6th International Conference on Applied Human Factors and Ergonomics (AHFE 2015) and the Affiliated Conferences, AHFE 2015

Behaviour based intervention for occupational safety – case study
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Abstract
Safety at work is the subject of continuous debates, studies and researches. Traditional safety programs put the responsibility of accident prevention and safety coordination on the shoulders of upper management in each company. An alternative currently being used in industry is Behaviour Based Safety (BBS) concept. A behavior-based approach to industrial safety management has been advocated by many authors and has been found to effectively improve safety performance in different industrial settings and on different continents. In the paper the BBS approach was characterized and the examples of good practices within this area implemented in businesses running in Poland.

Keywords: Safety culture; Behaviour Based Safety; Observation program

1. Introduction
The costs associated with workplace injuries and the time required for accident investigation, provide companies with the incentive to identify ways to reduce these injuries [1, 2]. Traditional safety programs put the responsibility of accident prevention and safety coordination on the shoulders of upper management in each company. Upper management generally has to designate a person to act as a safety coordinator and, depending on the size of the company, a group of people to act as the safety team. This person or team has the designation and the responsibility to ensure a safe working environment. An alternative currently being used in industry is Behaviour Based Safety concept [3, 4, 5]. Behaviour Based Safety (BBS) is a term used to describe the prevention of accidents, injuries and loss in the workplace. BBS safety involves the practical application of safety procedures based on the real world behaviours of employees in work situations. Everyone is considered responsible not only for their own safety, but for the safety of others. Unsafe behaviour can trigger accidents and injuries. Identifying common workplace safety
issues enables a company to assess the problem areas and create behavioural-based safety guidelines [6, 7, 8]. Behavioural change is not brought about by changing the person, but by changing their perception of accidents and by changing the environment in which they work. It involves observing behaviour and detecting “at-risk” or unsafe activities, followed by directing or modifying behaviour to achieve safe operation [9]. Primary techniques in BBS include peer observation and feedback, training and education sessions, behaviour-based incentives, prompts, and goal setting.

Paper describe the literature review, including a description of BBS, BBS observation techniques and the practical implementation in companies. The authors reviewed the fundamental assumptions and steps of BBS and successful BBS applications in industries.

2. Evolution in approach to safety and health of employees

Over the years the approach to safety and health of employees have been changing from the reactive (taking actions towards safety after an injury/accident happens) to the proactive one (taking actions preceding the accident). The reason for the changes is not only growing severity of law regulations, but also managers seeing economic benefits from actions taken to provide safety and health of employees. The consequence of identification of losses that companies are facing, is searching for the new methods of safety culture improvement, and safety culture assessment has become one of many tools used for identification of problems and areas requiring improvement. One tool that can help companies, track the evolution of their safety culture is the DuPont Bradley Curve (Fig. 1).

Moving from left to right, the figure illustrates the spectrum of a safety culture as it matures from reactive to proactive. The model characterizes four stages of safety culture shaping in a company, namely:

- **Reactive stage**: These companies handle safety issues by natural instinct, focusing on compliance instead of a solid safety culture. Responsibility is delegated to the Safety Manager, and there is generally a lack of management commitment to safety issues.
• **Dependent stage:** While there is some management commitment, supervisors are generally responsible for safety control, emphasis, and goals. Attention to safety is made a condition of employment, but with an emphasis on fear and discipline, rules and procedures. Such companies do value all their people and will provide safety training.

• **Independent stage:** These companies stress personal knowledge of safety issues and methods, as well as commitment, and standards. Safety management is internalized and stresses personal value and care of the individual. These companies engage in active safety practices and habits and recognize individual safety achievements.

• **Interdependent stage:** These companies actively help others conform to safety initiatives – they become “other’s keepers,” in a sense. They contribute to a safety network and have a strong sense of organizational pride in their safety endeavors.

In the “Interdependent” stage of the DuPont Bradley Curve the concept of BBS has become an important part of the safety management system, and more and more managers are implementing BBS to help improve the safety performance of their companies.

