

ENHANCING ACCIDENT INVESTIGATION BY APPLYING BEHAVIOUR-BASED TECHNOLOGY

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INTRODUCTION

Ninety Two percent of all Humber Refinery accidents in 2002 had critical behaviours as a direct contributing factor. Given that behaviour is the final path to most accidents, it would seem logical to identify and measure the frequency of the safety critical behaviours that contribute to those accidents.

Whilst the Humber Refinery had an effective behaviour-based safety process, no consideration was given to identifying the contributing safety critical behaviour sequence of events, at the initial accident investigation or subsequent management review.

There is a frequently cited phrase;

"What you can't measure you can't manage!"

By developing a process that captures the data it has enabled the effective formation of strategies to prevent recurrence.

One of the many benefits to this approach is the feedback that the injured party receives. All too often people injured in an accident are unclear how their behaviour contributed. *(If behavioural extraction isn't carried out soon after the event you are effectively second guessing without the input of the individual involved).*

This approach can help people understand and identify how and at what point they placed themselves at risk and establish why.

By applying this systematic approach it has been able to ensure a high level of detail is collated at the initial investigation and then utilise the data effectively to identify and remove the barriers to avoid repetitions of similar accidents.

"All the answers can be found in our failures"
.....(Bob Nelms 2003)[1]

Accident investigation has become commonplace within some organisations as they seek to understand how and why risks in the workplace occur. Unfortunately, for some they are viewed as a huge drain on resources with very little return, particularly for smaller companies. There is also a fear that internal investigations can leave companies exposed, with their own investigation findings being used against them by the enforcing bodies.

Whilst organisations have a duty of care to their employees, currently there is no compulsory duty or specific requirement to carry out internal investigations on workplace

incidents irrespective of incident classification. For some companies therefore, the temptation not to carry out an investigation will always be there. This is something that has troubled many people within industry and the HSC *(Health and Safety Commission)*.[2]

The HSC have now produced a consultative document (*CD 169*)[3] outlining proposals for making the investigation of accidents, dangerous occurrences and diseases a requirement of the Management of Health and Safety at Work Regulations 1999.

If legislation is to be the driving force behind accident investigations there are many issues that need to be considered and addressed:

- Will the quality of these investigations be of a suitable standard?
- Will they get to the true root cause of accidents?
- Who will monitor compliance?
- Would monitoring be a good use of public money?
- Will the investigations be value adding?
- What is a value adding investigation?

This paper will consider some of the issues that companies currently face within industry. It will also look at how ConocoPhillips Humber Refinery developed an approach that adopts current best practice. It ensures that they understand and learn from their accidents from both the organisation and the injured parties perspective with the ultimate aim of preventing future occurrences.

In 2001/2002 *t*he HSC stated that:

> *There were 249 deaths and over 27,477 'RIDDOR' reportable (Reporting of Injuries, Disease and Dangerous Occurrences Regulations 1995) work related accidents within Britain.*
> .....*(Gregg Myles 2004)*[9]

When you consider the number of accidents and incidents that do not fall under the category of a 'RIDDOR' reportable *(Fig 1) not* only is there a wealth of information that

Figure 1. Accident triangle[8]

could and should be investigated and analysed to prevent reoccurrence of the same or similar events. There is a strong business fiscal case to investigate.

All too often accident investigation is driven by RIDDOR only.

Within the Management of Health and Safety at Work Regulations 1999 *(MHSWR 99)*[4] there is a clear duty to;

> "*. . . make a suitable and sufficient assessment of the risks to the health and safety of his* (the) *employees to which they are exposed whilst they are at work . . . "*

To fulfil this requirement the risks must be identified and reasonable yet effective mitigation steps or actions should be taken.

If an individual was to suffer a work place accident it could be viewed that an area of risk has been highlighted that was not sufficiently dealt with or reduced to an acceptable level during the assessment, pre-planning and work execution phase.[10]

Often this is the case and these gaps can clearly leave companies exposed to third party action.

However, the risks that contribute towards the most common types of personal injury as a result of workplace accidents would not have necessarily been identified during a risk assessment.

For example:

a. An individual's inability to recognise emerging hazards as a result of work activity.
b. An individual's inadequate response to change in environmental conditions.
c. Distraction from the tasks in hand.

The above examples would possibly never be highlighted within a risk assessment and on the occasions when they are, would typically be dismissed as "not significant" and therefore no precautionary or preventative mitigation would be initiated.

When accident investigation is carried out thoroughly, it takes into consideration all of the contributory factors and probes into areas often overlooked or disregarded during the hazard recognition and risk evaluation stage of an assessment.

