2017-5435/14/63-155-162
INTERNATIONAL JOURNAL OF OCCUPATIONAL HYGIENE

IJOH 9: 155-162, 2017

ORIGINAL ARTICLE

Establishing of Participation Maturity System in Safety Management by Using Safety Culture Maturity Model through Targeted Hazard Identification System (THIS) Technique

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Received July 01, 2017; Revised July 25, 2017; Accepted August 14, 2017

This paper is available on-line at *http://ijoh.tums.ac.ir*

ABSTRACT

Current study aimed at establishing and improving participation maturity system based on safety culture of maturity model through Targeted Hazard Identification System (THIS) technique in safety management system conducted an intervention in rolling industry. The present study was carried out as a case study in a rolling company from 2012-2015, composed of 72 participants. Firstly, participation status was specified using a formulated questionnaire (Cronbach's alpha=0.79). Safety culture maturity model was used in order to establish safety participation model and improve participation maturity system. These steps include ground making for establishment of participation system, participation at management level, individual involvement, group participation, and finally continuous improvement of participation system. In order to develop individual involvement, THIS technique was run. Following implementing interventions for improvement of participation maturity system in three-year period, participation level was reinvestigated. Initial mean score of workers' participation was 26.94, while optimal score of participation is 30, and supports interventions. Mean score of participation after interventions and establishment of safety participation system was 34.06 which was a bit higher than expected average. Although workers' participation in safety management system is away from ideal maximum, essential attempts are needed. Realization and achievement of participation for improvement of participation maturity are focused on investigation and identification of effective and facilitator factors in this process. To this end, planning and implementing improvement programs in structured and systematic way including training and increasing awareness of workers in workplaces and creating participatory structures and formulating instructions can be effective in participation.

KEYWORDS: *Participation maturity system, Safety management, Safety culture maturity model, THIS technique*

INTRODUCTION

Workers' participation is recognized as one of the main elements in achievement of safety culture and climate which specifies outcomes related to safety including events [1]. Participation in safety programs is raised as a form of safety behavior, goal of which is determining any possible contrast, and helps workers to become aware of critical issues and information related to safety and health [2].

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in safety programs is raised as a form of safety behavior, goal of which is determining any possible contrast, and helps workers to become aware of critical issues and information related to safety and health [2]. Thus, participation level is reached to optimal level among individuals so that the organization can be directed toward creating a sustainable culture. Therefore, establishment of safety culture is important for any optimal changes in the organization including improvement of conditions and successful performance of safety management system [3-6]. If a system has safety culture, attitude and behavior of individuals toward safety and occupational health issues are more institutionalized in them [4-5, 7].

Participation describes voluntary activities that contribute to strength and develop safety in a supportive workplace [2, 8]. These activate include communicating safety issues to coworkers [2], assisting coworkers, and performing safety tasks [9], analyzing accidents, reviewing procedures and rules [5], promoting safety programs [10], and tending to attend in safety meetings and committees [5, 9]. These activities have special role to enhance the performance of safety policy [11], improve [1] and promote safety in the workplace [10].

Thus, success of safety management system depends on the establishment of participation among workers of the organization. Management systems can have the best performance in creating participation among human resources when they use safety culture maturity model (SCMM) [7]. This technique enables the managers to purposefully use organizational resources and activities considering existing threats so that suitable safety culture is achieved [12].

The current study was conducted to establish and improve the participation maturity system (PMS) in an industrial environment. SCMM was used for developing PMS at all organizational levels. In addition, Targeted Hazard Identification System (THIS) technique was used for developing individual involvement.

SCMM: There are many models regarding safety culture including standard and experimental models, most of which refer to participation and involvement of workers in safety issues. Among various models, SCMM directly considers participation as one of the main aspects in improvement of safety culture. This model includes five levels [13-15]. At first level, emergence and manifestation, safety is defined as a technical and procedural solution. At second level, management is committed toward the safety and attempts for prevention of accidents, and top managers show tendency toward participation in safety affairs and occupational health. Third level refers to involvement of active individuals in implementing safety and participation in safety-related issues. Fourth level refers to participation and support and majority of organization's workers are valued and important attempts are done for preventive actions and preventing accidents. Fifth level refers to ongoing improvement, and prevention from all damages (occupational and non-occupational) is raised as real value for the organization and various indicators are used for monitoring safety performance and searching for better mechanisms for risk control.

