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Construction Workers Perceptions Toward Safety Culture

Andi[1]

Abstract: Efforts to reduce construction accidents can be initiated by building good safety culture. Researches concerning safety culture, however, are still limited. This research aims to empirically gauge worker's perception toward safety culture in construction projects. Data were obtained through questionnaire survey to three large construction projects in Surabaya. Two hundreds and seven sets of questionnaires were gathered and used for subsequent analyses. Results show that in general workers' perception toward safety culture are quite good. Further analysis indicates that workers in the three projects have different safety culture perceptions, especially on factors of top management commitment, safety rules and procedures, communication, and worker's competency.

Keywords: construction, accidents, safety culture, construction workers

Introduction

Construction is unique compared to other industries (e.g. manufacturing). It has been repeatedly stated that each construction project is different from another by presenting different situations and problems during its execution. Planning and execution under time and budget pressures, temporary workers with various skills, and works influenced by weather conditions and external environments are some characteristics that differs construction projects from projects in other industries. These characteristics make construction projects face hazardous conditions that are potential to cause accidents.

Mohamed [1] mentions that construction industry has poor safety records compared to other industries. There are many perceptions indicating that accidents in construction projects, which can range from minor injuries to loss of life, are originated from workers' unsafe acts [2]. In other words, unsafe acts (or sometimes called human errors) are the main causes of accidents. However, this perception is argued by Reason [3], who states that attempts to reduce accidents by focusing only on unsafe acts will not be able to tackle the underlying causes. Unsafe acts are illustrated by Reason [4] as mosquitoes. They can be swatted one by one, but they still keep coming. The best remedies are to create more effective defenses and drain the swamps in which they breed.

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The swamps, in this case, are the ever-present latent factors lied beneath the organizational and managerial factors. Recently, there is a shift in managing safety from a measurement that considers just accident rates to a management that takes into account safety culture [5]. This consideration is driven by awareness that the underlying causes of accidents originate from organizational and managerial factors [6]. Therefore, attempt to measure safety culture is a very important step in order to generate safe working condition and at the end to reduce accident rates.

Empirical researches considering safety culture have been progressing in manufacturing industry [7,8], but are still very limited in construction. Considering the limitation, this paper attempts to investigate workers perception towards safety culture in construction.

Safety Culture

Safety culture is a sub-component of corporate culture, which alludes to individual, job, and organizational features that affect and influence health and safety [5]. Uttal [9] defines it as "shared values and beliefs that interact with an organization structure and control systems to produce behavioral norms" (cited in [5]). Another definition by Turner [10] is "the set of people's shared beliefs, norms, attitudes and expectations shared collectively by members of a society, organization or group".

Defining and measuring safety culture is complex tasks when all of the above facets are considered. In this study safety culture is composed of six main factors, i.e. top management commitment, safety rules and procedures, communications, workers competency, work environment, and workers involvement. The followings briefly discuss these safety culture factors.

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Top Management Commitment

According to Reason [6] safety program should be initiated from top management of an organization. The top management should formulate a policy indicating a commitment to safety. This step will lead other policymakings concerning safety. Without it, it is very difficult to achieve a successful safety program [1,7]. Marsh et al. [11] have shown that management commitment was the most significant measure to determine and influence safety performance in 26 building sites across the United Kingdom.

Safety Rules and Procedures

The presence of safety rules and procedures may minimize accidents caused by unsafe conditions because they give clear picture and border of safety program implementation in construction project [12]. The problems often found are that the rules and procedures are difficult to understand and implement, inappropriate with the current condition, and over specification.

Communication

Communications related problems have been repeatedly reported in literature to be responsible for many human errors resulting in structural failures, design quality problems, building defects and design defects [13]. It is thus important, in order to support site safety program, to make available appropriate information lines from management to workers and vice versa. Information such as unsafe conditions and new rules and procedures are very important to support the safety program.

Worker Competence

Workers' adequate knowledge, skill and ability to their works, especially toward risks and dangers in their work, may minimize accidents. These competences can be enhanced through training and appropriate workers selection [1].

