



AN INTERVENTION STUDY ON BEHAVIORAL COMMITMENT-BASED SAFETY IN THREE PETROLEUM COMPANIES IN ALEXANDRIA "FULL STUDY"

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ABSTRACT Safety problems are related to unsafe & careless employees, many safety problems can be resolved, if behaviors are closely monitored. Studies found that the causes of accidents at the workplace were due to the workers negligence, failure of obey work procedures, and poor safety attitude.⁽¹⁾ Survey study was designed to determine the current status of commitment behavioral based safety in some petroleum companies in Alexandria, analyze the safety management, identify its dimensions, propose the consequences of safety management and employees' safety behavior, reduce risks and improve safety. The research has been performed on 3 petroleum companies. First survey on the 3 companies was individual survey measuring the percentage of apply the occupational management systems according to OHSAS 18001/2007, the second survey was carried on Company A for measure the relation of safety behavior with safety knowledge, the total participated number (n=100); The study was done during the period from January 2016 to May 2017.

KEYWORDS : BBS, behavioral based safety, commitment, OHSAS 18001/2007, petroleum, safety.

1. Introduction

According to the Behavior-Based Safety Approach and Safety Improvement, the Behavior-Based Process was created in 1998 and was included in a larger program to prevent accidents. Originally, it concentrated on "typical" safety concerns, but studies have shown that it can enhance safety behavior and lessen injuries.⁽²⁾

In application BBS is a "bottom-up" approach where the primary attention is directed at specific safety related behaviors that are typically performed by frontline employees. Changes in the frontline safety behaviors will improve safety performance and over time diffused into the organization to become culture. The mode of safety intervention is effective significantly improving employee safety performance. The implementation of BBS showed a reduction of injuries rate, indicating the possibility of application of BBS to improve performance.⁽⁵⁾

Behavior-based approaches are intended to safely focus on systematically studying the effects of various interventions on target behaviors related to the applicable certified safety management systems, 1st by defining the target behavior in a directly observable and recordable way, and 2nd by observing and recording it in its natural setting. When the stable baseline measure of the 1-frequency, 2-rate, or 3-duration of behavior is obtained, an intervention is implemented to change the behavior in beneficial directions. Moreover, studies suggested that the typical implementation of behavior-based safety program usually involves four well-defined steps.⁽⁶⁾

The BBS steps start by defining one or more critical behavior targets. Certain work conditions allow for the observation and recording of behaviours. Once a baseline measurement of a behavior's frequency, duration, or rate is established, an intervention is put into place to shift the behaviour in a positive direction.

To change the likelihood that a reaction will occur, this intervention may involve removing obstacles, changing workstations, and introducing antecedents or consequences. The length or rate of the target behaviour is noted both during and after the intervention, and its effect is compared to baseline measures of behavior.⁽⁷⁾

Methods

2.1. Sampling

A survey on the three companies was individual survey measuring the percentage of applying the occupational management systems according to OHSAS 1881/2007 using ACC's workplace safety management audit checklist which aligns with AS/NZS 4801:200.⁽⁶²⁾ The criteria for sample selection are where a company should be certified as an integrated management system (OHSAS 18001, ISO 14001, and ISO 9001) and achieve the lowest percentage of complying with the OHSAS 18001/2007 requirements.

A random sample of workers (n=100) from Company A were selected as a study samples, the selected sample accepted to fill in the BSI audit questionnaire (BSI)(63) and DOW questionnaire (DOW)(64) for

safety behavior. ACC's workplace safety management audit checklist can be used in Measuring your capabilities in workplace Safety

2.2. Description of the three types of Questionnaires

The ACC's workplace safety management audit checklist is to measure the company's health and safety systems and practices against these Workplace Safety Management Practices Audit Standards. The checklist has proven reliable and valid. It contains positively and negatively formulated items using a three-point complying scale. The scale respondents to take a stand as to what degree they comply with each item, and are scored as follows: comply=Yes; not fully comply=No; not applicable or no prove=N/A.