THIS: THIS method is designed to enhance the ability of employees in order to identify and target to safety and health hazards related to work environments. This method also provides a possibility opportunity for employees to share and transfer their observations to other colleagues in the workplace. Factually, this method enhances the proactive safety and support the cooperative system among employees. It focuses all attentions of employees on the main hazards that are the root causes of undesirable consequences in the company (Philips Lighting Company) [16]. The THIS approach attend to targeted hazards that are the top main hazards with undesirable consequences.

MATERIALS AND METHODS

Current study as analytical- cross-sectional type was conducted as intervention that conducted from 2012-2015. First, respective industry's conditions were examined and monitored. Considering findings and studies, interventions were taken place aiming at improving safety participation. This study was carried out as a case study in a rolling company, composed of 72 participants.

Informed consent was taken from the participants before the study and the study was approved by the Ethics Committee of the university. Steps are provided in the following.

Questionnaire: Formulated questionnaire was used for evaluating participation level of individuals. Self-implementation semi-supervised method was used. In addition, five-point Likert scale was used for measuring participation score.

Interventions were taken for improvement leading to establishment of participatory system in this complex. After three years, participation level was examined for specifying effectiveness of intervention actions and provided programs.

Implementing Safety Participation Maturity Model (SPMM) Based on SCMM : The model provided in this study is adopted from SCMM conducted with emphasis on continuous establishment and improvement of PMS (*Fig*.1)

[13].

Level 1: Emergence of PMS: ground making for establishment of PMS.

At this level, grounds for establishment of PMS in the respective industry were formed. This stage dealt with holding explanatory sessions at managerial level, holding educational sessions at management and top workers level, formulation and informing administrative regulation of PMS for all units and parts.

Level 2: Management participation: determining and formation of participation system council;

This level is initiation of management participation and commitment. To this end, participation system council was formed directly supervised by the management. At this stage, managers perceive that root reasons for accidents originate from managerial decisions. Observation of safety principles and rules was actively monitored. Safety was considered as obedience to managerial control including rules and instructions. In addition, top managers were committed to participation in safety and health affairs and engineering controls were implemented.

Level 3: Individual involvement, involvement of individuals and providing proposals.

At this level, individuals took part individually in safety issues. They expressed their suggestions and ideas. At this stage, the form suitable for expressing safety and health-related issues and problems were prepared and formulated. THIS technique was used for implementing this stage.

Level 4: Group participation: developing participation among human resources including workers, employees, and managers. In this stage, continuous sessions were held among workers, employees, and management regarding problems, suggestions and solutions. In addition, suggestions provided in the previous stage were expressed and examined. Then, suggestions were informed to the expert group. Following receiving their ideas, again they were discussed in the meeting. Finally, interventions were taken into account through participation system council.

Level 5: Continuous improvement of participation, following actions were taken for continuous development and improvement of PMS. In this stage, participation challenges and shortcoming were discussed and the quality of participation will be improved for the next stage. Furthermore, with regard to the findings and in order to continuously improve the process of participation, the required corrective actions for the next stage were identified.

1- Providing effective communication and participation among all interested parties especially contractor human resources.
2- Providing instructions regarding preparedness and coordination issues in emergencies associated with higher participation of employees.
3- Formation of technical and safety committee meetings attended by one of the production workers in order to express the safety problems and safety issues directly to the management and officials on a monthly basis.
4- Installing the records of the technical and safety committee on board in order to inform all staff of the new legislation on health and safety issues.
5- Installing analysis account regarding accidents and near misses in the aftermath of any accident and providing corrective and preventive measures to inform and educate personnel on board.
6- Installing the suggestion box to comment by personnel about the company's safety issues.

At the end, cash rewards were given to people who participated with respect to the organization's financial condition and budget.