There is a common saying "You should never waste a good accident".

CONOCOPHILLIPS HUMBER REFINERY BACKGROUND

The Humber Refinery is wholly owned and operated by ConocoPhillips an international integrated energy company who operate in over 40 different companies across the world.

When Conoco Ltd merged with Phillips Petroleum Company in 2002 they became the fifth largest refiner in the world. The Humber Refinery is situated on a 480-acre site that sits on the south bank of the Humber river estuary near Grimsby and Immingham port, North Lincolnshire.

Heritage Conoco began construction of the Refinery in 1966 with plant operation and production commenced in 1969. Since that time the Refinery has developed and grown with continued investment to achieve their goal of becoming the cleanest, safest,

most profitable Refinery in the world. The Humber Refinery is currently the most complex Refinery in Europe, which operates with a staffing level of approximately 750 employees and up to a total of 1800 core and non-core contract personnel processing up to 400,000 barrels of crude oil per day.[5,7]

Safety has always been a high priority at the Humber Refinery with a large investment of resources being made to further improve the existing engineering controls, process safety and written systems.

Another area that the Humber Refinery have invested in is the understanding of Critical Behaviours and the application of Behaviour Based Technology by utilising BAPP® *(Behavioural Accident Prevention Process)* provided by BST® International *(Behavioural Science Technology International)*.[11]

Humber Refinery commenced development and implementation of their own behaviour based safety process PUMA, *(an acronym Personal Undertaking to Minimise Accidents)* in 2001 to help further improve their safety performance record, which had reached a plateau over recent years. Since then the Humber Refinery have begun to understand the extent that critical behaviours impact workplace safety *(whether it be personal safety or process safety)* and are currently utilising this resource wherever appropriate.[14]

At Humber there is a strong desire to understand and determine the true root causes of their accidents not only for moral reasons but also because managing this risk makes good financial business sense.

This was supported by findings as a result of a study they carried out utilising the Six-Sigma tools to determine the controllable inputs, variables and true cost of their accidents.[6]

The results from the study showed that during 2003 the cost of 0.1 *TRR (Total Recordable Rate, calculated as number of recordable accidents* $\times$ *200,000/Total man hours worked)* at the Humber Refinery was approximately £46,000.

Many industry best practice methods and techniques are applied at the Humber Refinery for accident and incident investigation including RCFA's (Root Cause Failure Analysis), mini RCFA's, Management Reviews and behavioural initial accident investigation. The latter was the latest addition to the investigation techniques used, placing focus on safety critical behaviours, an area that was identified as a gap in any of the investigation processes.

Previously the approach to initial accident investigation at the Humber Refinery was very much based around the 'traditional' theory of accident causation where accidents were a result of "unsafe acts or unsafe conditions".

Humber wanted to ensure that they considered the multi-causal theory in their approach by looking at the combination of at-risk behaviours *(behaviours simply being defined as observable acts by persons that have the potential to cause or contribute to an accident)*, at-risk conditions and at-risk systems/procedures that ultimately result in workplace accidents.[12, 13]

Whilst the investigation systems that were already in existence were very good at establishing the at-risk conditions and the at-risk systems and procedures, at-risk safety critical behaviours were often either overlooked or not fully understood.[15]

Through implementing and utilising a Behaviour Based Safety process the Humber Refinery has gained a thorough understanding of safety critical behaviours and the impact that they have on personal injury within the workplace regardless of the accident classification.[16]

By carrying out behavioural extraction *(an exercise that enables the identification of safety critical behaviours that either contributed towards an accident or could have prevented or minimised the potential for injury)* on each of the accidents that occurred it was established that 92% of all the accidents that Humber had experienced during 2002 had critical safety behaviours as a major contributory factor. At the year end of 2003 that figure had increased by 7% to 99%.

This clearly highlighted that behaviour was by far the biggest contributor towards accidents and the final route to personal injury.

Prior to carrying out behavioural extraction the point of the breakdown of the critical behaviour sequence of events was never established. All too often investigation findings would simply read "Individual did not pay due care and attention" or "Individual did not follow the procedure" without determining the point that they had deviated from the procedure or what exactly it was that distracted them from the task they were carrying out. Often the latent or cultural issues were lost beneath a blanket causation statement.

SELECTION OF THE INITIAL ACCIDENT INVESTIGATORS

Historically, the personnel responsible for carrying out the initial accident investigations at the Humber Refinery were the Shift Safety Officers, most of whom who had received limited if any training to assist them with this aspect of their role.

Therefore there was no consistent approach to carrying out investigations and the methods and techniques applied were very much down to the individual's preferred approach. This meant that the level of detail and information captured during an initial investigation was inconsistent and very much dependant on which of the Officers carried out the investigation.

