CUSTOMISED SAFETY BEHAVIOUR CHECKLIST AT CONSTRUCTION SITE

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Abstract

Organization X is a project based company which specialised in the installation of scrubber and other air pollution control equipment in Malaysia. In the year 2013, 39 cases of incidents have been recorded during scrubber installation at construction sites. This situation has not only affected the economic burden of the company but has also affected the work efficiency, company's performance and reputation. At risk behaviours of workers were identified as the main contributor to this problem. The behaviour based safety approach have been used by implementing the Safety Behaviour Checklist (SBC) to minimise this delinquent. The study was done to investigate the at-risk behaviours that workers may pose and performed during installation of scrubber. Further investigation on the impacts of implementing the customised SBC was also done. After three months of observations, the study found that the implementation of the SBC contributes to the improvement of workers safe behaviour.

Keywords: Behaviour Based Safety, Construction, Safety, Safety Behaviour Checklist

Introduction

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Safety in the workplace plays a vital need in a construction industry. Employee accidents threaten the integrity of an organisation through personal injuries, lost production time, costly lawsuits, disability payments, damaged equipment and waste materials that often result (Hensen, 1991). The concern for safety in the place of work is a quite recent development. Safety pesonnel, supervisors and concerned workers today are trying their very best to find the “best” safety approach for their safety at the workplace. In general, many companies in the construction industry have spent a lot of time and effort for improving safety, typically by addressing hardware issues and implementing safety management system that includes periodically (i.e. monthly and quarterly) internal safety audits. Over the years, these efforts tend to lead to the dramatic reductions in accident rates. However, a number of minor accidents remain to appear that are stubbornly resistant to all efforts to remove them. Therefore, these minor accidents indirectly contributed to the gradual increase in the accident rate and number in the construction industry.

Since the early 1990’s Behaviour Based Safety (BBS) tools have fast become an established weapon in the war on workplace accidents prevention, as its use has helped many companies dramatically slice through their accident rate and much of these researches on psychological variables have focused on safety-related behaviours (Montgomery and Kelloway, 2002). The focus on behaviour is based on the observation that 70 percent to 95 percent of workplace accidents resulting in injury are thought to be caused by unsafe behaviour (Reber et al., 1989).

Many companies have dealt with this issue by forming a safety committee or department that capable in determining how tasks should be carried out safely. In recognizing that 90 percent of all accidents can be attributed to human error (McKenna, 1983), a typical concern of a safety department is to design the work so that the possibility of risks to happen can be tolerated to a minimum level. Therefore, the Safety Behaviour Checklist (SBC), which is one of the BBS tools is developed that intents to tolerate the risks to a minimum level as well as circuitously improve the worker's safe behaviour modification.

Since the year 2011 until 2013, Organisation X has involved in more than 25 projects that involved installation of scrubber systems. This installation is a high risk job as it involves the external activities, working at height, and use of heavy lifting machinery and equipment as well as hot work activities. Based on the Organization X’s safety record, from January 2013 until December 2013, total numbers of 36 incidents have been recorded which comprise of 19 cases of near miss, 12 cases of employee injury and 5 cases of property damaged were reported during scrubbers installation activities. Even though there is no fatality recorded, all the incidents are in a fret category which potentially affects the worker's safety as well as organisation reputation.

In order to achieve a better safety performance specifically during installation of scrubbers at construction site, improving organisation’s safety reputation and educating construction workers about safe behaviour while conducting their works, a customised SBC which at this prime stage focused only on the installation of scrubbers are going to be developed in Organisation X. Since accidents originate from the at-risk behaviours of people, they can be prevented through the identification and elimination of these behaviours via a customised SBC that main initiative is to improve the construction workers safe behaviour modification and gradually reduce the potential of accidents events. Therefore, it is time to conduct a study among Organisation X's construction workers on a construction site as to gratify all the problems that are currently affecting the organisation reputation in term of safety aspects.

