

PITFALLS IN IMPLEMENTING AND USING SAFETY MANAGEMENT SYSTEMS AND BEHAVIOURAL MODIFICATION PROGRAMMES

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Safety management in the process industries depends on managing the three key elements of People, Systems and Hardware. Significant investment in time and money has been devoted to implementing formal systems such as OHSAS 18001 and a variety of behavioural modification programmes. Some of these systems and programmes have failed to deliver the improvements expected by the companies involved. Using the experience of several Southern African companies, the author will demonstrate a variety of mistakes that can be made and makes suggestions as to how they can be avoided.

Some companies have focused on only one or two elements of the safety management model. The practical implications of this will be discussed. The need to take an integrated view of managing safety will be discussed and examples given of where this has lead to performance improvement.

KEYWORDS: Safety, Behaviour, Integrated safety management, Safety systems

INTRODUCTION

High standards of safety performance in the process industries rely on managing three major areas. These are: Hardware, Safety Management Systems (SMS), People. Figure 1 illustrates this below.

This simple model has been used by many of the safest chemical companies including DuPont. Hardware includes all the physical assets including plant, trips, alarms, interlocks, stores, vehicles, buildings and medical facilities. Intrinsic safety can be built in depending on the attention paid to this and capital spent in the original project decision. SMS refers to the suite of documentation in hard copy or in a computer that guides and instructs employees in how to make decisions and carry out tasks in an approved manner. The Safety Management Systems are often derived from legislation and lessons learnt from past incidents. In this paper the term System will be used to denote a policy, standard, guideline, instruction, procedure. These could also be considered parts or subsystems of one overall safety management system. The Systems are often linked in hierarchical form with policy being at the highest level. The People sector includes all human activities that influence safety. This covers plant designers, operators, service personnel, line management and staff support. Important human factors include selection, induction, training, leadership, motivation, culture and discipline.

The three sectors can and often are dealt with in isolation. They are, of course, related. The best-designed plants with intrinsic safety built in clearly require less ‘protection’ in the form of safety systems. Plants with inadequate safety systems would allow

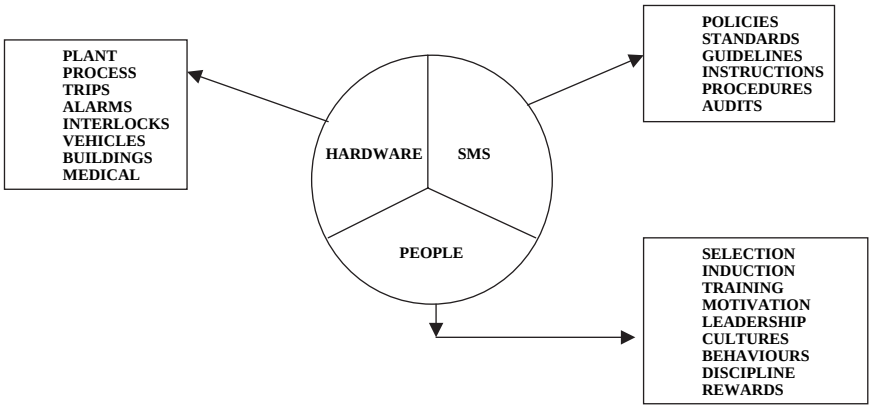

Figure 1.

more risks to be experienced by the employees. An experienced and aware workforce can to some degree 'make up' for plant and system inadequacies. This aspect is expanded upon later in this paper.

In recent years improvements in safety performance have been focussed on the 'People' area with the primary improvement tool being behavioural safety modification. Inherent safety in design continues to receive periodic attention without resulting in widespread changes in plant design. Inherent safety is well covered by other authors at the HAZARDS Symposia. Safety Management Systems receive little attention apart from when new international standards such as OHSAS 18001 are being contemplated.

The author's experience in the process industries has given him insight into problems with aspects of implementing SMSs and getting behavioural change programmes to function effectively. The paper is not meant to be a comprehensive review of all issues but is aimed at highlighting a number of practical issues. Some possible solutions are proposed.

