Learning from Accidents

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Final Report

Prepared by the European Process Safety Centre

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The European Process Safety Centre

Objectives

1. **Information**
   To provide advice on how to access safety information and whom to consult, what process safety databases exist and what information on current acceptable practices is available.

2. **Research and Development**
   To collect European research and development (R&D) needs and activities in the safety and loss prevention field, to inform members accordingly, to act as a catalyst in stimulating the required R&D and to provide independent advice to funding agencies priorities. "R&D" here includes experimental research and the development and review of models, techniques and software.

3. **Legislation and Regulations**
   To provide technical and scientific background information in connection with European safety legislation and regulations, e.g. to legislative bodies and competent authorities.

4. **Know How Exchange**
   To provide a platform for development of process safety knowledge for its members and to act as a focal point for dissemination of that knowledge to the European process safety community. Involvement in the Centre's groups gives organisations and individuals the opportunity to meet safety professionals from other companies, to discuss areas of common interest and to share knowledge and experience, thus enabling informed comparisons of safety management systems and practice.

Benefits of Membership

- Improved cross-European co-ordination on safety standards
- Identification of areas where manuals and guidelines could be produced
- Improved co-ordination of safety R&D and handling of complex technical research programmes
- Stimulation of R&D in areas where there are gaps in knowledge
- Transfer of knowledge from elsewhere to Europe and between European countries.
- Technical input to legislators and standard makers to ensure more realistic legislation
- Sharing and dissemination of information on safety technology and accident prevention
- Access to information from a single source

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- Willem Patberg Dow
- Norbert Baron ExxonMobil
- José Herbaux Total Petrochemical

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1 Background

This report on Learning from Accidents has been prompted and developed by a series of EPSC related activities and discussions which are outlined below

1. Work on Leading Indicators for Process Safety (LIPS) which resulted in an EPSC report on the topic which was published in 2004

2. Discussions arising from a DNV invitation to both EPSC and member companies to participate in a joint industry initiative on Leading Indicators for Major Accidents issued in 2004

3. A presentation given by Willem Patberg in late 2005 on the Dow developed Event and Action tool

4. Member response to a question posed by Dirk Doornbos of Lyondell in 2005 on how members ensured that process safety related knowledge was effectively disseminated across their own organisations

A working party of EPSC members met for the first time in January 2006. It was agreed that we should not repeat the work on LIPS but stand back from the topic of indicators and concentrate on lessons or learning from accidents. The group agreed to adopt the title of Learning from Accidents and focus on how lessons from adverse process safety events are transferred internally within EPSC member organisations and whether such learning can lend itself to measurement.

2 Introduction

The aim of this report is to provide a contemporary snapshot of member approaches to and use of incident reporting and action management systems from a process safety perspective. In so doing we set out to identify several of the issues which confront the modern global organisation in the high hazards sector in learning from accidents.

When we initially started this work we intended to structure our on site member interviews with a survey (Appendix 1) which had been developed with the assumption that incident reporting databases, action tracking and learning systems were still in their infancy as far as technology. The reality was somewhat different when we visited several EPSC member sites as many of the elements of the survey are found to exist not as disparate systems but often integrated into a single system. We expected the results from such a survey not to be particularly helpful. We found that it was better to use the survey to start a dialogue which focussed on the use of incident reporting and action tracking systems and their overall place in incident investigations and wider learning from accidents.

Our fact finding visits were made to DSM, Borealis, Dow, Total Petrochemicals and Solvay in order to understand their use of information systems to report on incidents and resolve the issues which result as well as the distillation of pertinent information into lessons which can be disseminated to their wider workforce and beyond. We also visited AIG in order to understand the insurer perspective on incident investigation and learning from accidents. In each case we fed back an account of our discussions to the host company which we have recorded as a narrative in the main body of this report

The report also includes a section on the BP Texas City accident which acts as a reality check on the use of incident reporting and action management systems against the backdrop of a major event. The independent Baker Panel report and BP's final report provide interesting insights to the weaknesses and deficiencies which can grow up around such sophisticated systems. Such critiques we found hard to ignore.

We have also conducted web searches on learning experience systems and where appropriate have used materials, appropriately referenced throughout the report in order to provide some theoretical framework. Finally we have offered up some opinion and comment in our conclusion and to the likely direction of travel of future EPSC work on this topic.

3 Learning Experience Systems

An effective system for learning lessons from incidents would need to include the following elements (HSL)

- An incident/accident reporting system
- A process for incident investigation that ensures that the underlying as well as immediate causes of accidents and incidents are understood, taking full account of human and organisational factors
- A process for analysing cumulative information on accidents and incidents from both internal and external events
- A process for ensuring that the findings of incident investigation and analysis of accident and incident data are acted upon in a timely fashion and suitable interventions put in place or modifications made to prevent a recurrence of the incident or similar incidents
- A process for evaluating the success or otherwise of interventions and modifications
- A process for disseminating information on accident and incident causation and suitable interventions/modifications to all relevant parties (both internal and external), as quickly as possible
- A system to capture the information in a format that is readily searchable and retrievable to allow ease of access, so that any lessons learned stay learned (corporate memory)

In a well managed organisation, the elements of an effective learning lessons process outlined above (with the exception of elements of dissemination of information) should form part of a good health and safety management system. That is, it should not generally be necessary to specifically have a separate learning lessons system.

The focus of this report is on the first element, that of incident reporting systems and how their use touches on the other above elements. From our visits to member companies it is apparent that several organisations have adopted the orthodoxy of single corporate wide databases. The argument for such systems lies in the logic that since many facets of business suffer adverse incidents, it would necessarily follow that the same investigative approach and training may work well for all incidents regardless of type. Furthermore some benefit may accrue from combining the systems and in particular, the incident databases (CCPS) In other words a certain loss of sovereignty over the management system of an adverse event be it a personal injury, process safety event, environmental release or security breach can be more than compensated by pooling resources into a single rule based system which offers universal access across a large organisation, easier system maintenance and at the “touch of a button” performance reporting.

A typical rule based system is illustrated in Figure 1 (Phimster) in which the system automatically reminds the action takers to close out actions which result from an adverse event. Provided that the action taker has agreed to the action, the setting up of system reminders would appear to be a reasonable approach to driving the organisation to a closure in the aftermath of an adverse event. In other words the system supports the work flow and with system generated reminders the possibility of losing or simply forgetting actions is much reduced.

