Reducing Injuries by Applying Behavior Based Safety

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Abstract. Many companies have made many efforts to reach to a safe operation. These efforts have led to improve their safety level but all too often still unwanted events associated with injuries occur. To achieve a sustainable safety, many techniques have been adopted. Among them, behavior-based safety has been applied to improve safety through employees' safe behavior. In this paper, the BBS model is more closely studied. The aim of the study is to understand the features of the BBS model, its coming into existence, its pros and cons and how the model works in the industry.

Keywords: Behavior based safety · Reducing injuries · Workplace safety

1 Introduction

Safety is an important task in every workplace. In a safe workplace, it is not only important to protect the employee's health and wellbeing, but also to minimize the costs connected to occupational injuries. In 2009 there were 25 260 reported occupational injuries in Sweden, of them were 41 fatal [1]. These numbers indicate that the safety culture and the human behavior must be integrated to a higher extent, and the work with safety systems must continue and be even more effective than they are today. During the last decades, there has been an improvement in the working conditions, and this has led to a decrease in occupational injuries. Nowadays, in Sweden, most occupational injuries are not connected to working conditions, but instead to human behavior. Therefore, it is necessary to change people's attitudes towards safety. Several psychological models have been developed to work with safety within workplaces. Examples of these models are critical incident analysis, attitude creation group discussions, risk analysis and behavior-based safety [2].

2 Objectives of the Study

The objectives with this paper are:

- Implementation of BBS into industries,
- Investigation of everyday work including the BBS Performance at the complex under the study will be investigated,
- Advantages and disadvantages with the BBS model, and

- An analysis of the safety culture will be done with the purpose to evaluate how the BBS model affects the safety culture and vice versa.

  The goal of the study is to decrease the work-based injuries.

3   Methodology

The objectives will be fulfilled by conducting literature studies, case studies and interviews. The literature study is used to receive an overview of the BBS model in a broad perspective. For the more detailed view of how the BBS model works in reality, in a chemical plant in Sweden, an interview with a safety engineer working in the complex was performed. The interview was focused on the implementation of the BBS model, if the employees and managers have noticed any changes in safety behavior. This study is mainly prepared based on a project conducted at Chalmers University of Technology, Gothenburg, Sweden [3].

4   Description of the Concept

One reason why people not always act safe is because unsafe actions might be followed by short-term positive consequences that are appealing, like comfort, convenience and efficiency. Therefore, it is not unlikely that people act unsafe because that leads to the best positive consequences in a short-term perspective. An unsafe behavior may save time, uncomfortable protecting clothes are not needed, and reward is gained in a short-term perspective. However, in the long term the risk for accidents and injuries is increased. It is important to consider what the consequences for a desired behavior are and try to make these consequences positive. A usual way to describe behavior and their consequences is with a so-called ABC-analysis. A is standing for *antecedent*, B is standing for *behavior*, and C is standing for *consequence*. An antecedent is the incident that comes before the behavior. An example of an ABC-analysis is given as follows:

A: A machine item breaks down
B: Someone fixes the machine quickly without concerning current safety regulations (which would have taken longer time).
C: The advantages are that time is saved and that reward is gained due to a rapid action. But in the long run the risk for injuries is increased.

Advantages
There are several advantages with using the BBS model compared to use methods that are more traditional. There is sufficient with minimal professional training to be able to administrate the BBS model and it is a relatively easy to administer since the behavior-change interventions are straightforward. It is also a cost-effective method that can reach people where the problems occur since the BBS model, unlike traditional methods, teaches the employees to take control of their own safety. Another advantage is that managers can teach the behavior-change techniques which are most likely to work in their specific case [4].

Disadvantages

Even though the BBS model has a large potential it is not a universal tool that can be applied in every situation, and there are some problems with using the BBS model to increase safety. The individual worker does not create most problems with quality and safety; hence trying to change the behavior of the workers will not improve the safety. With the BBS model, the workers are treated, as they know nothing about what they want and need regarding safety. They should do as the management tells them even though the workers in most cases know more about the safety needed in the everyday work. The employees might feel anxiety during the BBS control since they are being watched, which may cause long term negative consequences [4].

