Firm Size Influence on Construction Safety Culture and Construction Safety Climate

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Firm Size Influence on Construction Safety Culture and Construction Safety Climate

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Abstract: Smaller construction firms represent the majority of US construction firms. The safety record of smaller construction firms indicates a lower safety performance and higher incident rates than those found in larger construction firms. Therefore, there is a need for a greater understanding of the challenges that prevent smaller construction firms from achieving higher safety performance levels. Understanding these challenges will help construction safety practitioners and policymakers provide the necessary interventions to improve overall construction site safety. Data were collected from 275 construction practitioners in the US, resulting in scores for safety culture, climate, and behavior. The results suggest a statistically significant positive correlation between firm size and construction safety culture, which represents the safety-related actions of upper management and safety personnel. Thus, interventions that aim to develop sustainable safety and health management systems for smaller construction firms are necessary. On the other hand, the study indicates no statistically significant correlation between firm size and the construction safety climate, which represents the safety-related actions of field personnel (frontline supervisors and workers). These findings contribute to the body of knowledge by providing a meaningful understanding of the interventions needed to improve the overall safety performance of smaller construction firms. **DOI: 10.1061/(ASCE)SC.1943-5576.0000610.** © *2021 American Society of Civil Engineers.*

Introduction

The safety performance of the construction industry is still an area of concern. The construction industry's share of fatalities is greater than its representation within the overall workforce, making it the most hazardous industry (Waehrer et al. 2007; Liu et al. 2020). The construction industry's share of fatalities is the highest of all industries, accounting for roughly 19% of all workplace fatalities, although the industry accounted for roughly 4.5% of the total workforce (Al-Bayati et al. 2019). The US Bureau of Labor Statistics (BLS) found that construction firms that hire 11–250 employees often have a higher average rate of days away from work, days of restricted work activity, or job transfer cases [days away, restricted or transferred (DART) cases] than construction firms with more than 250 employees, see Fig. 1 (BLS 2020). Fig. 1 illustrates the DART rates based on firm sizes, which have been divided into five groups (i.e., 1–19, 11–49, 50–249, 250–999, and 1,000+). The accuracy of the data provided by the BLS regarding the incidence rates of construction firms with fewer than 10 employees is arguably questionable; the actual number of incidents is likely to be higher than indicated due to potential underreporting as suggested by Mendeloff et al. (2006) and Legg et al. (2015). There are several explanations for the suggested underreporting such as the lack of safety services and incident management (Oleinick et al. 1995; Thomason and Pozzebon 2002; Al-Bayati et al. 2020), and the workforces hired by smaller firms tend to have certain characteristics that may contribute to underreporting, such as younger age, male gender, and undocumented immigration status (Oleinick et al. 1995; Azaroff et al. 2002; Al-Bayati et al. 2018).

Accordingly, small firm size contributes to a greater vulnerability to work-related incidents (Cunningham et al. 2018; Al-Bayati and Panzer 2019). As of today, there is no clear definition of small construction firm in terms of the number of employees. Table 1 presents the scales that have been used to categorize firms based on their size. Guo et al. (2018) recommended avoiding a binary categorization to classify construction firms based on their size. Binary classification could hinder meaningful, comprehensive analysis and prevent a clear understanding of the influence of firm size on overall safety and health performance. This study uses the categorization scale presented in Fig. 1 to categorize firms based on their size.

An acceptable safety performance could be defined as the performance of an organization's safety management system during a safe operation (Wu 2001; Hsu et al. 2012). There are three types of safety performance measurements:

- traditional measurements (i.e., lagging indicators), such as incident investigation, DART, and experience modification rate (EMR) (Costin et al. 2019; Al-Bayati et al. 2020),
- transfer measurements, such as disaster prevention analysis and safety target rate (Wei 2008), and
- predictive measurements (i.e., leading indicators), such as workers' involvement and subcontractors' safety prequalifications (Hinze et al. 2013; Costin et al. 2019).

