

Corporate Culture

A study of firms with outstanding construction safety

By Keith Molenaar, Hyman Brown, Shreve Caile and Roger Smith

THE CONSTRUCTION INDUSTRY HAS made great strides toward a safe working environment. Although many construction companies have comprehensive safety plans, a plan's quality does not necessarily correlate to the company's safety performance. Written safety plans can be effective, but companies must go beyond the letter of the plan and create a true "safety culture" (Hinze 101). This study explored the correlation between a corporation's culture and its safety performance; based on the findings, recommendations are offered regarding how a company can change certain cultural characteristics

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to create a safer working environment. The findings indicate that a strong correlation exists between corporate culture and good safety performance. Findings also reveal that certain cultural characteristics are more prone to affect a safety record. In the authors' opinion, it is evident that firms with these cultural qualities will more likely have positive safety records.

The study described here examined three Denver area construction companies with outstanding safety records and found that the company

with the most consistent safety culture also had the best safety record. The researchers developed a questionnaire that was used as a type of "cholesterol test" for safety culture. By comparing the opinions of upper management, middle management and field personnel, this survey instrument found discrepancies between the beliefs, values and behaviors of employees. These discrepancies can result in a weak company safety culture. Just as a poor cholesterol test does not absolutely predict a heart attack, a poor safety culture test does not indicate an impending accident. However, both are good indicators that a catastrophe is more likely and that some behavior should be changed.

Study results are based on 212 survey responses from the three participating companies. All survey questions were based on previously validated research and the results of this study are examined in conjunction with the previous research results. Although data for this study produced robust results, this study was constrained by the fact that only three companies were analyzed and each had an outstanding safety record compared with national averages. Future research will be conducted to further validate the results of these preliminary findings by examining more companies, including less-successful firms and those from other construction sectors.

Corporate Culture

Just what is "corporate culture"? Hampden-Turner defines it as "a pattern of basic assumptions invented, discovered or developed by a given group as it learns to cope with its problems of external adaptation and internal integration that has worked well enough to be valid and to be taught to new members as the correct way to perceive, think and feel in relation to these problems" (12).

Corporate culture is a collection of uniform and enduring beliefs, customs, traditions and practices shared and continued by employees of a corporation (Hai 162). These shared beliefs define an organiza-

tion's fundamental characteristics and create an attitude that distinguishes it from all others (Maloney and Federle 7). Corporate culture refers to the unique configuration of norms and behaviors that characterize the manner in which employees combine to accomplish tasks (Graves 30). It also refers to the values held by employees that tend to persist even when membership changes (Kotter and Heskett 4).

Corporate culture is instrumental to an organization's success. It provides the workplace environment for employees. When people work in an environment that they perceive as rewarding, they are more likely to perform at a high level. Furthermore, a company's success is the result of it performing certain tasks very well (Maloney and Federle 7). Corporate culture is what determines these work environments as well as the tasks at which an organization excels.

To truly understand corporate culture, its characteristics must also be understood. Following is a compilation of the most prevalent cultural characteristics.

- Corporate culture represents behaviors that new employees are encouraged to follow (Kotter and Heskett 4).

- It creates norms for acceptable behavior (Hai 162).

- Corporate culture reinforces ideas and feelings that are consistent with the corporation's beliefs (Hampden-Turner 2).

- It influences the external relations of the corporation, as well as the internal relations of the employees (Hai 162).

- Culture can have a powerful effect on individuals and performance (Kotter and Heskett 9).

- It affects worker motivation and goals (Hai 162).

- Behaviors such as innovation, decision making, communication, organizing, measuring success and rewarding achievement are affected by corporate culture (Hai 163).

The definition of corporate culture is complex when all of these facets are considered. In this study, corporate culture is defined as the beliefs, values and behaviors that are consistent among all members of the corporation. These beliefs, values and behaviors must be consistent across all levels—upper management, middle management and field employees. This study measured the consistency of corporate culture and explored the correlations between consistent corporate safety culture and safety performance.

Research Methodology

Three companies with outstanding safety records were analyzed: Hensel Phelps Construction Co., M.A. Mortenson Co. and Turner Construction Co. They were selected because they share many common traits. All are large national firms with an office based in the Denver area; all perform some of their own work (e.g., carpentry, concrete placement, masonry); all primarily concentrate on large commercial buildings; and all were willing to actively participate in data collection. Furthermore, all three companies have outstanding safety records (one has an exemplary record).

A small amount of data (16 samples after removing outliers) was also collected from a fourth com-

pany that was considered comparable. However, some differences were discovered which proved that this company was not closely enough related to the other three to be included in the study. Some of the differences included a smaller workforce, a small amount of self-work and a lack of field management. These differences were discovered early in the data collection process and these data were discarded.