PITFALLS IN IMPLEMENTING AND USING SAFETY MANGEMENT SYSTEMS

SYSTEMS FOR THE USE OF TOP MANAGEMENT ONLY

A large developing gold mine in East Africa had a serious accident involving fatalities. In carrying out the investigation into the accident it was relevant to examine the nature and effectiveness of the safety management systems in use at the time. The mine was North American owned and had expatriates manning the top team. Two major Australian and South African contracting companies did the actual mining work. Top management insisted that the mine was run strictly to the Ontario Mining Act and Regulations, which were at a much higher standard than the local legislation. The impressive

documentation was very visible in the Senior Manager's office and it was clear that he and his colleagues were familiar with its contents. It was maintained that the entire mine complied with this legislation.

The investigation revealed that the mining staff was totally unaware of the Ontario Mining Laws. They applied their experience and knowledge from working in their native countries.

Very little documentation was available at the operating level. Not surprisingly there was an in consistent standard at the operating level and safety was largely sustained by the practical approach of the employees. No process had been laid down to ensure that the required standards were known and understood by the workforce. No auditing was in place to provide feedback on practices being used by the workforce. The top management team was not in touch and did not have control of working practices. This was probably not intentional.

SYSTEMS FOR SHE STAFF ONLY?

A large minerals-processing plant in the Northern Cape Province of South Africa contains large scale crushing, screening and conveying equipment. The site is very strong on all management systems including those governing safety. The culture of the holding company is very control orientated. The control mechanism is generally a standard, procedure or procedure. The State previously owned these assets. The plant is in general quite old and lacks much built-in safety features. A behaviour-based programme has been started but is not in sync with the generally autocratic management approach to people.

There is a strong SHE Department with the SHE Manager part of the Site Management Team. A strong flow of information and data on safety is fed to the Team from the SHE Department. This Department has significant power.

It was relevant for the author to request details of the critical safety systems like entry to confined spaces and lock out procedures. Line management up to Plant Manager level could not produce such procedures. There were, in fact, established ways of performing these critical tasks so in practice unsafe behaviour could be detected. Well - developed procedures developed by the SHE Department did in fact exist on the Site intranet but line management was unaware of their existence. The SHE Department did not consider it their task to ensure that the workers were fully aware of the official procedures. The old culture of command and control was still in force and did not reflect modern practice.

ALLOWING SAFETY MANAGEMENT SYSTEMS TO DEGRADE

In some recent work at a platinum refinery the author studied the offloading of liquid sulphur dioxide from a road tanker to storage tanks. A number of problems arose including a required coupling being missing. A spare storage tank has to always have sufficient space to take the contents of the tank in use. Major leaks have occurred and are most hazardous. Both tanks were in effect full. The tanker driver carried out most of the offloading and did

most of the work require of the operators. The offloading procedure had been drawn up some time before and was not available at the site. Both the operating staff and contract transporters had some vague knowledge of the requirements of the procedure. No auditing or checking by plant management had taken place recently. The procedure had fallen into disuse.

The universal 'law' of management systems including safety management systems states that 'if systems are left alone without attention they will progressively degrade until they not longer function'. In particular a system put in by management but not supported by management declines quickly. Front line workers are quick to sense and react to what they perceive as being important to more senior management. The old maxim 'you get what you measure' is applicable. The degradation process seems independent of the importance of the procedure. This is particularly noticeable in companies where systems are seen to be management imposed and hold no benefits for the workforce.

Auditing in a regular and thorough fashion is the best way of ensuring systems remain effective. The auditing system itself has to be strictly maintained. The right seniority and level of professionalism needs to be consistently applied in auditing. As experienced in the Piper Alpha disaster it not just the quantity of auditing effort that is critical but the quality.

This unwritten law of system degradation can and must be countered by a number of approaches. The system needs the support of the entire workforce. Where possible the workforce or its representatives must be involved in its framing. The system must be kept as simple as possible. Thought needs to be given to the wisdom of including every possible exception in procedural detail as opposed to letting trained motivated people make decisions. The reasons for systems and specific aspects need to be spelt out with the benefits for all made clear. Time needs to be put aside for this on an ongoing basis. The most suitable ways of accessing information needs to be used.