Literature Review

Scrubber

Scrubber is an engineering control system to control the generation of air pollutants before released directly to the atmosphere (Cooper and Alley, 1994; EPA, 1982 and Jaegar, 2007). In other words, it functions as a form of filtration system through a details chemicals reaction process and neutralisation phases. In most industry, scrubber comprised of a range of type and models where the most prominent models used in current industry are wet scrubber, wet scrubber comprised of two distinct models namely venture scrubber and packed bed column scrubber (Jaegar, 2007), whereas for some industry, the use of dry scrubber is important depending on the type of gases or air pollutants that they planned to treat.

The process of installation of scrubber involves several main tasks starting from arriving of the scrubber at the site by delivery truck until unloading and securely install and mounted the scrubber at the designated location (AAF International, 2014; Hensen, 2012 and Mapco, 2006). In order to unload the scrubber from delivery truck, the scrubber needs to be positioned in an upright position, then by using a crane or lifting machine, the scrubber will be lifted and shifted to a designated location (Harrington, 2005). After conforming the exact position and location of the scrubber, the workers will conduct a minor adjustment and mounting the bottom part of the scrubber column, at this point some workers may require working at height depending on the location specified for the scrubber (Bureau Veritas, 2015; AAF International, 2014 and Harrington, 2005). At the end of the installation, the construction workers will conduct a housekeeping accordingly followed by client acknowledgement for the installation works.

Throughout these processes, workers are required to wear personal protective equipment (PPE) at all time, and the use of machinery and power tools are involved. All of these processes roughly take about 6 – 7 hours depending on the size of the scrubber and the ease of access to the designated location for the scrubber (MAPCO, 2006). During installation of the scrubber, several activities which are categorised as high risk tasks have been performed especially during lifting of the scrubber and shifting the scrubber from delivery truck to the designated location. Throughout the observation during supervision, construction workers tend to conduct the tasks without aware the at risk behaviour that needs to be taken into consideration during the installation process, such as using bare hand to receive and adjust the lifted scrubber, improper use of tools, for example, using spanner for hammering and etc. In order to prevent any injury or accidents throughout the installation process, project engineers, site supervisor and safety personnel have come to realise that their worker's safety is a priority for every installation made.

Behaviour Based Safety (BBS)

Historically, organisations have focused on improving safety by addressing the work environment surrounding employees, providing hazard-free facilities, providing better tools and equipment without achieving any appreciable reduction in the rate of accidents. People have come to realise or be reminded that workers are people too and people are not perfect and will make mistakes despite their best intentions and work in the best of surroundings, and the work culture often allows or encourages at-risk behaviours to be performed. Thus, behaviour-based safety has become a popular way of managing the people side of safety since it revolves around what motivates and reinforces people's behaviour.

Behaviour Based Safety (BBS) has many advocates and critics. Advocates have seen or experienced the effects of a well-designed process on incident rates (Cooper, 2003). Conversely; critics do not believe it truly involves workers in the overall safety process (Howe, 1998), while some critics believe the concept has run its course (Naso, 2002). The promotion of operant theory (Skinner, 1953) within the behavioral safety field (Geller, 1996; McSween, 2002; Krause, 1997) has led many to believe that the antecedent-behaviour-consequence model focuses almost exclusively on the psychology of safety especially in the construction industry. In reality, like other safety management programs, behaviour-based safety requires the strenuous effort of both management and employees to produce desired results. Since its inception and application in the mid-1970s, BBS has undergone a series of evolutionary changes.

The first approach, popular in the early 1970s to mid-1980s, was largely a supervisory top down- driven process, based on operant theory (Skinner, 1953). In this approach, supervisors observed their workers behaviour, gave feedback and provided some form of positive or negative reinforcement. It is important to note that behaviour change did not last once reinforcers were removed. Although this concept is simple and cheap to implement, it attracted legitimate criticisms that have since been hard to dispel (Howe, 1998). Perhaps as a reaction to those criticisms, employee-led approach emerged in the early 1980s.