### 3. Behaviour Based Safety

Behaviour-based safety emerged from several well documented and used fields of study outside of safety, and the approach to building safety culture enhanced with BBS is not an entirely new solution. It originates in works of H. W. Heinrich published in 30s and 40s of the XXth century, proving that only 10% of accidents and occupational diseases were caused with inappropriate working conditions, while 88% of them were a consequence of dangerous behavior of employees [11]. Processes from Total Quality Management, organizational development principles, the field of psychology in applied behavior analysis, and safety practices are all combined into one conglomerate to form what is termed as behavior-based safety (The Total Quality Management (TQM) approach to safety offers more long-lasting results, but behavioural modification gives quicker impact, especially with specific, observable problems [12, 13]. The overall goal of this movement is to lower safety incidents and work place injuries. By combining safety with processes that have already been tried and proven techniques to modify behavior and improve quality, it is not surprising that there are positive results reported in journals and safety magazines. The concept of BBS approached refers to a systematic application of psychological research on human behaviour aimed at changing unsafe to safe behaviour [14, 15, 16, 17, 18, 19, 20, 21, 22, 23], and [24]. BBS is claims to equip companies with the tools they need to change employees’ behaviors and attitudes toward safety. Behavior-based safety systems educate employees to search for the root causes of their accident-prone behavior. It teaches them to realize trends of behaviors that cause them to succumb to safety hazards. It transfers the control of the incident into the hands of the employee. The employee then becomes proactive toward his own safety and less of a victim of the circumstances of his surroundings. BBS implementation examples presented in the literature prove numerous benefits. The most often mentioned include: improvement of commitment and awareness of employees in the area of safety and hygiene of work, decrease in number of accidents, occupational diseases and potentially dangerous incidents, as well as improvement of working environment by optimization of procedures and modification of equipment (machines, devices, tools). The effectiveness of behavioural safety observation and feedback programmes is dependent upon effective implementation. The component involved in the implementation steps of BBS approach differs among researchers. The example of a guide for implementation of BBS in a company based on literature survey is presented in the table below (Table 1).

One of the most important elements that need to be considered when designing implementation of BBS in a company is the assessment of an organizations readiness to implement a behavioral safety program. Recent research suggests that organisations should select behavioural safety programmes which match their level of cultural maturity because a mismatch is one reason why behavioural safety programmes fail. It is therefore important for organisations to establish that they are ready to implement a behavioural safety programme and to identify any potential problems they may encounter. By identifying potential barriers before implementing the programme, an
Table 1. Behaviour based safety implementation guidance.

| Step | Description | Characteristics |
|------|-------------|-----------------|
| 1    | Present concepts of BBS to company management and obtain their commitment. Set up a BBS Steering Team. | Each company will have to customize the basic material to fit their own organization as the success of BBS is dependent on the quality of a company's Environment, health and Safety management system, leadership, commitment and culture. |
| 2    | Steering Team receives orientation in BBS including review of the BBS process | Once the steering team members have been selected they need to receive training in Behaviour Based Safety. The training should include the following elements not specific to behaviours – problem solving, root causation, trend analysis |
| 3    | Select employees to be observers | Observers should be chosen from employees with as many as possible of the following characteristics: respected by peers, interest in safety improvement, interest in BBS, good people skills (able to provide positive reinforcement for safe behaviours, able to provide coaching/correction for unsafe behaviours, able to interact with co-workers) |
| 4    | Train observers | Some important training elements are:  
- Ensure observers know when the critical behaviours are being performed acceptably and when they are not. It can be damaging to the observation process if an observer suggests to a worker they are doing the behaviour wrongly when they are not.  
- Observation and intervention techniques  
- Observation recording techniques  
- Observation sequence: interrupt the workers or not, etc. |
| 5    | Set up an observation data recording tool | Steering teams can help the implementation by establishing some form of electronic tool to record and analyze the observation data. A tool that is user friendly and allows the observers to easily enter their data is most desirable |

organisation will be able to manage these problems more effectively. The next element that is believed to be crucial for success of the program is managers commitment. Without managers of top and medium level support and their consequent performance it is impossible to change the approach to work and to methods of its realization. Moreover, employees from operational level should also be involved in the program from the very beginning.

Each action taken as part of the project needs to be carefully planned and organized. Leading observation of behavior of employees at their workstations requires definition of the processes of planning, observing and reporting as well. (table 2)

Table 2. Characteristics of safety process based on observations [25].