NOT INVOLVING THE WHOLE WORKFORCE

A well-known large Fertilizer Company is currently implementing ISO14001 and OHSAS 18001 simultaneously in South Africa. This is substantial shift from their existing base of very simple systems in the form of limited instructions and policies. External consultants are being used to drive the process and the consultants are generating most of the new documentation. In doing a SHE audit on some of their plants I was in a position to become familiar with this project and assess the impact on the Company.

In the project the Company is moving from a handful of systems to a complex suite of 300 plus systems. The quality of the documentation is good but is mainly designed for technical consumption. There has been very limited involvement from the workforce that is supposed to be the target of the new systems. First line supervision has also been excluded. No prioritisation of the Safety Management Systems has been carried. In principle equal weight is place on everyone. In moving from a low base to this more complex situation it will be imperative to deal with the safety critical systems first. This is not the current plan.

It is clear that the implementation of these systems is going to be difficult and acceptance and effective use of these systems is unlikely.

MAKING THE SYSTEMS DIFFICULT TO ACCESS

The same Fertilizer Company is mounting the new systems on a set of six linked databases. These existing computer systems have not been upgraded or consolidated to meet the new requirements. Insufficient thought was given on accessing the new safety management systems. A simple requirement to access the new lockout procedure could not be met after 30 minutes with the plant manager attempting to find the information. User needs have not been well catered for in this application.

It is unlikely that these systems will be effectively used in the future unless access is vastly improved. There is a plan to use monitors at plant level to improve accessibility to systems including information like MSDSs. This will have to be implemented in a very user-friendly fashion or else there will be a major reversion to paperwork systems.

INSPECTING BUT NOT AUDITING

Some companies invest much time and effort in 'auditing' their Safety Management Systems. Some of these 'audits' include top management. In spite of the best intentions of all the focus is on specific aspects like machinery or the wearing of PPE. There is little questioning of the System that is meant to deliver consistent standards across a site or company. On reviewing these efforts the conclusion is that, in reality, inspections are being carried out rather than audits. There is a natural tendency amongst people with a technical or production background to look at physical aspects of a plant rather than to look for objective evidence that a system is working as designed. The purpose of auditing whether by internal or external agents is to prove that systems are working in practice and to make improvements to the system as a whole. Of course physical or field verification of the functioning of a system is an important part of an audit. This physical verification is, however, a chosen sample arising out of the review of the elements of the system.

The main differences between auditing and inspections are listed below in Fig 2.

The main reasons for this 'inspection' approach are the lack of training in auditing, failure to plan the audit and inability to understand the scope and application of the system. Auditing of Safety Management Systems is an activity requiring training of at least three days duration. Audit questions need to be generated for different situations. Checklists are useful but there is a danger of auditing becoming a rote activity. Failure to do professional auditing will result in a local verification or problem detection rather than a company-wide systems verification.

SYSTEMS BECOME TOO COMPLICATED

The development of a particular system reflects the ongoing experience of the company. This invariably means the system is added to over time and becomes progressively more detailed and complicated.

INSPECTIONS	AUDITS
Looks at specific item like motor	Looks at system of work like procedure
Can be focused on specific problem	Detects general problems
Often reactive	Usually preventative
Often not linked to other activities	Part of management control loop
Looks only at physical item	Looks at documentation AND some physical items for verification
Provides objective evidence on item	Provides objective evidence that system is working
Does not look at bigger picture	Big picture information but paperwork alone can mislead.
Need specific training to inspect	Need general audit training for quality audits
Look for deviation to standard	Look for deviations and positive findings
Mainly internal process	Can be internal or external

Figure 2.

A large chemical company in South Africa has a very comprehensive 'permit to work' system. The associated procedure is now 25 pages long. The requirements alone take up some 19 pages. The permit form has grown to A3 (plus) size with over 200 'box' entries possible. A form, reduced in size, is attached as Appendix 1.

Of course this is one of the most important "safety nets" in the management of hazardous materials and processes. Many accidents have occurred due, in part, to failures of these systems including the Piper Alpha disaster.