Work Environment

Workplace factors are situations and conditions within the place where the workers work, which directly lead workers, as an individual or a team, to initiate unsafe behavior. This may cover such internal conditions as motivation, boredom, and also external conditions as time pressure, and blaming culture.

Worker Involvement

Workers' involvement is very important in building workers awareness toward safety programs. The form of involvement can be workers participation during development of the safety program and accident or unsafe act investigation and reporting. It is hypothesized that higher level of involvement will give more positive influence to the safety behavior.

Research Method

Data for the research were gathered by distributing questionnaire to construction workers. The questionnaire consisted of three parts, where the first part covered general information about the respondents and the project. The second part included the six factors of safety culture. The final part captured the worker behavior factor, which was composed of several indicators. This study was limited to the first two parts of the questionnaire. Results of the third part have been presented elsewhere [14].

Table 1 exhibits six safety culture factors with their respective indicators. Here the respondents were given a number of statements indicating the condition of each indicator, and then asked to rate their agreement using a six point rating scale from 1 (strongly disagree) to 6 (strongly agree). Questionnaires were distributed to three on-going construction projects during the survey. Targeted respondents included workers, helpers and foremen. To avoid misunderstanding and mistakes, workers were helped when answering the questionnaire.

Score of six safety culture factors would first be analyzed by averaging the score of its respective indicators. Analyses were then performed to see any differences in workers perceptions based on the project. Techniques used were multivariate analysis of variance (MANOVA) and one-way analysis of variance (ANOVA). MANOVA was used to test any differences in overall safety culture in the three surveyed projects. The technique is recommended in the situation where there is more than one dependent variable (the six safety culture factors) and there are correlations among them. Several multivariate statistical analyses would be performed, such as *Wilk's Lambda* and *Pillai's criterion* [7] to assess significant differences in respondents answer (at $\alpha = 5\%$). The null hypothesis was there were no significant differences of the workers perceptions in the three projects. The null hypothesis would be rejected if the resulted p-values from the analysis were ≤ 0.05.

If the MANOVA results indicated any significant differences, ANOVA tests would be executed to show which factors that significantly different. In this research there would be six ANOVA tests reflecting the numbers of safety culture factors (B1, B2, B3, B4,

B5, B6). The null hypothesis for each test was there was no significant difference of the workers perceptions in the three projects toward the safety culture factor. The null hypothesis would be rejected if the resulted *p*-values from the analysis were ≤ 0.05.

Table 1. Safety Culture Factors and their Indicators

Code	Factors and their indicators
B1	**Top management commitment**
B11	Management pays attention to safety
B12	Management stops unsafe works
B13	There are efforts to improve safety performace in certain period
B14	There are safety monitoring to workers
B15	Management provides safety equipments
B16	Management provides safety training
B2	**Safety Rules and Procedures**
B21	Safety rules and procedures are required
B22	Safety rules and procedures are easy to implement
B23	The are sanction to such violation
B24	Safety rules and procedures are updated regularly
B25	Safety rules and procedures are easy to understand
B3	**Communication**
B31	Workers are satisfied with information lines
B32	Workers always get updated information related to safety
B33	There are proper communication lines between workers and management
B34	There are proper communication lines between workers shift
B35	Workers get informed about accidents happened
B4	**Worker competence**
B41	I understand my responsibility related to safety
B42	I understand fully risks related to my job
B43	Training gives me clear understanding towards safety
B44	I never do job outside my responsibility
B45	I refuse to do an unsafe job
B5	**Work environment**
B51	Workers prioritize safety at work
B52	There is no blaming culture when accident occurs
B53	I do not feel that my job is boring
B54	Workers motivation increase because of the safety program
B55	I am satisfied with the work environments (equipment, cleanness, lighting)
B56	I never get pressure in work
B6	**Worker involvement**
B61	Management involves workers in communication exchange
B62	Workers are involved in development of safety rules and procedures
B63	Workers are required to report accidents happened
B64	Workers are required to warn other workers about dangers and safety

Result and Discussions

General Information

Three on-going construction projects at the time of the survey were approached. The projects included shopping mall, office and clinic buildings. Mall project was performed by Contractor A, where office and clinic by Contractor B. From these projects, a total of 207 valid questionnaires were successfully collected from male workers. Most of the respondents' ages were 30 to 40, as displayed in Figure 1