In this approach, employees developed the overall process, conducted peer-to-peer or workgroup-based observations and provided feedback. However, the demerit of this approach is the exclusion of management, thus leading to the common perception that behaviour-based safety focused solely on employee behaviour (Hopkins, 2006). This led, in the 1990s, to the cultural approach based on the concept of management and employee partnership. At the same time, employees monitor the behaviour of all members of a workgroup or work area while managers regularly monitor their own safety-related leadership behaviours. Everyone involved receives regular feedback while some also received tangible reinforcers or incentives (Chandler and Huntebrinker, 2003). Surveys of behaviour-based safety users show that all three approaches are widely used around the world (Cooper, 2008). Each has tried to address the most efficient way to design the process to produce positive results in a cost-effective manner. Sulzer-Azaroff and Austin (2000) stated that the effectiveness of the various approaches is often dictated by the purpose of implementation.

BBS got its start in the industry in the late 1970s, but it is only in the past several years that the field has really taken off. The term “Behaviour-Based Safety” has become quite popular among safety personals, consultants, and members of safety steering committees. It is commonly used to describe a proactive approach to injury or on safe behaviours that can contribute to injury prevention. Behaviour refers to acts or actions by individuals that can be observed by others (Geller, 1996). In other words, the behaviour is what a person does or says as opposed to what he or she thinks, feels or believes. The safety of the workplace is influenced by a number of factors such as the organisational environment, management attitude and commitment, the nature of the job or task, and the personal attributes of the individual (Walker, 2003). Safety related behaviour at the workplace can be modified by addressing these major influences. The successful introduction of a behavioral safety process, focusing on identifying and reinforcing safe and reducing the unsafe behaviour, is one means of improving safety performance.

It is now widely accepted that 80 percent to 95 percent of all accidents are triggered by the unsafe behaviour of employees (Krause, 1990). The more recent evidence suggests that yearly reduction in accident rates is 34 percent, 44 percent, 61 percent and 71 percent (Krause, 1997). It is recognised that people make mistakes or even violate safety procedures for reasons beyond their control. Traditional approaches to safety often try to encourage the goal of accident reduction.

The behavioral approach, however, concentrates on encouraging safe behaviour. This should then lead naturally to a reduction in accidents (Makin and Sutherland, 1994). Safety at work is something that is important. Statistics show that workplace accidents continue to happen in frightening numbers, despite initiatives designed to encourage safe working. Some individuals see their safety as the responsibility of those further up the hierarchy. Yet, the reality is that even though employers have a duty to care, all employees should play an active part by working safely.

The benefits of implementing BBS process are varied. They include a promotion of a positive safety culture, active involvement of employees in their own and other’s safety, reinforcement of safe working procedures, and enhanced employee communication and feedback. With proper implementation of BBS processes, there is a significant improvement of 10 percent to 30 percent in reduced injuries and property damaged and return on investment in 12 to 18 months.

Critical Behaviour Checklist

The basic tools of BBS can be applied to improve the behaviours of everyone involved in an organisational process, from the worker performing the hands-on activities to the supervisor overseeing the entire effort. These tools are not limited to safety undertakings but are pertinent to all aspects of an organisation’s mission statement. This is the first of a two-part series on one of the most valuable BBS tools – the critical behaviour checklist (CBC). The descriptions and examples in generic CBC address safety, but this tool are obviously applicable to everything people do in the workplace. It is vital to increasing one's competence at any task. Performance cannot improve without behaviour-based feedback, and feedback is often most informative when linked to observations recorded on a CBC (Geller, 2000).

Generally, CBC consists of a list of some of the specific behaviours required to complete a task effectively. There is also a column to check whether each behaviour is performed "competently" or "incompetently." For safety applications, this column distinguishes between "safe" and "at-risk." The definitions of "competent" versus "incompetent" or "safe" versus "at-risk" are developed through structured group discussions and consensus building (TexaSafe, 2004; Geller, 2000 and Cooper, 2008).

