

Measuring Construction Safety Climate in Supervisory Environment with Multi-level Analysis on Projects in Pakistan

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Abstract

Supervisory level acts as conduit to proper implementation of safety on construction projects, lie in the alignment of safety perceptions of cross supervisory levels which includes sub-engineer/overseer, inspector and superintendent. This study focused on within group consensus and differences among the supervisory representative in terms of safety climate. Safety climate of overseer was found positive, partially positive for contractors and weak for consultants. There is no significant difference between safety climate of superintendents and inspectors. Overseers have highly significant difference in perceptions of safety climate with inspectors. Variation in perceptions leads to distraction of safety instruction from managerial level towards front line workers level and cause non-conformance of stakeholders as overseer, inspector and supervisor to attain zero level accident on projects. Positive and clear perception of supervisors at cross level increase effectiveness of safety implementation in construction operations.

Keywords

Safety climate, Supervisory level, Safety performance, Construction, Pakistan

1. Introduction

Construction ranked third among most hazardous industries in Pakistan with high injuries, occupational diseases (PBS, 2011) and fatalities rates (both reported and unreported). Earlier research showed poor safety culture (Farooqui et al. 2007) with inadequate safety management system (Farooqui et al. 2008; Choudhry et al. 2012), safety climate with weak perceptions (Masood et al. 2011), uncertainty avoidance attitude and non-practice behavior (Ali.T.H, 2006; Masood et al. 2012a;) in situation with saturation of many safety rules and regulations with less application caused negligence towards labour law in context of safety (Raheem et al. 2011; Jafri et al. 2012). Lack of concern of managers and workers for safety on construction sites is the reason of unawareness about high rates of injuries and fatalities in this very industry. Additionally, safety is not considered as prime issue in employment and even in organization which addressed lacking of expertise for safety in practice which create climate inadequate for safe work.

Instructions to perform any construction activity flow from Managers to supervisors to operatives. A clear difference between management attitudes and behaviours of workers was revealed by earlier research which provides space to address safety culture with holistic approach as both counter parts have activities

interrelated in combination of action-reaction (Arboleda et al. 2004). Research demonstrates that managers at different levels, including senior managers and first-level supervisors, have a significant impact upon safety performance (Choudhry et al. 2008). Managers gave priority to productivity over safety with less superintendence because weak safety management system prevailing on construction sites which influence supervisors' attitude and actions (Masood et al. 2012b). Communication gap among organizational levels (managers, supervisors and workers) is evident by low accident reporting on construction sites in Pakistan, supervisor perceived managers are mainly responsible for safety issues and workers have superstitious approach towards safety (Choudhry et al. 2011). Construction activities need supervision on daily basis during site execution phase of project, which is the prime duty of superintendent and followed by subcontractor's workers (Schaufelberger et al. 2002). Solely supervisors/superintendents responsible for safety on construction site which is a critical criteria for project success (Sanvido et al. 1992); including inductions, accident investigations, accident reporting and implementation of OH&S measures on project sites. Supervisors' role is very important due to interventions in each construction process and act as channel for sender (manager) to receiver (worker) which helps to achieve projects goals in true means. Site supervisors make decisions that influence operations directly under their supervision. The scope and magnitude of these decisions vary from level to level and are based on different types of experience and use a variety of decision support tools. Alignment of perceptions of employees improves safety performance and supervisors' role is considered critical to maintain the understanding level of information (instructions). Developing communication linkage with labor, material, equipment and subcontractors for streamlining construction process is main responsibility of superintendents. Supervisory environment is conducive to run construction project equally allied with management to resolve conflicts in first hand, assure the working performance and identify hazardous conditions. Current study is an effort to investigate the safety and health in supervisory environment on construction sites in context of safety climate. This study focused on within group consensus and differences between groups.