A survey methodology was selected to analyze company culture because it offered the best method of capturing a cross section of the companies. As noted, this study defined culture through consistent beliefs at all company levels. Identical questionnaires were administered to upper management, middle management and field personnel. The questionnaire was developed through a rigorous multiattribute technique (Miller 31). A comprehensive literature review was performed to identify cultural characteristics that might influence company culture. These characteristics were then organized into a hierarchical structure and broken down into measurable questions. The following discussion describes the construction of the multiattribute hierarchy.

Multiattribute Analysis of Construction Safety Culture

Measurement of corporate safety culture is a complex task. Employing multiattribute analysis, this task can be divided into three main categories: people, process and values (displayed in Figure 1 as branches of the "safety culture hierarchy"). People are integral to defining the cultural characteristics of a corporation. They determine the beliefs, values and behaviors that create a corporation's culture. This branch was further broken down into measurable characteristics (Figure 2).

The second branch of the hierarchy—process—is the manner in which a company incorporates safety into practice. A good "safety process" is necessary for a company to properly communicate its safety goals. The final branch concerns values, which are a company's philosophies regarding safety. This category determines the extent to which employees believe that safety is a high priority of the company. The following characteristics form the indicators of corporate safety culture.

People

The role of top management. Management both creates and controls the environment in which construction accidents occur (Alves Dias and Coble 215). This section measures the level to which management acknowledges the significance of a safety program and becomes involved in the safety process. This category is made up of the following characteristics.

- **Importance.** The importance that management places on safety, as well as whether or not safety is of a strategic concern to the well-being of the company ("Fluor Daniel" 73).

- **Initiate.** The level at which management initiates safety concerns (Alves Dias and Coble 199).

- **Communication.** The effectiveness of manage-

Corporate culture is defined as the beliefs, values and behaviors that are consistent among all members of the corporation.

Figure 1

Highest Level of Safety Culture Hierarchy



ment in communicating safety goals to employees in the field (Duff, et al 75).

- *Training.* How often management attends safety training (Duff, et al 75).

- *Accountability.* Whether or not management assigns specific safety accountability to individuals (Alves Dias and Coble 218).

The role of field personnel. Employees in field operations receive the greatest benefit from safe conditions. This section measures field personnel commitment to the safety program and involvement in the process. The following are characteristics of this category.

- *Importance.* The level of importance field personnel and site managers place on safety (Meijer and Schaefer 401).

- *Empowerment.* A measure of the power bestowed on field personnel to change or improve the company's safety performance (LaBar 48).

- *Safety personnel.* How often dedicated safety personnel are used in the field, as well as how often they observe and correct field personnel (Jaselskis, et al 67).

- *Preconstruction.* Level of importance placed on safety during construction engineering ("Fluor Daniel" 74).

The subcontractor relationship. Subcontractors are often an integral part of construction projects and can have a direct bearing on company safety. This section measures subcontractors' commitment to the safety program and involvement in the process.

- *Importance.* The level of importance that typical subcontractors place on safety (Alves Dias and Coble 406).

- *Attendance.* How often subcontractors are required to attend safety meetings and training (Alves Dias and Coble 408).

- *Past performance.* The importance of a subcontractor's past safety performance when soliciting bids for new work (Alves Dias and Coble 407).

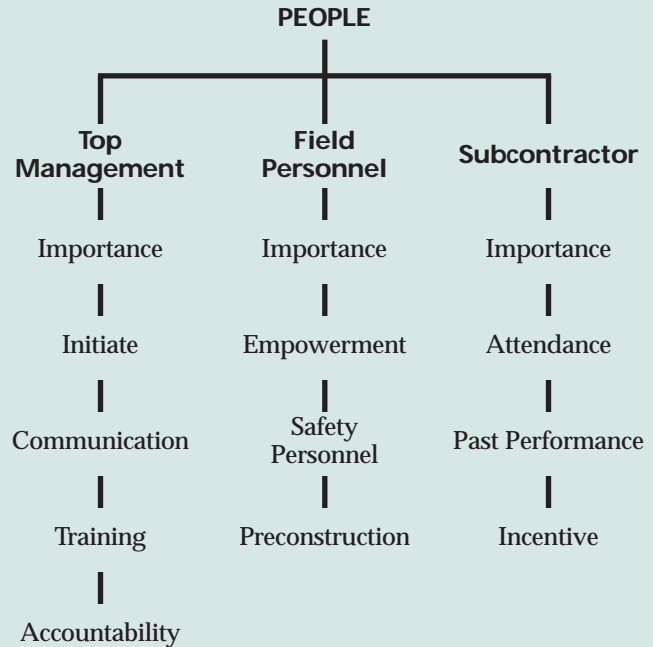
- *Incentive.* Amount of incentive offered to subcontractors for excellent safety performance (Alves Dias and Coble 409).