The process of developing a practical CBC that is acceptable to all potential users is invaluable. If done right, it instills a sense of team ownership, as well as self-efficacy and personal control. These positive person states increase when everyone agrees to use the CBC, and these feelings are integrated into the culture whenever the CBC is used to observe coworkers and provide behaviour-based feedback (TexaSafe, 2004 and Geller, 2000).

Research Methodology

In general, this study is a monitoring based study using one of the Behaviour Based Safety (BBS) tools which is SBC for specific jobs and activities for scrubber installation at site. The SBC research is attempted to determine the actual nature of at risk behaviour among construction workers of the test organisation during installation of scrubber. From the pre-research observation and meeting with safety expert at sites, a tasks breakdown such as personal protective equipment (PPE), housekeeping, tools and equipment use, communication and body positioning and protection are determined so that the scope of determining at-risk behaviour in these five task categories can be narrow down to the specific and prior task involved during installation of the scrubber. The development of customised SBC will be followed concurrently from the sequence of progression of this research. From the data collected using SBC, the comparison of the result within three months period of observation is made.

Results and Discussion

Activity list has been sorted out based on the primary observation conducted. Activities were categorised based on five keys criteria that comprised of Personal Protective Equipment (PPE), Housekeeping (HK), Tools and Equipment (T&E), Body Position / Protection (BP/P) and Communication (COM). Table 1 shows the generic list of activity primarily involved during installation of scrubber at sites whereas Table 2 shows the aspects of criteria that have been observed throughout the study for segregation between at-risk and safe behaviour.

Task Breakdown Form with Hazard Identification (HAZID) assessment records is used for the purpose of determining the at-risk behaviour from activities performed by construction workers. Concurrent with activity list, HAZID becomes the basis of observation in determining the at-risk behaviour and safe behaviour of construction workers while performing their installation work of scrubber at the site. Table 3 shows the sample of at-risk activities performed by construction workers during installation of scrubber which have been recorded during observation earlier on. Based on the activities identified, most of the at-risk behaviours are related to the compliance with the PPE and improper body position and protection due to its higher number of at-risk behaviours for these criteria.

Table 1: List of activity primarily involved during installation of scrubber

No.	Category	Abrv.	Activity/Observation
1	Tools & Equipment	T&E	Webbing are in decent condition
2	Housekeeping	HK	Work area / path are clear from any scrap, trash, and debris
3	Tools & Equipment	T&E	Length of Tagging Line is adequate
4	Body Position/Protection	BP/P	Worker apply rigging/slinging technique correctly
5	Tools & Equipment	T&E	Worker use Tagging Line to adjust the scrubber position
6	Communication	COM	Signalman using walkie talkie and visible hand signal
7	Communication	COM	Signalman is visible to the crane operator
8	Body Position/Protection	BP/P	All points of hook are securely hooked before lifting
9	Personal Protective Equipment	PPE	Workers use PPE provided along the activity
10	Body Position/Protection	BP/P	Workers do not pass below scrubber to move to the other side
11	Tools & Equipment	T&E	Conditions of tools / equipment is decent
12	Tools & Equipment	T&E	Electrical Appliances already been tagged
13	Body Position/Protection	BP/P	Workers wearing fall protection (e.g. harness) when working at height > 2m from ground
14	Tools & Equipment	T&E	Workers using tools & equipment in proper ways
15	Personal Protective Equipment	PPE	Workers using dust mask / face protection during grinding, drilling and welding works
16	Body Position/Protection	BP/P	Practicing buddy system when lifting heavy equipment
17	Body Position/Protection	BP/P	Ergonomics working posture
18	Housekeeping	HK	Practicing good housekeeping along the activities
19	Communication	COM	Practicing safe warning intervention