1.1 Cross Supervisory Level on Construction Projects

On construction projects main stakeholders are client, consultant and contractor and easily identify through their representatives on construction work. These are front managers and have different responsibilities. Supervisors from client and consultant are called overseer and inspectors respectively who are mainly deal with checking of construction work (formwork, steel fixing and concrete etc.), material testing, in-term bills of work, etc. On other side supervisor or superintendent from contractor is purely engage in execution of work and management of resources. In few projects there is no representative from consultant side and client representative have more authority in terms of design issues. (Figure 1)

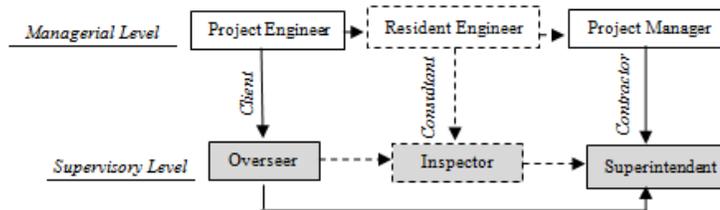


Figure 1: Cross Supervisory level on Construction Project.

Overseer and Inspector are least concern about safety aspects of construction process and mainly focus on quality and progress. Contractors are bound to execute the work safely and bore the safety risk of project to avoid danger through project contract agreement with client. Contractors have to ensure safety of all persons, site operations, and methods of construction, property, and public. Contractors have to prevent epidemics, incidents, injuries and fatalities. Application and implementation of contract clauses is mainly responsibility of client and consultant, proper monitoring of safety on jobsite helps for efficient safety management system developed by contractor. If the perceptions of stake holders' representative in

supervisory environment are not aligned and positive then it is predicted that unsafe work will be executed prone to injuries and accidents.

1.2 Safety Climate in Supervisory Environment

On construction projects Safety climate is like the crust and safety culture is the inner core of the earth. Safety climate deals with the perceptions of employees for safety management system to perform work safely. Safety climate has been measured in multi-dimensional way of organizational, managerial and human factors. Major dimensions include safety attitude and management commitment, safety consultation and safety training, the supervisor's role and workmate's role, risk-taking behaviour, safety resources, appraisal of safety procedures and work risk, improper safety procedures, worker involvement, workmate's influence and competence, workers' safety motivation (Glendon et al. 2001; Mohamed, 2002; Fang et al. 2006; Choudhry et al. 2009; Masood et al. 2011; Haadir et al. 2012).

In the construction sites, site managers and gang supervisors have significant involvement for workplace safety and ensure the implementation, and acceptance of employees for safety rules and procedures become high when they find fairness in their supervisor's action (Yule et al. 2007). In context of Pakistan staffing at supervisors has impact on work progress which found to be inappropriate, less qualified and inexperience especially for financial matters related to projects which includes accounting to procurement (ADB, 2007). Supervisors play a vital role to develop subordinates and workers beliefs for safety through their influential position. Supervisors' appropriate behaviours is modelled by subordinates and workers and reinforced by consistent behaviour of managers. An agreement is needed between top management and supervisors to drive top management commitment to front line workers. Supervisors must be accountable and active to develop a conducive environment. Employees become resentful and disgruntled if get threats from supervisors for their job, which make them annoyed with managers and company; and ultimately urge them to violate the supervisors' instruction even for their own safety. Supervisors act as a "conduit" through which organizational safety priorities are communicated to workers and monitor their behaviour aligned with safety appropriateness (Niskanen 1994).

Supervisors have the knowledge of safety rules and procedures but often take "shortcuts" due to TIME (time, information, manpower and equipment). These latent failures, in the identified influences, can be linked to each other. The failure in this instance is not only due to the supervisory influence of a planned unsafe act, but rather to the failure at the operations level of anticipating solutions that are presented when schedules collapse, manpower is short, the right equipment is unavailable, or the right information is not supplied, as evidenced in an incomplete job hazard analysis. Identifying employee and field supervisory personnel behavioural traits and motivators are extremely important in the management and development of those employees, which will further mitigate situational exposures (Garrett et al, 2009).