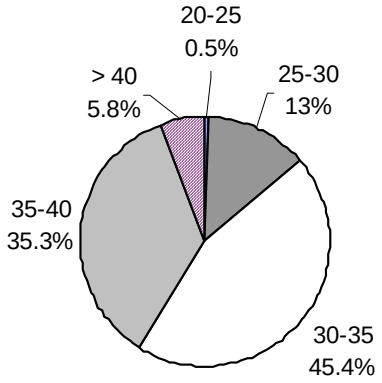

Fig. 1. Distribution of workers' age

Most respondents did education until elementary school (81.2%). The rests were either until junior high school or having no education. Three types of respondents participated in the survey, i.e. helper, skilled workers, and foremen. Figure 2 exhibits the composition and Table 2 details it in the three projects.

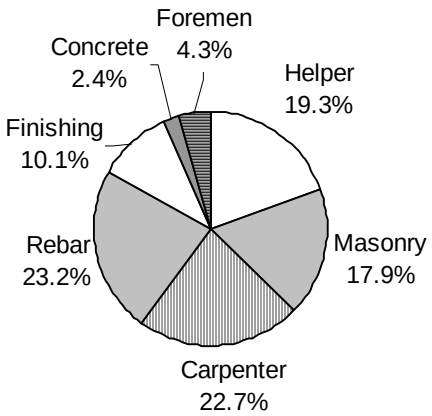

Fig. 2. Respondents' Composition

Analysis of Top Management Commitment

In general, as shown in Figure 3, management gave good commitment to safety, except to indicator B16 (safety training). Construction companies were reluctant to give safety training to workers because workers in construction projects were usually temporary. In other words, they may not work to the company permanently. This reluctance was also happened to other trainings, such as productivity improvement [15].

As can be seen, management commitment in mall project was better than others. From on-site inter-

Table 2. Respondents Distribution in each Project

Project	Helper	Masonry	Carpenter	Rebar	Finishing	Concrete	Foremen	Total
Mall	20	27	23	14	17	5	5	111
Office	16	7	20	19	0	0	4	66
Clinic	4	3	4	15	4	0	0	30
Total	**40**	**37**	**47**	**48**	**21**	**5**	**9**	**207**

views and observations, in mall project all workers were equipped with safety helmet and shoes. It became the responsibility of the workers to keep them well. In addition, the management provided passenger lift, with guardrail, for the workers. The commitment can be observed also from the rules that workers without safety helmet and shoes would not be permitted to enter the project.

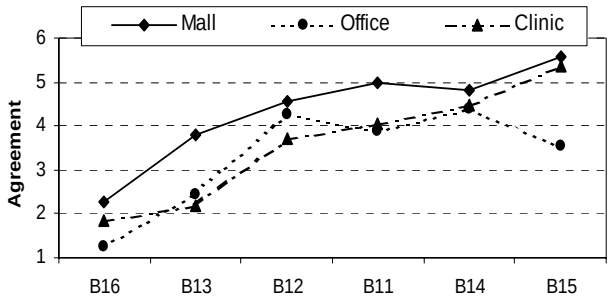

Fig. 3. Mean Scores of Management Commitment Indicators (B1)

Analysis of Safety Rules and Procedures (B2)

Figure 4 presents that workers in the three projects understood the applicable rules and procedures (B25). Socializations of the rules and procedures were conducted through posters and signboards so that easily understood and seen by the workers.

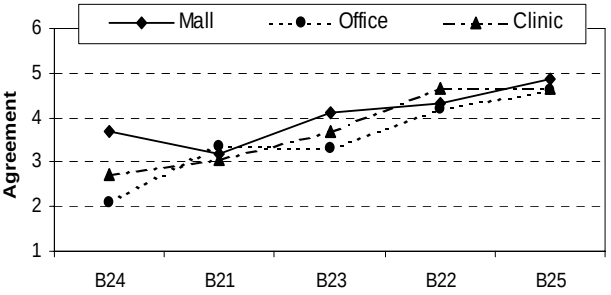

Fig. 4. Mean Scores of Safety Rules and Procedures Indicators (B2)

In mall project, safety rules and procedures were updated regularly (B24) and sanctions would be given to workers without safety helmet and shoes (B23). The mean scores of these two indicators were higher in mall project. Management would first give memo to the respective foremen for such violation by worker. If no improvement were shown then there would be penalty in money wise to the foremen.