Another problem with the BBS model is that by only concentrating on the employees' behavior it is possible that the real causes to accidents are ignored, i.e. organizational problems and technical problems. To improve safety, focus must first be on engineering improvements. When the number of accidents is no longer decreased by the engineering improvements a shift in focus towards the safety management systems should be done for further safety improvements. Finally, when both engineering improvements and safety management systems have exhausted their potential, the focus should be shifted to behavior-based safety. This indicates that the BBS model is the last step in a long chain of safety procedures, and that the BBS model should only be used when the work with the safety process has come far. The BBS model can also be misguiding if it is only used for the workers at the end of the production chain. In order to have the best result it is important to understand that the safety work must be carried out in all directions in an organization [5].

5   Implementation of BBS in Industries

The BBS model focuses on what people do (action), analyze their action and then implement a strategy to improve the behavior of the performance. The purpose of implementing with the BBS model is to create an environment where safe behavior is connected to positive consequences and at-risk behavior is connected to negative consequences. There are four steps to implement the BBS model:

1. Risk assessment: Identify at-risk behaviors causing injuries and losses,
2. Observation: Observation over sometime period of identified at-risk behavior,
3. Intervene: Trying to increase safe behaviors and reduce at-risk behaviors,
4. Improvement: Improvement based on findings and feedback on the performance [6].

6   Application of BBS at Chemical Company A in Sweden

Chemical company A started to implement the BBS model in 2003 but the model ended up in the shadow of other models and was first used in a wider extent in 2008. After the safety training was performed at the company, 81% of the employees thought they had changed their approach and had become more positive toward safety work and 62% were more focused on the safety in their work [3]. One of the daily projects of the

company is behavior-based safety, where the project leader together with the other employees works to implement the safety behaviors as a fundamental behavior; emphasizes the importance of role of BBS models, shearing knowledge with each other, having dialogues, giving feedback and having focus on safe behavior [3]. One simple everyday example he gives is, "*Why we always walk against the red light? We rarely think about the consequence of the risk that is taken every day*". The project leader repeats the importance of having the courage to criticize and questioning the risks that are taken without pointing fingers [3]. To be anonymous makes it easier for the management to collect information about the risks in the daily work. The information collected can further be distributed to every employee. Several other employees will probably recognize the at-risk behaviors and the risk behind the behaviors and how it can be prevented can be explained. In order to change a behavior, it is important that the management motivate the employees to safe daily work and reward safe behavior immediately. It is also important to allow errors, so they can be detected and prevented in the future. Long-term and clear priorities and goals should be set so that every employee easily can understand the goals, but also be able to perform them. The project leader stresses that behavior changes takes time and is a process that cannot be generalized. To change a behavior might take 10–15 years and cannot be done without following up the behavior [3].

> "*Chase results are not the goal, instead we should slowly try to build fundamental safety behaviors*", *says project leader* [10 in 3]

7   Performance of BBS Observation in Chemical Company A

The BBS observations are performed spontaneously or at scheduled time at the company where one observant evaluates the performance of a worker. The BBS observation should be performed in every department but is mainly focused on the area where accidents most likely happen. The BBS observations are usually performed on the employees in the production. The behaviors studied are for example body position, ergonomics, tools/equipment, instruction/routines, protective equipment, work environment and transportation. The used checklist contains a questionnaire about the place, time, work task and the number of people observed. The area of work is for example an office, a workshop, a lab, a plant or a loading site. "No names – no one to blame" is written at the top of the checklist, which means that the person that is observed will be anonymous. While the work is done, the observant fills in the questionnaire regarding if the worker acts safe or has an at-risk behavior.

The behaviors that are considered safe respectively the behaviors that are considered to be at- risk are counted in order to receive an overview of the risks at each area. The comments that were made during the observation will finally be discussed. The discussion provides information and understanding for people's actions and makes it possible to analyze the areas at risk. An example of a part of a checklist is presented in Table 1.

Table 1. Checklist for a BBS procedure [3].