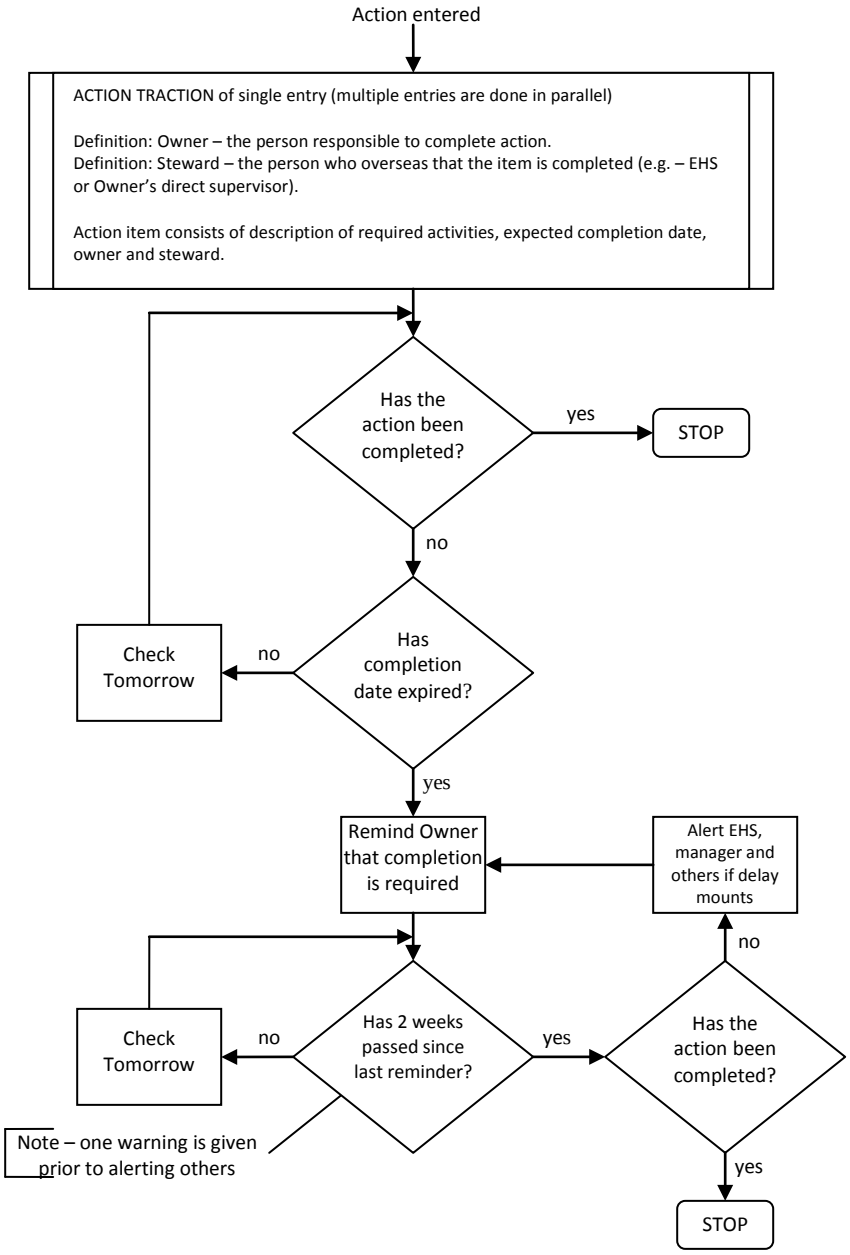


Figure 1

There are currently several electronic databases on the market that provide the similar features as Figure 1 and which can be configured to an individual organisation's structure and needs. It is not the intention to provide a detailed description of the attributes of a typical system but certain features and benefits do stand out.

The key benefit is that hitherto different systems are brought together by one database which offers universal access across sites. In theory this brings the opportunity to report incidents to those workers, who have access to a computer, which can increase the reporting of adverse incidents, especially near misses. Indeed the prospect of increased near miss reporting and the possibility to strike at the base of the accident triangle is one of the principal justifications for such systems. The singularity of the one company database is also valuable in that all users have the same view of the status of an event and its resulting actions. Moreover users have visibility on progress.

Another feature is that modern databases provide a means to store and archive files in terms of the user being able to upload documents and images to an event or action entry. This facility is especially useful for storing camera or video shots of the event itself which can be used as a reference by the investigation team. The investigation team themselves can also upload a file of their report which at least provides a context to those who later have the task of taking corrective actions.

Finally as with most systems the ability to provide regular summary reports on progress towards resolution and key indicators means the managers have the information to hand to begin conversations with operating staff at several levels within an organisation on performance and resource issues.

4 Findings – Summary

The following table summarises the salient features of EPSC member company approaches to incident reporting and action management systems and the related activities associated with incident reporting (see Appendix 2 for typical flowchart).

A gap in the table does not indicate an absence of that element only a gap in our conversation with the host company. For space we have use acronyms which are detailed in the glossary.

Elements	Dow	Borealis	DSM	Total Petrochemical
Company wide incident reporting system	Event & Action	Synergi	ARIA	IMPACT Enterprise
Status as of 2006	Established	Established	Established	European pilot
PS Incident Classification	A potentially serious accident (PSA) is treated in the exact same way as a reportable	Offline PS classification and notification and follow up	Offline classification is based on learning potential (approx 20% of sites within DSM group)	Offline risk based classification (5 S matrix)
Investigation method for PS incidents	RCA (Apollo Methodology)		Tripod/ RCA	RCA
Associated PS systems	GIRD			SHARE
Learning Experiences	LER to be archived by team in a searchable database		Investigation team self assess actions to single/double/triple loop learnings	
Learning Indicators			Ratio of single/double/ triple loop learnings	No of HVLE's created, shared and actioned

There now follows a more detailed description of each member company approach to the deployment of process safety reporting systems.

5 DSM

In 2001 DSM decided to create a single reporting system for all unexpected adverse events. DSM intended that the use of such a system would result in the formation of an extensive database, making it easier for the whole group to learn from incidents and take measures to prevent recurrence. A web based system known as ARIA (Application for Recording of Incidents and Actions) was developed in collaboration with Cap Gemini Ernst & Young. The aim of ARIA is to facilitate the incident reporting procedure, describe the measures taken in response to each incident, and improve the monitoring of response activities. Following successful trials in the Netherlands (Geleen) and the US (Addis), the global roll-out of the system began in 2002.

ARIA allows a description of the nature and causes of an incident to be entered straight from the shop floor and automatically monitors any remedial action that is taken. All incidents are investigated in order to learn from them and to prevent their repetition. The reports contained within ARIA are also analysed with a view to achieving structural improvements in safety at DSM. The intention is not only to address the obvious, immediately apparent errors or shortcomings but also to identify latent problems that could become manifest at a later stage, such as problems with instructions, knowledge, organisation and management.

Initially DSM had established global reporting requirements for unexpected adverse events which cover losses in

- SHE
- Containment
- Financial Damage
- Reputation

A requirement in the sense that DSM use the term is a non negotiable obligation placed on operations sites. From 1 January 2007, DSM intends to introduce adjusted global reporting requirements as follows

- Injuries (single event)
- Travel injuries
- Occupational illness
- Environment
- Containment
- Financial Damage
- Reputation
- Near Misses

Each adverse event is expressed in terms of levels of severity which indicate standards for degree of management involvement and timeliness of the post event investigation. In major accidents the DSM Board take responsibility for the accident investigation with the support of Corporate SHE department. High to medium risk incidents, known as monthly reportable incidents, are reported to the Corporate Group level. Locally reportable incidents, such as first aid cases, are reported to site level and Business Group level.

As of 2006, about 20% of DSM operating sites have adopted the practice (a practice within DSM is a non obligatory activity which is viewed as a good role model for all other plants to follow) of scaling the investigation, that is the incident is assessed as a low risk or medium to high risk incident. The remainder of the sites currently operate little scaling of a post-event investigation. For the analysis of major incidents DSM use the Tripod method, which enables the organisation to find structural solutions that help prevent recurrence.

DSM have flow charted each stage of the incident reporting and investigation process as illustrated in Appendix 1. For medium and high risk incidents a series of checks are carried out to assess the effectiveness of the actions resulting from the investigation activity and process. A work process 'learning from incidents' with its own tools is made available as a practice.

With reference to Appendix 1 the first check is to assess the effectiveness of the actions resulting from the investigation and to assess the effectiveness of the communication of the investigation with those who were in the immediate area of the event (i.e a check on both substance and process). DSM admit that in this process an area for improvement is the follow up communication with those immediately involved in the incident in order to validate their opinion on the outcomes from the incident investigation. The second check is a periodic analysis of incidents whose aim is to identify recurring incidents for which apparently the actions taken were not effective. The third check is to improve the detection and reporting of incidents in order to improve overall SHE performance – the introduction of adjusted global reporting requirements is an example.

DSM proposes that each site within the group selects stage indicators which are appropriate for their own circumstance (Appendix 3). A novel KPI is to assess the recommended actions arising from the investigation in terms of single, double and triple loop learnings (Figure 2). A single loop action refers to a recommendation which essentially is to "do the same things but better", a double loop action is to "do the same things but in a better way" and finally triple loop action is to "do other things". DSM are proposing to introduce site KPI's which measures the ratio of single/double and triple loop actions as an indicator of the quality of outcomes from incident investigation.

