A FRAMEWORK FOR ENHANCING AND IMPROVING THE SAFETY CULTURE ON SAUDI CONSTRUCTION SITES

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Improving safety culture is necessary to reduce the number of injuries and fatalities on construction sites internationally. A comparative study of eight developed and Arab countries shows that Saudi Arabia is performing poorest in terms of the rates of major injuries and fatalities, and embedding a safety culture in practice remains a challenge. Three key elements of a safety culture model are identified from the literature: person (safety climate), environment/ situation (safety management system) and behaviour (safety behaviour). These have been constituted into safety culture models. There is also a fourth element relating to organisation. However, there is a lack of research which considers how these components can be integrated into a holistic safety culture model. A conceptual framework is proposed that adopts and integrates these elements for application to the Saudi construction industry. The framework is composed of the three elements derived from the existing frameworks in the literature, and the fourth element of organisational context. The framework will be developed and tested using Saudi construction projects and it is expected that the results of the study will be of benefit to contractors for measuring their own safety culture performance.

Keywords: safety culture, injuries and fatalities, comparative analysis, models, Saudi Arabia.

INTRODUCTION

Poor safety culture is one of the main attributes causing many injuries and fatalities in the construction industry all over the world (Choudhry *et al.* 2007). In Saudi Arabia, the General Organization for Social Insurance (GOSI, 2010; 2011) has revealed that the total number of serious injuries from 2004 to 2010 was 261076 (an annual average rate of 3413.9 per 100,000 employees), while the deaths totalled 2176 (an annual average rate of 28.3 per 100,000 employees). Most of these accidents were caused by the employee's safety culture due to the fact that majority of the employees (95%) in construction are from migrant workers. Therefore, applying any improvements to reduce or eliminate the accident record will not be effective until safety culture is considered as a principal matter (Blockley, 1995). Thus, the safety culture

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measurement is good as a starting point for improvement and many studies have built models for this goal.

The "reciprocal safety culture model" is an example of one of these models (Bandura, 1986; Geller, 1997; Cooper, 2000; Choudry *et al.* 2007; Ismail *et al.* 2009) which focuses mainly on person (safety climate), environment/ situation (safety management system) and behaviour (safety behaviour). All these authors assert the importance of belief in the value of the organisation (top management) for support. However, there is a lack of research which considers how the organisation (top management) can be integrated into the reciprocal safety culture model. This paper is part of continuing PhD research aimed at improving the safety culture on Saudi construction sites with the following objectives:

1. Identify the current status of the safety performance in the Saudi construction industry.
2. Compare the safety problem in the Saudi construction industry to other countries.
3. Identify and incorporate the component(s) that need to be added to the Chaudhry's model to improve the safety culture in the Saudi construction industry.

BACKGROUND OF CONSTRUCTION SAFETY IN SAUDI ARABIA

Safety performance

Over the last two decades, Saudi Arabia has become one of the fastest-growing economies within the Arabian Middle East, especially in the construction sectors. Despite this fact, the safety level on construction sites lags behind this development and is considered relatively poor. To clarify this point, over the past 15 years many researches have been done and published on safety performance measurement based upon a random sampling and it is summarized in Table 1

As shown in Table 1, the earlier study done by Jannadi and Sudairi (1995) used only a traditional approach "lagging indicators" such as injury frequency rate and compensation costs. In fact, one of these tools has been used in research (injury rate) to find safety rate for company by calculating the number of all work injuries per million employee hours worked. It concluded that mean rate injury for large companies is better than others because the injury rate is relatively low. Nevertheless, Mohamed (2002) ; Choudhry *et al.*(2007) criticised this approach and considered it as a poor measurement tool to assess the safety performance of any company because its measure only historical events of the organizations based upon the availability and reliability of data regardless the current safety activities.
Alamoudi (1996) ;Jannadi and Assaf (1998); Alasmari (2010) tested the safety performance by using one of the modern approaches "leading indicators" such as safety climate measurement (Mohamed, 2002), safety culture (Cooper, 2000) and the hazard identification checklist or behaviour observation (Choudhry *et al.*2007).In particular , Alamoudi (1996) and Alasmari (2010) used safety climate as tool of the assessment by testing the individual perceptions of project managers or safety officers toward the safety. They concluded in one of the studies that the safety level was poor while the other ranged from poor to good.

