Construction Safety Culture Models and Their Effectiveness in Construction Industry: A Review

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1 Introduction

We all know that construction sites have more hazards and hazardous jobs, so for improving the performance, we need to follow safety culture. The topmost importance of every construction company is to execute and enhance the safety of the construction site. The construction sector is distinct from other businesses in that building activities are frequently carried out outside, in hazardous situations. Construction companies all across the world are working to improve site safety [1]. Safety culture influences the overall safety of the organization, however, it is not completely clear about how it is effected and eventually influences the efficacy of the overall safety within the construction sector, and it is important to define what really means about safety culture. To ensure the safety of everyone specially the extrinsic and intrinsic elements of the culture that change people's attitudes and behaviors. All activities involving internal and external parts of the organization will be imbued with organizational culture. This information will then be distributed to all members of the organization. Construction sector works, managerial practices and the structure of work vary differently from other sectors and compared to other sectors maintaining safety at construction sector is challenging mainly due to inconsistent and dynamic working environment throughout the organization [2].

Construction industries have its own unique characteristics when compared with other industries due to the worker's attitude towards safety, the construction organizational structure, the managerial attitudes, the way of carrying out the construction

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projects as well as the environment in which they are working and developing a model towards the construction safety culture depends on these characteristics, and the effectiveness of the model depends on how these characteristics are valued. In most of the construction sites, various activities will be carried out in parallel sharing of the work spaces simultaneously as a result, the construction works may shift from place to place as the project proceeds and due to these characteristics, the workers may need to take important decisions individually and may result in undesired output. The responsibility of maintaining safety at the construction site is dependent on various factors like procedures, methods and techniques used and the management attitude towards safety. As a result, managing safety at construction sites is rather difficult compared to other industries [2].

"Safety culture" first came from the nuclear report of 1986 Chernobyl disaster, now, it is used commonly throughout industries as a term to determine the industry's atmosphere towards safety. At high-risk industries like construction sites, safety must be a number one priority and the safety culture attitude is taken from the corporate culture including personal mentality towards the safety. Safety culture is not only affected by the corporate culture but also the other non-safety-related operations of the organization. Safety culture has its own importance and impact in a construction industry but understanding the measurement of safety culture as well as managerial practices, the organizational attitude towards safety, the measurement of safety culture are the issues regarding maintaining the safety culture in a construction sector. The reputation of the construction sector is determined by its safety culture and improving the safe work environment will increase the total productivity of the company eventually. In this paper, various models of construction safety culture are studied along with the factors influencing them to improve the overall health and safety performance of the construction site [3, 4].

2 Literature Review

This paper describes what safety culture is, and how it influences behaviour of the worker. According to R. M. Choudhry, S. Mohamed and D. Fang, for the construction industry, the phrase safety culture is a different study but it has major attention because it deals with both the behaviour of management and attitude of the worker. This paper also describes a systematic conceptual framework, firmly rooted in appropriate academic and applied literature, to deal with an absence of verifiable process for analysing the culture of building safety. It investigates the principle of safety culture, as well as other but related concepts including the security environment, behaviour-based safety and the security system. The model in this paper is also compared with currently existing security culture models in order to emphasize its functionality on construction sites. According to Glendon, organizational culture is defined as the difference between management and workers' way of thinking. It also describes that further studies should focus on some new strategy to describe the patterns by which safety culture deviates or be influenced by other safety factors [2, 5].

There are many other models discussed in this paper like "Total safety culture model", "Socio-Technical model", "Safety Maturity Model" and "Reciprocal Safety Culture", each models has their own methodology and all models deals with the same theme like behaviours of management and workers. The total safety culture model consists of a safety triad which includes three factors like environment, person and behaviour. Likewise, different models have different factors. On the other hand, there are definitions like safety climate and safety culture. Organizational culture theory indulges with practices that affect the workers' behaviour. Almost all industries are trying to increase the importance of safety culture in return it helps the organization to minimize their accident potential [6, 7].

3 Safety Culture in Construction Industry

Present new findings in the sector of safety management have given rise to a new perspective on safety. Implementing safety culture within the construction industry is related to many issues regarding the workers as the problems include the skill level of workers, and the unsafe acts that are performed by the workers and the increase of worker turnover within the construction sector. More focus is being placed on ensuring that everyone recognizes the significance of safety, with the difficult challenge of altering attitudes and behaviour. Safety is not solely the duty of the manager; everyone must contribute [8, 9].