Although all types of safety performance measurements are important, some are more important than others. The traditional measurements are indirect measurements of safety performance because they measure the outcomes of the overall management system. To measure safety performance, the safety management systems such as safety culture, safety climate, training programs, and enforcement policy should be the focus. Hinze et al. (2013) suggested that the effectiveness of the traditional measurements has reached the point of diminishing returns, and predictive measures may be more appropriate to improve safety performance. This does not mean traditional measurements should not be used, but their

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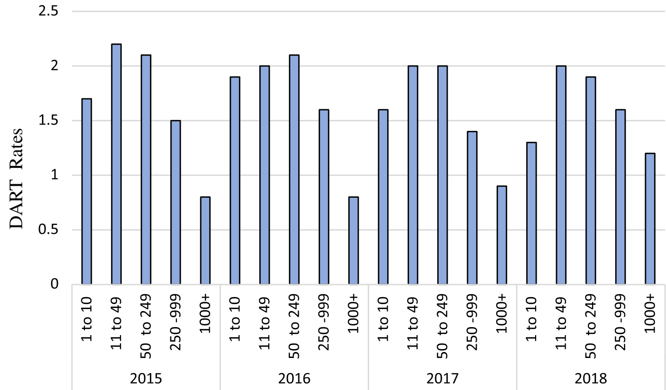

Fig. 1. DART rates per firm size (2015–2018).

effectiveness in predicting safety performance is limited. Safety culture and safety climate represent predictive measurements of safety performance (Jin et al. 2019). Safety culture represents the principles and policies of a construction firm that guide safety decision-making at the firm management level. Thus, construction safety culture is a direct result of upper management commitment and safety personnel competency (Al-Bayati et al. 2019). On the other hand, the construction safety climate is the manifestation of the principles and policies in the form of practices and behaviors at the field level. The safety performance of field personnel is often influenced by upper organizational levels (Guo et al. 2018). Thus, the construction safety climate is a direct result of frontline supervisors' safety performance and workers' participation (Al-Bayati et al. 2019).

Larger construction firms have centralized policies and principles. However, they have decentralized workplaces. Therefore, a construction firm often has one safety culture and several safety climates (i.e., one in each of the firm's projects). Unlike other frameworks, Al-Bayati et al.'s (2019) construction safety culture and climate framework provides measurements that assess the safety-related actions of construction firms at the organizational level and the field level. Safety culture and safety climate serve as safety measurements that play a critical role in predicting and improving overall safety performance. In addition, safety behavior could be used as a predictive measurement to develop preventative safety actions (He et al. 2020). Higher levels of safety behavior could reduce risk-taking, which in turn reduces work-related incidents (Wallace and Chen 2005). Safety behavior played a partially mediating role between safety climate/culture and safety outcomes (He et al. 2020). Safety behaviors consist of safety compliance with the firm's policies and voluntary safety participation to improve site safety (Neal and Griffin 2006). Accordingly, this study will utilize Neal and Griffin's (2016) safety behavior measurements and Al-Bayati et al. (2019) construction safety culture and climate measurements to assess overall safety performance based on firm size.

Problem Statement and Research Objective

Limited resources, incompatible safety programs, and financial constraints have been identified as the main challenges that hinder acceptable safety performance in smaller construction firms (Legg et al. 2015; Guo et al. 2018; Cunningham et al. 2018). In addition, smaller firms often have few or no full-time safety personnel and lack safety leadership skills (Hoffmeister et al. 2014; Al-Bayati et al. 2020). As a result, it is expected that smaller construction firms will have lower levels of safety performance. However, it is not clear how these challenges impact the overall construction site safety and at which level (i.e., organizational level versus field level). In addition, a few studies suggest that there is no correlation between firm size and safety climate (e.g., Baek et al. 2008; Rodrigues et al. 2015).

No efforts have been made to examine the systematic differences in the level of safety climate between small and large construction companies (Guo et al. 2018). This gap could be explained in part by various varying safety culture and climate measurements and by the fact that they are often used in research as if they are interchangeable (Al-Bayati et al. 2019). This study assesses the influence of firm size on safety culture, climate, and behavior. It is expected that the study findings will provide a better understanding of the influence of firm size on overall safety performance.

