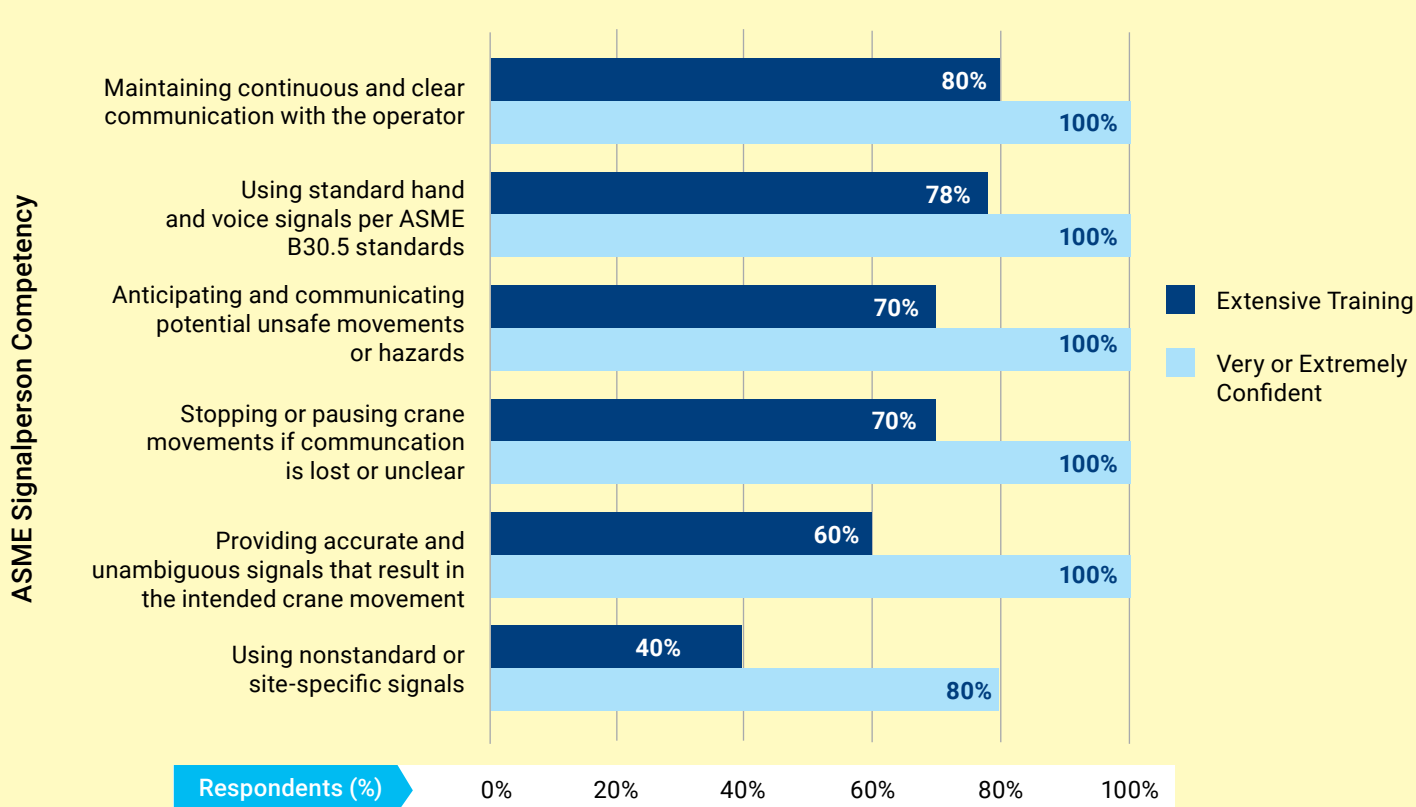


Figure 10. Signalperson Training Experience and Confidence

Certification Challenges

Despite broad support for certification, respondents identified several challenges related to implementation and workforce development. A recurring theme centered on barriers created by cost and training requirements, which some felt could disadvantage otherwise experienced workers while encouraging accelerated, test focused pathways that may not fully reflect real site conditions. Respondents noted that experienced field operators may struggle with formal testing, even as less experienced workers successfully obtain credentials without sufficient practical context.