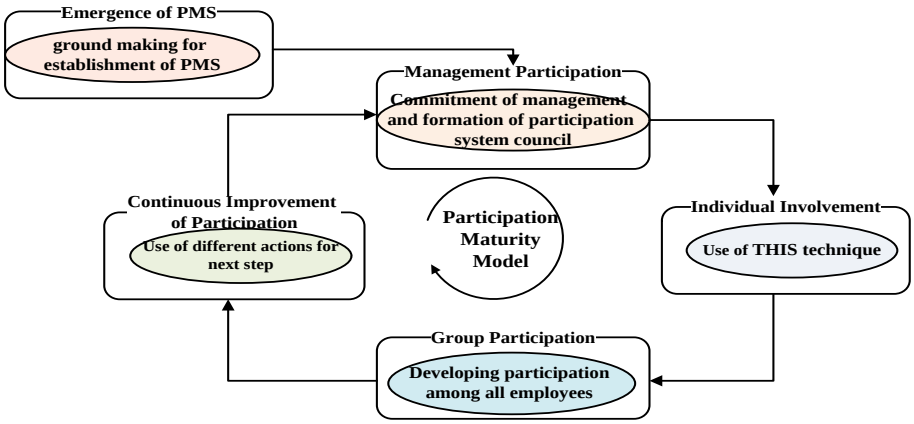

***Fig*.1.** PMS establishment and improvement process (Implementing SPMM based on SCMM[13])

Published online: September 20, 2017

THIS Technique: This technique was implemented in four steps [16]:

Step 1: this step aimed at identifying and perceiving safety and health hazards for the workers. The training was done with emphasis on identification of unsafe conditions and actions, perceiving accidents, near miss and the way of their occurrence. In addition, the way of completing THIS card was instructed.

Step 2: based on the training at the previous level, individuals completed their observations on THIS observation card. The card prepared in this study included observation description, its causing factor, observation time and place, proposed solutions and the name of the person who completed the card.

Step 3: Putting the card in the safety participation box.

Step 4: Reviews, revision and follow up participation cards by safety experts.

Output of this technique was used as input at fourth level of SCMM (*Fig*.2). During implementation of the study, safety expert checked safety participation box daily and took completed cards. In addition, some feedbacks were paled on the information board so that workers are aware of the affairs trend.

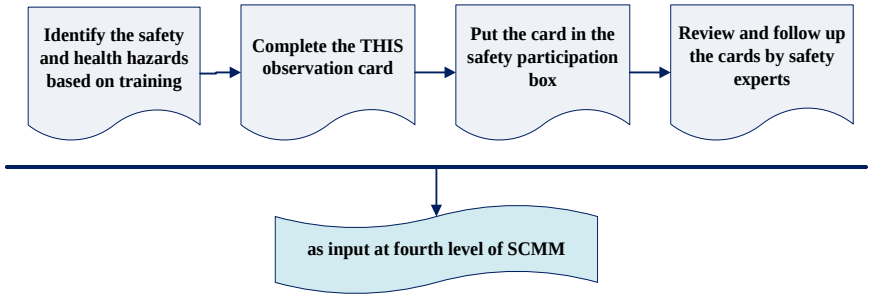

***Fig*. 2.** Individual involvement based on the THIS technique at four steps

Data Analysis: Obtained data were analyzed using statistical processes and related tests including statistical chi-square, independent t-test, and pair-wise t-test via SPSS (ver.16, Chicago, IL, USA).

RESULTS

Demographic Characteristics of Research Population: 10.2% of the study subjects were at management and supervision position. 62.7% were active in manufacturing and technology sector including production line, mechanics, power, etc. 27.1% were active in service units such as accounting, warehousing, and finance and so on. The mean age and SD of the subjects was 31.47 ± 7.31 and they were relatively young. Moreover, mean and standard deviation of their working experiences was 9.6 ± 7.3. All of the individuals in this complex are male except safety and health authority. In terms of education, 15.3% had university education. The rest were people with high school diploma. 49.2% worked during daytime and 51.8% were working twelve-hour shifts for their activities. In addition, 23.7% of them were married and others were single.

Partnership Status at Baseline: In order to measure participation, the questionnaire was used prior to any intervention in order to participation establishment and improvement. Firstly, this stage was aimed at specifying status of participation. In addition, following implementation of interventions, effectiveness of interventions was also supported. Validity of the questionnaire was examined using expert ideas, and content of some items was changed. In addition, reliability of questionnaire was examined using ideas of workers in service, manufacturing, and management staff in rolling industry and given similar regional culture. Cronbach's alpha was obtained as 0.79 that was acceptable. Mean participation score of workers at the beginning of study before any intervention was 26.94±0.437, while mean optimal score of participation is 30. This finding suggests lower participation score compared to optimal score and supports implementation of interventions for improvement of participation.