The BSI audit checklist has been adapted and modified to 6 clauses according to OHSAS 18001/2007 elements to evaluate and assess the health and safety management systems. It has proven dependable and valid. It contains positively and negatively formulated items using a seven-point complying scale. The scale respondents to take a stand as to what degree they comply with each item, and are scored as follows:

- Fully documented and fully applied.
- Partially documented and fully applied.
- Un-documented and fully applied.
- Fully documented and partially applied.
- Partially documented and partially applied.
- Not documented and partially applied.
- Not documented and not applied, or I do not know.

The safety action checklist has been adapted and modified to 32 questions according to DOW chemical safety behavior self-checklist to evaluate, assess the awareness and understanding of safety techniques.

The safety action checklist was used as a survey of candidates to check the awareness and understanding of safety techniques.

The score in Modified BSI ranges from 0-6, where zero is the lowest score and 6 is the highest score and belong to the following criteria:

- Score zero = no knowledge.
- Score one and two = little knowledge
- Score three and four – medium knowledge.
- Score five and six = high knowledge

The score in Modified DOW ranges from 0-3, where zero is the lowest score and 3 is the highest score and belong to the following criteria:

- Score zero and one = low behavior.
- Score two = medium behavior
- Score three = high behavior

2.3. Pilot Study

A pilot study was conducted on seven workers of quality assurance department and health and safety department other than the participated sample from the selected company. They were selected for two purposes:

- Proper formulation of the final questionnaire sheet to be clear enough.
- To find out any administrative or technical difficulties to deal with them.

2.4. Increasing the awareness and commitments of company workers

Giving a suggested worker from all company departments (n= 115) some training programs to increase the commitment to safety and safety behavior.

- OHSAS 18001/2007 “comply and audit of health and safety management system”.
- NABOSH in oil and gas "International examination board in safety and health in oil and gas field"
- NFPA 1035, standard for professional qualifications for public fire and life safety educator
- NFPA learn not to burn, a safe escape house.
- OSHA "introduction to occupational safety and health administration"

2.5. Timetable of the study

The comparative study of safety management applying on the three petroleum companies sample of petroleum companies in Alexandria, and safety behavior in one company of them. The safety behavior survey was distributed, and responded to, over 15 months. from the period from January 2016 to May 2017. The safety behavior questionnaires were administered during work hours. The questionnaires data were collected and processed for a period of 3 months following the initial data collection phase. Then measure the change of safety behavior after the training for 3 months. The study's intent was to compare the employee's perception of safety behavior domains and the factors to be strengthened to build up a good safety behavior and therefore enhance safety performance through promoting and understanding of management practices,

2.6. Statistical Analysis, Data analysis

The data collected through the Modified BSI with Dow items were revised, coded, analyzed, and fed to statistical software SPSS Statistics (IBM-SPSS Statistics, 2010) version 20. The given graphs were constructed using Microsoft Office Excel (2007 and 2016).

2.6.1 Regression analysis: is a set of statistical processes for estimating the relationships among variables. It includes many techniques for modeling and analyzing several variables when the focus is on the relationship between a dependent variable and one or more independent variables (or 'predictors'). More specifically, regression analysis helps one understand how the typical value of the dependent variable (or 'criterion variable') changes when any one of the independent variables is varied, while the other independent variables are held fixed.

3 Result

3.1. The ACC's workplace safety management audit checklist

Table 1. The percentage of companies' HS management system achievement with the nine element of solo audit survey.

achievement %	Company A	Company B	Company C
Element One	46.6	60	56.7
Element Two	90	100	95
Element Three	77.3	81.8	81.8
Element Four	45	87.5	83.3
Element Five	77.7	83.3	83.3
Element Six	40	100	100
Element Seven	100	100	100
Element Eight	100	93.3	93.3
Element Nine	100	100	100
Sum	75.2	89.5	88.1

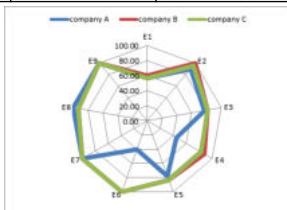


Figure 1. The percentage of companies' HS management system comply with the Nine Elements of solo audit survey.

