 

# THE BEHAVIOUR-BASED APPROACH TO SAFETY

Gordon Sellers # and Paul Eyre ##
# Behavioural Science Technology International®, Bracknell RG12 1JB, UK
## Montell UK Ltd., Manchester M31 4AJ, UK

Responsible organisations have made substantial efforts to ensure that facilities and equipment are designed for safe operation, and that appropriate safety management systems are in place. These efforts have led to significant improvements in safety but, all too often, employees are still having accidents and the improvements have plateaued out. To achieve continuous improvement, leading organisations have adopted many of the ideas of quality management, namely an upstream process measurement system, adjustments on the basis of statistical data, and employee involvement and participation across organisational levels. The resulting behaviour-based approach to safety focuses on employees themselves identifying the critical behaviours that lead to accidents, measuring the incidence of at-risk behaviours, providing immediate feedback, and using data to remove barriers to safe work. But each organisation is different; how should a behaviour-based safety process be adapted to its specific needs? Therefore it is important to start with a safety climate assessment to identify the key factors to be considered, as well as providing a valuable baseline against which to measure the subsequent sustained improvement in safety. The Carrington site of Montell UK has implemented behaviour-based safety and provides a good case study of its effectiveness.

Keywords: safety; behaviour; safety climate; employee-led.

## BREAKING THROUGH THE PLATEAU

Many organisations have reached a plateau in their safety performance. Investment has usually been made in two distinct areas: Engineering Controls and Written Systems.

***Engineering Controls*** include design, installation, inspection and repair

***Written Systems*** include policies, procedures, rules and audit programmes

Although the engineering controls and written systems have generally been successful in improving safety standards, people are still having accidents. Thus another strategy needs to be adopted to break through the plateau and achieve continuous improvement in safety performance. This is where Behavioural Processes are utilised, including motivation, reinforcement of safe behaviours and providing good role models – often achieved through behaviour-based safety (BBS).

The fundamental cornerstone of behaviour-based safety is the elimination of at-risk behaviours. One can view accident rate as an iceberg, the "Accident Iceberg". At the tip we have fatalities followed by lost time accidents and so on down to near misses. However, just like an iceberg only the tip is seen, hidden beneath surface is the larger portion of the iceberg, in this instance, at-risk behaviours. If we can shrink these behaviours then the accident iceberg above it will shrink as well.

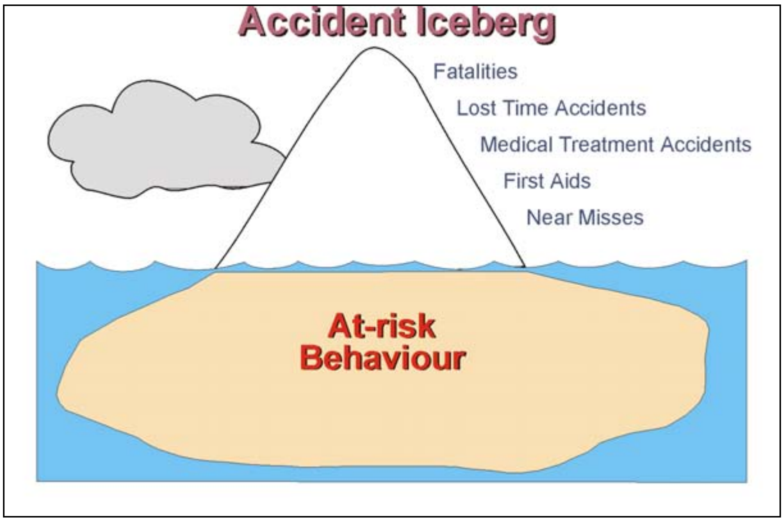


Figure 1: The Accident Iceberg

Behaviour-based safety is an employee-led process that allows workgroups to manage their own safety performance. The process operates with employees identifying critical behaviours, gathering data, provide two way peer-to-peer feedback and using the data to remove barriers.