Relationship between Safety Participation and Demographic Variables: In this step, relationship between safety participation score with demographic variables including marital status, job rotation, age, working unit, education level was evaluated. The relationship between marital status and safety participation with independent t-test showed that married or single status had no effect on safety participation level (P=0.069). The independent t-test showed that job shift of individuals at work does not affect the safety participation (P=0.571). In fact, there is no significant relationship between these two parameters. The relationship between age and safety participation with correlation test showed

that age does not affect safety participation of individuals (P=0.27). The relationship between working unit and safety participation with ANOVA test showed working unit does not affect the safety participation (P=0.439). The relationship between level of education and participation of personnel with one-way ANOVA showed no significant correlation between these two parameters (P=0.170).

Results of Participation Card in PMS: Management and safety expert reviewed the cards completed by workers, and some measures were taken for eliminating deficiencies (Table 1). Most observations were related to production line (60%). Over 50% of reports addressed investigation and description of unsafe conditions by workers. In addition, 52% of proposed solutions refer to improvement of unsafe acts. In addition, 26% of subjects believed that if the cause of unsafe condition, the prevention way can be through unsafe action. Of course, 17.39% believed if the cause of unsafe action, the prevention way should be done through unsafe condition.

Table 1. Results of investigating participation card in PMS

Cases reviewed in participation form	**Results obtained from participation form**		
Observation outcome	34.8% of observations were allocated to presence of hazards	39.1%: near miss	26.1%: incidents with serious consequences
Observation time	11-12 (40%)	1-2 (21%)	10-11 (25%)
Observation description	52.2% described unsafe conditions	17.4% described unsafe acts	30.4% described accidents
Observation place	60.9% of observations were from production line workers	36.1% of observations of production line of their coworkers	3% did not express
Proposed solutions	52.2% referred to improvement of unsafe actions	45.8% mentioned correcting unsafe conditions as prevention way	2% did not provide any solution
Mentioning the name	95.3% mentioned their name	4.6% did not mention their name	0.01% had illegible name

Participation Status after Interventions: Re-evaluation results for workers' safety participation after three ears showed the value 34.06, which suggested positive impact of safety PMS establishment. The maximum score possible in this study was 50. According to the poll, 85% of workers showed tendency to participate in technical and safety committee sessions. About 83% of them regularly studied minutes related to technical and safety committee on the board. Overall, 67% of workers tended to participate in providing instructions on safety and health issues. In addition, 45% of workers tended to participate in accident analysis. Finally, some gifts were given to active individuals for encouragement and acknowledgment.

DISCUSSION

Modern approach emphasizes on promoting participation in order to enhance safety culture in safety and health management system recognized as one of the factors affecting safety performance [17]. Current study aimed at providing a safety participation environment among workers of the respective industry. Considering culture model [6, 18], creative step refers to active and dynamic participation at all organizational levels. In this step, safety is perceived as an integral part in work place. Current research also attempted to perceive participation in safety management system as integral part of safety activities at all organizational levels. In fact, realization of safety and health objectives depends on development of participation culture among human resources of the organization [19]. It requires identification and consideration of necessary grounds, facilities and conditions as effective and facilitator factors related to achievement of participation. Thus, current research dealt with establishment of PMS in safety management system using SCMM and THIS technique at different levels of the respective industry.

Management commitment is recognized as one of the basic and influential factors in participation [8, 20] and plays significant role in safety performance especially participation in safety issues [2]. In fact, the higher is management commitment toward safety; individuals discuss easily regarding various issues related to workplace safety. Thus, workers' participation and their decision-making about safety issues got higher [21-23]. It leads to increasing attitude and priority of safety overproduction [20]. While lack of management skill [24] or negative attitude toward individuals' participation in safety issues is regarded as one of the critical challenges in participation process [25]. In this study, developing commitment and participation in management was

Published online: September 20, 2017

considered as second level.

Given wide range of hazards existing in occupational environments and unacceptability of its consequences and outcomes, identification and control of dangers is necessary and participation and utilization of though and creativity power of all workers and involvement of personnel in promoting workplace safety level is acceptable [26]. Hence, one of the key factors in success of safety systems is workers which should optimally participate in the organization [27-28]. Therefore, THIS technique was used in this work for developing individual involvement system. This technique is specifically designed for enhancing ability of workers for perceiving, identifying, and determining safety and health risks of workplace. Individual involvement refers to the fact that how organizations direct workers for participation in safety issues, accident analysis and risk identification [5].