Process

The safety plan. The safety plan is an integral part of a company's safety practice. A company can clearly delineate its safety goals by developing an

Figure 2

"People" Branch



effective safety plan. This section measures the attributes of the safety plan.

- *Involvement.* Who is involved with writing the organization's safety plan, and at what level do they participate. Management, field personnel and external consultants are included in this category (Preston and Topf 52).

- *Change.* How often the safety program is changed or updated to reflect current industry trends (Alves Dias and Coble 400).

Program assessment and change. Safety programs are often in a state of constant change and improvement. This section measures the process of assessing and changing the safety program.

- *Feedback.* The amount of feedback involved in the safety program; this includes management-to-personnel, personnel-to-management and peer-to-peer feedback (Garis 8; Hofmann 18).

- *Change.* What effect does feedback have on changing the safety program (Hodson and Graham 79).

Safety training and education. Safety training and education are integral to teaching safe behaviors and to providing feedback on the effectiveness of current safety procedures. This section measures the level and frequency of safety training.

- *Dedicated time.* How much time per week is spent on training; this also considers how much safety training new employees receive (Jaselskis, et al 67).

- *Effectiveness.* How effective time spent on training is; this also considers whether training tools and techniques are effective (Alves Dias and Coble 230).

Incentives. Incentives are defined as any gifts or

Figure 3

“Process” Branch

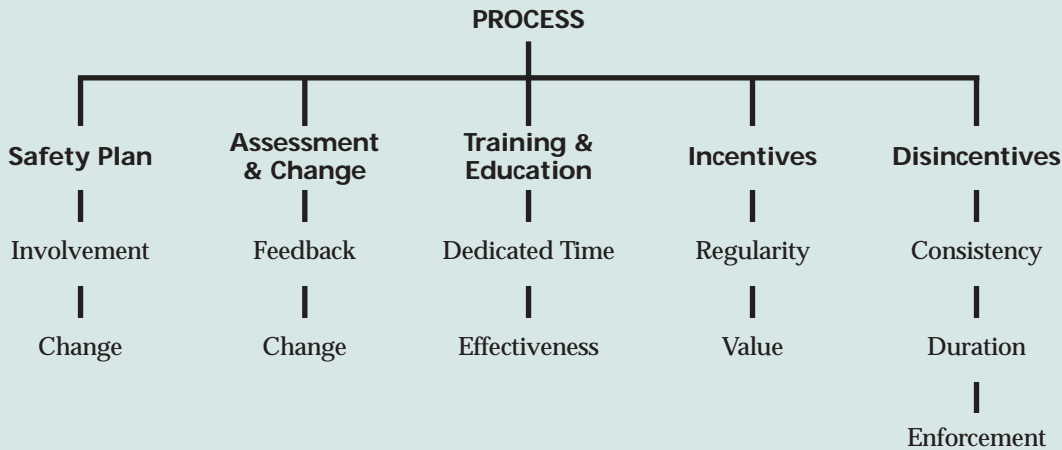


Figure 4

“Values” Branch



use of disincentives to improve safety performance.

- *Consistency.* The consistency of supervisory personnel when punishing for rule violations; it also takes into consideration the severity of punishment compared to the severity of the violation (Hartshorn 115).

- *Amount of time before punishment.* The time between the actual violation and the administration of disciplinary action (Hartshorn 117).

- *Enforcement.* The degree to which safety rules are enforced when a safety violation occurs, yet no accident results. This characteristic also considers how often displays of sympathy occur during disciplinary action (“Fluor Daniel” 73).

Values

Safety values. Safety values are a company’s principles in response to safety. This section measures the value a company places on safety.

- *Importance.* The importance of safety to the company (Groover and

rewards given out on a regular basis. An incentive can be anything from points toward company merchandise to actual cash or merchandise. This section measures the company’s use of incentives to improve safety performance.

- *Regularity.* How often incentives are given to employees (both field personnel and management) (Garis 8).

- *Value of incentives.* How valuable employees believe incentives are (Alves Dias and Coble 408).

Disincentives. A disincentive is any form of punishment—ranging from an oral reprimand to a written reprimand, garnishment of wages or termination. This section measures the company’s

Krause 139).

- *Actions.* Whether company actions portray a true commitment to safety (“Fluor Daniel” 74).

- *Responsibility.* How the company defines safety responsibility—whether it is the responsibility of safety personnel only or whether it is everyone’s responsibility (Preston and Topf 53).

- *Length of employment.* The average length of employment for both hourly and salaried personnel (Jaselskis, et al 68).