Because each organisation is different, we recommend that a safety climate survey be conducted before deciding how best to implement behaviour-based safety at a site.

## THE SAFETY CLIMATE SURVEY

A site's safety foundations are the antecedents and consequences which have significant impact on safety-related behaviour. Thus the characteristics which distinguish safe from less safe sites are present in the culture of the site and in attitudes and behaviours of employees at all levels. The focus of the survey is to study the safety culture at a site, engage employees in the improvement process and on the basis of findings and input from employees to develop an implementation plan.

The survey has two main objectives, to discover cultural forces and foster employee involvement. By analysing the current status of existing systems and culture it is possible to locate factors that will help or hinder an implementation. Can a behaviour-based safety process build upon the existing systems and what challenges might be faced when trying to do so? The survey is able to foster employee involvement in a number of ways. During the process there are numerous opportunities for providing information as well as collecting it.

For example, many of our clients brief their employees about behaviour-based safety (through a live presentation, showing a video or issuing written materials) before issuing the survey. Giving the behaviour-based safety process wide exposure and gathering input that is timely and positive are successful in obtaining employee involvement. Two particular surveys are those offered by Behavioural Science Technology (BST®) and the UK Health & Safety Executive.

The BST survey was designed in the late 1980s and has been used many times at the beginning of a behaviour-based safety implementation. The survey is issued to the entire site personnel. The survey is anonymous and simply asks for level (e.g. manager, supervisor, shopfloor) and location (e.g. production, maintenance, administration). The survey has 29 questions which can be answered True, False or Don’t Know. The completed surveys are returned to BST for processing.

The survey results are analysed through eight scales:

1. Management support
2. Production pressure
3. Involvement in safety
4. Adequacy of safety training
5. Management fairness and consistency on safety
6. Reinforcement for good safety
7. Awareness of the role of behaviour in accidents
8. Adequacy of facilities, equipment and maintenance

The survey scores are benchmarked against BST’s database of other sites surveyed which helps indicate how good the existing system is: below average, average or above average.

The Health and Safety Climate Survey Tool[1] has three main components; a questionnaire, guidelines for administering the questionnaire and software for organisations to analyse the results and produce reports. The questionnaire consists of 71 statements about health and safety. All levels of personnel are asked to express agreement or disagreement on a five-point scale. The 71 statements are analysed against 10 factors:

1. Organisation commitment and communication
2. Line management commitment
3. Supervisors’ role
4. Personal role
5. Workmates’ influence
6. Competence
7. Risk taking behaviour and some contributory influences
8. Obstacles to safe behaviour
9. Permit-to-work systems
10. Reporting of accidents and near misses

RESULTS OF A SAFETY CLIMATE SURVEY

Through analysing the results from either survey one is able to highlight areas of strength and challenges within the existing safety process. The survey results help illuminate these strengths and challenges, and give an indication of what areas of the existing system can be used as the foundations of a behaviour-based safety initiative and what areas could cause potential barriers to this implementation.