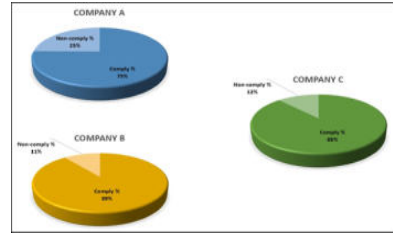


Figure 2 The total percentage of companies' health and safety management system comply with OHSAS17001/2007 audit survey.

From the result of ACC's checklist, the company that has lower achievement percentage was Company A which get 75% comply with the OHSAS18001/2007 thus Company A achieve the further studies with the second and third questionnaires “The DOW questionnaires & BSI questionnaires” to measure the worker commitments for safety and understanding the safety and health management systems.

3.2. The Modified DOW questionnaires & BSI questionnaires A- Modified BSI Questionnaire result.

The study is exclusive for technician workers that are involved in the assessment to answer only the DOW questionnaire and not answer the BSI questionnaire because of its high technicality and language values. The maximum degree that the participated worker can get is 204 degrees, the lowest degree is 77 (37.75%) that worker S42 get, and highest degree is 158 (77.45%) that worker S4 get. The degrees that participated workers get and the percentage of knowledge for the health and safety management "OHSAS 18001/2007" is shown in Table 3.11 and Figure 3.12.



Figure 3. The participated worker knowledge percentage

B. Modified DOW Questionnaire result.

The maximum degree that the participated worker can get is 96 degrees, the lowest degree is 23 (23.96%) that worker S52 get, and highest degree is 82 (85.42%) that worker S65 get.



Figure 4. The participated worker safety behavior percentage.

3.3. Increasing the Awareness and Commitments of Company Workers

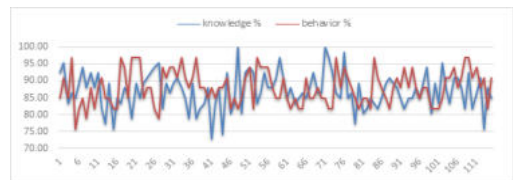


Figure 5. The participated worker knowledge and behavior percentage after training.

3.4. Analysis of Linear Regression

3.4.1. Regression Before training

Table 2. Behavior before training Coefficientsa

Model		Unstandardized		Standardized Coeff Beta	t	Sig .
		B	Std. Error			
1	(Const)	16.143	18.526		0.871	0.386
	Behavior B.	0.254	0.291	0.088	0.874	0.384

a. Dependent Variable: Knowledge before training

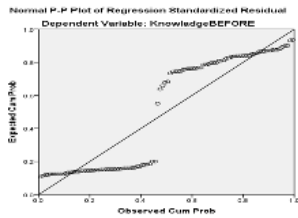


Figure 6. Regression analysis for the Behavior before training in relation to Knowledge showing the relation between observed and expected probability.

3.4.2. Regression after training

Table 3. Behavior after training Coefficientsa.

Model		Unstandardized Coeff		Standardized Coeff Beta	t	Sig.
		B	Std. Error			
1	(Const)	97.379	8.660		11.245	.000
	Behavior	-0.118	0.098	-0.112	-1.197	0.234

a. Dependent Variable: Knowledge after training

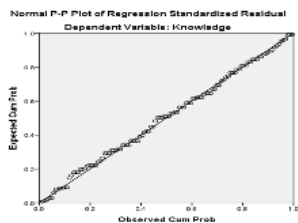


Figure 7. Regression analysis for the Behavior after training in relation to Knowledge showing the relation between observed and expected probability.

