It's the people, dammit! Assessing process safety competence: one company's approach.

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Abstract

Over the past 50 years we have come to see process safety (PS) as vital to the public acceptance of - and to the continued success of - the process industries. Across industry and academia, and guided by the Regulators, we have analysed thousands of accidents and incidents, and recognised the failings that led to them; amassing a great deal of knowledge about what causes accidents and what could have prevented them. The Institution (that is IChemE) and its counterparts around the world, regulators in many countries with advanced process industries, academia and - and by no means least - the process industries themselves, have used that knowledge to develop systems for process safety management (PSM) and training courses to go alongside the systems.

However, all this knowledge is of no use unless it actually affects the way the process industries are managed and operated, at both the strategic and daily, operational levels. That management needs to be done competently and companies who aspire to excellence in PSM need ways to assess the competence of those making their management decisions. The process of competence assessment (and re-assessment) must be accompanied by a system to support and improve individual's competence wherever gaps in their knowledge are identified. This paper reviews some approaches to this issue and discusses one company's approach to competence assessment over the last ~10 years.

Background

In a Chemical Safety Board video included in IChemE's Fundamentals of Process Safety course Trevor Kletz says "For a long time people were saying that most accidents were due to human error and this is true in a sense but it is not very helpful. It's a bit like saying that falls are due to gravity." The video is part of a section on human errors and how they led to the major accident at Texas City in 2005. Of course, the session focusses on the safety culture and management systems failures which lay behind the operational errors made during the 14 hours leading up to that accident. Prof Kletz's point is that to make real changes to process safety we have to make changes in a company's culture and the way it manages its major accident hazards and not blame the operator who was, to paraphrase Prof James Reason's words, "handed the loaded gun, primed and ready to go off".

However Prof Kletz does note that blaming human error "is true in a sense", recognising that we *all* make mistakes, and that the best safety culture and the best safety management systems are still designed and operated by fallible people. We can have good systems for HAZID, LoPA and Hazop run by diligent chemists, engineers and managers and still leave "errors" in plant hardware and operation which could have serious consequences. Reducing this sort of error is why so much of PS is about working in groups who bring a greater diversity of knowledge than that available from any individual. We back this up with multiple layers of protection (hardware and managerial) to provide adequate - or better excellent - levels of safety to our processes. Yet still the problem remains: all of this is operated by people who bring with them an inevitable, unavoidable human error rate. How do we reduce that error rate too "as low as reasonably practicable"? Reduce it as far as we can, recognising the constraints of time and availability, without stopping everything in its tracks?

At an individual level, the answer is largely "competence". Of course individuals can only be usefully competent if they work in a system which is itself fit for purpose: giving them the appropriate tools, authority and time to use their competence effectively. Synergistically, even a fit for purpose system will only work if it is populated by competent people. This means that companies need to have a method of deciding if its staff - in key positions at least - are "competent". So what do we mean by competent and how do we judge if the individuals in our system have this magic ingredient?

Defining competence

Defining competence is not easy, despite the quite extensive literature on the subject. Arguably the start of competence for an individual comes by recognising their own incompetences: recognising the boundaries of their own knowledge, experience and skills, and thus all the areas where they are not a competent person. In all these areas, outside their own area of competence, they do not

have enough skill to act effectively and need the assistance or guidance of other people to achieve a reasonable (safe) result. Equally, competence is organisationally located: to be a person who can competently manage a plant, an engineering team or a safety group in organisation X, does not make them automatically and instantly competent to manage even a quite similar operation in organisation Y. The new organisation and the individuals within it will be different; with different hazards to deal with and bringing different skill sets and experience to the task. A competent manager will be aware of, and allow for, these difference while they themselves become competent in the new organisation. Even time comes into competence: inside a person's own area of competence in their own organisation, their competence will change with time, as they learn and the organisation's technology changes. Competency is a slippery concept.

HSE offers a slightly tangential definition in their document "Managing competence for safety-related systems" (ref 1) . Paragraph 22 says:
"For a person to be competent, they need qualifications, experience, and qualities appropriate to their duties. These include:

- such training as would ensure acquisition of the necessary knowledge of the field for the tasks that they are required to perform;
- adequate knowledge of the hazards and failures of the equipment for which they are responsible;
- knowledge and understanding of the working practices used in the organisation for which they work;
- the ability to communicate effectively with their peers, with any staff working under their supervision, and with their supervisors;
- an appreciation of their own limitations and constraints, whether of knowledge, experience, facilities, resources, etc., and a willingness to point these out."