Technical personnel following an incident invariably modify the system. Operating personnel are rarely included in such work. Very few companies review their systems with the objective simplifying them. There is a perceived risk of omitting something important. As the system becomes more complicated the understanding of the system by those who need to use it becomes more difficult. Detail is critical on a typical permit to work. It is very easy to not "see the woods for the trees" and forget that the permit is a communication device not just a tick-box exercise. It is very easy to ignore common sense when concentrating on the permit detail.

PEOPLE HAVE TO MAKE SYSTEMS WORK

In the explosives industry where the author was engaged for many years the detail that has to be managed is critical. An example is the "permit to work" system where the required level of authority for sanction was the plant manager. An early morning task was the

creation of permits for tradesmen to carry out maintenance work. One such task involved welding on an explosives building. A fire ensued killing two people. The permit required the building to be cleared of explosives and the work site to be inspected by the permit authorizer before the permit was issued. This was not done.

The enquiry found the plant manager liable and he was summarily dismissed. The manger had been an exemplary employee and was fully aware of his duties. The evidence lead in mitigation showed the permit workload in the mornings to be excessive (up to 30 permits) with the resultant pressure to take short cuts. Senior management did not know this. Was the manager solely to blame?

INTEGRATED SYSTEMS WILL FIX EVERYTHING

A zinc mine in Namibia is currently implementing ISO 14001 and OHSAS 18001. The project is consultant driven. The belief in the management team is that this will solve their safety and health problems. Prior to these systems initiatives very few policies, procedures and instructions were in place. The mine relies heavily on motivated experienced employees to maintain an acceptable safety and health record.

The drive to in implementing the systems is to gain accreditation and access to new markets. Mine Management is convinced that the integrated nature of these systems will address all issues. However the building blocks for this are not sound. In consulting to this mine it is clear for, example, that the hazardous chemicals used in the beneficiation process and laboratory is not understood and no effective control is being exercised. There is also no evidence that the statutory exposure limits are being adhered to. The mine lacks a lot of knowledge on many of the risks they face. In my view the systems alone will not rectify that situation.

PITFALLS IN IMPLEMENTING AND USING BEHAVIOURAL MODIFICATION PROGRAMMES

BEHAVIOURAL SAFETY – INAPPROPRIATE MEASUREMENTS

Many Behavioural Safety Programmes incorporate making observations of behaviours. and recording them in some form. The recordings are normally collected and analysed by staff to understand and predict trends that need attention.

In one application in a major open pit mine in South Africa a programme had been in progress for about a year. Considerable time and money had been spent on training and data collection. The programme was structured on sound principles. However progress was minimal. The major emphasis of the programme was the collection of observation data to generate trends in at-risk behaviours. The trends could then be used to plan site wide improvement efforts. The sole measure used by management to judge the performance of subordinates was the number of observation cards filled in. The interactions with the operators whilst doing observations were minimal and poorly done. Supervisors and other observers developed a number of short cut methods to deliver the target number of cards. If short of the target a supervisor would devote the last day of the month to

doing observations. As with other performance measures, people under pressure look for the easiest way of making the numbers.

The author spent many hours on this site and it became clear that behavioural observation was an activity to be done only when the schedule dictated and was often totally ignored even though serious at risk behaviours were being practiced. The desired safety culture was clearly some way off.

Careful thought has to be given to how to measure performance in this area. Hard measurements are tempting but the softer tools of climate surveys are probably more useful in the implementation phase. Of course the accident/incident/at risk behaviour measurements in the longer run will have to demonstrate the improvement or lack of it.

BEHAVIOURAL SAFETY – MAKING THE INTERACTIONS WORK

Most behavioural safety programmes do effect a change in behaviour of the workforce. The sustainability of such change is an issue. Having observed applications in several South African Companies, a conclusion is that a weak part of the process is the interaction between an observer and an employee who may be carrying out an at-risk behaviour.

The interaction may range from merely recording the at-risk behaviour to in-depth feedback about the behaviour. This interaction has the potential to be very negative, neutral, or very positive. The author's experience is that, in general, the interaction is poorly handled and is often negative. Little preparation and training is provided for this key step.

The most common approach is for the observer to bring the at-risk behaviour to the operator's attention and suggest corrective action. The most common perception by such operators is that they are being disciplined even if it has been done with some sensitivity. There may be some learning but the most common human reaction is to avoid being disciplined in the future. Often this means that safe behaviour will happen when the operator believes he under observation. Motorists and traffic police have a similar relationship.