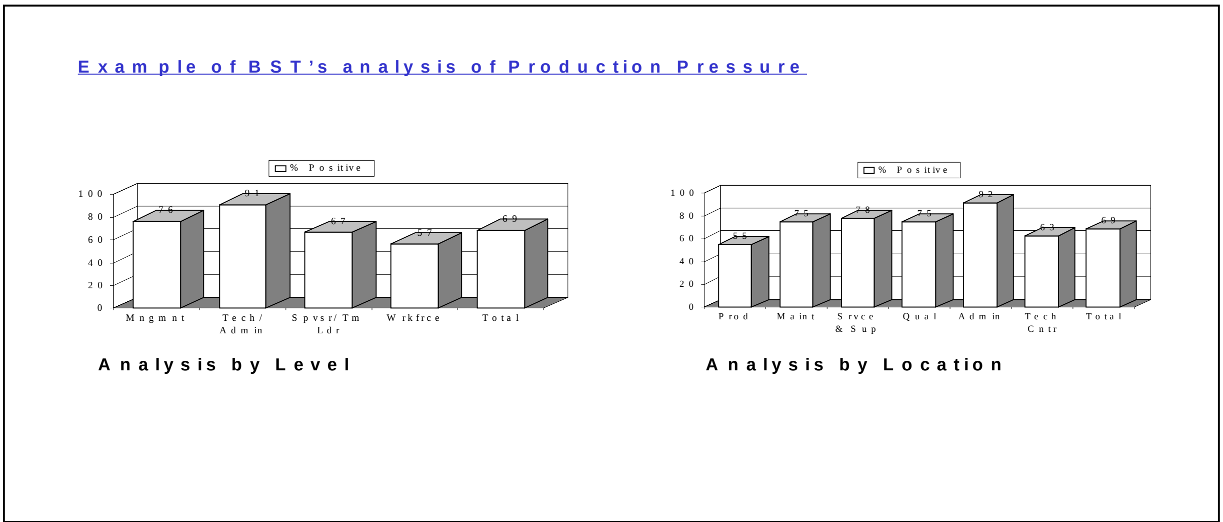


Figure 2: Example of Survey Results

The above example from a BST safety survey reports perceptions of the priority given to safety and the effect of production pressure on safety. Not unusually, this shows that production employees find production pressures more intense than do their supervisors, while management considers the production pressures to be even less.

In addition the survey begins a greater level of communication through out the organisation, particular in relation to safety. The results of the survey need to be broadcast to as many people as possible, especially those who participated in the survey and interviews. Hopefully this increase in communication about safety will see a similar increase in safety awareness across the organisation.

NEXT STEPS AFTER THE SAFETY SURVEY

The safety climate survey is only the first step to improving safety. Management now needs to act on its findings. In situations where behaviour-based safety is seen as the way forward, BST would typically:

- Conduct one or more Focus Groups sessions with a cross section of personnel to identify strengths and challenges in the existing safety management processes.
- Work with an Implementation Design Team made up of key/leadership employees to analyse the information developed in the Focus Group session(s) to tailor the behaviour-based safety technology implementation to the specific needs of the organisation.

## BEHAVIOUR-BASED SAFETY – A SYSTEM FOR CONTINUOUS IMPROVEMENT

Quality and safety go hand in hand. Total Quality Management is a term that encompasses ideas such as the utility of an upstream process measurement system, production system adjustments on the basis of statistical data, and employee involvement and participation across organisational levels. Quality management means the establishment of a system for continuous improvement using data-based methods and long-term goals. While companies who are involved in continuous improvement efforts realise great success in the process and production facets of their businesses, it is often not clear to them how safety can be addressed in a similar way[2].

In many facilities, safety is managed from downstream. That is, the predominant measure of safety performance is accident frequency rate. When accident frequency rates increase, management responds. Once the problem has been addressed, frequency rates are expected to decrease. But will they? Management may see a decrease for a short time, but not for long. Like previous quality control efforts, safety is being addressed after the product has been produced. Any efforts to increase safety at that point are not reaching the underlying mechanisms that are producing the faulty product. Temporary solutions are applied to the symptoms, not to the causes. Safety, in this type of environment, is not being managed. It is being treated in a reactive fashion.

Safety performance CAN be measured upstream. Employee behaviour is the final common pathway in a large proportion of incidents. The at-risk behaviour that precedes incidents can be measured. The behaviour-based approach to safety provides tools and methods by which the management systems that influence employee behaviour can be identified and redesigned to prevent injuries downstream. In this way companies can take a proactive stance towards safety management.

### AT-RISK BEHAVIOURS AS A CRITICAL MASS

It is helpful to picture the link between at-risk behaviour and injuries in terms of the relationship between the critical mass of a radioactive substance and its explosiveness. When a quantity of uranium is large enough to have reached critical mass, no one knows precisely which unstable atom will touch off the chain reaction that results in an explosion. On the other hand, physical scientists have demonstrated that the activity of the whole mass of uranium is statistically very predictable. The fact that the material has reached critical mass indicates that the probability of an explosion is extremely high. As a result, people who manage uranium 238 and other radioactive substances are very careful to store them in quantities well below their critical mass thresholds.