Behavior-based safety. This form of safety promotes behavior modification. Behavior modification attempts to change unsafe behaviors into safe behaviors by involving everyone in the organization. This

The goal of this analysis was to find discrepancies within company beliefs, values and behaviors, and to relate these discrepancies to safety performance.

section measures the level of a company's behavior-based safety practices.

- *Identification and correction.* How often unsafe behaviors are identified and corrected (Hodson and Graham 78).

- *Participation.* The level of upper management participation in the safety of field personnel. It also considers how active upper-level managers are when they participate (Peterson 29).

- *Hazard prevention.* The level of importance placed on hazard analysis, prevention and control (Hodson and Graham 79).

These 31 characteristics are used to define and quantify corporate safety culture; they form the basis for the data collection questionnaire (pp. 24-25). The questionnaire was developed by adding measurements to the characteristics as well as further separating some characteristics into more measurable parts. The final survey contained 54 questions.

Data Collection

From this point forward, the participating companies will be referred to as Company "A," "B" and "C" in no particular order. Data on these 54 characteristics were collected as potential indicators of safety performance. Experience modification ratio (EMR) and a series of recordable incident rates were gathered as measures of performance. More than 800 questionnaires were distributed to the companies at safety meetings and through payroll mailings. A total of 237 were returned. After the removal of the small sample from the fourth company and statistical outliers, 212 surveys were used for analysis—Company A (43), Company B (39), Company C (130). Figure 5 displays overall response rates and individual response rates.

Since this study defines corporate culture as the beliefs, values and behaviors that are consistent throughout all members of a corporation, it is necessary to generate a comprehensive cross section of the companies in question. A characteristic must be viewed consistently by all members of a company before it can be considered company culture. As Figure 5 shows, the goal of collecting data from a representative cross section of the company was achieved in this study, although multiple data collection iterations over a period of three months were required to achieve this goal. The disparity in overall data collection is a function of the differing company sizes. An acceptably consistent response rate was received from each company individually in order to accurately model its safety culture.

As noted, employees were categorized as upper management, middle management and field personnel for analysis. Upper management is those in charge of decision making at the company level; this includes (but is not limited to) the president, chief operating officer and operations managers. Middle

management is those responsible for decision making at the project level; this includes (but is not limited to) project managers, project engineers, estimators and site safety personnel. Field personnel are those who spend much of their time in the field; this includes (but is not limited to) craftspeople, forepersons and superintendents. Administrative personnel (such as accounting and purchasing personnel) were not included in this study because they did not have a direct or strong indirect influence on field safety. Figure 6 shows the breakdown of responses by company and category.

The differences between categories within each company are representative of the actual company distribution. All three companies have a lower proportion of upper management as is common in the construction industry. Also, the differences between field personnel and middle management are due to the fact that Company C self-performs the most amount of work, while Company A self-performs the least amount of work. Again, the goal of achieving an accurate representation of each company from upper management to field personnel was achieved.

Data Analysis

The purpose of this analysis is to find discrepancies within company beliefs, values and behaviors, and to relate these discrepancies to safety performance. If these discrepancies are found to correlate to safety performance, then the characteristics causing these discrepancies can be considered indicators of safety culture performance.

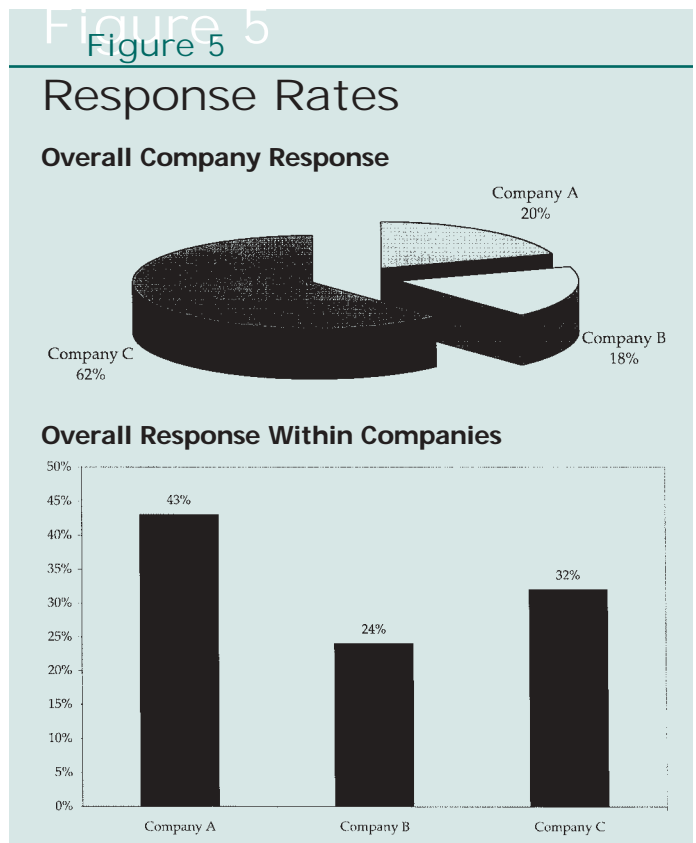
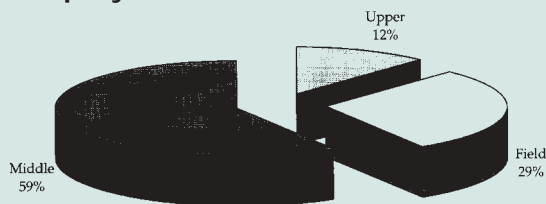