A decision was made to address this gap by developing and providing a Behavioural Accident Investigation Process training package that consisted of:

- Foundations and principles of Behavioural Accident Investigation.
- An understanding of the barriers preventing safe working.
- Interviewing/listening skills.
- Techniques for dealing with resistance.
- Application of behavioural analysis.

The training package was designed with the objective of providing the accident investigator with a systematic and standardised approach to investigating. This fundamentally changed the purpose of the investigation from one of initial decision-making or finding fault to one that sought to establish exactly '**what**' had happened.

There is a clear need to establish the '**what**' before the '**why**' is explored. However, there is a tendency for many accidents to be either dismissed after classification without

any underlying causes of contributory factors being determined, or for accident investigators to jump to the '**why**' and conclude before the '**what**' has been established and fully understood. One example of such an approach is when in the past the '**why**' and the solutions were arrived at after a time consuming and costly management review carried out by people who may have no appreciation of the situation or the barriers the injured party was faced with and very little input from the personnel involved in the incident.[17] This often left the injured party feeling aggrieved and a solution was often put in place that was not effective.

To state that there is a need to understand the '**what**' before the '**why**' may seem to be stating the obvious objective of any accident investigation, however the difference from this approach to that of other investigations is that by establishing the '**what**' with the injured party and then working with them to understand '**why**', not only helps the organisation but also the injured party to prevent reoccurrence by having it clear within their own mind how their behaviours contributed.

The investigator is not expected to make judgements or form opinions. Their role is simply to facilitate the direction of the investigation whilst providing the injured party with immediate specific feedback where appropriate which will be based on agreed behavioural standards. If the investigator sticks to finding out exactly '**what**' happened and refrains from forming opinions around '**why**' the incident occurred it will help to prevent the investigator from having a biased approach and potentially trying to prove their own theories around an incident to be correct.

By allowing the individual involved in the incident to provide his or her own account of what happened can help to pinpoint the critical safety behaviours that led to the incident and establish and develop a practical and effective solution to prevent any reoccurrence.

Most accidents would not require further investigation as the critical behaviours have been established and understood by all involved parties and simple behavioural barriers are removed. However if further investigation is required the information collected from the initial accident investigation can be fed directly in to a process like RCFA with confidence that it is a fact based, non-biased account of what happened.

TOOLS REQUIRED FOR AN INITIAL ACCIDENT INVESTIGATION

One of the aims of developing the Behavioural Accident Investigation Process was to provide a planned systematic approach to establish the critical behaviours, conditions, barriers and events that contribute to the workplace accidents.

In order to achieve this each investigator has to be consistent in their approach. This is essential for any form of data collection, as you need to ensure that your data is reliable and is not subjective as a result of the investigator's own opinions and thoughts.

To achieve this measure all contributing critical behaviours within an investigation are identified against a document known as the Behavioural Accident Investigation ICB® *(Inventory of Critical Behaviours)*. This document contains all of the critical behaviours that are known on site to have resulted in accidents *(this was established through*

behavioural extraction) with each one of those behaviours clearly defined and practical examples of each of the behaviours being carried out safely. By clearly and specifically defining each of the critical behaviours it negates the need for the investigator to make any judgement calls on whether a contributory behaviour was carried out safely or at-risk. The definitions ensure consistency.

At Humber Refinery, to ensure that a behavioural accident investigation was carried out at the earliest possible opportunity after an event a behavioural accident investigation form was developed and placed as an attachment to the existing accident form. This form was kept reasonably simple with the main body of it made up of a checklist of the different potential critical behaviours allowing for the frequency of these behaviours to be identified and captured for both safe and at-risk critical safety behaviours.

THE THREE KEY ACCIDENT INVESTIGATION QUESTIONS

Quite often the injured party can come away from an incident in pain and/or embarrassed and aggrieved. They may also have come away from an accident investigation without really learning much about what had happened, why it happened and what they could have done differently to prevent it from happening in the first place.

During a Behavioural accident investigation (B.A.I.) the investigator will always ask three key questions when discussing the contributory behaviours that have been identified as at-risk during the lead up to the accident:

Q 1. Does the injured party **agree** that their particular behaviour placed them at-risk?

This question is very important; as one of the things that you want to happen as a result of the investigation is that the individual knows exactly where their behaviours contributed towards that accident so that they can change their behaviour on future occasions. If the individual does not agree that there is risk present from this behaviour then there is very little chance of them changing. This also helps to establish the behaviour as a true contributory factor.

Q 2. Was the injured party **aware** that they were placing themselves at-risk at the time?