Analysis of Communication (B3)

In average workers were satisfied with the information line (B31). Based on observation on the projects (Figure 5), briefings or meetings were always conducted in the morning before starting the works. The topics were generally about working plan on the day and also safety issues.

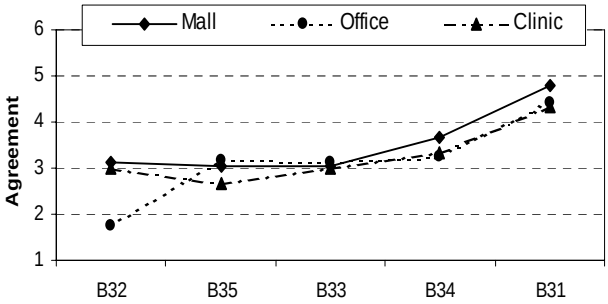

Fig. 5. Mean Scores of Communication Indicators (B3)

However, it seems that information received by the workers were emphasized on jobs related issues and less on updated safety issues (B32) and recent accident (B35). This maybe because in one project usually there would be many teams headed by several foremen. If accident happened in one team, other teams might not hear about the accident because the working area was distant.

Analysis of Worker Competence (B4)

Analysis results (Figure 6) show that safety training had not given clear understanding to workers (B43) especially in the office project. As observed almost all workers never received safety training (factor B16 in Figure 3), only briefing. Their understanding of safety related activities mainly based on personal experience in previous projects (factor B41). Looking at the average scores, mall project maintained better worker competence. This was supported, for examples, by information dissemination about detail safety procedures from management to workers (such as procedures for releasing formwork and scaffolding, and using safety belt).

Analysis of Work Environment (B5)

From Figure 7 it can be examined that workers in office project rated the lowest perception to all indicators, except indicator B55. Serious attention

should be placed especially to indicators B52, B53, and B56 because their mean scores were less than 2. In this project workers perceived the presence of blaming culture if safety problems or accidents happened. In addition, they felt that their jobs were boring and full of pressure.

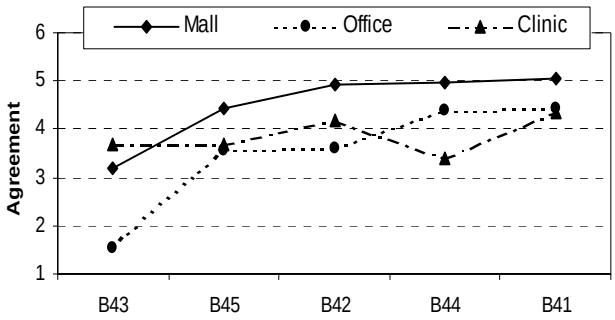

Fig. 6. Mean Scores of Worker Competence Indicators (B4)

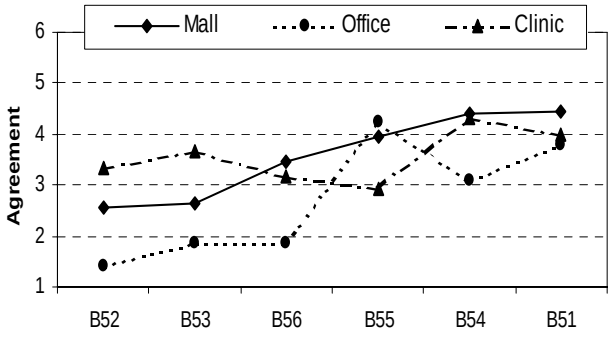

Fig. 7. Mean Scores of Work Environment Indicators (B5)

There was indication that safety programs did not motivate workers in the office project. Furthermore they even felt disturbed by the programs. The situation was quite different from mall and clinic projects. Though the workers there were also disturbed, they still recognized the importance of the program so that they could work safely and had higher motivation.