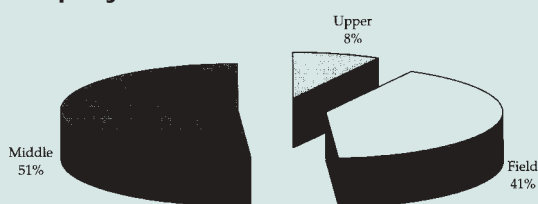
Figure 6

Responses by Level

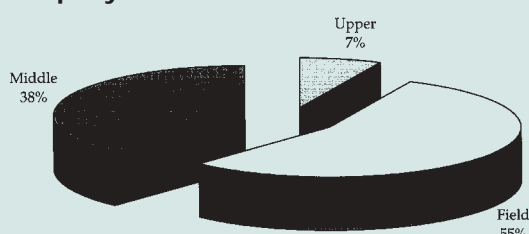
Company "A"



Company "B"



Company "C"



The first step is to rank companies by safety performance. In this study, such performance was measured through both EMR and recordable incident rates. The three companies ranked the same by either measure, but regression tests and structural equation model tests revealed that EMR was a more consistent measure for this data set. Although EMR may not be the most accurate measure of company safety, it is well suited for this study, which sought to identify internal inconsistencies in company culture rather than inconsistencies across companies. As further research is developed and more data are collected, other measures may prove to be more accurate.

Company C had the lowest EMR, with Company A and Company B approximately 25 percent higher (but within six percent of each other). For this portion of the study, Company C was ranked first in safety performance, with companies A and B ranked second. Again, all three companies in this study have outstanding safety performance, but Company C's is considered exemplary.

Methodology

To perform this analysis, the means and variances for upper management, middle management and field personnel for each company were computed. The means for upper management and middle management were compared to those for field personnel for all 54 survey questions. First, the differences between the means were compared within each company, then they were compared from company to company. Analysis was then conducted to determine which questions had large differences from within each company. Hypothesis testing for population means was used to determine which questions have large variations. The hypothesis used for this analysis is:

- There is no significant difference between the means of upper management or middle management and field personnel (H_0).

- There is a significant difference between the means of upper management or middle management and field personnel (H_a).

The null hypothesis (H_0) will be accepted unless statistical tests provide evidence for rejection. Rejection results in support of the alternative hypothesis (H_a).

The statistical test used to test the hypotheses is the student's t-test. This test performs a comparison of samples by determining whether they fall within a specified range or confidence interval. If samples are within this interval, they can be considered similar populations; if they are not within the interval, they can be considered different populations (Sachs 135). The rejection region was specified to be $(\alpha) < 0.10$. In other words, there is a 90-percent certainty that the result is not due to chance. For this analysis, a two-tailed test must be performed because the null hypothesis states that the population means are equal to and not greater than or less than each other. As a result, the alpha value must be adjusted by dividing it by two. Therefore, results with probabilities less than 0.05 conclude in the rejection of the null hypothesis or acceptance of the alternative hypothesis. Once hypothesis testing had been conducted, several questions were identified as having significant variations.

Results

When comparing data from all three companies, one thing was obvious: Company C had no statistically significant differences in means from the upper, middle and field levels, whereas companies A and B had several questions where statistically significant

Safety Culture Questionnaire

Following are questions posed to study participants. They were asked to rank the items on a scale of 1 (lowest/disagree/never, etc.) to 6 (highest, agree, always, etc.). Respondents could also select a "cannot answer" option.

People

1) The Management Component

Management both creates and controls the environment in which construction accidents occur. This section measures the level to which management acknowledges the significance of a safety program and becomes involved in the safety process.

- What level of importance does management place on safety?
- Safety is initiated by top management.
- Safety is a strategic concern of top management.
- How effective are managers at communicating safety goals in the field?
- How often do managers attend safety training?
- Management assigns individuals specific safety accountabilities.

2) The Field Component

Employees in field operations can benefit the most from safe conditions. This section measures field personnel's commitment to the safety program and involvement in the process.