Supervisory team has unique group level safety climate which may differ from organizational or sub-units safety climate (Zohar 2000). Supervisors play role of motivator and monitor for safety implementation through action and reaction in situational context. Supervisors shift the major responsibility for safety to managers because of implementation of rules/procedures are enforced by them but the supervisor acceptance for safety is of great concern which influence the worker behaviour for safe work. Safety climate is predictive and better judge from the situational facts when supervisors priorities work accomplishment over safety (Zohar et al. 2004). Supervisor perceived quick response from managers regarding safety problems, help to develop trust and confidence upon management. In other words, top managers are concerned with policy-making and the establishment of procedures to facilitate policy implementation, while at lower organizational levels supervisors execute these procedures by turning them into predictable, situation-specific action directives (identified as supervisory practice) (Zohar, 2010).

Safety supervision system in construction industry lacks comprehensiveness and technical preventive measure against accident and management. Supervisors are mainly supposed to manage the safety risk

and avoid any hazardous situation. Safety supervision system is inefficient to create a supervisory environment which is responsive to safety non-practice behaviour and require alignment of perceptions for implementation of safety on worksites. Lingard (2012) revealed the important role played by first-level supervisors in construction as the linking mechanism between the organizational safety-climate, specifically perceptions of top management commitment to safety, and injury rates within construction organizations. The role played by group-level safety climate in mediating the relationship between organizational safety climate and safety performance highlights importance of adopting a multilevel stance towards the analysis of safety climate within construction organizations.

Farooqui (2009) found competencies and attributes of superintendent/supervisors required for the success of projects in Pakistan in ascending order Leadership, Time Management, Ability to Plan Ahead, Understand subcontractors' work, Ability to work with Different kinds of People, Conceptualization (Thinking how it will work), Team Building, Cost Control, Estimating and Scheduling. Researchers highlighted strategic position of supervisor to address safety aspect in managerial and supervisory tasks by applying skills with innovative approaches. Leadership qualities are seldom nourished in the supervisors and site engineers/managers with the result that they do not understand their role and responsibility. The supervisors and engineers do not interact openly with the workforce at site and there is a sort of communication gap between them. It is often observed that two different teams are working on the site, one is composed of supervisors and site engineers/managers and the other is composed of the workforce (Huda, 2008). Miscommunication, beginning at the operations level, account for a significant amount of all supervisory preconditions that cultivate the environs in which unsafe acts are created. Failure to convey proper information to supervisors regarding quality control protocols or loss control best practices account for a significant amount all of incidents involving rework and accidents from lack of safe practices (CII 2006). The most effective supervisors discuss safety issues with construction workers from different trades, and provide feedback about safety behavior and performance to those workers (Mattila et al. 1994)

2. Objective

This study focused on safety climate of supervisors and address Within group consensus and differences between groups for safety climate (group includes superintendent versus overseer, superintendent versus inspector and overseer versus inspector), and perceived safety performance of construction site.

3. Research Methodology

Following are the main phases of the research study:

1. A questionnaire, adopted in previous studies as Masood et al. (2011), was used for current study. This questionnaire consists of forty safety climate items which asked the participants to endorse the statements using a five-point Likert - type (from 1 = "strongly disagree" to 5 = "strongly agree") scale.
2. In data collection phase, a questionnaire survey has been done on 36 construction projects (of different type as industrial, facility, housing, community buildings etc) located in different cities of Pakistan, moreover both lower and higher categories of contractors (as per P.E.C). Supervisors from twenty one construction sites had responded.
3. Average age of the supervisors is between 21 to 30 years, all of them were male, 65% of them were married, and average dependents of supervisors were from 3 to 4 excluding themselves. Almost all supervisors have certificate/diploma or higher college degree. Responses received from overseers (3), inspectors (4) and superintendents (35). Average supervisors have 1 to 5 years' experience in the same firm and 3 to 10 years in the construction industry.
4. Collected data was fed in SPSS 20.0 for statistical analysis, in stance to assess multi-level safety climates, evaluate aspects of agreement within groups by degree of cohesiveness ($rwg(j) \geq 0.75$, derived by James et al, 1984).