An improved approach that has worked well involves getting the observed person to define the consequences of and resolve his own 'at – risk behaviour' situation. After an appropriate 'gaining entry' strategy the following steps are followed:

- Operator asked whether he is aware of the risks he is creating or being exposed to – a 'What if' question is asked. E.g. what if the damaged ladder collapsed?
- The critical question 'Why' is then asked to find out the root cause of the behaviour. It might be that the person is unaware of the hazard, or the method is impractical or the person is on 'auto pilot'.
- The operator is the asked what could/should be done to correct the situation. The observer has to restrain himself from providing the answer. Mostly the operator knows the solution and the observer's role is to encourage the operator to take action
- The operator should be suitably praised to reinforce the positive behaviour.

The strength of this approach is the empowerment of the individual.

BEHAVIOURAL SAFETY – EVERYBODY'S BEHAVIOUR HAS TO CHANGE

Most behavioural safety programmes focus on the direct workforce. Supervision may be involved but often middle management and senior management are excluded. Most companies limit the role of management to funding the programme, doing ceremonial activities like opening training sessions, becoming trained as observers sometimes and overseeing the implementation of programmes.

As behavioural safety is aimed as changing company safety culture it is logical that all employees should change including top management. However top management has to change in appropriate ways. The one major difference that top management has to take into account is that most of its critical safety behaviours occur in decision making that takes place behind 'closed doors'. Apart from the requirement to make the correct strategic decisions that maximise safety, say, in approving capital plant, the problem arises in how to ensure that the rest of the company understands this and will take it as a signal that safety is a value. These aspects need to be communicated to all rather than remaining hidden.

Management, particularly line management, has a critical role modelling function. The limited exposure to the rest of the employees therefore takes on a particular importance. If no visible changes are perceived then whatever the merits of the behaviour change programme as experienced by the workforce it will not be perceived as critical for the entire company.

The challenge is to find visible top management behaviours to change. Even if they are partially symbolic and uncomfortable to adopt, top management has to demonstrate it is capable of doing things differently. Some examples might be changing driving habits, upgrading office safety including ergonomic improvements, making more plant visits and introducing a much more safety orientated agenda. Particularly powerful is to uphold safety and sacrifice production / profit in a public manner when a choice has to be made. Supporting a junior employee or whistle blower in this fashion can send a powerful message to all.

AN INTEGRATED APPROACH TO MANAGING SAFETY

WHY THE FOCUS ON A SINGLE SECTOR?

As stated in the Introduction the three areas of Hardware, Systems and People need to be addressed for high safety standards. Most companies do not look at safety in this holistic fashion. Companies tend to pick one sector and focus on one improvement initiative to get control of safety. Until the last few years the focus was on a systems approach to improve safety. More recently the focus has been on human factors and more specifically using a behaviour modification approach to change behaviours and improve performance. There is a large element of using the 'flavour of the day' to fix safety and health issues without taking a hard look at the nature of the problems and whether the basics are in place.

Companies appear to be prone to chasing the 'quick fix' and the latest 'tool'. In doing so they sometimes forget the basis for safety present and past. The blame for this can probably be laid equally at the door of relevant company executives and consultants. Many consultants sell specific tools and are unable to present a more balanced approach

because of commercial or perspective reasons. There is also some difficulty in convincing potential clients that the client's chosen solution to safety issues is inappropriate or sub-optimal. Companies tend to be driven by short - term results and the 'quick fix' is always attractive. This also reflects the view that safety is a priority (to be moved up and down the scale) and not as a deeply held value. Companies also have poor memories and fail to learn from past experiences. They are also very poor at learning from other's experiences. Safety experience has been learnt over centuries and future improvement has to be based on this solid foundation.

RELATIONSHIPS BETWEEN HARDWARE, SYSTEMS AND PEOPLE

The case for inherent safety to be built into new plants and modifications is incontestable apart from the possible cost implication. As Trevor Kletz has pointed out maintenance causes many accidents. Industries where maintenance is undesirable like the nuclear industry has high reliability equipment and systems. The chemical industry could adopt some of the more cost – effective approaches to reduce the need for maintenance and employee input. Fewer systems and fewer people are required for more automated plants. Intrinsically safe plants have fewer risks and therefore fewer controls in any form are needed.