| Action | Characteristics |
|--------|-----------------|
| Planning and preparation of observations |
| Observation | Development of weekly and monthly plans of observations, appointing the observers, audit of dangerous or potentially dangerous incidents at workstations and corrective and preventive actions taken  
The observer observes employees while they are working on regular bases. The observer focuses on whether the employee uses safety means identified for the workstation and defined in the observation sheet. |
| Questions | In case of the employees not using safety mean(s), the observer is supposed to make a conversation to identify the cause of such situation. The information is to be used to define efficient plans of actions concerning tendencies identified on the bases of the data coming from observations. |
| Identification of good practices applied | An important part of the process of observation is to identify best practices in the field of personal safety and positive reinforcement. During the observation, the observer transmits positive feedback to employees about their behavior in terms of safety and to promote safe practices. The primary objective of the observation is to prevent injury / injuries. This process aims to increase awareness and improve communication in the field of personal safety and promotes the development of a supportive environment in which employees feel comfortable discussing objections on safety and jointly seeking solutions. |
| Formulation of reservations | Development of report on conducted observations, analysis of reports to identify trends, determine corrective and preventive actions, implement them and evaluate their effectiveness. |
A popular BBS technique is peer observation and feedback, which involves both the individual performing the target behavior(s) (i.e., the observee) and a peer (i.e., the observer) who observes the behavior, records information based on these observations on a behavior checklist, and delivers feedback to the observee. There are two main types of feedback, summative and formative. Summative feedback provides the individual with information on their performance, but formative feedback provides information on how they can improve their performance. Formative feedback needs to be delivered by someone who is perceived as credible and knowledgeable by the individual receiving the feedback. Summative feedback can be given in public or in private, but formative should only be given in private or it may be perceived as a punishment. There are two main types of feedback, summative and formative. Summative feedback provides the individual with information on their performance, but formative feedback provides information on how they can improve their performance. Formative feedback needs to be delivered by someone who is perceived as credible and knowledgeable by the individual receiving the feedback. Summative feedback can be given in public or in private, but formative should only be given in private or it may be perceived as a punishment. Alvero, Bucklin, and Austin [26] reviewed the feedback literature from 1985 to 1998 describing 64 applications of performance feedback in occupational settings. In their study, they classified different types of feedback and factors related to effectiveness. Key results of this review follow:

- Medium: The most consistently effective medium was a combination of written feedback, graphs, and verbal feedback.
- Privacy: A combination of public and private feedback was more effective than either alone.
- Content: Interventions involving feedback paired with antecedents (prompts) produced the most consistently effective results.

The BBS process is not focused on separate employees but on elements of the systems of companies that enhance to safe work routines or discourage to the dangerous ones. Safety based on behavior can be defined as: identification and elimination of barriers preventing safe behavior of employees and introduction of systems supporting and promoting safe behavior. The goal of the process is not:

- replacing traditional safety and hygiene of work system, nor releasing managers of responsibility for providing employees with safe workplaces,
- forcing new rules or new responsibility ranges,
- forcing employees to “spy” on each other and report dangerous behavior which would lead to disciplinary consequences.

But the goal of the process is:

- enhancing employees to improve communication ad increase awareness of safety issues while they are systematically identifying the most severe risks at work,
- empowering employees so that they were decisive and solving problems, after the critical risks are observed and identified.

Analysis of the literature on BBS enables identification of strong and weak points, as well as threats and opportunities of its application in companies (table 3).
Table 3. SWOT analysis of BBS processes.

| Strengths                                                                 | Opportunities                                                   |
|--------------------------------------------------------------------------|-----------------------------------------------------------------|
| • Increases safety on site                                              | • Builds awareness of safety and site values                    |
| • Increases interaction between employees and supervisors               | • Opportunities for communication/knowledge sharing             |
| • Provides the opportunity for a high level of employee involvement     | • Create a set of safety rules that are accepted through        |
| • Provides employees with a clear understanding of safe/unsafe behaviour | • Change the worker’s poor perception of safety                  |
| • Development of employee’s skills                                      | • Problem identification and employee driven solutions          |
| • Highlights a direct link between behaviour and consequences            | • Get more employees actively involved.                         |
| • Utilizes the basic management principle of measurement to realize      |                                                                 |
| improvement.                                                             |                                                                 |

| Weaknesses                                                              | Threats                                                         |
|------------------------------------------------------------------------|-----------------------------------------------------------------|
| • Often, only behavior that is easily recognized without going into     | • Lack of trust to colleagues may cause aversion to the         |
| the detail is included                                                  | program                                                         |
| • The quality of feedback depends on the involvement of the observers   | • The current low level of education of employees may prevent    |
| and surveillance staff analyzing the data                               | the majority of workers from becoming observers                 |
| • Developing a good plan of observation requires reliable information   | • Supervisors may resent the task of observers as                |
| and continuous analysis of data obtained from previous observations.   | unwarranted interference                                        |
| • In general, it is necessary to benefit from support of external       | • No incentive system for observers can cause unfairness         |
| consultants                                                             | during the observation                                          |
| • In the absence of involvement and understanding of the principles     | • The need to respond to all suggestions of employees,           |
| it may lead to conflicts                                               | regardless of their merits.                                     |

There are many ways to implement the BBs program, and some are more efficient than others. The basic elements can be executed in many ways allowing to adjust the process to individual working conditions and culture. The basic five elements of the system include:

- identification and operational definition of the most important safety practices for each type of workstations, tasks performed or working environment,
- development of measure system for the practices identified,
- providing feedback information to the employees assessed,
- analysis of trends to practices suitable for final interventions,
- conducting empirically supported analyses to identify the most efficient practices and enhancing to these practices or identifying barriers preventing employees from using the predefined practices.

Though they seem simple, the five basic elements require application of implementation strategies to make sure that the program is enthusiastically welcomed, commonly used and provides long lasting success. Basing on their long experience in implementation of the BBS program, the CEO of one of international consulting companies [Shawn M] proves that success depends mostly on managers commitment, employees commitment, fitness for industry, company, investments in human capital and technical support.