To achieve the study objectives, Al-Bayati et al.'s (2019) safety culture and climate framework was adopted. As mentioned earlier, this framework provides unique metrics to assess the safety performance at the firm's organizational level (i.e., safety culture) as well as the field level (i.e., safety climate). This framework assumes that each construction firm manages several construction projects (i.e., decentralized operations) and has one set of safety principles and policies (i.e., centralized policies). However, this assumption is more compatible with larger construction firms (Sørensen et al. 2007). Thus, the levels of safety culture and climate are expected to differ between smaller and larger construction firms. As a result, this unique framework could provide a meaningful comparison between larger and smaller construction firms, in turn delivering insights that can help prevent fatal and nonfatal injuries. Table 2 shows the list of actions that have been suggested to evaluate construction firms' safety cultures and the list of actions that have been proposed to assess construction firms' safety climates. Safety behavior consists of safety compliance and safety participation. Neal and Griffin's (2006) measurements to assess safety behavior were adopted in this study (Table 2). Numerous studies (e.g., He et al. 2020; Yu et al. 2021; Seo et al. 2015) have successfully

Table 1. Sample of scales for categorizing firms based on employee number

Article	Title	Firm categorization	Number of employees
Schwatka et al. (2020)	Change in frontline supervisors' safety leadership practices after participating in a leadership training program: Does company size matter?	Small Medium Large	Fewer than 75 75–200 More than 200
Cunningham et al. (2018)	Differences in safety training among smaller and larger construction firms with nonnative workers: Evidence of overlapping vulnerabilities	Smaller Larger	2–50 51 or more
Guo et al. (2018)	Does company size matter? Validation of an integrative model of safety behavior across small and large construction companies.	Small Large	2–20 20 or more
Targoutzidis et al. (2014)	The business case for safety and health at work: Cost-benefit analyses of interventions in small and medium-sized enterprises	Micro Small Medium Large	1–10 11–50 51–250 More than 250

Table 2. Construction safety performance measurements factors

Factor	Subfactor	Variables	Variable explanation
Safety culture (Al-Bayati et al. 2019)	Upper management (UM)	UM1	Upper management has a strong core of safety values that guide decision-making
		UM2	Upper management responds to all incidents in a positive manner and uses them as a learning opportunity
		UM3	Upper management allocates time and funds when corrective safety actions are required
		UM4	Upper management adheres to all safety requirements and procedures
		UM5	Upper management considers safety an integral part of the job, which receives the same amount of attention as other aspects of the job
	Safety coordinator (SC)	SC1	Safety personnel tries to implement accident prevention techniques
		SC2	Safety personnel clearly communicates safety regulations and expectations
		SC3	Safety personnel is approachable and receptive
		SC4	Safety personnel strives to improve overall site safety
		SC5	Safety personnel communicates accidents reports to workers in order to prevent future accidents of similar nature
Safety climate (Al-Bayati et al. 2019)	Frontline supervisors (FS)	FS1	Frontline supervisors encourage recording and reporting all near misses
		FS2	Frontline supervisors actively participate in reviewing safety procedures
		FS3	Frontline supervisors correct unsafe conditions quickly
		FS4	Frontline supervisors lead by example when it comes to safety
		FS5	Frontline supervisors always ensure that workers are following proper safety regulations
	Workers involvement (WI)	WI1	Workers feel okay to report unsafe conditions
		WI2	Workers know how/where to file an incident report
		WI3	Workers follow all safety policies and procedures
		WI4	Workers' actions suggest that they learn and apply concepts from safety training efforts
		WI5	Workers actively participate in reviewing safety procedures
		WI6	Workers feel confident that safety issues will be corrected if they report them
Safety behavior (Neal and Griffin 2006)	Safety compliance (SC2)	SC21	I use all the necessary safety equipment to do my job
		SC22	I use the correct safety procedures for carrying out my
		SC23	I ensure the highest levels of safety when I carry out my job
	Safety participation (SP)	SP1	I promote the safety program within the organization
		SP2	I put in extra effort to improve the safety of the workplace
		SP3	I voluntarily carry out tasks or activities that help to improve workplace safety

utilized the Neal and Griffin (2006) measurements to achieve reliable research findings.