4- Discussion

In this hypothesis, safety knowledge role as a core interpreter of personnel safety motivation to safety is investigated. Five primary first order characteristics, including management commitment to safety, employee attitudes towards safety, coworkers' support for safety, behavioural workplace pressure, and behavioural sites safety management systems, are used to construct safety culture as a second order latent component. The results of the study demonstrated that safety culture significantly positively influences employees' incentive to behave safely (=0.112, p=0.234). This result emphasizes the role of safety culture as a central predictor of personnel safety motivation to behavioral safety. Furthermore, the finding highlights the significant contribution of safety management systems and management commitment to improve personnel safety motivation to petroleum safety by making them involved in safety processes, accommodating their safety concerns, assigning clear safety accountability to enable personnel to make crucial decisions about safety problems, and more essentially, to empower the personnel to be more committed to adhere , as well as to improve safety daily rules and procedures. Mohamed (2002)(70) conducted a safety climate investigation study on behavioral workers in ten different construction companies in Australia. He used the following aspects of safety climate including management commitment, communication, workers participation, attitude, capability and skills, management positive monitoring, safety rules and procedure and supportive environment.(71) The results of the study stated that safety climate has a positive impact on a supportive environment and positive monitoring, which are directly related to safety motivation.(72) Many studies evaluated safety climate dimensions and they concluded that employee safety empowerment and motivation are greatly affected by safety culture.(73, 74, 75, 76)

Furthermore, safety culture is positively impacted by management commitment, management support, workers motivation through awards to good safety culture(76, 77). Based on the questionnaire approach of their study, they stated that behavioral improvement and good safety behavior reassurance are the main blocks that a good safety program consists of.(76, 77) Also, Ismail et al. (2012)(78) stressed in their study that safety culture has an influence on management support and workers motivation because they are considered as safety climate elements. Therefore, the previous study in literature supported the findings of this research in regard to the influence of safety culture on personnel safety motivation to behavioral safety.

The research's final findings relate to the direct influence of safety culture on employee mistake behaviours. Safety culture does not significantly influence staff mistake behaviours directly (=0.112, p=0.234). Personnel awareness about safety culture in petroleum is not sufficient to influence error behaviors. There is a study implemented by Fogarty (2004)(79) that investigated safety climate effect on maintenance personnel error behaviors. It was concluded in Fogarty (2004)(79) study that error behaviors of maintenance personnel could not be interpreted only through safety climate directly. This supported the study result in which safety culture has no direct effect on behavioral personnel error behavior. Therefore, safety culture is not enough to be only used for predicting behavioral personnel error behavior, which was supported by Fogarty (2004)(79) study.

5- Study Implication

The present study has several implications for safety culture research in behavioral field and also for Petroleum Company's field. First of all, the study indicated that safety knowledge has a significant effect on personnel safety motivation to behavioral safety. This outcome implies the substantial need to assess and enhance safety knowledge in behavioral sector. Petroleum companies' top management personnel should concentrate on appraising and improving the current safety culture in the behavioral sites, which, in accordance, will improve personnel safety motivation to behavioral safety. In order to improve personnel safety motivation to behavioral safety, Egyptian petroleum government behavioral officials should have a high management commitment to safety, enhance employee attitudes through safety awareness and should get workers involved in decisions regarding safety.

Second, the present research confirmed the significant influence of safety culture role in forming personnel safety behaviors in petroleum sites. Safety-behavior culture did have a direct and significant effect on behavioral personnel attitudes toward risks and an indirect impact on behavioral personnel error behaviors through safety motivation. These outcomes emphasize the obligation of Egyptian petroleum governmental behavioral management to decrease unsafe conducts and improve safety processes and daily application routine. These results highlight the urgent need to examine safety management systems, accidents and near miss cases to find out the organizational characteristics that took part directly or indirectly in influencing unsafe performance. Egyptian petroleum government behavioral management should not directly make the decision to blame behavioral personnel for unsafe acts, but instead they should explore the elements that formed their behavior to make an error or risk behavior.

6- Research Limitations

The participation in this research was voluntary, where the respondents were free to join in or abstain from engaging in the survey, or any of the questions contained within. The study was supervised and facilitated by a government institution in Petroleum, in which all the collected information is based on the participation of behavioral personnel working in petroleum companies. The assessment of safety culture, personnel motivation to behavioral safety, personnel attitude toward risks and personnel error behaviors are performed based on behavioral personnel safety awareness to report their safety behaviors as a self-report study using the survey instrument.