Analysis of Worker Involvement (B6)

For this factor, the workers in the three projects generally held similar perceptions, except for indicator B64 (Figure 8). It appears that workers involvements in communication line (B61) and development of safety procedures (B62) were not too high. Management thought that it was enough for them to communicate to the foremen regarding these issues. However, this would be difficult for the foremen to deliver the issues to their workers since they were under pressure to fulfill their target (money). In other words, there was not enough time to deal with the issues.

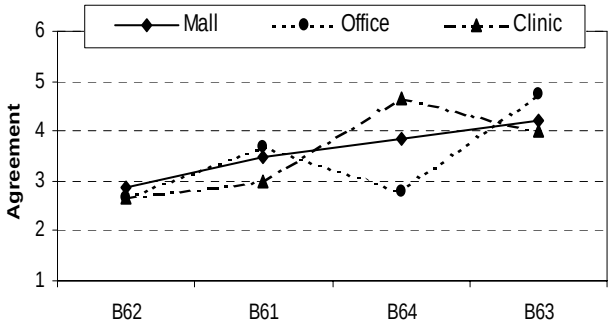

Fig. 8. Mean Scores of Worker Involvement Indicators (B6)

Mean differences across projects

This section is intended to compare the mean scores between groups (projects). In particular, whether or not projects differed in their average perceptions of safety culture was examined. MANOVA and one-way ANOVA tests were performed on the measured safety culture factors. MANOVA was used to test for the effects of project on each safety culture factor. A Box test was first employed, showing that there were statistically significant differences between the variance-covariance matrices across the different projects (*Box's M* = 270.93, F = 6.071, p = 0.000). Further multivariate analyses displayed in Table 3 highlight significant differences between the projects (all the p-values of the multivariate tests were less than 0.05).

Several one-way ANOVAs were then performed one for each dimension. Table 4 shows four factors that were statistically significantly different, i.e. top management commitment, safety rules and procedures, communication, and workers competence (p-value less than 0.05). From the mean scores, it can

Table 3. Multivariate Results of Differences in Workers Perception

Effect		Value	F	Hypothesis df	Error df	p-value
Intercept	Pillai's Trace	0.989	2886.112	6.000	199.000	0.000
	Wilks' Lambda	0.011	2886.112	6.000	199.000	0.000
	Hotelling's Trace	87.018	2886.112	6.000	199.000	0.000
	Roy's Largest Root	87.018	2886.112	6.000	199.000	0.000
PROJECT	Pillai's Trace	0.811	22.744	12.000	400.000	0.000
	Wilks' Lambda	0.301	27.273	12.000	398.000	0.000
	Hotelling's Trace	1.948	32.139	12.000	396.000	0.000
	Roy's Largest Root	1.733	57.754	6.000	200.000	0.000

be seen that the mall project possesed better safety culture than the two other projects, especially upon the aforementioned four significant factors. The results thus reinforce the aforementioned descriptive analyses.

Tabel 4. ANOVA Results

Safety culture factors	Mean values			*F*	*p*
	Mall	Clinic	Office		
Top management commitment	4.34	3.61	3.30	5.51	0.00
Safety rules and procedures	4.03	3.77	3.51	6.38	0.00
Communication	3.53	3.27	3.14	10.04	0.00
Workers competence	4.51	3.85	3.51	9.03	0.00
Working environment	3.58	3.57	2.71	1.89	0.15
Workers involvement	3.60	3.58	3.48	2.71	0.07

Conclusions

The mean scores in the three projects indicated that in general the workers perception toward safety culture is somewhat good (mean score more than 3.00). However, there are several things that need to be improved, such as safety training and management commitment in implementing safety rules and procedures. In addition, workers participation and communication in improving on-site safety should be enhanced.

Analyses results signify significant differences in workers' perceptions in the three projects, where mall project demonstrates the best safety culture. It is interesting to understand that clinic and office projects were performed by the same contractor organization. It can be said therefore that the contractor construction the mall project possesses better safety culture than the contractor on the two other projects. It can be argued that top management is a pivotal driver of safety culture. In other words, safety culture improvement should be initiated by top management, for examples by giving full commitment on safety. Another paper [14] has empirically examined this argument.

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