Methodology

A survey was designed and pretested by several construction practitioners to assess the safety performance of construction firms based on their sizes. Lawrence Technological University's Human Subject Institutional Review Board (HSIRB) reviewed and approved the research protocol in September 2019. The survey consists of four parts: construction safety culture, construction safety climate, safety behavior, and demographic information. This study uses a numerical scale (1–10) to measure the safety culture and safety climate variables, in which 1 indicates a severely inadequate level of safety culture or climate and 10 indicates an excellent level. This scale is compatible with the analysis of variance (ANOVA) statistical test method that will be used in the study. Similarly, a numerical scale (1–10) will be used to assess the variables of safety behavior, in which 1 means totally disagree and 10 means totally agree. The overall values of safety culture, climate, and behavior per participant will be calculated using the following equations:

$$Construction\,Safety\,Culture = \frac{\sum_1^5 \mathrm{UM} + \sum_1^5 \mathrm{SC}}{10} \quad (1)$$

$$Construction\,Safety\,Climate = \frac{\sum_1^5 \mathrm{FS} + \sum_1^6 \mathrm{WI}}{11} \quad (2)$$

$$Safety\,Behavior = \frac{\sum_1^3 \mathrm{SC2} + \sum_1^3 \mathrm{SP}}{6} \quad (3)$$

where UM = upper management score; SC = safety personnel score; FS = frontline supervisor score; WI = worker involvement score; SC2 = safety compliance score; and SP = safety participation score.

Firms were categorized based on the number of employees into five groups: fewer than 10 employees, 10–50 employees, 50–100 employees, 100–250 employees, and more than 250 employees. The assumption is that this scale renders results that more clearly and accurately reflect the potential influence of firm size.

The survey was administered in October 2019 and November 2019. A convenience sample of 275 valid responses was received from construction practitioners. The participants' job descriptions were as follows: 54 (19.6%) workers, 65 (23.6%) supervisors, 98 (35.6%) management personnel, and 58 (21.1%) safety personnel. The participants' levels of experience were as follows: 65 (23.7%) had fewer than 5 years, 63 (22.9%) had between 6 and 10 years, and 147 (53.5%) had more than 10 years. The participants' experience levels and job titles are representative of the construction workforce as a whole, which strengthens the overall study findings.

The areas of specialization of the respondents' firms were as follows: 37 (13.5%) were single-family residential contractors, 24 (8.7%) were residential apartment complex contractors, 134 (48.7%) were commercial building contractors, 38 (13.8%) were special trade contractors, and 42 (15.3%) were civil and heavy construction contractors (Table 3). The annual revenues of respondents'

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Table 3. Characteristics of construction firms within the study sample

Characteristics	Number
Firm specialty	
Residential—single family	37 (13.5%)
Residential—complex apartment	24 (8.7%)
Commercial buildings construction	134 (48.7%)
Specialty trade contractors	38 (13.8%)
Civil and heavy construction	42 (15.3%)
Annual revenue	
Less than 100,000	20 (7.3%)
100,000–500,000	38 (13.8%)
500,000–1 million	23 (8.4%)
1–10 million	68 (24.7%)
More than 10 million	126 (45.8%)
Number of employees	
Less than 10	28 (10.2%)
10–50	51 (18.5%)
50–100	54 (19.6%)
100–250	68 (24.7%)
More than 250	74 (26.9%)
Firm geographical location	
North Carolina	91 (33.1%)
Virginia	20 (7.3%)
Illinois	15 (5.5%)
New Mexico	14 (5.1%)
South Carolina	10 (3.6%)
Florida	10 (3.6%)
Others	115 (41.8%)

firms were as follows: 20 (7.3%) made less than \$100,000, 38 (13.8%) made between \$100,000 and \$500,000, 23 (8.4%) made between \$500,000 and \$1 million, 68 (24.7%) made between \$1 million and \$10 million, and 126 (45.8%) made more than \$10 million (Table 3). The firm sizes in terms of number of employees were as follows: 28 (10.2%) had fewer than 10 employees, 51 (18.5%) had between 10 and 50 employees, 54 (19.6%) had between 50 and 100 employees, 68 (24.7%) had between 100 and 250 employees, and 74 (26.9%) had more than 250 employees. Most of the participants came from North Carolina (33.1%), followed by Virginia (7.3%) and Illinois (5.5%); see Table 3 for more information about the firms' geographical locations. Overall, the characteristics of construction firms that participated in the study seem to be diverse, which provides useful information about the differences between firms based on their sizes.