Protective equipment		Safe	At risk
1	Helmet		
2	Goggles		
3	Safety shoes/boots		
4	Ear protection		
5	Correct protective clothing/gloves		
6	Respirator		
7	Fall protection		

The company target is to decrease the total reportable accident rate per million working hours down to two [3]. The actions taken to reach this target are:

- show sustainable behavior-based safety (BBS) system for all employees and contractors
- meet challenging targets for number of BBS observations
- meet implementation rate for BBS-improvements >60%
- analyze the root cause to all incidents
- action plans with improvements at all sites

The critical success factors are a good safety culture and an efficient communication about safety between employees and between sites. It is shown that by applying safety culture and by changing behaviors, the absence from work decreases significantly [11 in 3].

8   Safety Culture and BBS

The safety culture within a company is very crucial for the outcome of a BBS operation. To be able to have a successful BBS work every employee must have the same believes about safety and how the company should work towards a safety environment. An important factor to reach a good safety climate is the employee's feeling of having empowerment, which means that they feel that they make a difference and have the power to affect the situation they are in. The feeling of empowerment is reliable on the feelings of self-efficacy, personal control and optimism. Empowerment together with self-esteem and belonging creates a working safety culture. This is shown in Fig. 1 in an orderly manner. In the middle of Fig. 1 where the circles empowerment, self-esteem and belonging meet the desired feeling of "we can make valuable differences" is created [6].

It should be noted that, the situation described above is not too often match reality. Many companies struggle with problems in the safety culture, which makes it difficult to work with the BBS model. Safety is a social and psychological phenomenon that is based on people's values, believes and attitudes. Sometimes it is said that a particular manner "is in the walls", but it is always the mentality between people that sets the culture. Therefore, it is much more difficult for an individual to break social rules than
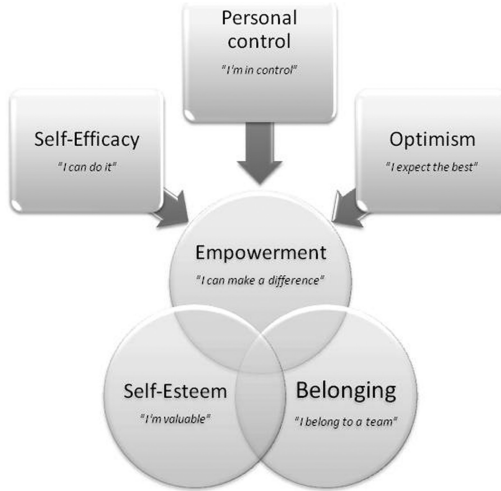
Fig. 1. Important factors to get employees to care for the safety and health of each other [6].

technical rules. People that work in a safe way might be told that they work too slowly, that they are not "macho" and that they are "chickens". The outcome of this might be that people, who act safe, stop using protecting clothes, do not ask the manager about safety equipment and choose to work quickly rather than safely. It is also of highest importance to remember that the behavior of the management is almost always a factor contributing to how the safety climate is. For the management to convey a safe behavior there cannot be any double messages such as "Safety rules are OK – but it takes too long time if we always should follow them!". If there are double messages like this a sustainable and lasting safety culture can never be achieved, and the BBS model cannot be used. There will be conflicts between what the manager says in a meeting and what s/he later on conveys in the real process.

Normalization of risk is a phenomenon when the risks in a process are not considered as risks since they are so common. The same is with the silent consensus phenomenon that means that the common ways of thinking and doing things are never questioned. These behaviors create a "safety culture" where some risks are not considered as important, and an implementation of a safety system is not possible because no one thinks there are any risks at the workplace. Many safety systems are good, but they will not support a good safety culture unless the employees consider the system meaningful [12 in 3].