All too often people will place themselves at-risk and they can be blissfully unaware of the fact. This question helps to highlight whether this simply is an awareness issue that can be swiftly dealt with through education, information and instruction.

Q 3. Was the critical behaviour within the injured parties **control**?

It is only at this point that the investigators begin to establish things that went wrong. Up until now all they will have been interested in is establishing what happened. If the behaviour was in the individual's control it is at this point that the individual will be invited to explain how they could have changed their behaviour so as not to give rise to any risks. However, if the individual states that that this behaviour was not within their control, this is indicative of a potential system or procedural breakdown or weakness. The injured party would then be asked exactly what it was that was preventing them from carrying out the behaviour safely.

Finally the investigator could discuss with the injured party what immediate remedial action needs to be taken to prevent reoccurrence and stop others from being hurt in a similar way. The reason that this question is asked of the injured party is because they have first hand experience of the situation and may well know information about the risks that the investigator may have over looked. In the past at the Humber Refinery the immediate remedial action was left down to the initial accident investigator to form his/her own opinion on what they thought was needed to ensure any existing or residual risk was eliminated.

DATABASE

Humber have utilised the BAPPTrack® database for storage and analysis of their behavioural accident investigation data. This was a very logical step for a number of reasons:

- The database was already in use on the Humber Refinery network for storage and analysis of the sites Behavioural Safety Process. Personnel were already familiar with the database and the way that data was presented.
- Reports can be pre-prepared by key users so that other users may view them by simply hitting the correct tab making it very user friendly.
- Many of the necessary data fields were already created within the database
- This database was already networked across the site making access to the data very easy *(Differing levels of access can be controlled by the site Administrator)*
- The BAI data can be directly compared with the behaviour based safety process data.

DATA ANALYSIS

Examine the accident investigation data (Figure 2) that was collected from the behavioural accident investigations in 2003 at the Humber Refinery. Figure 2.

You will then see that by focusing on the top three most common at-risk behaviours that contributed towards the accidents, you could then eliminate those at-risk critical safety behaviours that alone could provide a potential of reducing the accident rate by almost 50%. Figure 3.

By tracking all of this information within the BAPPTrack® database Humber are further able to drill down this information to establish the location where these behaviours are being most frequently carried out, the trade of the personnel carrying out these at-risk behaviours, the severity potential of the resulting accident, etc.

CONCLUSION

Risk management considers financial, strategic and operational risk in a holistic approach to identifying and mitigating those risks that are the greatest threat.[16]

An accident is an unplanned event or by product and any subsequent investigation is an uninsured loss. However it can provide, accurate measurement of performance and increase scope for effective identification of issues.