Author & Year	company Size									
	Construction firms participated	Small			Medium			Large		
		Safety assessment methods			Safety assessment methods			Safety assessment methods		
		Mean Injury frequency rate	Mean Attitude score	Mean Checklist score	Mean Injury frequency rate	Mean Attitude score	Mean Checklist score	Mean Injury frequency rate	Mean Attitude score	Mean Checklist score
Jannadi & Al-Sudairi (1995)	16	43	---	---	19	---	---	11	---	---
Al-Utaibi (1996)	45	35.78	---	66.78% and rated "fair"	29.74	---	68.05% and rated "fair"	10.06	---	88.62% and rated "very good"
Al-Amoudi (1997)	122	---	16 % and rated poor	---	---	37% (poor)	---	---	45% (poor)	---
Jannadi and Assaf (1998)	14 sites	---	---	65.21 % and rated "fair"	---	---	---	---	84.55 % and rated "very good"	---
Baig (2001)	28	89.43		0.47 on a scale of 1 and rated (poor)	34.83		0.61 on a scale of 1 and rated "fair"	13.79		0.8 on a scale of 1 and rated "very good"
Alasmari (2010)	38	---	45.36 %, rated "poor"		---			---	75.23%, and rated "good"	

Table 1: Summary of earlier studies of safety performance in Saudi Arabia

Jannadi and Assaf (1998) used the hazard identification checklist as one of the tools of modern methods to measure the safety performance of the organisation .They concluded that safety level ranged from fair to very good. The good advantage of modern approaches is to display the current safety activities and to find out how successful the safety management system is for the organisation .A few researchers used the two approaches, modern and traditional, in combination (Baig ,2001;Al-utaibi,1996) which is indeed useful for helping the organisation to determine their safety performance in more accurate terms. Overall, these studies have indicated that the safety culture is a significant cause of the wide variations in health and safety performance levels in the construction industry.

COMPARATIVE STUDY

A comparative approach is considered the best option to emphasise and give clear images about the current state of any problem, which helps the practitioners to set plans to address these problems. The current comparative study concerns, the number of employees and the number and rate of injuries and deaths at sites depending on the statistics available in the following countries: Saudi Arabia, Jordan, Bahrain, Kuwait, the United Arab Emirates, the United States of America, the United Kingdom and Australia. These statistics are used to build a clearer picture of safety and to find where Saudi Arabia stands with respect to the other countries. Furthermore, a scale for the accident rates per 100,000 employees has been included and these rates have been calculated for some countries that do not include them in their documents by using the following formula: incidence rate = (number of injuries)/ (total number in employment) ×100,000. The incidence rate is a worldwide standard, which represents

the number of reported injuries on job sites during a 12-month period for the work of a group of 100,000 employees.

From Table 2, the findings of the comparison can be concluded as follows: (1) The methods of reporting vary from one country to another based on the culture of reporting, and for this reason the study will use the major injuries and deaths rate as a basic norm in this comparison; (2) Saudi Arabia has the highest rate of major injuries with 3117 out of every 100,000 workers injured in 2008; (3) the UK has the lowest rate of major injuries at 254.1 for every 100,000 workers in 2008; (4) Saudi Arabia has the highest rate of fatal injuries with 28 out of every 100,000 workers dying in 2008; (5) The UK has the lowest rate of fatal injuries with 3.4 out of every 100,000 workers dying in 2008; (6) Outcome final that Saudi Arabia was at the top of the list of selected countries in terms of the rate of fatal and non-fatal major injuries, and this indicates a very serious and worrying situation.

Country	Labour (Thousands)	No. injuries		No. deaths	Rate of major injuries / 100,000 employees/Year	Rate of fatal injuries /100,000 employees/Year	Date issued
United Kingdom	2404	Major	3286	53	254.1	3.4	2008
		Minor	6789		524.9		
Australia	926	Major	1621	55	175	5.9	2008
		Minor	13118		1416		
United Arab Emirates	1349	Serious	690*	20*	233.03*	6.7*	2008
United States Of America	13735	Major	164900	975	1200	9.7	2008
		Minor	316800		1500		
		Job transfer	207900		2300		
Kuwait	127	Serious	1257	13	1013	10.4	2008
*Jordan	374	Serious	2306	-	615.9	-	2008
*Bahrain	133	Serious	475	-	357.1	-	2008
Saudi Arabia	1248	Serious	38929	402	3117	28.19	2008
Max. Rate of Non-Fatal injuries (major)		3117 per 100,000 (Saudi Arabia)					
Max. Rate of Fatal injuries		28.19 per 100,000 (Saudi Arabia)					