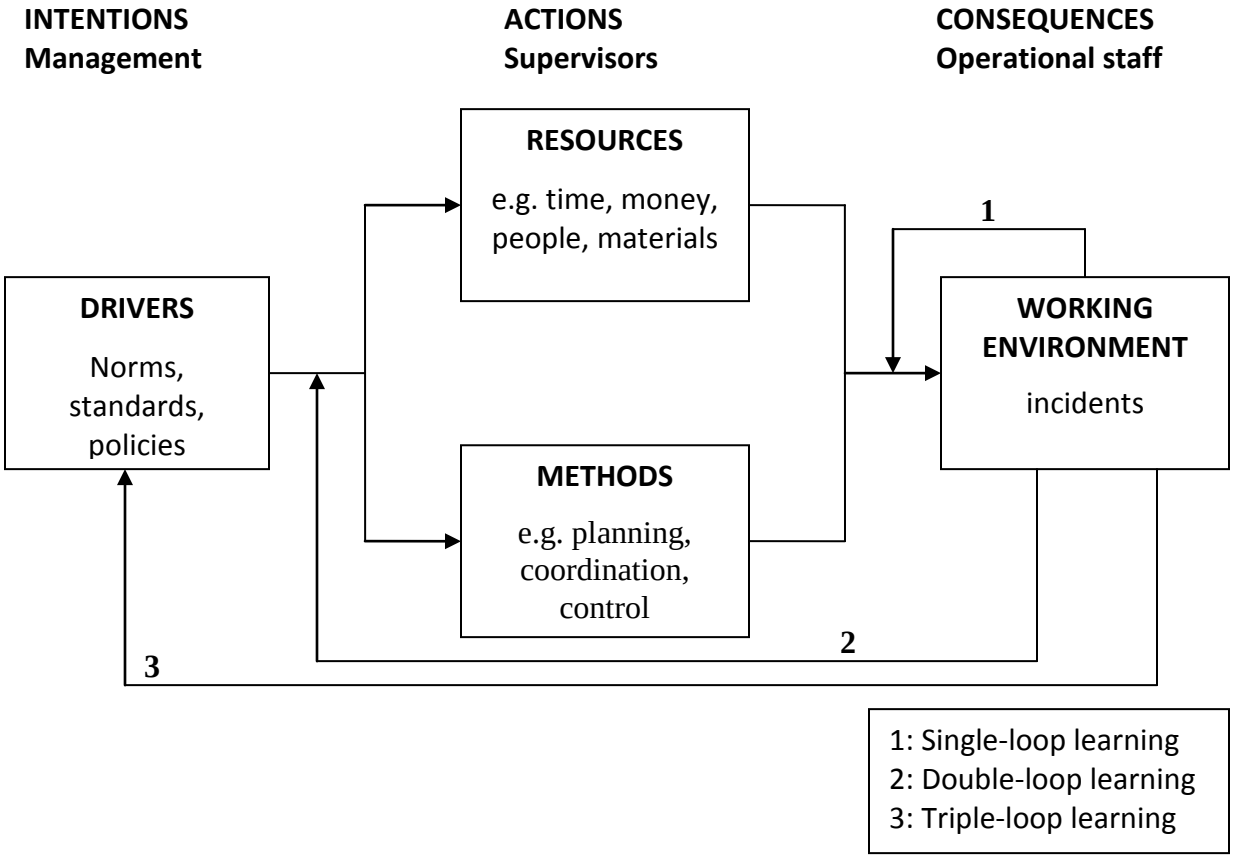


Fig 2

In support of ARIA, DSM Corporate SHE produces a variety of web based and hard copy reports and resources.

These include

- Quarterly web based newsletter with a broad distribution to the DSM community
- Quarterly SHE "league- table" styled performance report, with an annual award to be presented to the best performing site and most improving site
- SHE flyers which include useful information from outside and within the group

6 Borealis

Borealis use a single company wide incident reporting & action tracking system called Synergi, which is developed and marketed by a Norwegian provider. Synergi was introduced as a near miss reporting system in 2000 as a key element in reducing the frequency of adverse events.

By 2003 Borealis had achieved significant improvements in personal safety performance, in part, due to increased reporting through Synergi which had prompted significant senior executive attention to such incidents. This focus encouraged significant follow through on improvement actions even in the case of minor events. In contrast fairly serious PS incidents were overlooked. At the time, Borealis believed that senior management attention to PS incidents, comparable to that prompted by personal safety, was crucial to make progress.

In the first instance, Borealis established a clear definition of a PS incident.

A PS event occurs when

- There is an actual or potential loss of containment of the hazardous material
- The inherent properties or the physical condition of material creates a hazard, with the potential to cause harm to people, property, or the environment.
- A hazardous material ends up in a part of the installation for which it is not designed

The definition is consistent throughout the Borealis organisation although it is the responsibility of the site operating team to assess when an incident falls under the above definition.

When a PS incident occurs, the operations team rates that incident according to a ten element score

- Size of the spill or size of the material involved (reflects severity)
- Type of material (hazards involved)
- Inventory of equipment involved (reflects potential)
- Mechanical integrity (the degree of failure)
- Mitigating elements at the time of the occurrence (performance of mitigation measures)
- Protection systems (degree of functioning as designed)
- Number of people directly involved (proximity to incident reflects potential)
- Actual injuries
- Effect inside the site
- Property damage: business interruption and loss (in monetary terms)

The ten elements are scored and are weighted to arrive at an overall score; the maximum score available is 730. As with most scoring systems there is no “correct” answer as such but the system has been used across different teams across different sites to arrive at an overall score that is found intuitively to offer the right sense of scaling.

Ideally the classification of PS incidents would have been incorporated into Synergi. However about three years after its introduction, this post installation amendment of the system was considered a costly option. Borealis decided to route the reporting of medium to high risk PS incidents through a different channel as follows for the scores as indicated

- < 130: minor PS incident which uses the typical route provided through Synergi and monitored in the same way through the use of Synergi response factors (essentially a measure of completed action items)
- >130 < 230: reporter enters details on Synergi and completes a 24h standard report (in Excel) which is emailed to Borealis PS platform and senior management. This is followed by a local investigation and a report in English. Afterwards, a PowerPoint investigation report is created in order to disseminate lessons throughout the organisation.
- >230: same approach above with the addition that incident is investigated by international investigation team. The report is presented to Executive Board by line manager in the month of occurrence. After implementation of actions, a validation is conducted by an investigation team representative 6 months after the incident to check on the progress of agreed actions.

An unexpected advantage for the offline fast tracking of serious PS incidents is that notification by email is more effective than Synergi to alerting many senior managers These individuals are more likely to be able to receive an email (for example out of office travelling) than access the network for Synergi. For consistency, medium to high risk PS incidents are still monitored using the same measure as the Synergi response factor as for all adverse events. A typical presentation of performance across sites and year on year is provided (appendix 4).

For serious incidents, the reason to gather together an international investigation team is to bring objectivity and cross learning to both the investigation itself and the validation of the improvement action. However clearly both the report and actions need to be agreed and owned by the local site manager who is required to present the report to the Board. One of the advantages of preparing the investigation report in Power Point is that it encourages a more pictorial description of the incident. This in turn helps to spread learning across the several languages which are spoken across Borealis

The Borealis PS platform, a team of regional PS specialists, review all draft reports and possess the authority to return unsatisfactory reports to investigation teams.
A common problem is that investigation reports tend to address technical causes of an incident to the exclusion of human related causes.

7 Dow

Dow has developed in-house its own web based tool, the Event & Action tool (EAT), which is used throughout the Dow corporation as the generic action management system for all planned and unplanned events. Of the systems described in this report, the EAT has the broadest coverage in that its use includes details of those events which result in actions. By implication, an event which does not give rise to an action is not an event. This approach adheres to the Dow philosophy of “everywhere, the same thing, all the time” and use of MET (most effective technology) on all of the 750 operating facilities across the world. In effect the reduction of differences across the several businesses within Dow helps to drop down cost.

The implementation of EAT is seen as a success story within the company since it was not pushed from the “top down” but was pulled into operation by those sites that had witnessed its demonstration on pilot sites and wanted to have the tool on their sites as soon as possible. This represented an almost ideal “organic development” but did in fact cause problems with unofficial rollout moving ahead of the official programme of implementation.