In HSE's COMAH guidance on Human Factors: Training and Competence (ref 2) it is defined more briefly as:
"[Competence is] the ability to undertake responsibilities and perform activities to a recognised standard on a regular basis. It is a combination of skills, experience and knowledge."
This is a definition that most people will probably recognise; other definitions are similar and it fits in with what we see in ourselves and others as competence. Indeed most of us probably recognise competence in our colleagues - those who are and those who are not. The problems come when self-assurance is mistaken for competence; when colleagues are over-confident of their own competence; and when the regulator rightly asks for how competence is assured. The other problem with this second definition is that for PS there is not a formally "recognised standard" (though it will be argued elsewhere at Hazards 32 that there should be, ref 3).

For the Institution, there is currently an active project led by Helen Conlin and Caroline Nicholls, set up under the auspices of IChemE's Major Hazards Committee, to examine PS competence in its different guises, from individual to corporate (and even for the regulators). That group is currently working on the project's first phase which is looking at the PS competence we should be able to expect for chemical engineers, as they go from undergraduates to FIChemE, and even into active retirement. Again, the work of this group will be discussed elsewhere at Hazards 32. For the final part of the project there is an interesting document from the UK Government's Office for Product Safety and Standards which sets out guidance on competencies for regulators (ref 4).

Competence Assurance

For sites in the UK, HSE's assessment guidance makes it clear that the competency of the leaders of high hazard manufacturing sites is an essential part of any Process Safety Management System (PSMS). Organisational structures may differ from Company to Company, but any competence assurance system should at least cover the individual with overall operational responsibility for a manufacturing site, the individual with responsibility for the integrity of the physical assets on the site and the individual with responsibility for the implementation and performance of the process safety management system on site.

There are documents which help with Competence Assessment. HSE published a research report from Greenstreet Berman in 2003 (ref 5). The IChemE Safety Centre (ref 6) has published guidance on competence assessment and the Energy Institute has guidance on competence which supports its "High level framework for process safety management" (ref 7). HSE also set out their approach to safety report assessment (ref 8) for COMAH (Seveso) sites , which is aligned with the longer definition, quoted above, from "Managing competence for safety-related systems".

It is important to differentiate here between personal competence and institutional competence. A good PSMS will undoubtedly require both. As we have already noted dedicated, competent people cannot make up for an incompetent system; a good quality management system is rapidly undermined if it is run by incompetent people. Good PS management systems identify what is important to different levels in the company - something which can change with time, for example: as problems are identified and

dealt with; as circumstances change for the company and its regulatory environment; and as technology changes bringing new threats and possibilities. Whilst the rest of this paper is largely about the competence of individuals, it is important to remember that one essential feature of a "competent" PSMS is that its visibility and impact stretches from the factory floor to the board. It is essential that the measures used to gauge the health of the PS system are known to everyone in the company. Operators need to know if the systems they operate are performing well. Equally, the board need regularly to see indicators which (hopefully) assure them that the PS system is working well but also reliably tell them where there are problems and where attention is needed. In a competent PS system, appropriate PS KPIs will be seen by staff at every level.

It follows from this that the first step in a competence assessment scheme should be assurance that the leadership of the company and of individual sites have appropriate PS competence - competence at a fairly high level. The second step would be to develop each site's PS awareness and culture; particularly focusing on the front-line production, maintenance and engineering staff who operate or maintain the integrity of the process equipment. The third step would be developing and sustaining the PS competence of personnel in the "front line": principally operators and maintenance technicians. This should also include appropriate training and assessment of ancillary operational staff such as warehouse and transport technicians, whose errors can lead to major accidents on- and off-site.

The overall programme should be allied to individual's training and development, and the overall competence assurance system operating in the company. By bringing in a significant level of PS awareness and understanding, the meaning and importance of much of the other training will be clarified and enhanced. Embedding such a programme of development, assurance and maintenance of PS competence is essential if the organisational culture is to reach what the "Bradley Curve" defines as the state of “Interdependent Team Culture” (ref 9). This is the state in which, experience has shown, excellent safety performance is most likely to occur because an "interdependent team culture" positively impacts perceived organizational support (concern for needs and interests of other employees) and helps sustain a culture of risk reduction.

Ideally, the competence development and assessment system should be tailored to the needs of different levels of personnel in the company, though it should also ensure that the overall company approach is highlighted and reinforced by the training given. There is also much to gain by using common training for groups of more senior managers, brought together not just to be trained but to share and broaden their own experience by learning from each other. For front-line employees training and competence assessment will inevitably be more site based with PS comprising one - essential - part of the wider personnel development programme. For these employees, evidence of PS Competency is likely to include: training on PS essentials and local risk assessment; question and answer evaluation from supervisors; and documented observation of work being carried out.

Process Safety Competence in SE Asia

A good deal of the above is essentially a description of UK and EU approaches to competence development and assessment. However, with the Industry and the Institution's reach stretching outside Europe, it is important to consider the situation elsewhere. In this paper we consider SE Asia as that is the region for which we have experience.