Just as there is a randomness or unpredictability about the activity of individual atoms in a mass of uranium 238, there is a randomness and unpredictability about the effects of individual acts or at-risk behaviours at a particular facility. Not every at-risk behaviour leads to an injury. Yet the overall safety performance of a facility is statistically very predictable. When at-risk behaviours reach a large enough quantity there is a high probability that accidents will follow. The challenge is to manage at-risk behaviours at levels well below the threshold at which they result in accidents.

BARRIERS TO SAFE WORK

Employees engage in at-risk behaviour for many reasons, including cumbersome or ineffective management systems, informal and formal reward systems that inadvertently encourage at-risk behaviour, and the lack of proper equipment.

- A Safe Operating Procedure that requires the use of a ladder that is kept locked away in a workshop may cause employees to become frustrated. Instead of spending time searching for the workshop key, they may opt to take shortcuts to avoid frustration and get the work done.
- Employees are often rewarded for exceptional production performance. However it may not be evident that they had achieved the goal by taking great risks such as clearing a jam in machinery without first shutting it down.
- When gloves are unavailable because stores are consistently out of stock, employees are at risk because they are not wearing the appropriate personal protective equipment (PPE).

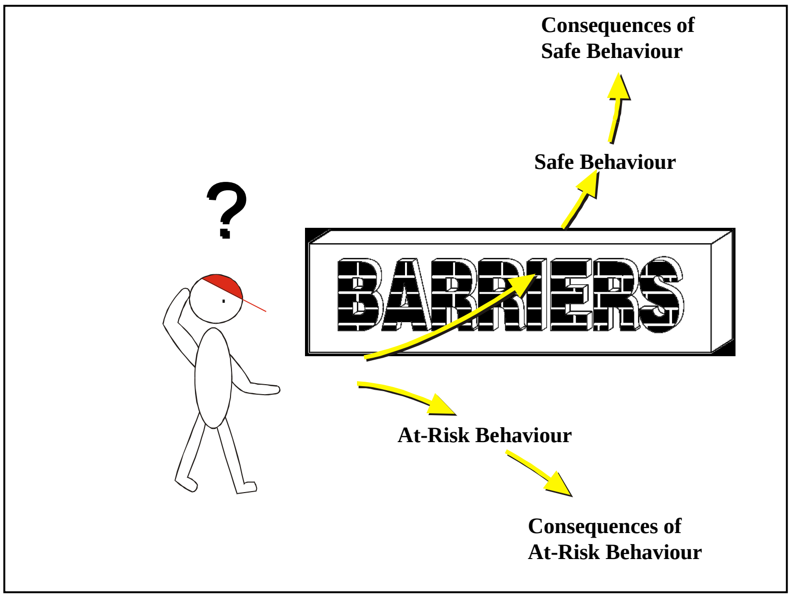


Figure 3: Behaviour-Based Safety Identifies and Removes the Barriers to Safe Behaviour

This list of barriers to safe work is certainly not exhaustive. However these few examples demonstrate that the factors that influence at-risk behaviour are varied in their origin and are not always as obvious as one might believe. With the recognition that these barriers exist, management needs to shift its focus away from placing blame upon the employee. Instead resources need to be concentrated upon identifying and understanding the source of at-risk behaviour, and finding ways to remove the barriers to safe work.

## THE ANTECEDENTS AND CONSEQUENCES OF AT-RISK BEHAVIOUR

Just as the physical sciences have methods to control the critical mass of radioactive substances, behavioural science provides methods to manage the critical mass of at-risk behaviours. Specific factors that exert an influence on at-risk behaviour can be identified through an analysis of the antecedents and consequences of the target behaviour. An antecedent is an event that triggers the occurrence of a behaviour. The behaviour is an observable act that occurs in response to the antecedent. Behaviours are followed by consequences. The nature of the consequences powerfully influences the likelihood that the behaviour will recur in the future.