EAT has no capability to offer incident investigation but the results of a Root Cause Analysis (RCA) investigation can be attached to an event. Within Dow, RCA investigation employs Apollo methodology, a generic approach to RCA, which is ideal for use by participants in net meetings. Many actions which result from events are one of communication; within the facility, within the plant sites, within the teams. The common protocol is that actions can only be assigned to team members.

In Dow, the investigation team has the option of generating an LER (Learning Experience Report) from an event. Until recently many teams have chosen to generate LER’s indiscriminately with little thought as the relevance and indeed the value of sharing the incident across Dow. Two criteria are now employed to raising LERs. The first is that it needs to be relevant to the technology or site. The second is that the action item needs to address operating discipline.

Near misses or PSA (Potentially Serious Accidents) are treated in exactly the same way as a real accident or a government reportable in terms of depth of investigation. Into the near future, Dow intends to remove the traditional distinction between Dow & non-Dow incidents and treat external incidents with equal seriousness; for instance, BP Texas City was a wake up call within Dow for siting of temporary trailers.

A small fraction of the events which are entered into the system are classified as PS. It is estimated that about 22-23,000 events are generated globally every year. In the narrower context of PS, Dow also employs a tool known as Global Incident Reporting Database (GIRD) to provide a consistent assessment as to whether the company is meeting its long term annual safety targets.

8 Total Petrochemicals

Total Petrochemicals has operating sites ranging from large sites employing 700 people to smaller sites that employ as few as 15 workers. Total in Europe is a relatively new user to corporate incident reporting and action management systems and are currently piloting IMPACT Enterprise (supplied by Syntex) on some sites. The same system was first introduced into the US organisation in 2003. IMPACT Enterprise can be described as a "loss of control" management system, a tool to manage loss control actions on site level.

Total has examined the option of a centralised bureau for the thorough follow up and progress chasing of actions to the satisfaction of all those in the loop and concluded that it would require between 10 to 20 people to maintain and would not represent a good use of resources. Their chosen approach as far as learning from accidents is to have the right people and right systems in the process.

Each site has the responsibility for reporting different situations as below.

- Potential critical event
- Incident or an unplanned event
- Accident with real loss consequences

With IMPACT Enterprise anyone can report an incident and the resulting cascade of information can be configured within the system, e.g. hierarchical (n+1) or area responsibility, so IMPACT Enterprise automatically assigns responsibility. The data is entered in "real time" and all data in the system (consequences, investigations, actions) are always up to date and thus can be easily followed up. The result is that responsibility for action resembles more closely the theoretical model of the safety organisation; hence it is difficult for various players to hide or escape from their responsibility.

Each site investigates an event of potential or real loss with two methods:

- KINNEY methodology (more relevant for personal safety)
- 5 S Risk Matrix (more relevant for PS)

There is a project for implementing IMPACT Enterprise in all Total Petrochemical facilities by end 2007. Currently the vehicle for statistical HSE reporting within the Chemical Branch of Total is known as SHARE and is a monthly loss control report which is consequence based rather than PS based (reports real loss as opposed to potential loss). The report is prepared by the HSE department on each site who agree on the level and content of the information contained in the report. It also includes reporting

of KPI's. It is envisaged that IMPACT Enterprise will provide all data that is required by SHARE in the near future.

A recent concept is the High Value Learning Experience (HVLE) initiative which collects relevant safety related experiences both within and outside Total at the corporate level and disseminates the information to HVLE administrators who are appointed on each site. The local administrator is believed to be in the best position to distribute the information to the relevant individuals on the site.

There are plans in the near future to use IMPACT Enterprise to track actions which result from HVLE's

The HVLE's fall into the consequence categories known as PEPEP:

- **P**eople
- **E**nvironment
- **P**roduct
- **E**quipment
- **P**rocess

Total have plans to assess the performance of each site as far as HVLE's and create indicators for the:

- The number of HVLE's created
- The number of HVLE's shared
- The number of HVLE's actioned

Sharing information and feedback from accidents both inside and outside Total plays a crucial role in preventing similar accidents from occurring at other sites. Accidents or near-misses may be the subject of Safety Feedback Notices that describe the circumstances and consequences of the event, analyse the underlying causes and make appropriate practical recommendations. Operational teams within the company use the notices to determine what prevention measures might apply to their site. Since 2003, a hundred or so have been issued each year and circulated across Total. They have been entered into a database that can be accessed from the intranet or a CD-ROM.

9 Solvay

In contrast to other EPSC members described in this report, Solvay has opted to employ an alternative strategy to a single company wide incident reporting and action management system. The company has about 150 sites across 50 countries each with its own individual need for the reporting of incidents and subsequent tracking and follow up. Local regulatory conditions can give rise to these individual needs. In part this decentralised approach is recognition of the significant impact that local language and culture can have on the reporting of incidents. Each site therefore employs its own system for action tracking which in their simplest form are Excel and Access databases.

Solvay recognise the importance of exploiting the knowledge from around the group and enabling seekers of that knowledge the easy access. In 2003 Solvay had over 400 Intranet sites developed with various types of software, not to mention other data sharing technologies like shared disks, shared files on Outlook, various forums.

In order to address the lack of integration, Solvay introduced Solia. Solia is a single web portal, accessible from everywhere and personalised for individual visitors. Employees can use it to access Intranet content, specified applications and their personal "TeamSite", that is their own personal virtual space for working and exchanging information with colleagues. The portal finally enables visitors to access application spaces, like the employee's or manager's self-service, informing them of the "TeamSite" activities to which they are registered.

The "TeamSite" is a web information management platform compatible with Microsoft applications, which has been developed to enable teams and working groups to centralise, update and share information sources in total security. With the Solia portal, "TeamSites" are to become platforms for managing information and sharing knowledge at global level for and between each business unit or project group within Solvay. Each team or working group member, anywhere in the world, has the same information and contributes to the same projects. Solia currently stocks over 645,000 documents and receives over 362,000 visits per month.

10 AIG

In order to obtain a fresh perspective EPSC visited EPSC member, AIG, one of the largest industrial insurance companies in the world in order to gain an insight into how an insurer views the key process of learning from accidents.

AIG sees the following as key to the investigation of incidents and the onward dissemination of lessons

- Person assigned as overall coordinator across all locations
- Incident notification
- Incident clearly defined (major, minor, near miss) according to defined thresholds
- Incidents classification
- Database for tracking of actions
- Minimal backlog on high priority recommendations
- Communication of findings and recommendations to workforce
- Database for analysis of causal factors

This list mirrors the ideal system of learning lessons from incidents which was offered in the introduction of this report, albeit more suited to the needs of an assessor. From our visits it can be seen that the database for tracking of actions can cover incident notification, incident classification and incident clearly defined according to defined thresholds and provides the capability of reporting on backlog of high priority recommendations.

AIG stress that it is unimportant which propriety database is used for the tracking of actions provided that there is at least evidence of a formal monitor of actions.

11 BP Texas City

The BP Texas City accident is quite possibly the most fully reported major accident in recent years giving rise to three official and public sources of information; BP's own account of the accident, the independent Baker panel report and finally that published in March 2007, the report of the US Chemical Safety Board (CSB). As such they provide an opportunity to understand the role that the systems for incident reporting and action management played prior to the accident.

In BP's final report published in December 2005 it was remarked that action tracking of PS related issues was performed in at least two systems. The first of these, TRACKS (Access database), monitored actions arising from Process Hazards Analysis (PHA) including major HAZOPS and MOC (Management of Change), and whose reports were regularly distributed to site management. The second system, Tr@ction, was used for corporate reporting purposes. Tr@ction was introduced into BP in 2001 as the global reporting and management tool and by 2005 had been rolled out to more than 39000 registered users across the company. In 2005, over 81000 incidents and near misses had been reported through this web based system as well as the outcomes from 267000 Advanced Safety Audits (ASA).