- What level of importance do site managers place on safety?
- What level of importance do field personnel place on safety?
- To what level are field personnel empowered to change and improve safety performance?
- The company designates dedicated field safety representatives.
- Safety accountability is clearly assigned.
- How often are the field personnel's safety practices observed by safety personnel?
- Safety is taken into account during construction engineering.

3) Subcontractor Relationships

Subcontractors are often an integral part of construction projects and can have a direct bearing on company safety. This section measures subcontractors' commitment to the safety program and involvement in the process.

- What level of importance do subcontractors place on safety?
- How often do subcontractors attend safety meetings and training?
- How important is a subcontractor's past safety performance to receiving invitations for new work?
- How much of an incentive is offered to subcontractors to become excellent safety performers?

Process

4) The Safety Plan

The safety plan is an integral part of a company's safety philosophy and practice. The company can clearly delineate its safety goals through the preparation of an effective safety program. This section measures the attributes of the safety program.

- Is your safety plan written by internal employees, external consultants or a combination of other?
- What level of involvement does upper management have in the writing of the safety plan?
- What level of involvement does field management have in the writing of the safety plan?
- What level of involvement do field personnel have in the writing of the safety plan?
- How often is the safety plan changed and/or updated?

5) Assessment & Change

Safety programs are often in a state of constant change and improvement. This section measures the process of assessment and change to the safety program.

- How often are opportunities for safety feedback presented?
- How often do field personnel receive feedback about safety from management personnel?
- How often do field personnel offer feedback to management concerning safety performance?
- Peer-to-peer feedback about safety is a common occurrence.
- How often does feedback concerning safety result in change?

differences between these categories were found. This was apparent for almost all questions. For seven questions, either Company A or B had statistically significant differences between the three employee group responses. Discussion on these seven questions follows. (See Figure 7 for t-test data on these questions.)

It should be noted that there were several questions where all three companies had large standard deviations throughout all companies; in fact, some questions had a response rate of less than 75 percent. In this initial exploratory study, it was expected that some of the 54 survey questions would not yield functional results, but all questions were asked as a matter of investigation. These questions were not included in the analysis. It was assumed that the poor response rate was because the questions were either poorly written or most respondents did not have enough information to properly answer the questions. In future research, these questions will not be included in the survey.

Actions Portray Commitment

Question 9b) asks, "Do the actions of your company portray a true commitment to safety?" When

comparing the upper management mean to the field personnel mean, there was a significant difference in Company A with a probability of 0.001, thereby rejecting the null hypothesis. This means that Company A has a statistically significant difference between the means for the upper and field responses. In contrast, Company C had an upper management mean of 5.56 and a field personnel mean of 5.55, thereby showing almost no difference between the two levels. Also, when comparing middle to field, Company B had a probability of 0.072. Although this does not allow one to reject the null hypothesis using a two-tailed t-test with an alpha of less than 0.05, it is a low probability and should be included because there is strong theoretical evidence for a difference between the means. Again, Company C had a very small difference between the means of the middle and field levels (Figure 7).

This question proves to be important when relating it to corporate culture. It is difficult to create a safety culture unless the company creates that behavior as a norm through its actions ("Fluor Daniel" 73). Company A's upper management felt the company portrayed a true commitment to safety,

6) Training & Education

Safety training and education are integral to teaching safe behaviors and to providing feedback on the effectiveness of current safety procedures. This section measures the level and frequency of the safety training program.

- The time spent on safety training is effective and worthwhile.
- How much time a week is devoted to safety education?
- How much safety orientation training do new employees receive?
- The training tools and techniques used for safety education are effective and up-to-date.
- Training on existing safety practices and methods is reviewed every ____ months.
- How much safety training is given by “in-house” personnel vs. “external” trainers?

7) Incentives

Incentives are defined as any gifts or rewards that are given out on a regular basis. This can be anything from points to earn company merchandise to actual cash or merchandise. This section measures the company's use of incentives to improve safety performance.

- There is an understanding with field personnel that they will be thanked for their safe performance.
- How often does the company offer incentives to upper management for safe work?
- How often does the company offer incentives to site managers for safe work?
- How often does the company offer incentives to field personnel for safe work?
- How often are safety drawings held?
- What is the value of incentives that are awarded?

8) Disincentives

A disincentive is any form of punishment. It can be anything from an oral reprimand to a written reprimand to garnishment of wages or termination of employment. This section measures the company's use of disincentives to improve safety performance.

- There is an understanding with field personnel that they will be reprimanded for their unsafe performance.

- How consistent are the punishments for rule violations?
- Does the punishment fit the crime when safety violations occur?
- How soon after a safety violation do the disciplinary actions occur?
- To what degree are safety rules enforced when no accident has occurred?
- How often are displays of sympathy shown when disciplinary action occurs?