5. A paired-sample test (with set significance value <0.05) was used to measure vital difference between supervisory representatives.
6. Difference of means safety climate score and safety performance index has also been measured to investigate supervisors' perception and overall safety performance on site in view of supervisor.
7. The results of the data analysis provided thought provoking issues for development of safety culture and termed to be taken as valid addition to safety research in perspective of Pakistani construction industry. In the same tune both conference and journal papers will be published to validate the research work.

4. Data analysis

Mean safety climate score for multi stake holder supervisory level of given sample is as client (3.85), contractor (3.48) and consultant (3.30). The party which has more stake has more clear and positive perceptions about safety.

In Table 1, it is shown safety climate dimensions which are agreed within a stakeholder supervisory level. Only statements with $rwg(j) \geq 0.75$ were considered. In Table 2, result of paired sample test of supervisory level is provided. There is significance difference in safety perception of overseer and both inspector and superintendent. But there is minor difference found in safety perceptions of inspector and superintendent.

5. Discussion and Conclusions

Variation in safety perceptions at supervisory level is alarming to implement safety on construction site. Clients are more concern about the safety issues in terms of owning the jobsite and any accident may lead to damage to property even the reputation in market and public. Consultants (designers) have least concern about safety which rise the question for role of designers in construction safety. Designers do not consider how safely the designed components could be built and how much impact the design components would bring to construction safety. This means that they normally do not take on the responsibilities in relation to construction safety and fail to exploit the potential of avoiding or reducing risks which are inherent in the construction processes and subsequent works. Contractors has double stake the asset (human resource, plant, equipment etc.) and contract agreement with client. Contractor has to fulfil the contractual obligations and if this is priority of client then efficiently implementation of safety is seen on sites, in which clear perception of safety helps to understand the safety management system.

Overseers believe there is no proper system of accident investigation from their part. They are involved in all documentation related to safety. Client provides necessary safety resources such as fire extinguishers etc. Safety inspection is vital to monitor hazardous conditions. Suggestions from overseers are highly appreciated by client as well as contractor to resolve issues. Overseer gives importance to safety on construction site but also of view that few tasks are quiet risky. Overseers believe that quick response to safety aspects helps to avoid dangerous conditions and develop trust on management. Overseer knows contractor is bound to provide PPE and always keep in mind the status human life during execution. If overseer keep record of safety related activities on construction site then this urge contractor to follow the safety issues contractually.

Inspector has to check the execution of work on daily basis. Most of the design consultants has fascinated safety policy but on ground no real input is seen from designers. They are forced to be part of safety related issues because of their loop with client contractor. Safety aspect is normally ignored during designing or even development of specifications.