Active and dynamic participation in safety management system requires that individuals have mastery and awareness over nature of their job and working activities and are able to identify hazards, near miss, incidents, and events given the working nature and process, and accordingly participate in it in active and ongoing way. Getting individuals involved allows that workers pay more attention to their environment and identify workplace risks and dangers which may lead to damage if not adequately considered so that control strategies are considered if necessary [29].

Participation grounds for all individuals in the organization should be prepared for improvement and controlling workplace hazards [26, 30]. Ineffective organizational culture, management should develop coherent and mutual communication in formal and informal manner among labor force and encourage workers to participate in safety-related issues and effective solutions [22, 31]. Participation of workers in decision-making and participation in safety issues can provide suitable workspace developed in fourth level of study aiming at increasing interactions among labor forces and human resources in the respective industry. Group participation means providing suggestions, ensuring cooperation and participatory actions in safety [17, 20]. This level is recognized as a method for empowerment of management and increasing safety participation in workers [9] and as a motivational factor leads to increased performance and commitment of workers toward the organization [32].

One of efficient tools and solutions for improvement of group participation is using suggestion and proposal system. Group participation allows that workers perceive their role as effective in the decision making trend and on safety and health processes. Participation in safety management system and giving proposals is a voluntary activity and individuals involve considering their personal tendencies [1, 8] and it causes that their activities are directed toward achievement of safety system objectives [26]. In this study, in order to organize proposals and suggestions of workers, participation system council was founded for receiving suggestions and evaluation of proposals on a regular basis, because access to proposals of workers can empower the organization and provides a powerful intellectual resource.

Following up acceptable suggestions and appreciation of bidders is one of the factors affecting participation of individuals. Strengthening participation spirit among workers and creating opportunities for establishment, implementation, and evaluation of safety programs are outcomes of such actions [31, 33]. In this study, proposals of all workers were welcomed. In addition, unacceptable proposals were also appreciated in written form and were logically replied. Some gifts were considered for active individuals for acceptable proposals given effectiveness of proposed proposals. Using reward system as motivational factor causes influence of management on safe behavior of workers [34]. It can influence beliefs and values of workers and thus it would affect quality and stability of participation [35]. Safety is perceived as an important priority by individuals and they would have more positive perception toward the environment [20] and they would be more committed to their work and this commitment is raised in the form of safety and health issues as an aspect of safety culture, and ultimately leads to enhancement of safety culture [9, 36].

One of the strategies utilized for continuous improvement of participation in this study was providing safety and health instructions. Preparation and formulation of instructions were done aiming at optimal participation and communication. For example, instruction of expression and registration of working problems and safety issues during shift change to supervisor of the next shift was done for understanding and perceiving the safety conditions. By providing written and formulated instructions based on the policies supported by the management it is possible to increase participation level [31, 37]. Individuals' participation can be optimally used for improvement of organizational activities and objectives in safety management solutions [31]. Of course, it requires consideration of obstacles and challenges for PMS continuous improvement, taken into account in safety management plans. More efforts are needed for achievement of ideal participation so that workers' commitment and participation in the future is ensured. Following approaches are emphasized for increasing participation of workers and their commitment toward safety:

- Increasing workers' participation in planning
- Improving communication between managers and workers through development of communication system and educational activities development
- Developing workers' activities by motivating them and training in order to extend their participation in decision making
- Developing and establishing working groups about their problems and finding solutions
- Publishing and disseminating workers' proposals suggestions

Research Limitations

One of the main aspects of safety culture is participation development [38]. While current study only addressed establishment and improvement of PMS based on SCMM, actually lack of consideration of participation effect on safety culture is one of the limitations in the current work taken into account in the future studies. Small sample size at management level is the other research limitation. Thus, larger sample size, especially at management level, should be considered in the future research works. In addition, individuals' participation influence efficiency and growth of the organization and causes that motivation and trust are increased in the organization, investigated in the future works.

CONCLUSION

Necessary actions were taken for improvement of participation level at all organizational levels and total participation level was increased. Safety culture enhancement can be mentioned as one of achievements of promoting individuals' participation which is ultimate goal of management for occupational safety and health objectives, discussed in future works.

ACKNOWLEDGMENTS

The authors would like to thank all employees in rolling company that participated in this study. No financial support was received for this study. All authors have no conflicts of interest to declare.

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Published online: September 20, 2017