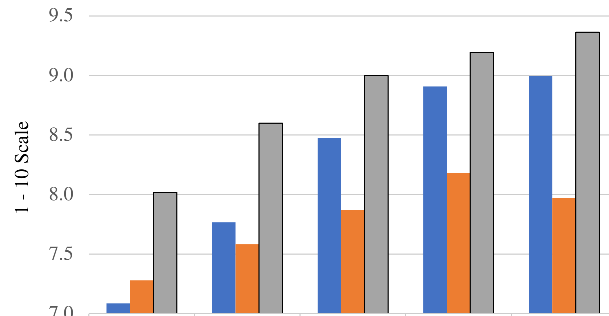
Survey Findings

The descriptive data of safety culture, safety climate, and safety behavior are presented in Table 4. Cronbach's alpha (α) was used to determine whether the scale was reliable, revealing a high level of internal consistency and reliable factor measurements.

The scores of safety culture, climate, and behavior (i.e., the study factors) have been categorized based on firm size, see Fig. 2. Firm size represents an independent variable that splits the sample

Table 4. Descriptive analysis results

The study factors	Mean	Standard deviation	Cronbach's alpha (α)
Construction safety culture	8.45	1.82	0.96
Construction safety climate	7.86	1.83	0.95
Safety behavior	8.97	1.31	0.93



	Fewer than 10	10 to 50	50 to 100	100 to 250	More than 250
Safety Culture	7.1	7.8	8.5	8.9	9.0
Safety Climate	7.3	7.6	7.9	8.2	8.0
Safety Behavior	8.0	8.6	9.0	9.2	9.4

Fig. 2. Average scores of the study factors per firm size.

into five groups. Fig. 2 shows that the scores for safety behavior across different firm sizes were higher on average than those for safety culture and safety climate. This could be a result of self-serving bias because the survey questions regarding safety behaviors ask about individual behavior rather than group behavior, as can be seen in Table 2. Participants who are asked to report their safety behavior may tend to respond to the questions in the manner that is likely to be most socially sanctioned (Davis et al. 2010). It is recommended to form the questions to ask about the overall behavior not the participant's behavior. Overall, Fig. 2 illustrates a linear relationship between firm size and overall safety performance, suggesting that firm size is an acceptable predictor of overall safety performance in terms of construction safety culture, construction safety climate, and safety behavior.

Overall Safety Performance and Firm Size

It is challenging to determine whether there are any statistically significant differences between the calculated scores. Therefore, a one-way ANOVA was conducted to identify any statistically significant differences in the scores of safety culture, climate, and behavior based on firm size. The results suggest a statistically significant difference in safety culture scores based on participant firm size ($F = 9.521$; $df = 4, 270$; $p < 0.001$). A statistically significant difference means that there is less than a 0.001 chance that the differences in scores could be attributed to random effects. However, the ANOVA test does not reveal where the statistical difference lies. Therefore, Tukey's honestly significant difference (HSD) tests were conducted on all possible pairwise contrasts. The results reveal that the safety cultures of firms with fewer than 10 employees (a score average of 7.08) were statistically significantly lower than those of other firm size groups, although they were not lower than the safety cultures of firms with 10–50 employees. The safety cultures of firms with 10–50 employees (a score average of 7.76) were statistically significantly lower than those of firms with 100–250 employees (a score average of 8.9) and firms with more than 250 employees (a score average of 8.99). Accordingly, it is reasonable to conclude that the following two groups differ to a statistically significant degree in terms of safety culture scores:

1. 50 employees or less
   - Fewer than 10 employees (M = 7.08, SD = 2.64), and
   - 10–50 employees (M = 7.76, SD = 1.17).
2. More than 50 employees
   - 50–100 employees (M = 8.47, SD = 1.72),
   - 100–250 employees (M = 8.90, SD = 1.13), and
   - more than 250 employees (M = 8.99, *SD* = 1.30).