Concerns about training frequency also emerged from the survey data. Although 35% of respondents reported receiving refresher training at least annually, most reported much longer intervals. Of those reporting longer intervals, 17% reported receiving refresher training every two to three years, and the largest share (35%) reported training only every four to five years, aligning with certification renewal cycles. An additional 13% received refresher training less than once every five years or not at all. In a field where equipment, regulations and jobsite conditions evolve continuously, these extended intervals raise questions about whether certification without regular reinforcement is sufficient to maintain the competency it establishes.

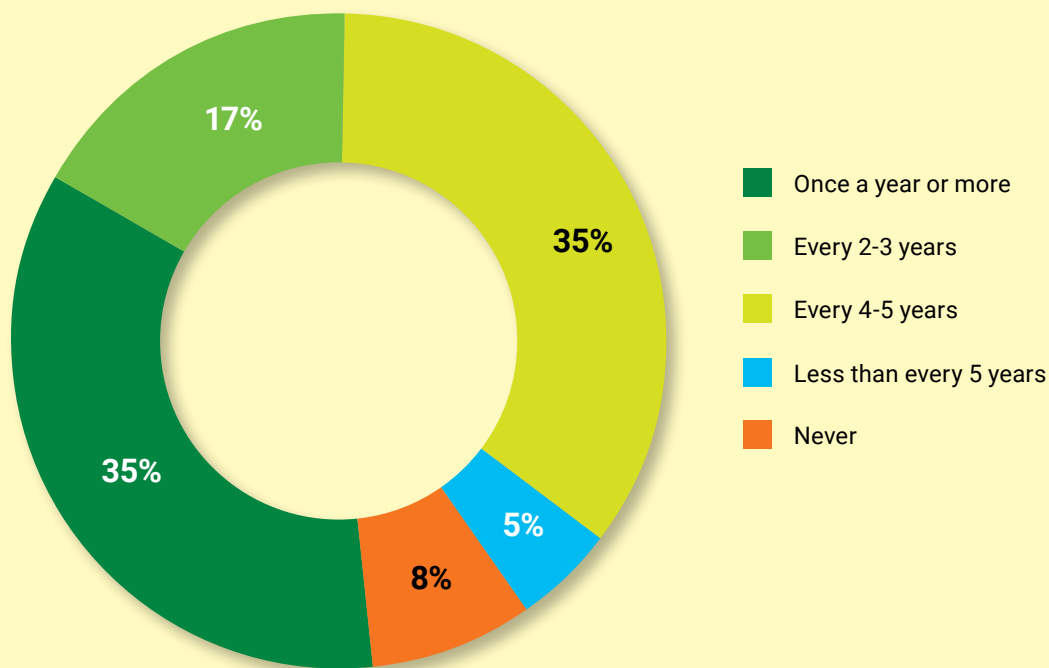


Figure 11. *Frequency of Refresher Training*

Across both survey responses and interviews, a broader disconnect between certification and operational competence emerged. While certification was widely viewed as an important starting point, respondents emphasized that passing written or practical exams does not guarantee real-world capability, particularly for newer workers with limited field exposure. Preferences around assessment formats reflect this concern, with most respondents favoring a combination of written and practical evaluation, and relatively few supporting written testing alone. Interview participants reinforced this perspective by describing challenges at both ends of the experience spectrum: experienced workers who perform well in the field but struggle in testing environments, and newly certified workers who enter jobsites without adequate supervision, mentorship or feedback to calibrate their performance. Together, these findings suggest that certification is most effective when paired with structured field experience, ongoing reinforcement, and training approaches that support the translation of knowledge into safe and effective performance.

"Certification is great. You know the basics and the rules, but there is so much more. Everything you learn in your first two years running a crane is more than what you're going to learn in school."