Table 2: The comparative study for 2008

- *Source: BLS in the USA,2009; ONS in the UK, 2008;HSE, 2010; Safe Work Australia, 2011; GOSI, 2010; GOSI, 2011; NBS in UAE, 2010; Redfern, 2010; CSO in Kuwait, 2008; Al Sharaky, 2009; SSC in Jordan, 2008; SIO in Bahrain, 2008*
- ** Data released by Build Safe UEA which covered 388 projects with 296,093 people working on site.*
- **No data available for fatal injuries in Jordon and Bahrain.*

REVIEW AND DEVELOPMENT OF AN INITIAL FRAMEWORK FOR SAFETY CULTURE

Over the last two decades, safety culture has become a challenging and interesting topic around the world for many researchers and practitioners due to it being responsible for many accidents and disasters within organisations (Choudry *et al.* 2007). Most of these studies focus on building a model either for interpreting the concept of safety culture or an assessment for improvement. However, there is not yet any universal and acceptable model for safety culture (Cooper, 2000) .In this research,

the "reciprocal safety culture model" as example will be used as theoretical fundamental knowledge to prepare an initial draft of framework for safety culture in Saudi construction context. The following paragraph gives a brief context of some researches on such model.

In the earlier study, Bandura (1986) tried to interpret the concept of safety culture in terms of reciprocal determinism based on social cognitive theory, and derived three components: behaviour, person and environment. Geller (1997) adopted Bandura's work and made an excellent effort to identify the characteristics for each component and that leading to the development of a model called 'total safety culture'. Bandura's model was also adopted and developed by Cooper (2000) who asserted through his new model that safety culture is a product based on interactions between people, jobs and organisations. Ho and Zeta (2000) developed a model called the "safety culture table model" which involved person, environment, behaviour and organisation, and they pointed out that safety culture is similar to the table that is constructed on four legs. Molenaar *et al.* (2002) developed a snap-shot assessment model based on Bandura's conception with different names, people, process and value, using 31 characteristic hierarchies as positive culture indicators. Choudhry *et al.* (2007) adopted Cooper's model with some modification in order to make it suitable for use in the construction industry. Ismail *et al.* (2009) adopted Cooper's model to develop a framework for operationalization of construction safety culture in Malaysia which involved three phases: Psychological (value & beliefs), behavioural and situational (observable practices & provided environment) and safety officers &supervisors (communication, trust & commitment).

The reviews have disclosed that these models will not be effective for safety improvement until they get support from top management (the senior leadership) who has the power to maintain the positive culture within the organisation. For example, if the organisation has a good attitude from the top management toward health and safety then this is reflected in the safety performance result. However, a few research studies have been carried out to explore the top management perception and attitude about safety (Gadd. *et al.* 2002).

Based on this review, the initial framework in this research will be developed and formulated from the family roots of the past reciprocal determinism of safety culture models, a person (safety climate) comes under psychological factors, while behaviour and environment/ situation come under observational factors by adopting Choudhry's model due to the importance of these components as being mainly responsible for the majority of accidents (Suraji, 2001).

Nevertheless, this model does not adequately represent the Saudi context and has fundamental limitations through absence of organizational (top management). This will be considered and developed as separate components before implementing the model within the Saudi construction sites as illustrated in Figure 1. This is due to the fact that safety perceptions of those in upper level management of organization, for example president, chief, senior executives , etc., and their decisions that influence the firm level (Molenaar *et al.* 2002) is considered a significant element to keep the safety culture balanced without any collapse (Ho & Zeta ,2000).

Moreover, Ismail *et al.* (2009) asserted that the characteristics of the three original components will not be created until the senior management have a positive culture. In addition, according to Blair (2003), those in top management have a greater ability to create and extend the safety culture within the organisation. Moreover, Sawacha *et al.*

(1999) found the most critical factors that impact the construction sites was the top management's perception towards the safety. The following subsections illustrate the details of each component which has relations with organizational (top management):