Individual professional development is well established in SE Asia for the engineering disciplines. For IChemE the same member progression and continuous professional development expectations exist in all regions, with the expectation that CEng has essentially the same meaning everywhere. However, process safety competence is not so well recognised in the region. Only major regional or international oil and gas companies, often companies headquartered outside SE Asia, and some leading companies in the pharmaceutical and health protection sectors have had a sustained programme for developing their staff's process safety competence.

Development of PS competence in Malaysia and across SE Asia is generally industry driven, rather than government driven. The Malaysian CIMAH regulations (1996) (ref 10) were developed from the EU Seveso directive (Seveso 1 at the time) and do not have the focus on process safety which is evident in Seveso 3. We understand that the regulations are currently being revised, so this may change significantly in the near future. Schedule 6 of the 1996 regulations does require information on a site's Major Accident Hazards (MAH), and a risk assessment with a description of the measures taken "to prevent, control or minimise the consequences of a major accident". Whilst this is clearly the domain of PS, the safety reports required must be approved by a small number of specialist Competent Persons (appointed under the regulations) and the schedule does not require that any report demonstrates that risks have been reduced to ALARP (or equivalent). We do not under-estimate the value of the regulations and the safety reports produced in raising standards in Malaysia, however there is a clear danger that the reports are not "living documents". In our experience, they have not yet produced the sort of process safety culture which Malaysia is undoubtedly aiming for.

The dependence on industry leadership results in a patchwork of differing effectiveness in the level of PS and PSM understanding and competence in different companies, across the region. On some sites, perhaps particularly those owned by companies based in regions (such as the EU) where PS is integrated into a more PS focussed regulatory regime, PS competence is at a relatively high level. With cross-industry support, notably from some of the oil and gas industry's major international companies, some local SE

Asian companies are also developing high quality standards in PS and PSM. Unfortunately PS standards and competence in other companies across the region can be at a relatively low level and implementation and application of good PS standards within the region's manufacturing facilities is clearly very variable. Despite the efforts being made, there have been a number of events related to errors in the management of hazardous processes over the last 5 years. The number of these which have led to loss of life suggest companies in the region have some way to go to achieve the status of a high reliability organisations as far as PS is concerned.

Across the whole SE Asia region, the international oil & gas industry leads the way in the use of publicly available PS leading indicators, which are used to measure PS performance and indirectly PS competence. This is because most international oil & gas majors are committed to the use of API RP 754 "Process Safety Performance Indicators" and the Recommended Practice (RP) specifies one of its leading indicators as 'the percentage of employees trained in process hazard awareness and risk assessment'. This indicator is a start on the path to PS competence, though site by site figures seem hard to obtain. Competence assessment is not a reportable indicator under the RP and does not seem to be well developed by companies resident in the region.

Case Study - one company's approach to competence assurance

Our case study's formalisation of its PS competence system began with a conversation between the Chief Executive (an engineer and alumnus of ICI Teesside) and the Group Risk & Safety manager. The company had recently merged with another; the new sites brought a different approach to PS, one more rule based than risk (ALARP) based. The Chief Executive wanted to know: how could he be reassured that those running the "new" sites were going to do the right job for (process) safety? What did they know? And were they the right people for the roles? (It should be stressed that the question was about how he *knew*; in fact the people and the sites were pretty uniformly of high quality.) The Risk & Safety manager was tasked with answering the questions.

The company board and senior management team had each already asked for and received process safety awareness training, following on from the publication of the OECD's document "Corporate governance for process safety: Guidance for senior leaders in high hazard industries" (ref 11). Existing company's staff were already attending in-house week long sessions of IChemE's Fundamentals of Process Safety course. That course is assessed with a written paper at the end of the teaching sessions. The company had adopted the principle that those in positions where they could significantly affect the PS performance of a site - and hence affect the performance and reputation of the whole company - should be expected to pass the assessment. Those failing were expected to undertake additional study and then re-take the assessment. The job roles put into this group were the site managers, the site engineers, and safety staff both group and site based. The chemists or process technologists who had responsibility for implementing new or modified processes on the plant were also included in the group trained and expected to pass the assessment. Many of the people in these roles in the existing company had already fulfilled this part of their competence assessment. Other staff such as plant managers, warehouse managers, engineering staff of all disciplines, and other operations staff also were attending the course and taking the assessment, though without the expectations that they should necessarily pass.

It was agreed that this part of the company's competence assessment was working well and would continue. However, given the number of new sites and the desire to have defensible answers to the Chief Executive's questions, an additional process was called for. Some different assessment was required and an enhanced system was designed.