As we all know that construction projects conducted are with a high-risk atmosphere, there is a difference between construction safety culture and traditional organizational safety culture. Throughout the formation of safety culture, both external and internal factors of culture will have effect on the organization's culture. This is not to say that the safety system is not important in our present world, but it will only work properly if the firm has built a safety culture. Over time, the law has evolved to place a greater emphasis on workplace safety. The laws and regulations are still being improved today to ensure a safe working environment. Aside from the impact of laws, several safety activism variables, including the active engagement of trade unions, consumerism and the legal battles waged by accident/incident victims, influence modern managers' safety. All of these reasons are prompting management to rethink their safety policies because the safety in the workplace will be improved [1, 10].

4 Definitions

4.1 Safety Culture

Safety culture is defined by many authors and has the same theme which goes through how worker's attitude is affected by companies' culture. The accident on 26 April 1986 at Chernobyl was a major one and the meeting conducted after this accident submitted a report in which the phrase safety culture was used first. Simply we can say that safety culture is common practice given to a group of employees and this includes both the behaviour of the management and behaviour of the employee. Mohamed described that organization culture has a sub-branch which is safety culture [2, 11].

4.2 Safety Climate

Safety climate is defined as a summation of the insight that workers share about their workplace environment, and safety climate gives an actual idea of how safety culture is carried out in an organization. Safety culture as well as safety climate are not much different from definitions as these two are different approaches towards creating an importance of safety within the organization, and if the safety culture is efficient, then it directly reflects the safety climate of the organization [2, 12].

4.3 Safety Commitment

One of the best ways to make a workplace safe is by start practicing all the rules and procedures set by the organization. In order to make that possible, each and every personnel starting from the management to workers, everyone should practise these safety norms in their everyday life when they step into the workplace. For achieving this, a strong commitment from each and every personnel in the organization is necessary. Developing a stringent commitment towards safety from the workforce can reduce the injuries and fatalities by a huge margin. According to a study conducted by OSHA, the organizations performing safety awareness, safety training, etc. tend to have a decline in the injury and fatality rate. So by developing this safety commitment to ourselves and to others, each and every one in the organization starts to feel like a family. Moreover, it will induce a positive culture in the organization. A good and harmonious workplace atmosphere will create a sense of belongings to the workers which will increase the morale of the workers. So after all, the word "Safety Commitment" is the stepping stone towards achieving a safer workplace [13].

5 Measures of Safety Performance

Safety performance measures to provide information on how well the safety is carried out within the organization as well as current performance level. In a construction sector, due to various activities, various hazards will be present and these hazard levels are measured and these inputs will give information regarding the effectiveness of the control measures applied to reduce the hazards. The health and safety management system will evolve from the initial principles as per time and is measured by evaluating the existing policies and the organizational structure regarding the planning and implementation of safety. Different parts of the organization will have various plans and these must be aligned together in order to provide overall aim towards the safety of the organization. The health and safety management systems: measuring health and safety at workplace is a continuous process and these techniques must be carried out in a effective manner. The frequency of these measurements which are to be carried out must be planned [2, 10].

6 Safety System

Safety system of work is a written procedure that is made from evaluating the present and possible hazards and risks associated with in the construction work site. This results in the identification of a safe system of work to be carried out, safe operating procedures (SOP) will establish a fixed method for executing the activities. SOP is a written procedure which describes the step by step instructions on how to perform a task with safety including sequence of jobs to be carried out, evaluating potential hazards and risks, recommended control measures, personal protective equipment (PPE) to be carried with the task and how to perform the task. Safety policy and goals, safety regulations and objectives, scheduling and work organization, execution and regular operating practice, tracking, responses and inspections, remedial action, evaluation and continuous improvements are the vital components of a system that represent safety in a construction sector are shown in Fig. 1. The system encompasses more than documentation areas as it describes the real execution of various activities and practices. A safety system includes all policies, objectives, roles, duties, accountability, codes, regulations, interactions, methods, techniques, instruments, information and records for safely managing site operations [2].

7 Behaviour-Based Safety (BBS)

This approach mainly deals with systematic approach of utilization, studies on psychology and human behaviour. BBS method is described as a bottom up approach along with the support of safety leaders. It is a data-driven or analytic method in which