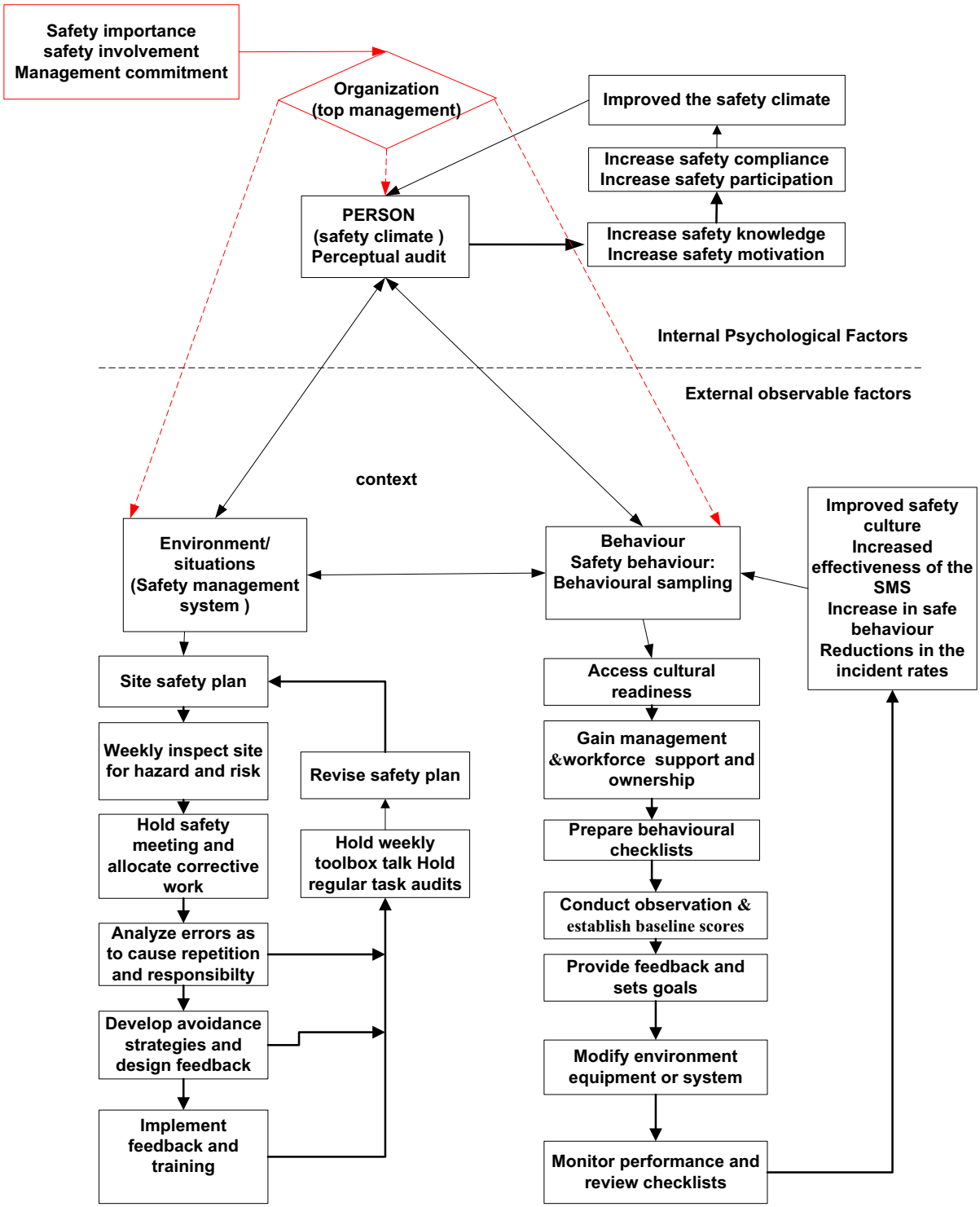

Figure 1: The Chaudhry's model with additional component in the red colour that need to be addressed

Person (safety climate)

The safety climate (value and belief) refers to safety perception of employees of the safety management system of the organization, and considered as product of safety culture (Mohamed, 2002). Because it is subcomponents of safety culture according to Cooper's (2000) definition that ' culture is the product of multiple goal- directed interactions between people (psychological),jobs(behavioural) and the organization (situational);while safety culture is that observable degree of effort by which all organizational members directs their attention and actions toward improving safety on a daily basis'. Nevertheless, there is wide confusion and overlap between the safety climate (perceptual approach from the bottom up) and safety culture the ability to manage the safety (organisational approach from the top down), and this may be one of the things that have contributed to slowing down the progress of improvement in safety performance (Mohamed, 2002).