Table 1: Within-group Inter-rater reliability for groups upon safety statements

Safety Climate Statement		rwg(j)		
		Client (Overseer)	Consultant (Inspector)	Contractor (Supervisor)
Q 01	Accident investigations are mainly used to identify who is to blame.	<u>0.83</u>	0.50	0.20
Q 02	No suggestions for safety and health improvement is considered	0.33	0.33	0.46
Q 03	I feel involved when health and safety guidelines.	<u>1.00</u>	<u>0.88</u>	0.25
Q 04	Productivity is given priority over safety	0.50	0.50	0.41
Q 05	People do safe work without supervision	0.33	-0.13	0.21
Q 06	Risky jobs are sometime necessary to do.	0.33	0.21	0.24
Q 07	Sufficient resources are available for health and safety here.	<u>1.00</u>	-0.13	0.26
Q 08	People who violate safety guideline faced opposition	0.33	0.54	0.09
Q 09	All the people who work in my team are fully committed to health and safety.	0.50	-0.13	0.20
Q 10	For improving safety and health of workers, inspection is always helpful.	<u>1.00</u>	0.50	0.57
Q 11	Some of safety guidelines cannot be followed.	0.33	0.21	0.28
Q 12	People are just unlucky to suffer an accident.	0.33	0.21	0.19
Q 13	The company encourages suggestions on how to improve health and safety.	<u>0.83</u>	-0.13	0.55
Q 14	People can always get the equipment which is needed to work to the health and safety procedures / instructions / rules.	0.33	-0.13	0.16
Q 15	There are always enough people available to get the job done according to the health and safety procedures / instructions / rules.	0.50	-0.13	0.52
Q 16	The company really cares about the health and safety of the people who work here.	1.00	-0.13	0.37
Q17	The company shows interest in my views from health and safety.	<u>0.83</u>	<u>1.00</u>	0.40
Q 18	It is important for me to work safely if I be respected by others in my team.	<u>0.83</u>	<u>1.00</u>	0.54
Q 19	Some jobs here are difficult to do safely.	<u>1.00</u>	<u>0.83</u>	0.08
Q 20	Not all the health and safety procedures / instruction / rules are strictly followed here.	-0.17	0.33	0.15
Q 21	Most of the job-specific safety training I received is effective.	<u>0.83</u>	0.00	0.61
Q 22	Management acts quickly to correct safety problems	<u>0.83</u>	0.50	0.49
Q 23	Management motivate site employees for working safely	<u>0.83</u>	-0.13	0.53
Q 24	Management clearly communicates safety issues to all levels within the organization	0.50	-0.13	0.52
Q 25	Management undertakes campaigns to promote safe working practices	0.33	-0.13	0.44
Q 26	Current safety rules and procedures are so complicated that some workers do not pay much attention to them	0.33	0.54	0.37
Q 27	Current safety rules and procedures enforce the use of personal protective equipment whenever necessary	<u>0.83</u>	<u>0.88</u>	0.65
Q 28	It is in my interest to maintain a safe workplace.	<u>0.83</u>	0.50	0.49
Q 29	My supervisor/safety manager usually engages in regular safety talks	0.50	<u>1.00</u>	0.16
Q 30	My supervisor/safety manager welcomes reporting safety hazards/incidents	0.50	<u>0.88</u>	0.29
Q 31	My supervisor/safety manager is a good resource for solving safety problems	<u>0.83</u>	<u>1.00</u>	<u>0.72</u>
Q 32	My aim is to achieve high levels of safety performance	<u>0.83</u>	<u>1.00</u>	0.45
Q 33	I participate in safety planning, according to our safety policy if being asked	<u>0.83</u>	<u>0.88</u>	0.46
Q 34	I am clear about what my responsibilities are for safety	<u>0.83</u>	-0.13	0.53
Q 35	I am aware that safety is the number one priority in my mind while working	0.50	<u>1.00</u>	0.47
Q 36	In our work environment working with defective equipment is not allowed under any circumstances	<u>0.83</u>	-0.13	0.17
Q 37	I am always given enough time to get the job done safely	<u>0.83</u>	-0.13	0.32
Q 38	I received adequate training to perform my job safely	<u>0.83</u>	0.54	0.15
Q 39	I am capable of identifying potentially hazardous situations	<u>0.83</u>	<u>1.00</u>	0.39
Q 40	Accidents which happen here are always reported.	<u>0.83</u>	-0.13	0.21

There is no significant consensus among superintendents but mostly they are dependent on their managers for safety issues. Significant difference of safety climate perceptions found between overseers and consultants, which is result of weak position of consultant. Consultants are not really concern with what is happening on construction sites especially when it is related to labour. Without practical experience of execution they don't know how to deal with labour especially when hard task is need to be done (like in extreme weather), they mainly focus on the design of facility and ignore the human element who build it. Overseer expects superintendent to develop a safe work environment in light if contractual clauses. On other hand superintendent are more concern for productivity and bypass many instructions received from client and follow his company manager.

Table 2: Paired Sample Test for Supervisory level

Supervisory Level	Paired Differences					T	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Superintendent-Overseer	-0.34800	0.59244	0.09367	-0.53747	-0.15853	-3.715	39	0.001
Superintendent-Inspector	0.12750	0.42651	0.06744	-0.00890	0.26390	1.891	39	0.066
Overseer-Inspector	0.47550	0.69264	0.10952	0.25398	0.69702	4.342	39	0.000

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