The current emphasis on people aspects is most useful for companies who have high integrity well designed plant and sound practical safety management systems. However the emphasis on one sector or another is a limiting approach. The role and impact of people needs to be considered in the design phase of new plant or modifications. Recent work at Loughborough University have produced useful analyses of misconceptions by plant designers and operators which need to be fed back into the design process, safety management systems and training. Engineering change control now caters for people aspects. It has become clear that organisational structure changes, changes in key personnel and the impact of different cultures can affect the risk profile of an operation. A recent HAZOP study done by the author on an oil installation in West Africa had to consider the impact of a largely manually operated plant on the number and competence of the operating staff. Risks which would not be significant in a more automated plant had to be considered and more procedures developed.

There is little understanding that the three sectors have a direct impact on each other. Democratic South Africa now trades freely with the rest of the world. One of the consequences is that international standards such as the 'ISOs' and OSHAS 18001 and similar are required for international trade. Such systems are put in to meet trading requirements and not to help improve safety and health as a primary goal. Therefore insufficient time and passion are applied to the people sector to get all onboard and involved in using the system to drive internal safety and health improvement.

Focussing on one or two sectors of the safety management model is clearly suboptimal and may rest, untested, on assumptions that the 'other sectors' are totally satisfactory. For most companies this is likely to be untrue. A chosen behaviour modification thrust might therefore not only have to achieve its specific goals but make up for

deficiencies in plant and poor safety management systems. We all know it is possible to keep an old unreliable car on the road by being ultra sensitive to every rattle and shake but for how long?

LEARNING FROM THE BEST

DuPont have built their reputation for 'best in class' on a safety culture lived out by all employees in an amazingly consistent manner. In many ways this is the 'icing' on the cake as comparisons with other global companies have shown that their plants and systems are also outstanding. The author's own experience in AECI in South Africa using this broad view was similar where world class safety performance resulted from exiting dangerous technologies and reducing technical risks, simplifying systems and auditing them, and changing people's behaviour in an integrated fashion. The appropriate mix of effort in the sectors has to be applied to a company or unit to achieve a sustainable improvement. This has to stem from a sound analysis of all hardware, systems and people factors and changes expected in the future.

CONCLUSIONS

5.1 The safety management system pitfalls described in this paper can be avoided by:

a) Ensuring that the system being introduced is transparent to all who are affected by it.
b) Ensuring that the staff specialists don't guard the system so jealously that the workforce has difficulty using it.
c) Checking for systems degrading and falling into disuse. A formal auditing approach is a minimum requirement
d) Having line management own and drive the systems implementation rather than consultants. The entire workforce to be informed and involved where possible.
e) Making the system and associated data must be simple to access
f) Understanding the difference between auditing and inspection and making sure that those systems are properly audited.
g) Making systems as simple as possible.
h) Ensuring the number of systems and the requirements are such that people are not tempted or forced to take dangerous short cuts
i) Not believing that integrated systems will solve all problems

5.2 Pit falls in behavioural safety programmes as discussed in this paper can be addressed by:

a) Measuring appropriate outcomes and input factors
b) Using a more positive and creative interaction between an observer and worker
c) Ensuring that all employees from CEO downwards are involved and are require to exhibit changes

5.3 It is clear that an integrated approach to safety management that includes hardware, systems and people issues is more powerful than focussing on a single element. To

improve the integration in a safety improvement plan the following suggestions can be tried:

(a) Any safety reviews and plans to include all three elements
(b) Hazard elimination by plant/process design or modification is always the first approach
(c) Systems are regularly reviewed for relevance and 'add on's which can be avoided by other means.
(d) Trips/alarms and interlocks are regularly reviewed for relevance and possible elimination by plant/process modification
(e) If a 'world class' behaviour safety programme is envisaged ensure it is complemented by world-class plant and systems.
(f) Benchmark regularly with leaders across all three sectors to get perspective as to which sectors need most attention.

RDC Prior 26.8.2005

APPENDIX 1-PERMIT FORM