4. Examples of good practices

Methods and practices supporting shaping the expected behavior of employees and safety culture development in companies are more and more popular in Poland which is proven by numerous works presenting good practices within this area [15, 22] and the growing number of consulting companies providing services of behavioral auditing. More and more employers come to the conclusion that further investments in safety of machines and other technical devices are no longer sufficient. Programs modifying dangerous behavior are the important element of the safety culture and their implementation in a meaningful way contributes to awareness of employees on safety and hygiene of work but also responsibility of employees for their own safety and safety of their colleagues. The examples of companies that effectively and efficiently implemented BBS program are presented in the table 4.
### Examples of good BBS practices [28].

| Organization                  | Characteristics of the program                                                                                                                                 |
|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Philips Lighting Poland S.A. Division in Pabianice | Analysis of the causes of accidents at work during the period 2008 - 2011 showed that more than 70% are the causes indicating the dangerous behavior of the employee.  
The team consisted of people implementing the program of Zero Accidents, heads of various departments, managers and leaders. The project involved the two consultants representing the scientific community of the University and the Technical University of Lodz.  
**Benefits:** increase in organizational culture (annual measurement), improvement of communication in terms of safety throughout the organization and change of employees’ attitudes. |
| Philips Lighting Pila S.A     | The aim of the program is to reduce the number of accidents by changing the dangerous behavior of employees through long-term program of observation / behavioral audits. The program was launched in 2010 with pilot implementation on the production line in the linear fluorescent lamps production department. During the first review of the sustainability of the program it was confirmed that Respond program applies to 2,600 people involved directly and indirectly in production, while 10 percent is a group of observers  
**Benefits:** As a result of the program the number of accidents in the PLP SA decreased from 98 in 2008 to 9 in 2013. An additional effect is a decrease of PLN 420 000 per year on average accident costs by eliminating serious accidents and accidents associated with long-term treatment process |
| Fiat Auto Poland S.A.         | Targeting all levels of management in the Factory (from the director to the operator) to identify dangerous behavior that could be the cause FA (first aid) and LTA (accident that causes absence of a worker) and taking actions to counter recurrence (soft actions, such as training and hard actions such as technical solutions). In the program there were 6 lessons, practical training - the first SMAT Audit with the assistance of the HSE inspector, learning the dialogue after SMAT Audit was conducted with the observed employee, creating a pyramid of “Safety Management” with the frequency of the audit assignment for each level of management.  
**Advantages:** the ability to observe and react to dangerous behavior, increase in safety culture and compliance with safety rules, more than a year without an accident (the last accident on 04.16.2013) |
| Żywiec SA Group Elblag Brewery | BBS system aims to: increase the involvement and employee awareness of health and safety, change employee behavior (elimination of risky behavior and other factors before they lead to an accident), reduce the number of accidents, occupational diseases and potentially accidental events, identify barriers to safe operation, providing suggestions of rapid improvements and solutions (behavior, problems, procedures), the use of the knowledge and experience of the person observed to potential organizational and technical solutions. The program applies to all employees of the brewery, contractors and visitors.  
The project included the following activities: training for Executives, developing a database and documentation to record the observation, identification and training of observers (23 people), observation (observation results are put into an electronic database BBS, the 1590 observations were carried out in 2014: 1355 safe and 235 dangerous behaviors were identified), analysis of the results of the observations (dangerous behaviors and other results from observation are discussed at the daily morning meetings (DCS) and the Safety pillar).  
**Benefits:** change in the organization of pedestrian traffic on the site, purchase of the lift to work at height, the new platform extension by machines and equipment, implementation of LOTO procedures for machinery and systems, installation of protective barriers on the ramp of loading warehouse. |

The examples presented in the table prove wide range and variety of benefits that can be achieved by companies applying BBS approach. The benefits refer to almost all areas of functioning, starting with production through maintenance and finishing with administration. However, it is worth noticing that for every organization listed in the table above, BBS is one of many methods implemented for improvement of safety and obtaining the goal defined as “zero incidents and zero accidents”. In each and every of them, BBS is an element of safety management system and not a single separated process.

### 4. Summary

Behavior-based safety training and implementation helps improve organizational safety culture. By increasing the quality and frequency of safety feedback in the organization, barriers between employees both within and across organizational levels are reduced. Improving safety communication (both correcting and rewarding feedback) through BBS leads to a more open, positive, and trusting safety culture as well as improved safety performance. BBS is a process that provides organizations the opportunity to move to a higher level of safety excellence by
promoting proactive responding to leading indicators that are statistically valid, building ownership, trust, and unity a cross the team, and developing empowerment opportunities which relate to employee safety.

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