To be able to have a well-functioning safety climate the atmosphere must be that the employees feel that they can inform the management about incidents without fearing blaming or dismissal. To reach a safety climate that works it is not possible to have the philosophy: "the one that finds a problem is the problem and should therefore solve the problem". If it works that way no one will ever report any incidents that are not obvious to everyone, and therefore no improvements can be made. In order to have all accidents and near misses reported it is necessarily to have a blame-free

organization. This is also important from the view that something should be learnt from previous accidents or near misses. If they never are reported, the same accidents might happen repeatedly. To be able to integrate a safety system like the BBS model in the safety culture it is important that the company has come so far in their safety work that when someone tells a colleague to put on a helmet, or similar, it is not seen as a threat by the person who is told, but instead as an act of kindness [13 in 3].

Behavior is perhaps the most important factor in order to reach a safety culture. Attitudes, norms and perceived control are all aspects that contribute to a specific behavior. To change a person's attitude, and thereby their behavior can be hard. If a desired behavior is voluntary, it is likely that a person, whose attitudes or beliefs do not agree with this behavior, do not care about the behavior. Stress can be created if a behavior is in conflict with a person's beliefs or attitudes. However, if the behavior is mandatory the person will in time change the attitude. One example of this is the behavior of wearing a helmet within a plant. If this behavior is mandatory, with no excuses the employees will adopt this behavior and in the end all individuals will wear a helmet regardless what their opinion was in the beginning. However, to make certain behaviors mandatory is first and foremost working on simple behaviors, when the desired behavior is complex it is more difficult to solve it with mandatory procedures. The risk is that the employees feel controlled by the management and do the opposite anyway [12 in 3].

Some BBS projects are well functional and some fail, and much of the outcome is dependent on the safety culture in the company. It has been shown that in order to have a BBS project that works the triangle in Fig. 2 should be applicable Trust is stated as the interpersonal attribute on the "person side" of the triangle. This means that in order to have a working BBS project the employees must trust the management and have faith in the management's decisions. Management support is stated on the "environment side" of the triangle. This means in order to have a working BBS project the environment must be that the management supports the safety work. There must be follow-ups and the manager must be involved in, and a part of the safety system. On the "behavior side" of the triangle, participation is stated as the important factor. Participation is necessarily in order to have a working BBS project. Everyone must work towards the same goal and everyone must believe that this is the right direction to go. The sides in the triangle are not static, but dynamic and interactive. If one side in the triangle is changed, the other sides are also affected. In the middle of the triangle, BBS training is stated. When the employees and the management have received the principles and the tools for a working BBS project it is important with training so this is something that can be implemented in all parts of the company [7].

9 Discussion

The BBS model is a psychological model with the purpose to reduce at-risk behavior, promote, and introduce safe behavior. There have been many discussions about the value of using BBS as a model to increase the safety within a company, and the model has both advocates and critics.
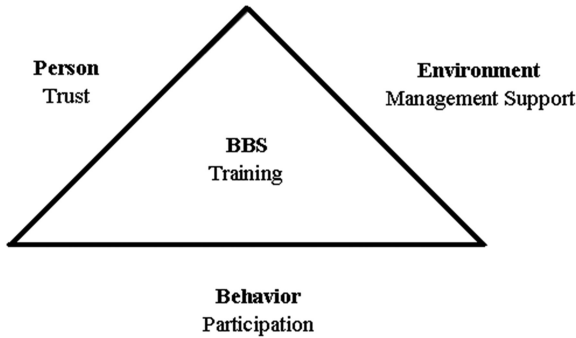
Fig. 2. BBS safety success triangle [7].

One important aspect to point out is that many companies introduce the BBS model too early in their safety process, and that is one reason why many BBS projects tend to fail. Another aspect is that companies may tend to expect consisting result after a very short time period. The BBS model is dealing with behaviors, and a behavior is very difficult to change for an individual. According to the BBS project leader of company A, it can take 10–15 years to change a specific behavior. With that in mind it is interesting that Kemi claims that only two years after the introduction of the BBS model at company A over 80% of the employees state that they have changed their attitudes towards safety at work, and that they now have a more positive attitude towards safety work.