Most actions have a cluster of consequences that follow them. For instance, here is a brief but representative list of consequences commonly cited by workers who choose not to wear personal protective equipment. The workers are aware of:

1. Greater comfort when they are not wearing the PPE.
2. Greater convenience in not having to locate the PPE to put it on; and
3. The possibility of injury.

These natural consequences are like plusses and minuses competing amongst themselves to determine what the worker will do next time. The first two consequences listed above influence the worker not to wear PPE, while the last consequence pushes towards wearing the protection. The power of a consequence to change or sustain behaviour can be ranked using three criteria:

- **Timing:** will the consequence happen sooner or later in the perception of the affected person?
- **Predictability:** is the consequence certain or uncertain to occur if the act is performed?
- **Significance:** is the consequence for doing the act positive or negative?

Consequences that are soon, certain and positive are the most influential in predicting a behaviour. Consequences that are later, uncertain and negative are least influential. In the case of the worker who is not wearing PPE, comfort and convenience are both soon, certain and positive. There is a risk that injury might occur but it is uncertain. After all, the employee might think, ‘I’ve not worn PPE in the past and nothing has happened so far’. So the employee chooses not to wear it this time.

Anyone who wants to change behaviour must look at both the antecedents and consequences of the behaviour. Are employees more comfortable without hearing protection because the only type that is available was not purchased with comfort in mind? Is it more convenient for employees not to get protective equipment because the stores are on the other side of the plant and there is an 80% chance that the needed PPE will be out of stock? Are employees so pressurised by management to achieve fast product turn-around that they do not have time to leave their work area in search of protective equipment? These questions point to barriers to safe work that can be addressed to produce antecedents to safe behaviour and consequences to sustain safe behaviour.

## BEHAVIOUR-BASED SAFETY IN PRACTICE

In the behaviour-based approach to safety, a cross-section of an organisation's employees is selected to develop a list of critical behaviours. The term 'critical behaviours' refers to behaviours that have been shown in previous accidents to increase an employee's risk of injury if the act is done at-risk; and significantly reduce the risk of injury if the behaviour is done safely. Through the analysis of at-risk behaviours, many companies find that, while the specific details of any given incident may vary, most recorded injuries are caused by a few consistent categories of behaviour such as a failure to wear personal protective equipment, or body placement (e.g. standing in the line of fire, or using improper lifting techniques).