The person as understood from Chaudhry's model refers to personal field which involves the middle management who are responsible at the project level for decision making (such as site engineers, project manager, etc) and also those in the front line who spend much time working on the site (such as workers, foremen, craftspeople etc.; Molenaar *et al.* 2002). Neal *et al.* (2000) indicated that one of the main influencing keys of the safety climate is the perceptions of senior management through considering the safety as important. Thus, when the organization have great understanding of the safety importance then it reflects their ability to improve safety climate by increasing employees' knowledge and the provision of motivation for compliance, and participation in safety activities (Neal *et al.* 2000).

Behaviour (safety behaviour)

It is useful as a starting point to mention the fundamental of behaviour, which refers to "How people think, behave, respond to a situation and how the environment influences people's behaviours"(Phillips, 2005). Therefore, when there is a shortcoming of understanding the value of safety and its priority within the workplace, then unsafe behaviour that leads to 80-90% of accidents will likely be the result, as past studies have indicated (Phillips, 2005; HSE, 2002). In addition, Slates (2008) indicated that the positive and negative attitudes towards safety of the top management have a great impact on people's behaviour. In contrast Wu *et al.* (2007) considered the relationship between the senior leadership and followers to be a process to achieve the organisational safety target. Therefore, the top management plays a major role in the promotion of safe behaviour for workers directly through their perception and behaviour (Muniz *et al.* 2007). However, previous studies suggest that behaviour should be changed to become a safe habit by using behaviour-based safety (BBS), a systematic approach to identify the critical behaviour through observation techniques which identifies base-period scores and aim to change these scores by arranging meetings and setting goals for improvement (Choudhry *et al.* 2007).

Situation/ environment (safety management system)

Situation/ environment refer to the quality of operations of the organisation's safety management system at the construction site (Choudhry *et al.* 2007). The main function of this system is to provide a process for planning, implementing, and monitoring and reviewing safety performance. Nevertheless, the safety management system will not be effective without support from the senior leadership who are considered as a vital element (Muniz *et al.* 2007). Also, Cooper (2000) stated that strong commitment and

involvement in safety within the organisation by senior management depends upon the extent of their perception of the value of safety.

THE MEASUREMENT TOOLS

The three main aspects of safety culture models (psychological, situational and behavioural) can be measured using different tools for quantitative and qualitative data collection to obtain a final score for each aspect (Cooper, 2000). In contrast, the new component that related to organization (Top management) that has not been considered in Chaudhry's model which is very important in construction sector will be developed using appropriate tools for measurement such as semi interview structure and questionnaire. The psychological aspect is popularly measured by quantitative approach using the safety climate questionnaire to assess employee's perception and attitude towards safety. The structuring of the questionnaire will be adopted from pervious questionnaires that have been developed by a number of researchers (e.g. Mohamed, 2002 etc). The situational aspect will appear in the firm's structure and will include such items as policies and safety management system, and can be measured by audits and regular inspections. The score will be calculated using the following equation (Cooper, 2000; Gadd. *et al.* 2002):

% Audits Score = (Positive Answer) / (Total Questions) × 100

The behavioural aspect can be seen in operational sites of construction by measuring the workforce behaviour periodically to determine whether they behave safely or unsafely to establish a baseline safety score. This can be repeated regularly to keep the review updated. These scores will help to give the employees a clear image of the status of safety behaviour at the site (Choudhry *et al.* 2007). Furthermore, the scores for this component are easily converted to percentages using the following equation (Glendon *et al.* 2001):

% Safety Behaviour = (Total Safe)/ (Total Safe + Total Unsafe) × 100.

Both behavioural and situational aspect of safety can be converted to five–point banding by dividing the percentage score by 100 and then multiplying the result by 0.5. This scale is of benefit as it can help identify which element(s) (legs) is/ are weaker and then attention can be paid in this area for corrective action (Cooper, 2000).

CONCLUSION

An extensive review of the scientific literature particularly the works of Cooper (2000), and Choudhry *et al.* (2007) has revealed that organization (top management) were not given enough attention or sometimes ignored especially when implementing safety culture procedures in construction sites. The Chaudhry's model that was adopted for this research has fundamental limitations when implementations within the Saudi construction context. These limitations will need to be developed and considered for the new conceptual framework due to their importance to the three original components. It will be developed and tested within context of the Saudi construction sites due to the fact that fatalities and injuries have continued to constitute a major problem. This is with a view to finding out their interactions in improving safety. It is expected that the results of the study will be of immense benefit to contractors for measuring their own safety culture performance and paying attention to weaker aspects.

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