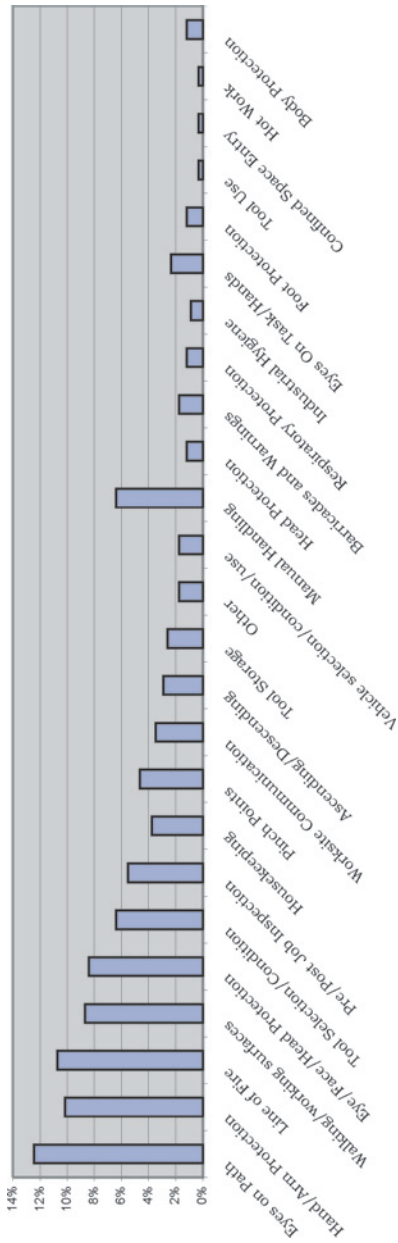

Figure 2. Contributory behaviours total accient rate humber refinery 2003

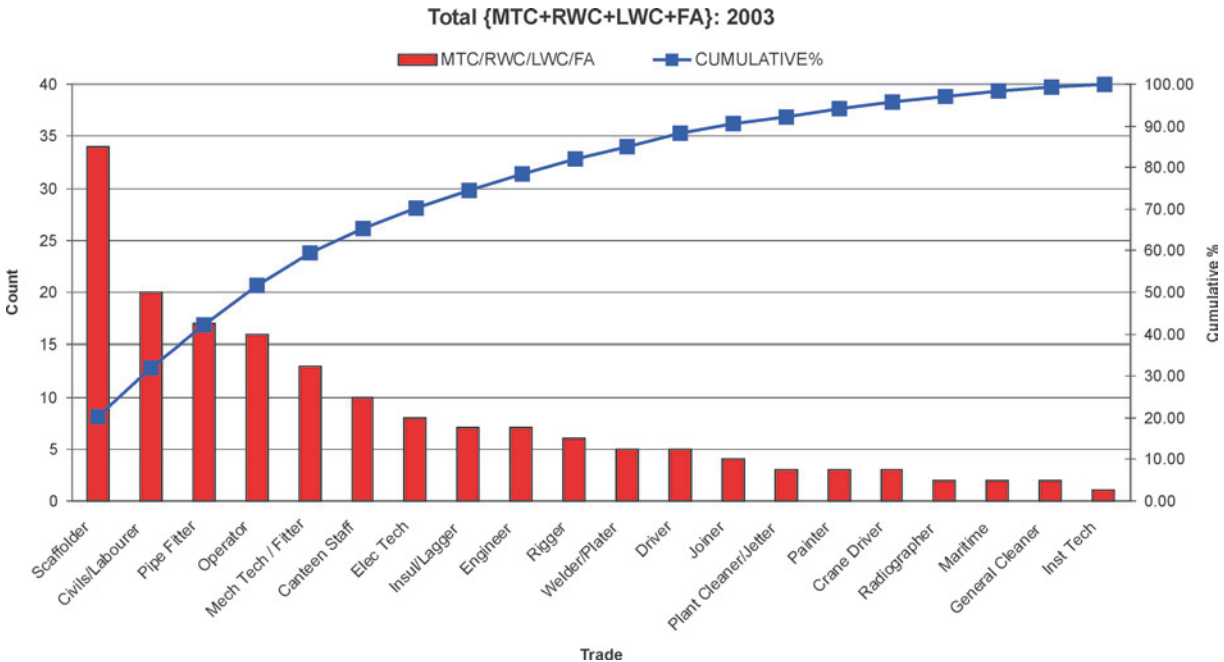

Figure 3. Trades involved in accidents

Unless the causes of workplace accidents and ill-health are properly understood, lessons will not be learned and suitable improvements will not be made to protect workers who may be affected by a particular activity.

> "*One of the most effective methods of controlling risk is to reinforce consistency, predictability and effectiveness in employee hazard recognition and their response*."
> ..... *Marsh — Fair 2004*

All too often little attempt is made to understand why the human failures occurred in high frequency low consequence accidents. Finding out the immediate and underlying causes of an accident is the key to preventing similar accidents.

Individual characteristics such as personal attitudes, skills, habits and personalities can be strengths or weaknesses depending upon task demands. Certain individual characteristics, such as personality, are fixed, whereas other characteristics, such as skills and behaviour, can be modified or enhanced.[15,18]

> *"We seem to have passed the era where the need was for further engineering safeguards in particularly hazardous industries. What we now need is to capture the human factor*."
> .....John Rimington, former Director General of the HSE.[1]

By implementing the behavioural accident investigation (*BAI*) process at the Humber Refinery they have been able to form corrective strategies by combining the findings from these investigations (*reactive*) with the findings from their established behaviour-based safety observation process (*proactive*). This gives a balanced view of the daily task-orientated risks people are faced with and a clear indication of some of the remedial action required to prevent either occurrence or more importantly reoccurrence, of events through utilising behavioural modification techniques.

Either of these approaches working in isolation leaves clear weaknesses within the armoury of risk and safety management. Reliance on accident investigation on it's own means waiting for the next accident to provide an indication of where to place focus.

Some accidents that occur have bad luck as a major contributory factor. Whereas the behaviour-based safety observation process provides a far broader source of data, it still however has its limitations. Behaviour-based safety is less effective at picking up on the at-risk behaviours that occur less frequently but have a higher potential of resulting in personal injury. One example of this would simply be the critical safety behaviour of looking at what you are doing (eyes on task). The vast majority of the time people look at what they are doing (*arguably even more so whilst being observed*); however when people allow themselves to be distracted accidents often occur. By utilising both methods of risk identification it can provide you with a double-pronged attack to accident limitation and prevention. End.

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