The BP final report notes that from 1999 that incident records were generally captured in Tr@ction and that these were more complete than prior to 1999. However it also observes that although a few near misses were recorded in Tr@ction, these were not completed in sufficient detail to provide an effective early warning. Local policy at Texas City indicated that instances of, eg relief valves lifting on start up, should have been recorded in Tr@ction but there existed neither the systems nor the behaviours in place to report or investigate process upsets. Furthermore, the lack of formal reporting is part driven by the incomplete use of Tr@ction provided further evidence of the high tolerance level of risk on the Texas City site.

One of the proposals for corrective actions identified in the BP report concerns the role of underlying systems and the need to integrate where appropriate the disparate databases that track actions such as TRACKS, Tr@ction and SAP for Planned Preventive Maintenance (PPM) and others. Moreover the report called for the interface with Tr@ction to be simplified and for the delivery of training to facilitate more user friendly and less cumbersome data entry for employees and systematic follow through.

The Baker Panel reported further concerns about the ineffective use of Tr@ction. The report notes that the system had several issues. The first issue was its inconsistent use; some sites used it to report only major accidents, others included near misses and still other sites included any other type of safety concern including those unrelated to PS. The Baker panel report does not clarify what Tr@ction was supposed to track although it is hardly likely that any such incident reporting system will be deployed to exclusively report and track PS events.

The second issue with Tr@ction noted by the Baker Panel was that each of the BP US refineries maintained its own database to differing degrees which ran in parallel.
The third problem lay in the systems ease of use. Many BP staff remarked that they found Tr@ction user unfriendly and some admitted they did not use it at all because they had no routine access to a computer. The final problem lay in the inconsistency of data which rendered the system unhelpful and unwieldy and it was found to contain substantial amounts of unfiltered information relating to other types of concerns.

Later in the report, the Baker Panel observe that BP used different methods at the corporate, business and refinery level to distribute information regarding incidents and lessons learned. At the corporate level, each major incident announcement and high potential incident investigation resulted in a “learning summary.” BP’s communication process required distribution of these summaries by email and entry of the summaries into Tr@ction. At the refinery level, some hourly paid workers complained about the difficulty in using Tr@ction and its poor design and admitted that they did not consult the system as part of their daily routine.

12 Conclusion

The EPSC members who hosted our visits represent a broad spectrum of the use of corporate wide databases for incident reporting and action management.

Each of the host companies to our visits can be characterised

Dow has a standardised approach with the introduction of EAT, which was accelerated through its implementation by the operating sites and offers coverage of all those events which gives rise to simply an action, both planned and unplanned. The investigation team have the option to generate a LER which are filed in a “lessons for the future” electronic archive. Solvay have adopted a decentralised approach and have implemented a “light touch” solution to enable authorised users to seek out relevant information stored on different intranet sites across the group. Total Petrochemicals are in the user familiarisation phase of their implementation of their corporate wide database but already have plans to use the system to distribute learning events through a network of local co-ordinators who are best placed to inform those “who need to know”.

Borealis, a mature user of corporate reporting systems, have adapted their incident reporting system to address a PS gap by introducing offline reporting, classification and subsequent fast tracking and escalation of those PS incidents that warrant senior management attention. Another mature user of corporate wide databases, DSM, have introduced a self assessment method to their sites which proposes a measure of the quality of the outcomes of an investigation in terms of the depth and permanence of fix.

One of the advantages of the reporting databases is that the information flows are configured on the theoretical model of how the organisation should behave in response to an incident especially in terms of line management involvement and contribution to follow up action. For example the reporter’s supervisor and the supervisors manager might be seen as an essential component of an investigation team as well as any local safety support. These two positions would automatically be system assigned roles in subsequent actions. Similarly lack of action or late action would be escalated to senior management.

The theme of the reporting system holding the blueprint to the organisation is one which is developed in the US where the system helps to manage the consequences of organisational change. For example a new starter filling an existing role will have actions assigned to that role as a result of prior incidents. For this approach to have value it is important that the new starter understands and owns the actions and is motivated to complete them. For this reason, Dow has a rule that only team members are assigned actions in the use of their EAT.

There are several unanswered issues with respect to the use of these systems that are apparent. One issue is that access, for security reasons, is normally restricted to employees of the host organisation. This excludes the contractor workforce who can represent a large percentage of those who are working on site and undoubtedly have the potential to observe and experience near misses. Another issue is that "non incidents" may be entered by a registered user but deemed in effect by the supervisor/line manager of the reporter as undeserving of further attention. In this situation the manager is able to close the case but is required to enter a justification (which is auditable at a later date). There is an argument for trending the non incidents over time to see whether they uncover underlying concerns but clearly the reporter in this situation needs to be handled with sensitivity.

For those members that operate corporate wide systems an important consideration is the language of the written word both for centralised reporting and communication of lessons throughout the organisation. It is crucial that any translation to the international language (the "lingua franca") is not seen as additional burden placed on the local sites because this task could pose a barrier to reporting an incident in the first instance. Moreover the translation task from the language local to the origin of the incident does not end with the "internationalisation" step but must also consider the "localisation" of the lessons into the various languages that operate across any global organisation (Figure 3). One way to overcome any language barriers is to employ a highly illustrated account of incidents together with their findings and recommendation for action on the basis that a picture is worth a thousand words.

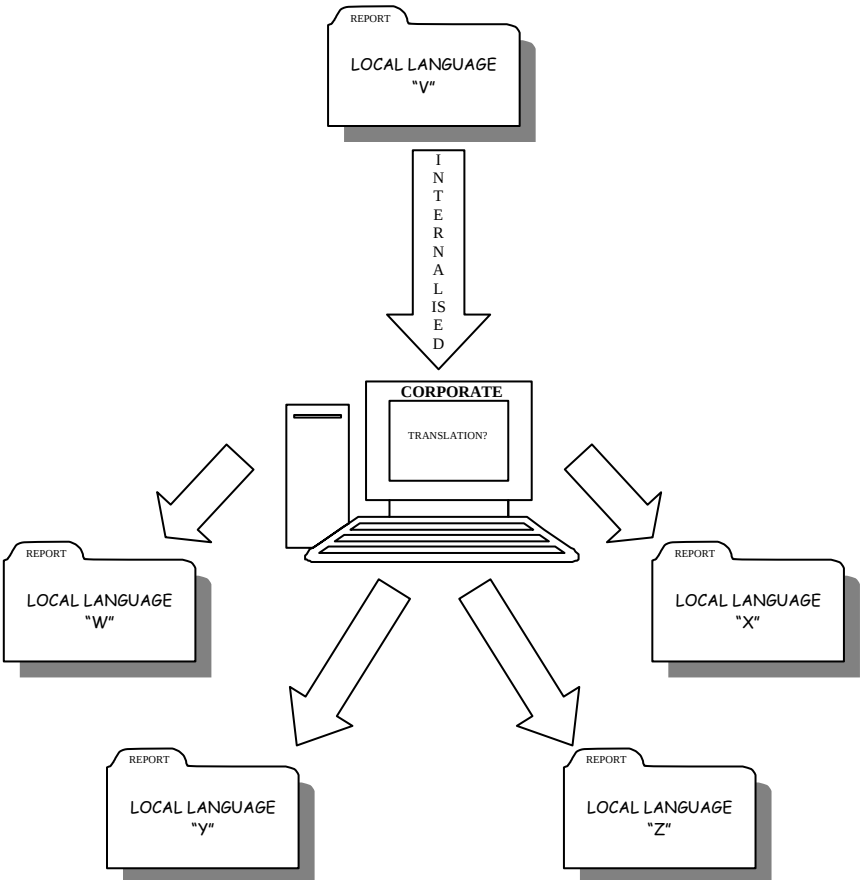


Fig 3

The big question is whether the use of incident reporting and action management systems drives learning or drives out learning. Learning by doing or learning by direct experience is viewed as a powerful way to improve an individual and collective intelligence. People also appear to remember more from what they have done than either they have read about or they have heard. The use of a system therefore which encourages the closure of actions (provided they are not "badgered" in the negative sense) would appear sound. Clearly the value of corporate systems lies squarely on the quality of their content, how they are structured and updated and ultimately the extent to which they are accepted as legitimate across the workforce.