Values

9) Safety Values

Safety values are the principles of the company in response to safety. This section measures the value of safety in your company.

- How important do you feel safety is to your company?
- Do the actions of your company portray a true commitment to safety?
- Whose responsibility is safety in your company?
- What is the average length of employment for hourly personnel in your company?
- What is the average length of employment of salaried personnel in your company?

10) Behavior-Based Safety

This form of safety encourages behavior modification. Behavior modification attempts to change unsafe behaviors into safe behaviors by involving everyone in the organization. This section measures the level of behavior-based safety practices in your company.

- How often does your company identify and correct safety-related behaviors (teach an employee how to do a previously unsafe activity safely)?
- How often does upper management participate in the safety of field personnel?
- How active is upper management when they participate in safety?
- What level of importance is placed upon workplace analysis, hazard prevention and control?

but field personnel did not feel as strongly. This suggests that although upper management feels safety is important, managers are not reflecting it in their actions and must strive to better demonstrate their commitment to safety through daily actions or through the use of incentives.

Field Personnel Will Be Thanked

Question 7a) also had a discrepancy. It states, “There is an understanding with field personnel that they will be thanked for their safe performance.” When comparing means for the upper management and field personnel, both Company A and Company B had differences in their responses. These results provided validity to the premise that the use of incentives will improve safety performance (Garis 8; Alves Dias and Coble 407). Results show that the upper management of companies A and B, as well as middle management of Company B, believe they are thanking field personnel for their safe work, but the field personnel do not feel as strongly that this is the case.

Involvement of Field Personnel

Question 4d) has an important role in corporate

safety culture. This question asks, “What level of involvement do field personnel have in the writing of the safety plan?” Analysis of this question showed a statistically significant difference between upper and field levels at Company A. This question was designed to measure a company's culture for innovation. Results show that upper management wants to encourage field personnel innovation with respect to safety, but field personnel do not feel as strongly that the company is implementing their ideas. For a company to encourage innovation among its employees, it must create a culture that involves employees in company actions (Preston and Topf 53).

Field Personnel Offer Feedback

Question 5c) asks, “How often do field personnel offer feedback to management concerning safety performance?” Analysis shows a statistically significant difference of opinions in the middle and field levels in Company B. This question is important as it identifies a corporation's culture for communication on safety issues. Communication is an important aspect of corporate safety culture; these results show that middle management believes there is more

Figure 7

Statistical Data Analysis

Question 1.f) Management Assigns individuals specific safety accountabilities									
	Mean Value Comparison		t Value	Probability	Middle Mean	Field Mean	t Value	Probability	
	Upper	Mean							Field Mean
Company 'A'	5.40	5.09	0.63	0.546	4.88	5.09	-0.63	0.537	
Company 'B'	5.00	4.21	1.24	0.303	5.37	4.21	3.58	0.001	
Company 'C'	4.88	4.90	-0.04	0.970	5.23	4.90	1.75	0.083	

Question 2.d) The company designates dedicated field safety personnel									
	Mean Value Comparison		t Value	Probability	Middle Mean	Field Mean	t Value	Probability	
	Upper	Mean							Field Mean
Company 'A'	5.40	5.25	0.34	0.744	5.08	5.25	-0.62	0.538	
Company 'B'	6.00	4.86	4.16	0.001	5.50	4.86	2.00	0.058	
Company 'C'	4.63	4.98	-0.59	0.572	4.73	4.98	-0.97	0.330	

Question 3.a) What level of importance do subcontractors place on safety?									
	Mean Value Comparison		t Value	Probability	Middle Mean	Field Mean	t Value	Probability	
	Upper	Mean							Field Mean
Company 'A'	4.60	4.17	0.73	0.487	4.36	4.17	0.57	0.578	
Company 'B'	4.00	3.45	0.53	0.692	4.25	3.45	2.62	0.021	
Company 'C'	3.75	3.89	-0.43	0.679	4.16	3.89	1.26	0.209	

Question 4.d) What level of involvement do field personnel have in the writing of the safety plan?									
	Mean Value Comparison		t Value	Probability	Middle Mean	Field Mean	t Value	Probability	
	Upper	Mean							Field Mean
Company 'A'	4.50	2.91	2.51	0.026	3.31	2.91	0.60	0.558	
Company 'B'	3.67	2.62	0.98	0.383	3.56	2.62	1.38	0.196	
Company 'C'	4.00	4.06	-0.15	0.885	3.90	4.06	-0.49	0.621	

Question 5.c) How often do field personnel offer feedback to management concerning safety performance?									
	Mean Value Comparison		t Value	Probability	Middle Mean	Field Mean	t Value	Probability	
	Upper	Mean							Field Mean
Company 'A'	4.80	4.33	0.79	0.454	4.27	4.33	-0.02	0.885	
Company 'B'	3.00	4.00	-0.10	0.211	4.82	4.00	2.32	0.030	
Company 'C'	4.78	4.73	0.13	0.900	4.73	4.73	-0.02	0.986	