– Tower Crane Operator, Construction



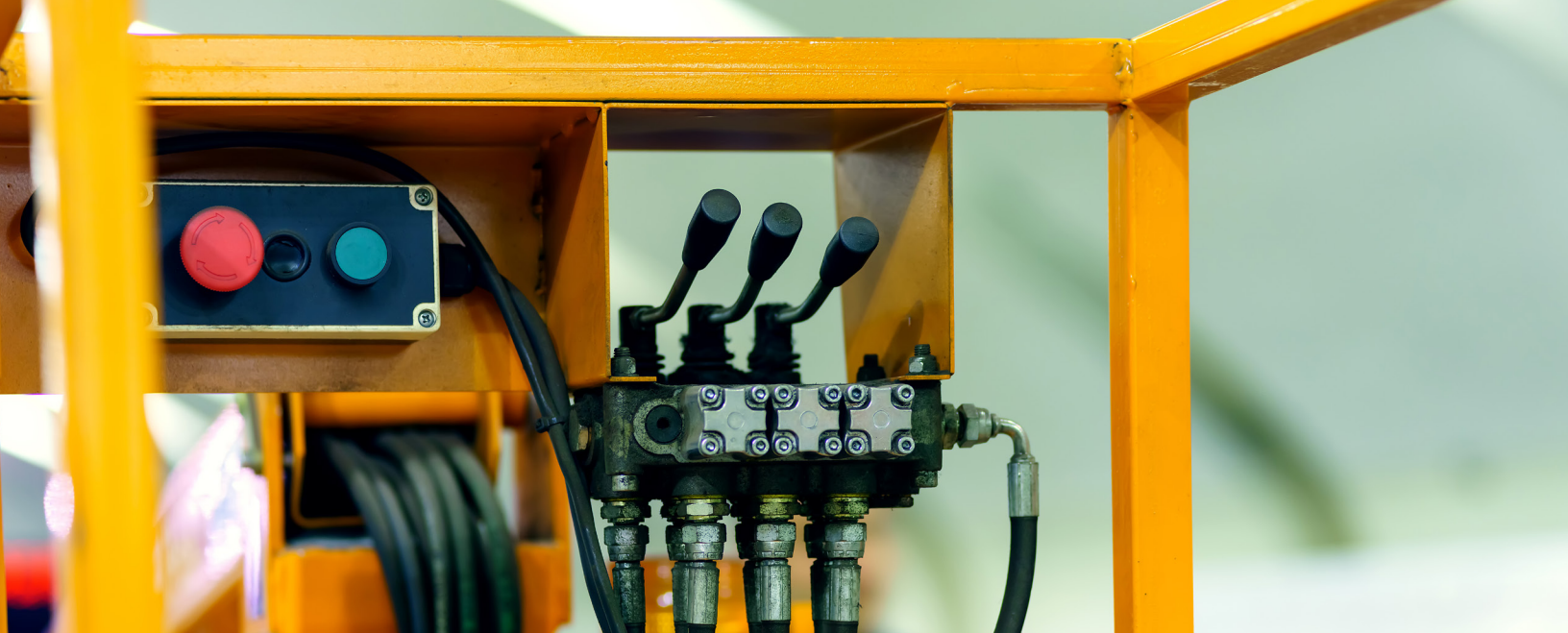
Recommendations

Based on these findings, several opportunities exist to strengthen the effectiveness of certification on crane safety:

- **Position certification as a foundation, not a standalone solution.** Certification should continue to serve as a baseline for knowledge and minimum competency, but should be consistently paired with structured on-the-job training, mentorship and supervised field experience. Employers and certifying bodies should explore pathways that formally recognize documented field experience alongside certification, ensuring credentials reflect both knowledge and demonstrated capability, and that experienced workers are not disadvantaged by testing environments alone. Certification, training and experience should be viewed as complementary rather than competing approaches to competency development.
- **Expand certification thoughtfully for riggers and signalpersons.** Survey and interview findings show strong support for certification in these roles, with certified personnel consistently perceived as more effective across core competencies. These results suggest that expanding certification requirements, when paired with meaningful hands-on training, could improve consistency and baseline competence for roles that directly influence lift safety.
- **Invest in structured mentorship and early-career development.** The decline of informal apprenticeship pathways has left many newly certified workers without adequate opportunities to build and calibrate real-world skills. Employers, unions and industry organizations should reinvest in structured early-career development programs that pair certification with supervised field experience and mentorship, recognizing that genuine competence develops over time through guided practice.
- **Strengthen training for complex and nonstandard tasks.** Tasks that are more technically demanding or context-dependent, like load estimation, sling angle effects, below-the-hook devices and nonstandard signaling, showed lower training consistency and greater variability in perceived effectiveness. Certification programs and employer training should place greater emphasis on these areas, including scenario-based instruction, pre-lift planning, crew alignment and clear protocols for establishing site-specific signals before work begins.

- **Improve data collection to better evaluate certification outcomes.** Ongoing evaluation would benefit from more consistent tracking of certification status in incident investigations, near-miss reporting and fatality data. Improved data quality would strengthen the ability to assess long-term impacts and inform evidence-based decisions about certification scope and requirements.
- **Reduce barriers to certification access while preserving rigor.** Cost and access barriers were identified as meaningful challenges, particularly for experienced workers with strong field skills who struggle in formal testing environments. Expanding access to affordable preparatory resources, offering flexible testing pathways, and ensuring assessments accurately reflect job-relevant competencies would broaden participation and reinforce the credibility of certification as an industry standard.





Conclusion

Crane-related fatalities in the United States have declined steadily since the 1990s, a period that coincided with the expansion of third-party certification programs, enhanced training requirements, stronger regulatory oversight and broader industry-wide safety improvements. While statistical testing did not identify a distinct change attributable solely to the 2010 OSHA Cranes and Derricks rule, the long-term decline in fatalities is consistent with the cumulative impact of certification, training, competency verification, regulatory improvements, and broader industry safety initiatives that expanded throughout the 1990s and 2000s. Because many of these initiatives, including industry-led certification programs, were implemented prior to the OSHA rule, their effects may have emerged gradually over time rather than as a single observable change following the regulation.

At the same time, insights from crane personnel consistently demonstrate strong support for third-party certification. Across surveys and interviews, certification was widely viewed as improving baseline safety knowledge, technical competence, career opportunities and overall jobsite safety. Importantly, these findings also revealed a shared understanding of certification's limits. Across roles and experience levels, respondents emphasized that certification establishes a standardized foundation of knowledge, but does not, on its own, ensure jobsite competency. Hands-on experience, mentorship and continued training were repeatedly cited as essential for translating certified knowledge into safe and effective work in dynamic field conditions. These findings are also generally consistent with prior research from Ontario (Construction Safety Association of Ontario, 2007) and California (Cal-OSHA Reporter, 2008), both of which reported substantial reductions in crane-related fatalities following the implementation of certification and licensing requirements, suggesting that certification may contribute to safety improvements as part of a broader system of workforce development and safety management.

Differences across competencies further reinforce this conclusion. Certification appears most effective in supporting standardized, knowledge based tasks, such as hazard identification, load chart interpretation and use of standard ASME B30.5 signaling, where formal instruction and testing align well with job requirements. In contrast, more complex, situational and experience-driven tasks (e.g., load handling, coordination, nonstandard signaling) showed smaller gains and greater variability.

Notably, this study relied primarily on fatality data and self-reported survey responses, which limits the ability to fully identify root causes and to assess the causal impact of certification on crane safety. Future research should more closely examine crane incident causes using additional industry- and organization-level data sources, including injury data and detailed incident records, to better identify direct contributors to incidents. Further study is also needed to examine how certification interacts with experience, supervision and jobsite conditions to influence incident risk and prevention.

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