Aside from the systems there is also a need for intelligent reflection and analysis of the data contained in corporate wide databases. All the members we visited support the process safety activity within their organisations with materials (newsletters, feedback notices, alerts), training and support tools and recognition systems (league tables, awards) which play a part in raising and sustaining awareness and knowledge of the process hazards that they encounter.

One clear development is the use of material in DVD format which represents a cost effective opportunity to spread a consistent message. Dow, for example distribute a

DVD internally, “Look back in Time”, which is a compendium of major accidents that have occurred both inside and outside the corporation and introduced and concluded by the Dow Vice President in order to emphasise senior executive commitment to process safety.

Another notable example of a process safety DVD was that commissioned by Borealis. This short film shows a near miss which occurred on a site within the group. During a maintenance shutdown, technicians attempted to break into a reactor only to be prevented at the last minute by a vigilant operator who realised they were working on the wrong reactor; an active one!. The power of this film is that it recognises not an actual accident but a potentially serious one. Furthermore the film shows interviews with many of the staff involved in the incident which clearly brings home the significance of the event to them and conveys the importance to those viewing. Essentially it is a form of learning by re-enactment.

13 Future EPSC Work

In order to make sense on future direction is worthwhile to consider how EPSC arrived at its current focus on Learning from Accidents. Its origins lie in the work of an Incidents Sharing group who presented accounts of company incidents and whose summary reports were published to the EPSC website. Essentially these were accounts with an emphasis on technical issues with little in the way of organisational context. The group disbanded in 2001 and progressed to Leading Indicators which dealt with the precursors to major accidents and their measurement. The work culminated in a report in 2004. Our current work, Learning from Accidents, is more geared towards an account of member use of the data carrying systems. The next phase is hinted at by the presentation of BP Texas City accident which was heard at a TSC meeting in October 2006 and showed a great depth of investigation including human and organisation factors and an urge to know why the accident happened. It is likely therefore that the wheel will turn yet again but to a deeper sharing of incidents (Fig 4).

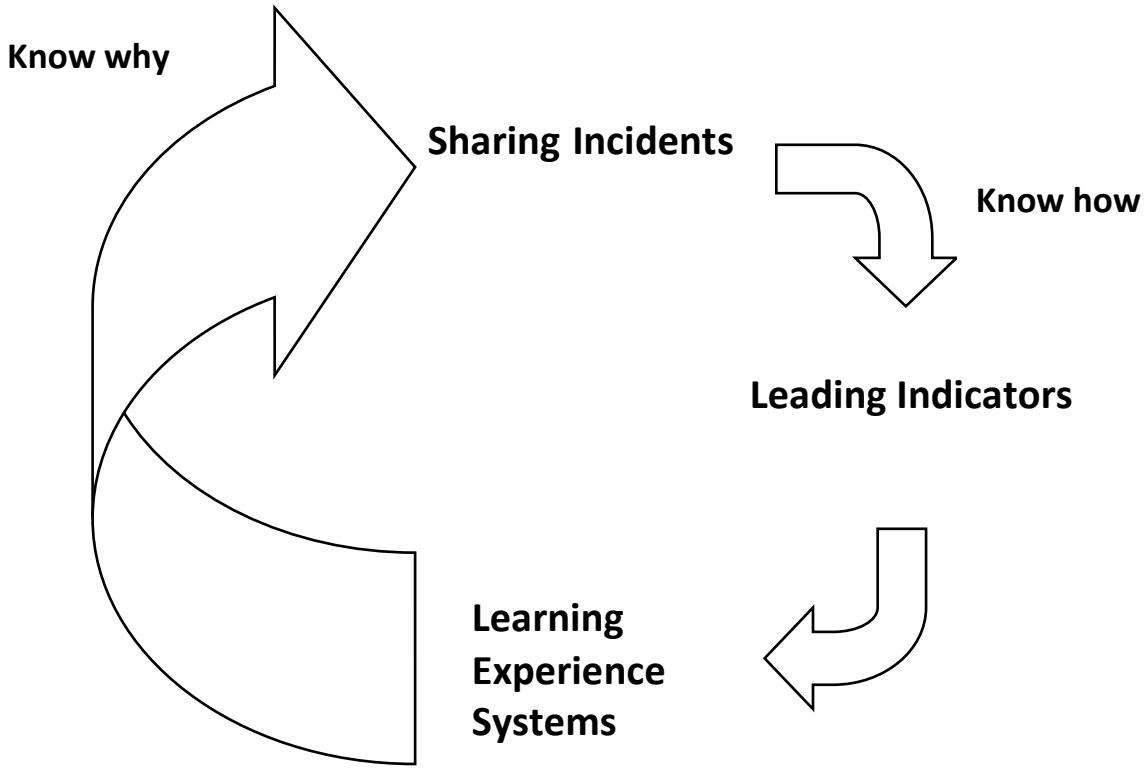


Fig 4

14 References

1. *Leading Indicators for Process Safety* EPSC report 27
2. *A survey of processes and systems for learning lessons from incidents within HSE and industry* HSL /2005/30 Health & Safety Laboratory 2005
3. *Guidelines for investigations chemical process incidents* (Second Edition) CCPS Book
4. *Near-Miss Management Systems in the Chemical Process Industry* James R. Phimister, University of Pennsylvania
5. *Safety Review Panel ('The Baker Report')* BP US Refineries Independent Safety Review Panel 2007
6. *Fatal Accident Investigation Report-Isomerization Unit Explosion Final Report* BP Report 2005

Appendix 1

Learning Experience Systems

These questions are written in an attempt to guide an interview conducted by EPSC staff or project person with EPSC member company staff who are able to describe their Learning Experience systems. In addition to the interview, a demonstration of how the system works (with examples) should be requested. Notes and documents should be provided wherever possible.

1 The Systems

1) Do you have a formal system for learning from events?

2) Can you ensure that agreed changes are properly implemented within:

   a) The plant?

   b) The site?

   c) The company?

2 Communication (alert etc.)

1) Is an owner (individual or team) defined for a Learning Experience?

   a) **If yes**, does the owner have a role in verifying that the follow up items are communicated? (repeat question in follow up and verification)

2) How do you define who should receive the information and if needed, what actions are required in follow up?

3) For the communication step,

   a) Is a special system used?

      - **If yes**, what sort of system?
      i) Flagged emails
      ii) Broadcast

iii) Paper
iv) Other (can you describe it please):

b) Or is the communication of LEs done in the same system as other (perhaps) less important information? (i.e. a generalised communication media)

c) Is the originator (individual or team) responsible for completely detailing the Learning Experience and the follow up actions required?

i) **If yes**, can you say more about it?

d) Or is this left to the discretion of the people who receive the communication?

i) **If yes**, can you say more about it?

3 Follow up

1) Is there a formal requirement for LEs to be followed up?

2) Is this a documented procedure?

3) Is this a paper system only?

a) **If yes,** is it:
i) Recording
ii) Communicating
iii) Gaining feedback on implementation of the Lessons Learned
iv) Other (can you describe it)

4) Is any software used in the follow up system? (other than the record making and storage)

a) **If yes** what are they?

4 Closing the loop and Verification

1) Has the Learning Experience an 'owner' (individual or team)?

a) **If yes**, are they involved in the verification step?

2) Does the LE system close the loop in the sense that the system itself includes an implementation and verification step?

    a) **If yes**, how is verification assured?
    b) Does verification require all persons who have to act to confirm that they have done so? (e.g when the action required is change the lubricant for a valve in chlorine service, all maintenance staff individually confirm that communication was received, procedure was updated, training was done and understanding is complete)

        i) **If not**, is there a supervisory sign off (e.g. Shift Leader confirms that operating procedure was adjusted and training was given to all shift staff)

            (1) **If No**, does the LE system connect to another formal system which deals with implementation and its verification?

3) If not covered by the questions above, how do you verify that the lessons learned have been communicated as required and any necessary changes been implemented (hardware, software, procedures etc.)