Question 7.a) There is an understanding with field personnel that they will be thanked for their safe performance.									
	Mean Value Comparison		t Value	Probability	Middle Mean	Field Mean	t Value	Probability	
	Upper	Mean							Field Mean
Company 'A'	5.60	4.42	2.45	0.027	4.55	4.41	0.24	0.809	
Company 'B'	5.67	4.58	2.15	0.064	5.67	4.58	2.63	0.019	
Company 'C'	5.00	5.19	-0.59	0.569	5.44	5.19	1.38	0.171	

Question 9.b) Do the actions of your company portray a true commitment to safety?									
	Mean Value Comparison		t Value	Probability	Middle Mean	Field Mean	t Value	Probability	
	Upper	Mean							Field Mean
Company 'A'	6.00	4.75	4.49	0.001	4.82	4.75	0.21	0.837	
Company 'B'	4.67	5.33	-0.74	0.537	5.74	5.33	1.89	0.072	
Company 'C'	5.56	5.55	0.02	0.985	5.53	5.55	-0.15	0.882	

communication than do field personnel. This question also addresses the issue of involvement. It measures the degree to which field personnel are involved with the safety process. If field personnel feel involved, they are more likely to be innovative (Hofmann 18; Preston and Topf 53).

Specific Safety Accountabilities

Question 1f) asks how often "Management assigns individuals specific safety accountabilities." The purpose was to gather information about the norms for acceptable individual behavior. Analysis shows that Company B has a statistically significant difference between responses of middle management and field personnel. Middle management believes it is creating norms of acceptable behavior

for individuals, whereas the field personnel do not believe as strongly that this is true. An important characteristic of corporate culture is that it creates norms for acceptable behavior; without these norms, employees are less likely to believe in the importance of safety in their company.

Dedicated Field Safety Representatives

Question 2d) asks whether "the company designates dedicated field safety representatives." Analysis shows that Company B has a statistically significant difference between upper and field levels, as well as a large difference between middle and field levels. These results reflect a cultural disconnect between upper and field personnel and middle and field personnel. In this case, upper and middle man-

agement feel that having dedicated safety representatives is important, while field personnel do not believe it is as important, or that there are as many dedicated safety personnel in the field as upper and middle management believe.

Subcontractors & Safety

The last question that had a significant difference is Question 3a): "What level of importance do subcontractors place on safety?" Analysis shows a statistically significant difference between the means of middle management and field personnel at Company B. This question provides an analysis of a company's cultural influences on its external relations. In this case, middle management believes that subcontractors place a high level of importance on safety, but field personnel do not feel as strongly about this. However, it has been shown that the safety records of subcontractors should be considered very important when considering them for work (Alves Dias and Coble 406). Field personnel must be aware of this so that they can give management feedback on subcontractor safety performance.

Conclusions

Findings indicate that corporate safety culture had an integral effect on construction safety performance in the three firms studied. A multiattribute hierarchy consisting of 31 characteristics was constructed to define company culture. Based on these characteristics, a 54-question survey was constructed to measure these variables. The hypothesis that corporate culture affects construction safety was proven correct through a comparison of responses between three companies' upper management, middle management and field personnel.

Results from this initial study reveal that the company with the best safety record also had the most-consistent safety culture. An unexpected result of this study was the fact that the best-performing company had no statistically significant differences between upper management, middle management and field personnel; this appeared to correlate to better performance. The other two companies had some cultural differences as revealed through inconsistent management and field beliefs. Primarily, these differences of opinion involved the value upper management placed on safety and incentives offered to field personnel for good safety performance. Evidence suggests that if these characteristics are improved, a higher level of safety culture and performance will result.

This study did have several limitations. The data collection task was onerous and data from only three companies were collected. Additionally, only companies with outstanding safety records were studied. While the goal of studying outstanding companies in-depth was achieved, an examination of more companies, including those with poor safety records, could yield better insights into the correlation between safety culture and safety performance. A study of subcontractors who self-perform all of their work may also reveal different indicators from the

general contractors studied who self-perform only a portion of their work. The survey questionnaire results in a type of "cholesterol test" for safety culture. If automated, companies could distribute this questionnaire to all employees and quickly identify inconsistencies in their safety culture. All questions were based on previously proven research and all should logically improve safety. Just as a poor cholesterol test does not absolutely predict a heart attack, a poor safety culture test does not indicate an impending accident. However, both are good indicators that a catastrophe is more likely and that some behavior should be changed. ■

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Corporate safety culture had an integral effect on construction safety performance in the three firms that participated in this study.

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