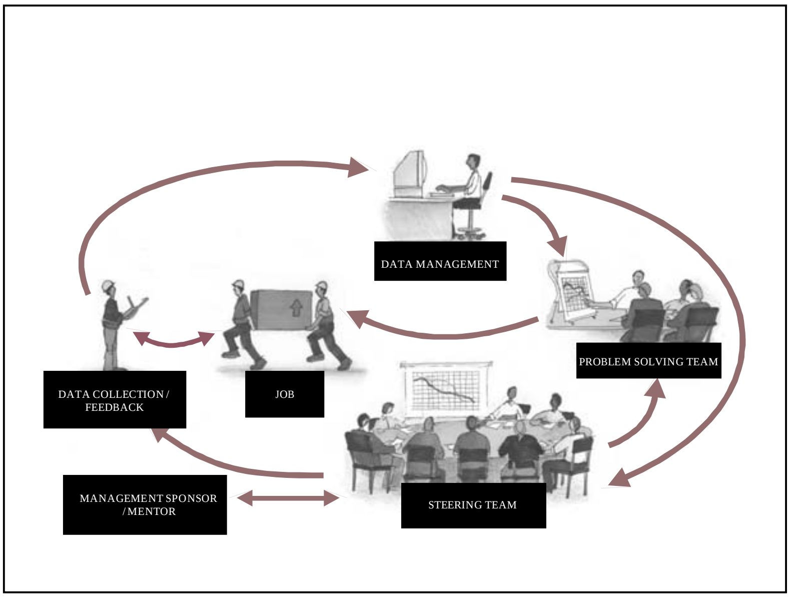


Figure 4: Data Flow for the Behavioural Accident Prevention Process® Technology

Once critical behaviours have been identified, a measurement and data tracking system can be established. Figure 4 shows the data flow and groups of people who are involved in the process. The Steering Team typically consists of eight shop-floor workers, a production supervisor and a maintenance supervisor. They will define an **Inventory of critical Behaviours®** in objective, observable terms so that observers can clearly identify and count the occurrence of safe and at-risk behaviour in a given facility. Observers – generally the Steering Team plus additional members of the workforce – are trained to carry out peer-to-peer observations in order to sample workforce behaviour using the inventory. Each observation will take around 20 minutes and may include one, two or occasionally three workers.

Steering Team members hold buy-in meetings with each work group. Definitions of the critical behaviours are shared with the work group and fine tuned as necessary. Then observations start to **collect data**, with a typical target of observing each member of the work force about once per month.

A key factor in behaviour-based safety is **immediate feedback** provided to the worker by the observer at the end of the observation. Positive verbal feedback is powerful reinforcement of safe behaviour, while guidance feedback leads to a discussion of the barriers that caused the worker to behave at-risk. Behavioural observation and feedback is an ongoing, highly flexible process that permits modification of the inventory of critical behaviours as necessary.

The observation data are entered into a computer database and the Steering Team starts to see which behaviours are putting workers most at-risk. From the comments gathered during feedback, they also see what barriers were cited by the workers. The Steering Team then works with relevant shop floor and management colleagues to analyse the barriers in more detail, before developing **action plans to remove barriers to safe working**.

## BEHAVIOUR-BASED SAFETY GIVES SIGNIFICANT IMPROVEMENTS

Through consistent feedback combined with removal of barriers, safe behaviour actually increases and accident frequency rates reduce. Within a few months after implementing the behaviour-based safety process, most groups achieve statistically significant reductions in incidence rates.

This is typical of implementation projects in which the first author's company has participated. Accident frequency rates continue to decline as the behaviour-based process takes root and become part of the culture. Reductions of 60-80% over a period of three to five years are not uncommon. Figure 5 shows long-term data for 102 companies, which have been involved in the process for five years or more.

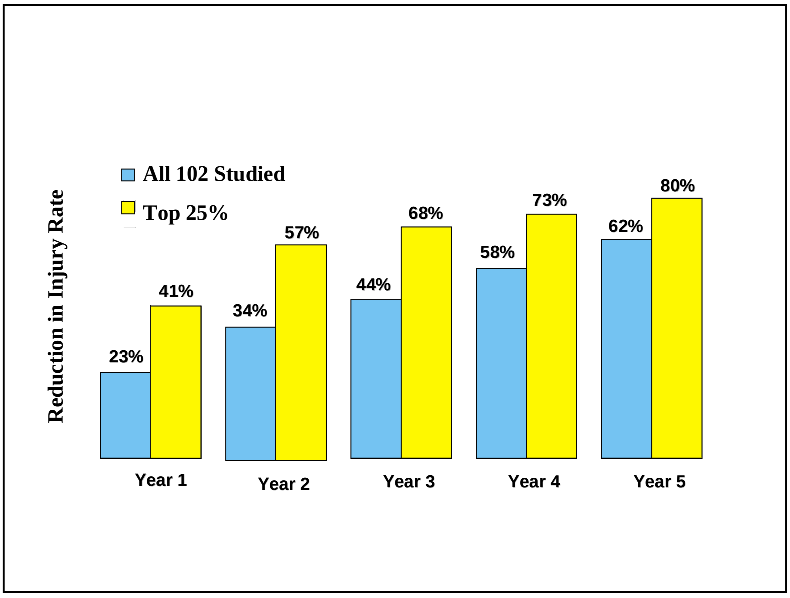


Figure 5: Reductions in Injury Rates with BAPP® Technology

The behaviour-based safety process promotes communication between management and shop floor workers by focusing on objective behavioural observation and data trends, rather than on personalities and individual perceptions. The participation of a cross-section of employees in the various facets of the process promotes involvement, ownership of the safety process and the development of problem-solving skills among the various groups in the organisation. Since the behaviour-based safety process facilitates the development of these systems along with the perspective that safety is a process with continued long-term goals, the process complements other efforts in a proactive management system.