Table 2: Aspects of criteria observed

No.	Criteria	Observed Aspects
1	Personal Protective Equipment (PPE)	• Safety Helmet • Safety Goggles • Safety Gloves • Safety Shoes • Long Sleeve Shirt • Dust Mask (mandatory for drilling and grinding works) • Welding Shield (mandatory for welding works) • Safety Harness (mandatory for working at height, height > 2m) • Hearing Protection
2	Housekeeping (HK)	• Condition of work area (before work) • Condition of work area (during work) • Condition of work area (after work) • Obstruction • Slip/Trip Hazard
3	Tools & Equipment (T&E)	• How they use the tools • Condition of the tools and equipment
4	Body Position / Protection (BP/P)	• Ergonomics • Working postures (Avoid awkward postures) • Body stretch and reach • Hand placement • Work practice
5	Communication (COM)	• Failure to warn • Safe intervention • Clear communication • Visible hand signaling

Table 3: At-risk activities performed by workers

Tasks Breakdown	Pre-Observation (AT-RISK BEHAVIOR)
1) Personnel Protective Equipment	• Take off the helmet during climbing a ladder • Does not wearing gloves while handling the materials • Not wearing safety harness • Not wearing safety goggles while grinding • Welding shield not use for welding works
2) Housekeeping	• Obstruction of tool boxes at exit doorways • Did not sweep the debris after works • Left the foods and drinks at the work area • Workers did not clean up the work area after complete work
3) Tools and Equipment Use	• Does not use proper tools for works • Using spanner as hammer • Equipment doesn't have voltage regulator • Using worn out disc grinding to grind
4) Body Position and Protection	• Perform work squatting • Awkward bending to reach tools • Improper lifting posture • Walking under suspended load • Using hand for positioning the suspended scrubber
5) Communication	• Does not intervene the partner when partner doing something wrong • Does not using walkie talkie • Difficult to understand hand signal for crane operator

The basic tools of Behaviour Based Safety (BBS) such as the use of customised Safety Behaviour Checklist (SBC) can be applied to improve the behaviours of everyone involved in an organisational process, from the worker performing the hands-on activities to the supervisor overseeing the entire effort. These tools are not limited to safety activities but are applicable to all aspects of an organisation's mission statement. Based on the customised SBC, five main keys criteria during installation of scrubbers have been observed i.e. Tools and Equipment (T&E), Personal Protective Equipment (PPE), Body Positioning and Protection (BP/P), Housekeeping (HK) as well as Communication (COM). The data collection was conducted for a period of three months starting from January 2015 until March 2015.

At the beginning of this study, a list of activities involved which specifically regards with the installation of scrubber was sorted out. Both the activity list and HAZID become the basis for conducting the observation using the customised SBC. As per result obtained from the preliminary observation, the at-risk behaviour and safe behaviour of construction workers while performing their duties were spotted. Based on the list in Table 3, most of the at-risk behaviours were from the non-compliance with the PPE and improper body position and protection. However, in terms of severity, most of the at-risk behaviour came from the improper body position and protection.

On the first month, the result shows the significant amount of very critical level of criteria observed. These criteria were housekeeping, communication as well as body positioning and protection. Even though the safe range target was targeted at the low range which is orange (critical), yellow (average) and green (safe), but some criteria performed are not meeting the safe range target; and the worst recorded was below than the critical level. Although the first and second weeks are showing the unsatisfied outcomes, the result shows gradual improvements for its next following weeks as the number of critical levels starts to decrease and switch to the average level. In overall, the pie chart showing the PASS or FAIL safe range target shows the higher percentage of PASS target recorded.

The result from January 2015 shows the very critical result for some criteria. This situation occurred due to the first implementation of customised SBC observation which is a new approach for most of the construction workers in Organisation X. In addition to that, on the first month of observation, workers tend to conduct their routine at-risk behaviour while performing their works. Hence, this behaviour modification requires a lot of time and intervention in order to make them realise that what they were doing is wrong and unsafe. In order to educate them about the safety awareness while performing the job, the observers who conduct the SBC observation have to intervene and explain the right and the safe way to do the job. Even though the safe range target set for the first month is quite low, but a gradual improvement can be seen from day to day in the random criteria.