5 Managing the system

1) Metrics:

    a) Is it possible for the system to generate statistics (e.g. number of action items, number completed, number overdue or not verified)

If you want to say more:

2) Auditing:

    a) Is it possible to audit the LE system to
        i) Check it meets company requirements
        ii) Follow inputs through to the required conclusion

    b) Do you carry out such checks on the effectiveness of the system?

3) Other questions relating to links to other systems

    a) Is there a formal link with Root Cause Analysis?

    b) Is root cause analysis practised for:
        i) Accidents to people, property or the environment
        ii) Incidents affecting people, property or the environment

iii) Near Misses which have the potential to affect people, property or the environment
iv) Maintenance failures
v) Loss of Primary Containment
vi) Security Incidents
vii) Other – please describe

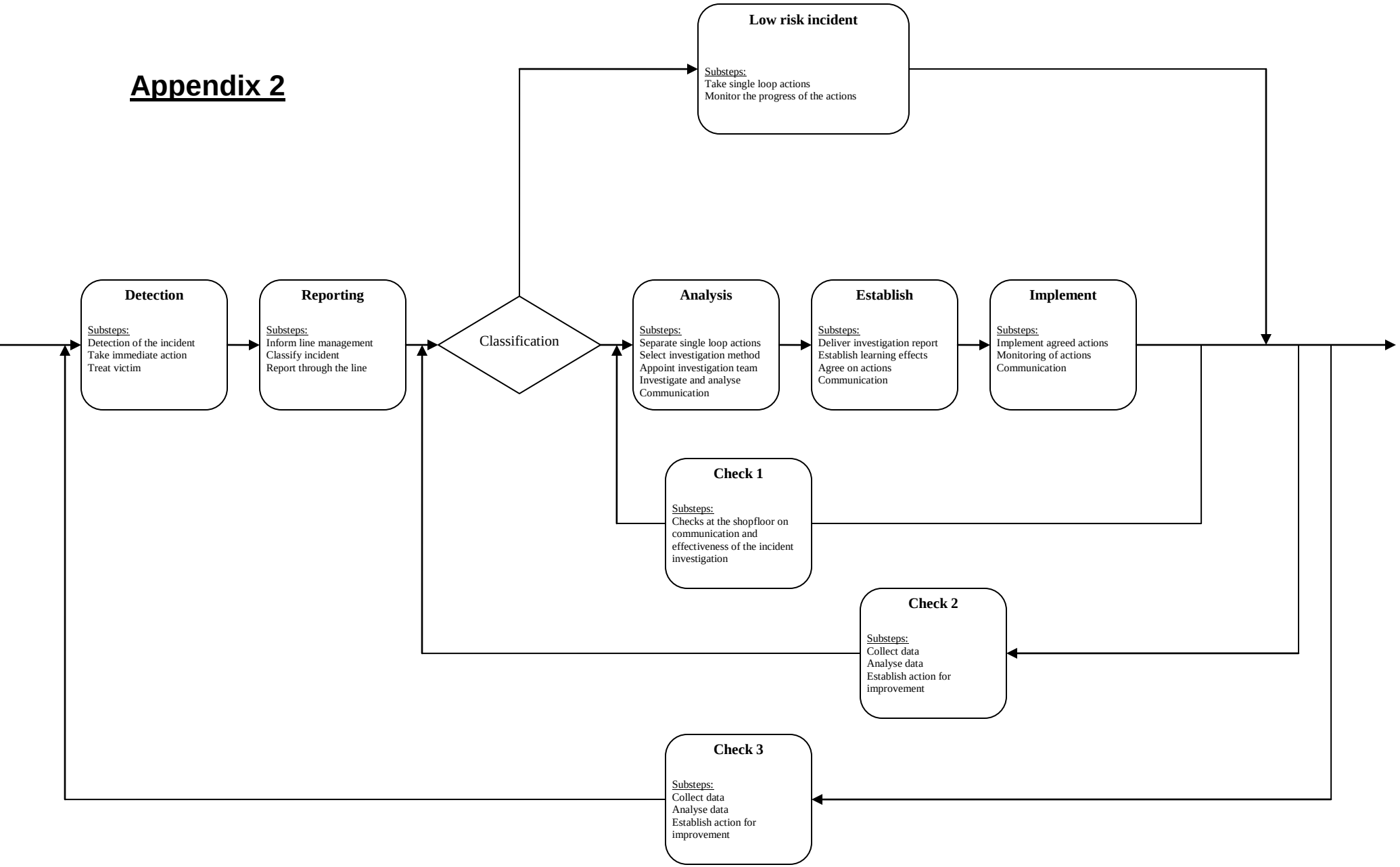
6 General methods of generating and progressing to completion of agreed actions.

1) Do you have a single system to achieve this for a range of inputs e.g.?

   a) **If yes**, what sort:
      i) Project 'Punch Lists'
      ii) Audit action items
      iii) Regulatory Authority communications
      iv) Process Hazard Analysis action items
      v) HAZOP action items
      vi) Follow up from accident investigations
      vii) Follow up from accident investigations
      viii) Implementation of LEs from external events (communicated from other locations in the company or from other companies.
      ix) Follow up from Management of Change process
      x) Other: describe please

   b) **If no** are these all treated
      i) Separately
      ii) Partially combined?
         (1) **If yes**, which topics are combined?

Appendix 2


Low risk incident
Substeps:
Take single loop actions
Monitor the progress of the actions
Detection
Substeps:
Detection of the incident
Take immediate action
Treat victim
Reporting
Substeps:
Inform line management
Classify incident
Report through the line
Classification
Analysis
Substeps:
Separate single loop actions
Select investigation method
Appoint investigation team
Investigate and analyse
Communication
Establish
Substeps:
Deliver investigation report
Establish learning effects
Agree on actions
Communication
Implement
Substeps:
Implement agreed actions
Monitoring of actions
Communication
Check 1
Substeps:
Checks at the shopfloor on communication and effectiveness of the incident investigation
Check 2
Substeps:
Collect data
Analyse data
Establish action for improvement
Check 3
Substeps:
Collect data
Analyse data
Establish action for improvement