The question is if this is only because the BBS model has recently been introduced and therefore there is a positive trend in the result. The change in behavior might be because the employees feel involved in the safety work and they understand the purposes of it. That shows that company A has managed to engage the employees to work towards the same direction. It would be interesting to have an evaluation of the BBS work at company A a couple of years from now to be able to compare the results. It would also be interesting to do a comparison between the management's opinion about the use of the BBS model and the employee's opinion. The result of such a comparison might be that the management believes that the safety work with the BBS model works fine while the employees do not agree. This can especially happen if the communication between the management and the employees is not working efficiently and the employees therefore cannot see the use of the safety work. Another interesting aspect to evaluate would be study how the employees who have undergone a BBS project affect new recruits that has not been part of a BBS project. An interesting question would then be if the "old" employees affect the new recruits in a way, so the new recruits change their behaviors and attitudes and adopt a safer behavior.

As was discussed above, behavior and attitudes are difficult to change because they are many times rooted in people's values and beliefs. To make a desired behavior mandatory is one way to force the employees in the direction towards a safe behavior. But if the situation is very complex this solution might not work. If the employees feel forced by the management and if they do not understand the importance of the safety work they might just do the opposite to what they are told just to show that they can

take decisions about themselves. Another way to reach a desired behavior is to reward the employees, for example with money. But this will probably just give positive effects in short-term perspective. People tend to forget what they ought to do if they do not fully realize the consequences. In the end people need to understand that they act in a certain way to ensure the safety for them and their surroundings, and not for the money. Therefore, the only way to make employees behave safe in complex situations is to ensure that they are aware of the risks, why a safe behavior is necessarily and what the consequences can be if they have an at-risk behavior. The feedback and the management's commitment are therefore two factors that are crucial for the BBS model to work. Those factors are not just important in the beginning, but during the entire process. The culture within a company is many times set by the conduct of the management. It is of highest importance that the management understands the features of the safety work and can convey the importance of it to the employees.

Often people have an at-risk behavior because no injuries or accidents have happened. Statements like "I have always done the work in this way" are not rare. But even though no accidents have occurred until today the risk is high that there eventually will be an accident caused by the unsafe behavior. To realize and pay attention to at-risk behaviors and take action before something severe happens is of crucial importance.

It is important for both the management and the employees to realize that the BBS model is not about pointing fingers on individuals. It is not about finding errors in certain individuals, but to change the overall behavior and climate within a workplace. Even in this situation the management has an important role. It is the management's responsibility to ensure that the climate within the group of employees is open and friendly and make sure that the BBS work is not about finding an individual's mistakes.

Normalization of risks is a phenomenon that is hard to reduce. The BBS model will not help to solve this problem since the persons in the situation are not aware of the risks. One possible solution would be to use consultants that have not been part of the team before to make them document all risks they see. A disadvantage with this is that the employees might feel that somebody from the "outside" comes and tell them what to do and how to perform their work.

It is everybody's responsibility to be aware of the risks in a workplace in order to prevent normalization of risks.

In order to have a more efficient implementation of the BBS model in the industry there are some things in the implementation strategy that could be improved. First of all, it can sometimes be hard to identify the desired behaviors. This can be because the people involved have worked at the same workplace for a long time and have become used to their situation. Study visits to other plants and companies can be a solution to this. This makes it possible to see how other people work and think about safety and it also makes it possible to exchange experiences. To improve the implementation further it is important to have a parallel work with the safety culture within the company. To be able to create a sustainable safety climate it is important that the focus is not only on the behavior in the work, but also on the behavior toward each other. The BBS model does not consider how the climate between individuals is in a group. That aspect should be included since the ability to reach a desired safety culture many times is dependent on the behavior between individuals. To be able to work towards the same goal it is desired that the BBS model is implemented in the entire company and not only in one

department. This will also facilitate collaborations across borders, which will increase the effectiveness of the implementation of the BBS model.

10   Conclusion

The BBS model can be useful in the safety work in industries. The purpose with the model is to identify at-risk behaviors and reduce them. It can be an effective model to ensure a safer climate if the problem is the behaviors and attitudes among the employees. However, it is important to be aware of the limitations and not believe that this is a miracle model that will solve all safety issues within a short time. Safety work is a continuous process that must take part in all levels of an organization and include all employees without any exceptions.

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