The very critical behaviour observed for February 2015 was housekeeping whereby this criterion is showing twice the output of very critical result from the first and second week. However, on the following third week, it shows a good improvement of this criterion whereby the average and the safe level was achieved on the first and second day of the third week respectively. On February also, it can be seen that the proportion of SAFE percentage for safe range target is higher than FAIL percentage recorded. This result to some extent indicates a good sign of improvements of construction workers behaviours.

The results on February tend to be as such due to the process of developing a safe behaviour among the construction workers. Interventions still need to be done in order to make the construction workers fully aware and understand their roles in maintaining the safe workplace. In general, toolbox meeting was conducted every time before workers commencing their work. During toolbox meeting, the Safety and Health Officer (SHO) will emphasize on the safety precaution that they need to take into considerations while performing their works as well as the implementation of SBC and observations. The purpose of this reminder is to ensure that workers tend to behave and improve their safety performance. In regards to the result obtained, it shows that the authorisation for every worker to intervene is required as they are working as a team and achieving the best result on safety performance, they also need to work and look after each other as a team. The trends of distribution of safe behaviour on February are believed to be improved from time to time and the following month is forecasted to give a better result from the implementation of this SBC observation.

The general improvement can be seen when the safe range target has been upgraded to the next level. For example, safe range target was targeted at the green colour (SAFE) to test whether the implementation of the customised SBC able to improve the worker's safe behaviour or vice versa. Based on the outcomes of the result, most of the criteria observed were performed at average and safe level. This somehow lead to the improvement of the proportion of SAFE action by workers at the site. Again, the pie charts are showing a higher SAFE action performed by workers throughout the installation of scrubber for a month March 2015.

The result in March 2015 shows a great improvement if compared with the first two months of observation. This is due to improvement on the construction workers behaviour modification towards the safety of themselves as well as others. The improvement is probably due to the previous intervention of SHO by emphasizing the criteria that will be monitored, presenting and commenting on the previous team safety performance, and list out the critical criteria that need to be improvised by the team. Based on the previous review session, the construction workers relatively affected to improve their safety performance and compete to achieve the best team as exemplify to the other team. These kind of factors are part of the contribution towards achieving the behaviour modification among construction workers. Even though in the final month there is no pre-reminder during toolbox meeting by SHO on the SBC observation, the result came out positively. This shows that the correct implementation of SBC will relatively improve construction workers safety performance.

This chapter has deliberately discussed the results obtained through the observation by using the final checklist which is the customised Safety Behaviour Checklist (SBC) that lead to the establishment of the use of customised SBC in the installation of the scrubber at the site. The impact or result of the implementation of customised SBC towards worker safety behaviour modifications will be the basis for the establishing of this checklist. The overall results demonstrate the awareness and improvements in term of behaviour modification of the workers during installation of the scrubber. Besides that, the generic activity list for scrubber installation works has also been generated so that the at-risk and safe behaviour while performing all those activities can be identified for further safety control and mitigation.

Conclusion

As a conclusion, this study has successfully identified and met the objectives that were previously stated. Results from the analysed data have proved that customised Safety Behaviour Checklist (SBC) able to modify construction workers safety behaviour and improve their safety performance although requiring some times. In addition, the at-risk behaviours of construction workers during installation of scrubber have been identified successfully through the activity list as well as Hazard Identification assessment record from Organisation X itself. This study supports the idea of Geller (2000) which emphasized that developing a practical behavioral checklist that is acceptable to all potential users require a right implementation as it will instill a sense of team ownership, as well as self-efficacy and personal control. Based on the outcomes of this study, it is believed that customised SBC is able to modify construction workers safety behaviour during installation of scrubbers at the site and indirectly able to reduce the potential risks of accidents as well as save unnecessary costs caused by the accidents.

It is expected that this paper can be a reference material for any organisation that have a similar background like Organisation X to modify their worker's safety behaviour towards achieving a safety culture. For the future research, this dissertation can be a basis for developing a Safety Behaviour Checklist (SBC) that may apply to other installation activities other than scrubber installation. This study also provides the guideline on identifying the at-risk behaviour and developing the SBC for future researcher which the outcome can assist the reduction of incident cases through behaviour alteration.

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