The results indicate no statistically insignificant difference in safety climate scores based on participant firm size ($F = 1.59$; $df = 4$, 270; $p = 0.176$). This finding suggests that firm size is not a determining factor of construction safety climate. On the other hand, the results indicate a statistically significant difference in safety behavior scores based on firm size ($F = 7.5$; $df = 4$, 270; $p < 0.001$). Again, a statistically significant difference means that there is less than a 0.001 chance that the difference in scores based on firm size could be attributed to random effects. Tukey's HSD tests were conducted on all possible pairwise contrasts. The results revealed that the safety behavior of firms with fewer than 10 employees was statistically significantly lower than that of firms with 100 employees or more (a score average of 8.01). The safety behavior of firms with 10–50 employees (a score average of 8.5) was only statistically significantly lower than that of firms with more than 250 employees (a score average of 9.3). Accordingly, it is reasonable to conclude that the following two groups differ to a statistically significant degree in terms of safety behavior scores:

1. 50 employees or less
   - Fewer than 10 employees (M = 8.01, SD = 2.64), and
   - 10–50 employees (M = 8.5, SD = 1.57).
2. More than 50 employees
   - 50–100 employees (M = 8.9, SD = 1.17),
   - 100–250 employees (M = 9.19, SD = 0.88), and
   - more than 250 employees (M = 9.36, SD = 0.94).

Theoretical and Practical Implications

Research on the occupational safety and health of the work environment in smaller firms is relatively limited (Legg et al. 2015). The construction industry is known for having many smaller firms working in a dangerous environment (Hasle and Limborg 2006). Furthermore, larger firms often shift the risk down to smaller firms (Harrison 1997). In the United States, construction firms with fewer than 10 employees hired roughly 2 million workers in 2013 (Cunningham et al. 2018). In general, smaller firms serve a significant function within the economy because they create more new jobs than larger businesses (Headd 2010). Thus, there is a need to identify crucial resources to empower smaller firms (Cunningham and Sinclair 2015). Firm size has been previously identified as an influential factor on overall safety performance, but no study has provided a quantified measurement of its influence. Specifically, there are few studies, if any, that quantified the influence of firm size on construction safety culture and construction safety climate. This quantification helps clarify the inconsistency in reported findings concerning the influence of firm size on overall safety performance. Thus, the contribution of this study is theoretically and practically vital in identifying the necessary resources and interventions.

On the theoretical level, the present study suggests no statistically significant influence of firm size on safety climate. As shown in Fig. 2, the safety climate scores improve when the safety culture scores improve. However, this improvement is not statistically significant (Yet, the practical difference presented in Fig. 2 should not be ignored.). The construction safety climate in this study represents the safety-related actions of frontline supervisors and workers. Thus, it seems that the safety climate in construction workplaces (i.e., the actions of frontline supervisors and workers) is not deeply influenced by firm size. The finding partially confirms the findings reported by Rodrigues et al. (2015) who suggested that there is no correlation between firm size and safety climate. The safety climate measurement utilized by Rodrigues et al. (2015) consists of three levels: management level, supervisor level, and individual level. While this study confirms that there is no significant correlation between firm size and the field level (i.e., construction safety climate), the collected data suggest that firm size influences the overall safety culture in terms of upper management's commitment to safety and having competent safety personnel (i.e., the management level). Furthermore, the results of this study suggest that the improved safety culture present in larger construction firms (i.e., more than 250 employees) does not influence the overall safety climate. This confirms Guo et al.'s (2018) findings, which suggest that workers from firms of all sizes understand the safety performance measures in the same way. This is especially true on construction sites because field personnel (i.e., frontline supervisors and workers) work next to each other. As a result, the overall safety climate of field personnel who are hired by different subcontractors is often influenced by the main contractor (Guo et al. 2018). This study further suggests that the overall safety climate does not reflect the overall safety culture of the larger firm; rather, it reflects the actions of everyone on the construction site. This explains the insignificant difference in overall safety climate across different firm sizes (Fig. 2). This suggests that higher levels of safety culture have a limited influence on the safety climate of construction workplaces. This finding could be a result of inadequate communication between the management personnel and the field personnel of larger firms, which requires further investigation. Another potential explanation is that the safety climate is highly sensitive to peer pressure. That is, the nature of construction projects in which several firms work together seems to lower the overall safety climate of larger construction firms. Thus, larger construction firms should be aware of this influence on their overall safety climate and effectively communicate their policies and principles to field personnel. The competency of safety personnel and the commitment of upper management could significantly improve the overall safety climate (Al-Bayati et al. 2019). As a result, one of the most important contribution of this study is clarifying the inconsistency in previously reported findings regarding the influence of firm size on construction safety climate and culture. The safety behavior measurement seems to be sensitive to firm size. However, it should be noted that the average scores for safety behavior were higher than those for safety culture and safety climate (Fig. 2), which could be a result of a self-serving bias because the survey questions ask about the actions of the individuals who completed the survey. Therefore, it is recommended to modify the safety behavior measurement questions to avoid self-serving bias. In addition, the safety behavior measurement does not differentiate between upper management, safety personnel, frontline supervisors, and workers. As a result, this measurement does not reveal whether the measured behavior represents the organizational level or the field level of the firm, which represents a major shortcoming when utilized by construction practitioners. Overall, the findings of this study confirm the DART rates reported by BLS, as presented in Fig. 1, which validates the study's findings.