Appendix 3

Learning from Incidents Suggestions for KPI's

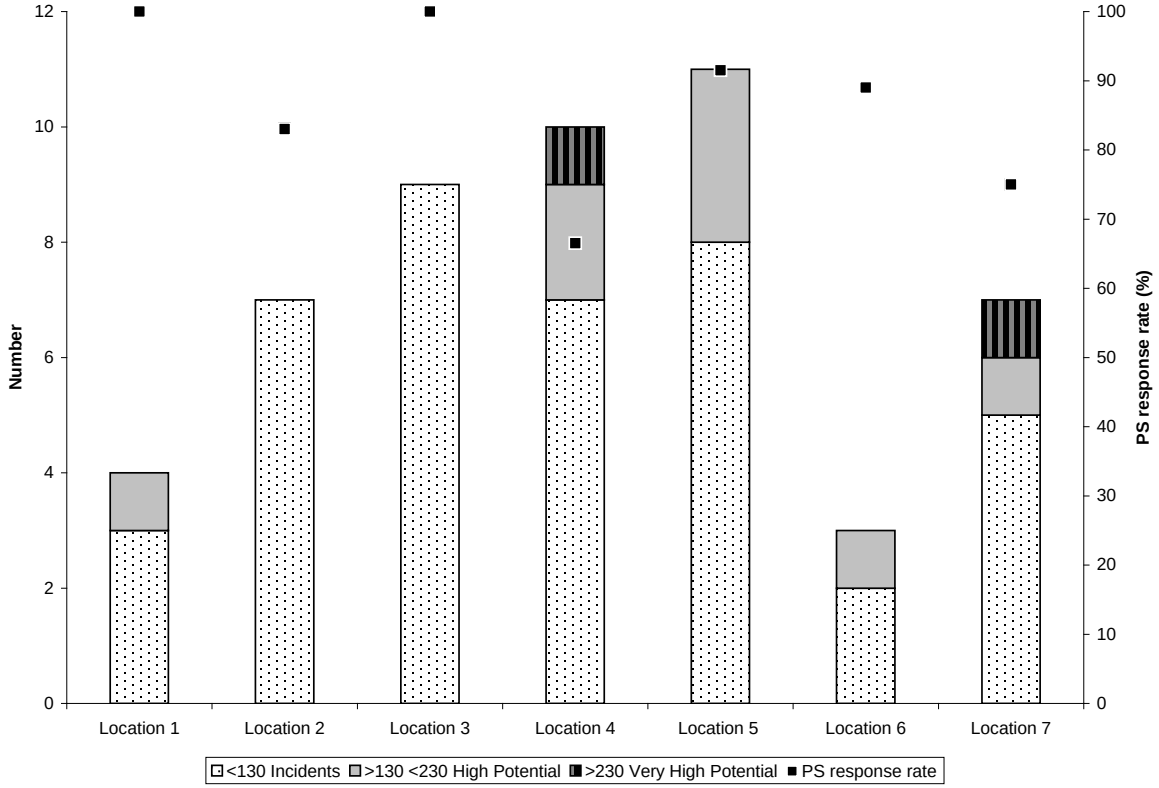
Step	Name	#	Definition of KPI	Target	Objective	Example (differs per site)
Step 1	Detect	1.1	# of people that report incidents related to total # of people.	×		>60%
		1.2	# of people that report incidents related to # of people per department	×		>75%
		1.3	# of "all incidents" / (# "monthly reportable incidents")	×		>10
		1.4	# of incidents of which can be proved that the circumstances were already there for a significant period of time (this proves that the detection was not solid)	×		low
		1.5	# of incidents in the several categories "high risk", "medium risk" and "low risk".		awareness	
Step 2	Report	2.1	# of incidents reported per month or week		awareness	
		2.2	# of incidents per employee		awareness	
		2.3	…			
		2.4	…			
Step 3	Analyse	3.1	# of incident investigations (RCA, Tripod) report done, related to the # of reportable incidents that occurred	×		100%
		3.2	# of incident investigations (RCA, Tripod) report done in time, related to the # of reportable incidents that occurred	×		100%
		3.3	# of reportable incidents which are analysed in a multidisciplinary team	×		100%
		3.4	…			
Step 4	Establish learnings	4.1	~~# of learnings per incident (outcome of RCA or Tripod)~~			no pragmatic KPI
		4.2	# of learnings in the categories: "single loop", "double loop" and "triple loop"		awareness	
		4.3	# of learnings related to: hardware, systems, behaviour		awareness	
		4.4	…			
Step 5	Implement learnings	5.1	# of learnings implement in time	×		>90%
		5.2	# of learnings implemented more than 1 month later than due time	×		<10%
		5.3	…			
		5.4	…			
Step 6	Check effectiveness of learnings	6.1	# of incidents checked by member of management-team on effectiveness within 2 weeks after completion date of the incident. (by a short discussion with a person working in the situation were the incident occurred)	×		note: effectiveness can not always be checked within 2 weeks. >50%
		6.2	# of checked incidents by member of management-team that is reported in MT-meeting.	×		>50%
		6.3	…			
		6.4	…			
Step 7	Communicate	7.1	~~# of SHE flyers or other information about the learnings~~			not effective KPI
		7.2	# of SHE flyers which are discussed in a department or team		awareness	
		7.3	# of actions/initiatives started as a result of the communication of an incident (e.g. a SHE flyer)		awareness	
		7.4	…			
General		8.1	time in days between the date of the incident and the date the final investigation report.	×	compliance to SHE Req.	serious incidents to be reported within 3 months
		8.2	# of incident reports reported in time (serious incidents)	×	compliance to SHE Req.	serious incidents to be reported within 3 months
		8.3	# of incident reports reported in time (monthly reportable incidents)	×	compliance to SHE Req.	monthly reportable incidents to be reported within … weeks

Note: Sites/plants use only those KPI's that are useful for their specific situation, and to improve and monitor those steps in the work process that are identified as 'weak'.

The objectives of these KPI's are:

1.to create awareness on the learning steps
2.to improve the effectiveness of the different learning steps
3.to track if an organisation is in control, w.r.t. learning from incidents
4.to monitor progress
5.to inform employees about the effectiveness of learning from incidents

Appendix 4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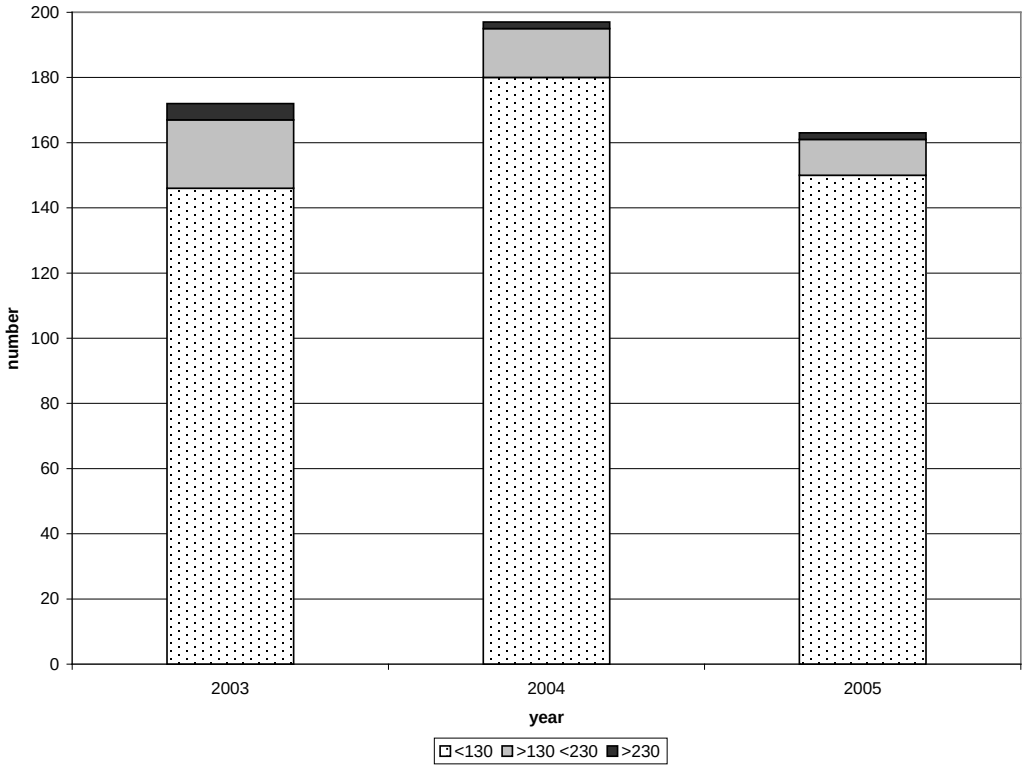
8
6
4
2
0
Number
100
90
80
70
60
50
40
30
20
10
0
PS response rate (%)
Location 1
Location 2
Location 3
Location 4
Location 5
Location 6
Location 7
<130 Incidents
>130 <230 High Potential
>230 Very High Potential
PS response rate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140
120
100
80
60
40
20
0
number
2003
2004
2005
year
<130
>130 <230
>230

Glossary

ARIA: Application for Recording of Incidents and Actions (DSM)
ASA: Advanced Safety Audits
CCPS: Centre for Chemical Process Safety
CSB: Chemical Safety Board
EAT: Event & Action Tool (Dow)
EPSC: European Process Safety Centre
GIRD: Global Incident Reporting Database (Dow)
HAZOPS: HAZard & OPerability Studies
HVLE: High Value Learning Experiences (Total)
KPI: Key Performance Indicators
LE: Learning Experience
LER: Learning Experience Report (Dow)
LIPS: Leading Indicators for Process Safety
MET: Most Effective Technology (Dow)
MOC: Management Of Change
PHA: Process Hazards Analysis
PPM: Planned Preventive Maintenance
PS: Process Safety
PSA: Potentially Serious Accident
RCA: Root-Cause Analysis
SHE: Safety Health & Environment
SOP: Standard Operating Procedures