## CASE STUDY OF BEHAVIOUR-BASED SAFETY IN ACTION AT MONTELL CARRINGTON

In early 1997 the Styrocell plant at Montell Carrington launched a Behavioural Accident Prevention Process® safety initiative titled ZAP – Zero Accident Potential[3]. A pilot implementation for the rest of the site, the Styrocell ZAP process in a short time overcame initial employee scepticism to achieve improved safety awareness and communication at the plant.


Figure 6: Logo for the Zero Accident Potential safety initiative

When Styrocell management began investigating behaviour-based safety in 1996, Carrington already had an above average safety culture. An active part of everyday work activities, safety was considered a priority. Styrocell workers regarded themselves as responsible for their own safety and that of their co-workers. In addition, the traditional, management-driven safety infrastructure was based on a "no blame culture" and contained good reporting, near miss, accident investigation and auditing systems.

In December 1996, BST helped a Steering Committee of Styrocell representatives develop their behavioural inventory, and in January of 1997 trained a group of 17 Observers to use the ZAP inventory to gather data. Although the new initiative was broadly welcomed on Styrocell, many saw this as yet another "flavour of the month initiative – something management had decided on.

In order to allow the process to flourish, management had agreed to stay in the background, ensuring full support was given as and when required. This support included acting promptly on any action plans developed by the ZAP Steering Committee.

Meanwhile the Steering Committee concentrated on devising ways to communicate to Styrocell employees about the potential of the ZAP process. This communication was achieved in a number of ways ranging from organising “buy-in” meetings for all employees involved, a coaching programme for Observers and helping them deal with any scepticism they might encounter, through to ensuring that any developments and successes achieved by ZAP were communicated to the whole workforce.

These communication efforts have had three important outcomes for Styrocell:

- The ZAP Committee obtained agreement from the workforce for observations to be undertaken
- The Observers are effectively being able to manage resistance as it arises
- The plant personnel are kept up to date with process successes and developments.

In addition the site has witnessed a decrease in accidents since implementation. By removing barriers to continuous safety improvement, the ZAP process has helped Styrocell in 1997 to achieve the best safety performance for 5 years – both in numbers of and severity. Figures for 1998 show the severity rating and numbers were even lower than 1997. The overall trend achieved during this period has been sustained during 1999.

The success achieved by Styrocell plant has paved the way for the ZAP initiative to expand to the remaining areas at Carrington. Following Styrocell’s lead, at present the Services, Oxide Derivative Unit (ODU) and the Low Density Polyethylene (LDPE) departments have begun their own BAPP implementations, along with the Polypropylene Plant.

Lastly, the site has established a Facilitators group, which meets once a quarter and is designed so that full networking is achieved across the site and to ensure cross-fertilisation of ideas and best practices are shared in all departments. This strategy will help guarantee continuous improvement in safety at the Carrington site.

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**REFERENCES**

1. Health & Safety Executive, 1998, The Health and Safety Climate Survey Tool, ISBN 071761462X, HSE Books, Sudbury CO10 6FS, UK
2. Krause, Thomas R., 1997, The Behavior-Based Safety Process (Second Edition), ISBN 047128758X, John Wiley and Sons, Inc.
3. Stewart, Andrew, 1998, The ZAP Team at Montell Polyolefins Improves Safety Communication, *Perspectives in Behavioral Management*™, Third Quarter 1998, Behavioural Science Technology International, Bracknell RG12 1JB, UK