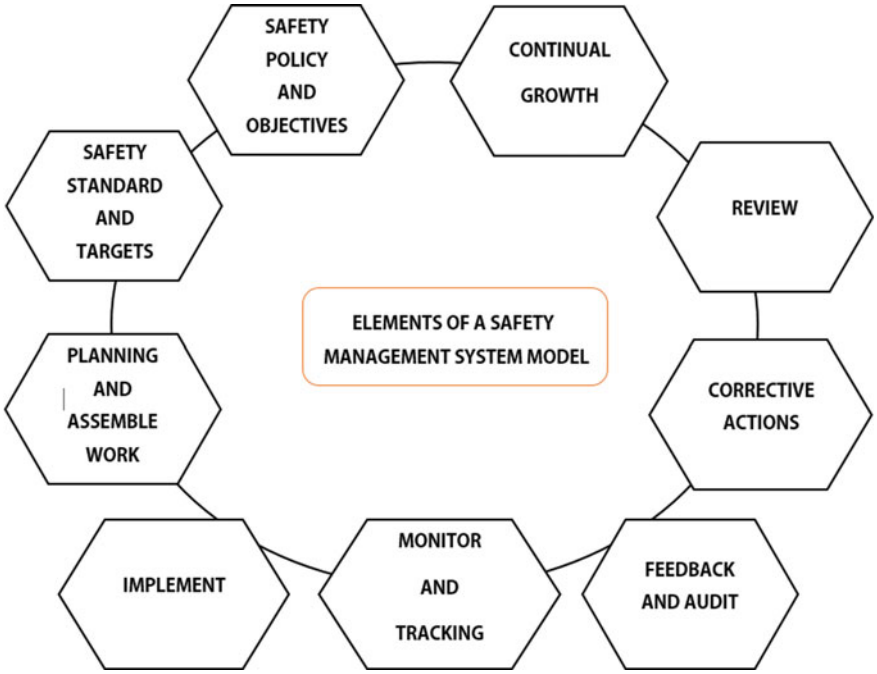

Fig. 1 Model of a safety management system's basic elements [2]

key behaviours of the workforce are detected and focused to make some impact that could create positive change in the workforce. It is based on principles of engaging, assisting and reinforcing safety behaviours. The changing behaviour of workers is on certain safety-related activities that are routinely carried out by labourers. Behaviour-based safety is more focused on increasing safety behaviours rather than focusing on the time period of injury. Positive feedback is an effective way to reinforce safety behaviour and corrective feedback for risky observed behaviours. Activities carried out by the employee are routinely assessed in order to determine baseline ratings. Goal-setting sessions with the input of staff are planned to set reasonable and realistic performance standards with these scores. To maintain a safe working atmosphere, employees are emboldened. BBS is a continuous process rather than one time process because the safety officer must continuously promote BBS to get desired results and help the workers to perform safely as a product of various safety behaviours and improve the overall safety culture [14, 15].

8 Factors Influencing the Model Development

This model, defined below, aims to make an objective study in safety culture and make it easier to improve safety in the construction sector. According to Cooper, the role of a relation between behaviour of management and worker behaviour is recognized in accident causation models. This model provides an overall framework and a multi-methodology approach for better evaluation and improving the overall safety of the construction site and the definition of safety culture model is formed from various factors including individual as well as organizational factors [3].

(A) ***Personal Factor***

The personal factors that influence safety include communication skills, the personal skills and competency. The overall attitude of the person as well as the personal traditions, the company practices. Each personal attitude will vary but the only attitudes that are common to the work practices might be shared throughout the construction company. Worker enforcement programmes will help in developing personal factors which influence safety [16].

(B) ***Management Factor***

The managerial factors include the management policies as well as the mission and vision of the construction company including the routine supervision activities carried out within the organization. Organizational support is very important to effectively manage the safety system and maintain a healthy relationship between the supervisors and employees. An effective safety management system includes both safety behaviour and safety leadership to maintain safety and these should be included in the safety codes and standards of the company policies [16].

(C) ***Behavioural Factor***

Behavioural safety evaluation will give an overall idea of the workers' mentality related to safety and how they approach the safety measures, and it is done by conducting behavioural checklist inspections for unsafe and safe. The safe and dangerous behaviours will then be measured regularly by trained and experienced observers to determine the baseline safety scores. The behavioural safety results are valid only for a certain time period and it must be evaluated and checked frequently and revised regularly, and these results will help to develop safety awareness and training classes to be provided to the workers to improve the safety culture of the construction company [2].

(D) ***Relationship Factor***

Relationship factors include the overall relation that the company holds between the stakeholders and interpersonal skills that are practised by the organization. Globalization and market competition between the companies have made many changes

in terms of technology as well as the importance to maintain a safe environment towards the workers within the construction site. Globalization has improved the working nature, industrial relations and expansion of the company resulted in an increase of overall productivity of the company [16].