Behavioral personnel error and attitudes toward risks behaviors were collected depending on what behavioral personnel believe about their own behaviors. Hence, self-reported behavior questions might make some of the behavioral middle managers hesitant to report their own errors or risks to avoid negative consequences. Although all the data collected in this research is anonymous, behavioral managers may still

be uncomfortable reporting negative behaviors. Therefore, it was an important target for this research to increase the sample size to more than 100 participants in order to overcome or lower the effect of such a limitation, as the information in this study and all self-report types of research are dependent on accurate and truthful opinions from the research participants.

7-Conclusion

As the number of behavioral projects increases to meet the necessary demand of developing cities infrastructures and economic development, the risk probability of having an accident on the behavioral site will be increased. The behavioral sector is one of the major industries that contribute to economic growth and social wellbeing of all countries around the world. Safety culture has a significant role in decreasing accidents and injury occurrences and it has become the center of attention in all industries in recent years, particularly in the petroleum field. Lack of safety culture is a key reason for injury and accident occurrences since safety culture is fundamentally related to organizational culture. Organizational actions and activities are considered as the components of organizational culture that have major contributions in accidents causality in hazardous industries. Organizational culture elements influenced personnel behaviors when performing a required task in the work environment. A focus on understanding and applying safety culture concept in the behavioral field is essential to assure the safety of behavioral personnel in this high-risk work.

The present research evaluated safety culture among behavioral personnel working in petroleum companies. This study investigated the effect of safety culture on personnel safety motivation to behavioral safety and the influence of safety culture on safety performance. The two safety performance measures are behavioral personnel error behaviors and behavioral personnel attitude toward risks. Moreover, this research further explores the mediating role of personnel safety motivation to behavioral safety between safety culture and the safety performances two measures, error and attitudes toward risks. A total of 115 behavioral personnel including project managers, engineers, supervisors and safety engineers agreed to participate in the study questionnaire representing an overall response rate of 12.5%. A confirmatory factor analysis is implemented in order to validate each latent variable in the research. Then, structural equation modeling is applied to test the research hypotheses by extracting the structural revised model. Study outcomes demonstrate the crucial influence of safety culture as a core predictor of personnel safety motivation to behavioral safety. Besides, safety culture has a vital consequence in forming behavioral personnel attitudes and behaviors within the behavioral project. Research findings revealed that safety culture, age and education in petroleum sites accounted for 7% of the variance in personnel safety motivation to behavioral safety, 20% of the variance in behavioral personnel error behavior and 73% of the variance in behavioral personnel attitudes toward risks.

The findings of this study highlight the importance of safety behavior culture as a significant part of organizational culture that influences employees' behaviors and attitudes. Furthermore, the current research verified and demonstrated the major effects of safety culture to improve behavioral personnel safety motivation and their safety performance in the behavioral field. Egyptian government management should provide more considerations for the scope of safety behavior culture in order to 1-detect, and 2-improve opportunities within the safety culture within these behavioral sites.

8- Direction of Future Research and Recommendation

The present research examined the influence of behavioral culture on safety performance in terms of behavioral personnel error in both 1-behaviors and 2-attitude toward risks. Behavioral safety-culture is conceptualized by five main factors, 1-management commitment to safety, 2-employee attitudes regarding safety, 3-coworkers' safety support, 4-behavioral work pressure, and 5-safety management systems in the behavioral sites. Research outcomes demonstrated that behavioral safety-culture has a direct effect on behavioral personnel attitudes toward risks and an indirect influence on personnel behavioral error-behaviors. The direction for future research must be focused on the five scopes of behavioral safety culture to inspect which aspect has the greatest impact on behavioral personnel safety performance. Safety culture is inherited through the individual's mind and psychology and it is going to be reflected in their daily actions and behaviors.

As a future research prospect, researchers may explore the differences among subcultures formed under the general safety culture within the same high-risk organization field, including various industries like aviation, manufacturing, mining, and especially the petroleum sector.

This examination will highlight the positive and negative characteristics of organizational safety culture which reflect the behavioral-based safety of workers in such a way that elaborates and develops the current knowledge about the concept of safety culture.

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