On the practical level, the study clearly identifies the resources necessary to improve the safety performance of smaller construction firms. The lower scores of safety culture among smaller construction firms indicate a need for safety policies and safety management training that support adequate safety performance. This confirms the findings of Cunningham et al. (2018), which suggested that smaller firms do not have adequate safety training policies. In addition, current training materials do not satisfy the needs of vulnerable groups, such as Hispanic workers, and they do not provide adequate preparation for the unique challenges smaller construction firms face (Cunningham et al. 2018; Al-Bayati et al.

2019). However, it seems smaller firms do not have adequate safety management policies in general.

In the US, the National Institute of Occupational Safety and Health (NIOSH) has tried to use the relationship between smaller firms and service providers to deliver essential standard training, such as trenching safety training for construction and compliance and hazard recognition for general industry (Cunningham and Sinclair 2015). However, this study reveals that the absence of essential safety training among smaller firms could be a direct result of the low levels of safety culture (i.e., low upper management commitment and low safety personnel competency). Thus, developing and delivering training materials that are designed for smaller construction firms will not be a sustainable approach without an accompanying focus on improving overall safety culture. Therefore, tailored safety policies, not just training materials, should be proposed and introduced to smaller construction firms. These policies will help empower smaller construction firms to improve their overall safety culture, which, in turn, improves safety climate and reduces fatal and nonfatal work-related incidents (Al-Bayati 2021). In addition, it is essential to create a one-call center or advising service office to help smaller construction firms create their own safety management programs to remedy low levels of safety culture. Such efforts would help overcome the noticeable lack of a systematic safety management approach among smaller construction firms.

Conclusion

The research reported in this paper enriches the current body of knowledge by illustrating the influence of firm size on safety culture (i.e., upper management commitment and safety personnel competency), safety climate (i.e., frontline supervisors and workers actions), and safety behavior (i.e., safety compliance and safety participation). The study suggests that firm size is positively correlated with the level of construction safety culture and safety behavior, in part because smaller construction firms have limited resources to create and maintain adequate safety and health policies. Therefore, it is recommended to empower smaller firms by providing tailored safety and health policies and written program advising services. Safety culture has been recognized as a predictive indicator of safety performance. Thus, addressing the safety and health management limitations of smaller construction firms is critical to improving the construction industry's incident rate.

This study delivers a meaningful understanding of the differences between larger and smaller construction firms in terms of construction safety culture and construction safety climate. Accordingly, this understanding could help public and private safety and health organizations issue the best possible initiatives to support smaller construction firms and reduce fatal and nonfatal injuries. In terms of safety climate, which represents frontline supervisors' and workers' safety actions, the study suggests that there is no statistically significant difference between firms of different sizes. It is expected that the findings of this study will drive future efforts to improve the overall safety performance of smaller construction firms and help larger firms effectively manage their multiemployer worksites.

Data Availability Statement

All data, models, or code that support the findings of this study are available from the corresponding author upon reasonable request.

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