Safety Culture Model

Safety culture included in the practices of organization is termed as safety culture model, and there are two theories for determining the person's psychological behaviour management: they are social learning and cognitive theories. Safety culture model interplays with both the behaviours of management and workers. According to Bandura, the factors like environment and individual persons are mainly responsible for workers' behaviour engagement. As we all know that the connection between the organization and safety culture is not up to the mark and there are some issues like organizational transparency, decision-making skill, coordination principles and handled safety culture as a different category. "Socio-technical model" was developed by linking the safety culture and safety socio-technical systems which includes worker, organization and technology for a better safety practice. By following this model, it recovered the gaps between the organization's things and characteristics. By conducting an audit using this model in the other sectors like petrochemical-based plants, the results were convincing and the organizational factors for developing the safety culture for the construction project were found by using this model [6].

Another popular safety model known as "Total safety culture Model" which also includes the concept of safety culture but the factors are different compared with other models, and the factors are environment factor, person factor and behaviour factor and the concept is known as safety triad, this concept includes the informative composition of the individual factors. As discussed above, the Bandura's model, there is other model based on this it is known as "Reciprocal Safety Culture" used to define the concept of safety culture in this model there are three different factors like observable ongoing safety-related behaviours, subjective internal behavioural factors and objective situational features. For measuring the safety culture, there are measurement tools like safety management audits, safety climate survey and safety management inspection [6, 17].

Safety Culture Maturity Model

To identify the safety culture maturity model of an organization, Fleming developed a model based on various elements including management and cooperative involvement based on their capability, productivity of the organization, the management visible safety willingness, effective communication, safety resources, the nature of working environment, the level of job satisfaction, inter-relational qualities and trust, the level of training provided to the workers and the level of maturity is determined by the ratings given to these elements and deciding at which level is the organization currently is appropriate for its evaluation. The improvement of the weaker levels will determine the progress level of the organization. However, this safety culture model proposed by Fleming was developed as a diagnostic tool but needs more research regarding this model [18, 19].

Fig. 2 Total safety culture model [14]

Hudson developed a safety culture maturity model based on pathological problems created by the workers, reactive actions from authorities, calculative management approach with collection of data, proactive workforce involvement towards safety, generative active participation and the framework of this model is applied to countries like Oman and the United Kingdom. When trying to improve the performance of the company, these different stages of safety culture must be taken into consideration. In other point of view, an organization cannot state the fact that it has a safety culture without passing through these elements of the model. Implementing these safety models takes time due to the nature of organization and the development may vary from one sector to another. Many organizations have achieved a good safety performance for their development but not all have achieved the highest stage of safety culture maturity. The importance of this safety culture model is that it gives a reference to the current level of safety culture the organization is following and can take appropriate measures to improve them [18, 20] (Fig. 2).

9 Innovation of the Conceptual Model

In the past, many studies are one on safety culture, and at last, in the end, every model failed to some extent and has some limitations. So now with the increase in technology, all the limitations of the previous approach have been modified. Some

research work is done in measuring the resilience level. For a super safe organization, the resilience safety culture is preferred. Recent times, many trials and research are done to bring the concept of resilience into organizational culture, and there are many issues in applying the concept of resilience to organization some of the issues are.

(a) Improper information about the theory of resilience safety culture
(b) Unidentified and undefined dimensions
(c) No practice of resilient culture in construction organization.

The model in this theory fulfils all the issues like measuring the dimension of resilient safety by resilient system, and secondly, it also explains the practice of the concept in construction organization and the final drawback is overcome by proposing a model like this in the construction projects. By using this final model, three practices can be fulfilled; they are hazard implementation, error management and creative organization practices. Finally by using this model, the organization can be super safe and can achieve the highest safety performance in the construction sector [21, 22].

10 Conclusion

In summary, this paper contains the concepts of safety culture, organizational culture and the new model of resilient safety culture. The traditional concept of resilient safety culture has some minor issues regarding the implementation in construction projects but later on, all the drawbacks of traditional resilient safety culture have been overcome and a new model of resilient safety culture is developed. The factors that influence modelling of the construction safety culture are personal factors, management factors, behavioural factors and relationship factors. The model serves as a conceptual foundation for deciding what to analyse and measure in terms of construction safety culture and how to do so. By following several sub goals, it allows you to follow a goal-setting paradigm. Safety climate surveys, system audits/inspections, measures of safety performance and peer observations may all be used to measure employee safety behaviours, attitude and situational or environmental factors eventually determine the overall safety of the construction site. By using the theory of resilient safety culture, the organizational safety performance can be improved. Apart from safety culture and resilient safety culture model, there are other models like "Total safety culture model", "Socio-Technical model", "Safety Maturity Model" and "Reciprocal Safety Culture", each models has their own methodology and all models deals with the same theory which indulges with the management behaviour and workers' attitude. As discussed in the literature review, safety culture is a combination of the workers' attitude and the rules held by the private groups. Evaluation of people's perceptions is done by using safety surveys and interviews.

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