The best competency assurance systems are a balance of challenge and support. In this case, and to make the system manageable for both the assessors and the assessed, it was decided that the system should focus on challenging the individuals' understanding of the MAH on their site, the potential consequences of those accidents, and the barriers (prevention and mitigation) in place to prevent those MAH becoming real incidents. The individuals should be able to demonstrate that they: understand the MAH of their site; have appropriate experience, attitude and ability to fulfil the leadership role required to give good PS performance; have suitable management systems and competent people in place to manage the PS performance of the site; and have thereby reduced the risk of major accidents to an acceptably low level.

It was decided that the assessors would be a senior member of the Corporate Safety team and one of the Operations Directors, normally the one with line management for the site.

The competence assurance process developed involves presentation, discussion, evaluation, feedback and appointment. The individual being assured is expected to create an up to date CV and make a presentation to the assessment team about the potential MAH on the site for which they are responsible. The presentation should then cover the management controls and systems to prevent the MAH occurring, including an assessment of the people responsible for day to day operations and maintenance on the site - an assessment of the competence of the site team. Alongside the competence assurance process, and available to all individuals in the process, are a set of global PS expectations, a description of the responsibilities of site leaders and a criteria assessment sheet.

The assessment team judge the individual based on the quality and breath of their CV; their ability to demonstrate their knowledge of the MAH and how they are managed; and how well they have demonstrated their understanding of their personal role in the PSMS. Immediate verbal feedback, including any conditions or requirements, is given to the person being assessed and this is confirmed by a formal letter of appointment, with or without any endorsements. The letter only deals with matters of their personal competence. If significant site matters are identified in the discussions, such as gaps in the staff competencies required to manage the MAH on site, these are dealt with outside the individual's competence assurance process.

Where competence has not been adequately demonstrated, the Company's approach is to offer additional support, such as additional training or familiarisation with particular systems, to enable the individual to reach the required standard. Time and support will always be offered to enable staff to achieve the competency required to fulfil their role in the company. However, ultimately, competency assessment must always have as a possible outcome that an individual has not effectively demonstrated the required competence for the role they are in and is judged not to be likely to be able to do so. This possibility exists but it is never the company's first choice. For obvious personal confidentiality reasons, it is not discussed further here.

The system has worked well in the company for over 10 years, during which time further new sites have been brought into the company and many staff have changed roles. It continues to be used. The aim is to complete the assessment within 6-12 months of a person taking up a new position. It is also worth noting that the assessment is for the individual in the specific role. If an individual judged competent in their current site engineer role (for example), moves to take up the role of site engineer on a different site they must re-demonstrate their competence in their new role with the changed MAHs on the new site.

Developing the system

Referring back to Trevor Kletz's comments at the beginning of the paper and to the point that we all make mistakes: at least one of us (KJP) has chaired and signed off a Hazop, attended by well trained, competent people working diligently, and still had an experienced supervisor on the plant point out (during the plant installation work) that the actual pipework installed meant overfilling a feed vessel could lead to a potentially violent reaction in a nearby scrubber. Oops! - and a lot of thanks to the excellent supervisor for his diligence in speaking up. This example shows the importance of spreading competence beyond senior levels. Whilst the company's assessment of the site managers includes their assessment of the site's overall competence, there is always a need to ensure PS competence is effective and the company is developing the competence assessment system to assist with this.

Changes have included the generation of a new PS training package focussing on the company's own particular risks and PS management system. This has had the advantage that the package can be given to a wider range of staff, notably to process supervisors, process managers and some operators. Interestingly, in the region where the PS competence system is being developed, the company chose to assess the plant shift supervisors before the production managers. This was seen as appropriate as out of hours shift supervisors are the highest level of management available on site and hold ultimate management responsibility on behalf of the company, for roundly 75% of the time.

Most recently, and in some regions of the company's operations, PS competency assurance has been extended to operators and maintenance technicians. In preparation for the assessment, operators and technicians will attend a 1.5-day company written PS awareness training which focuses on principles of major accidents, basis of safety, layers of protection and the safe working envelope for their process operations. This is followed by a 1-day site specific training which focuses on site MAH and the barriers in place to prevent major accidents. This training is run as an interactive workshop, delivered using the site's local language. The training includes videos of major accidents, pictures, diagrams, and dialog sessions to explain the working principle of each barrier. At the end of the training operators will be assessed, in their local language on their understanding of the company's PS principles, with the same options available as those for other staff members.

Conclusions

This paper has discussed some approaches to competence assurance and described the position in different regions of the world. It argues that Process Safety (PS) competence assessment is a "must do" not a "nice to have". It has described the approach one multinational company has taken to PS competence assessment, an approach which has so far been sustainable and possible (but not easy) to fulfil within reasonable resource limits. It is a continuous process, requiring new managers to be assessed as they take up new appointments. The approach is tailored to the different responsibilities of individual managers; and asks them to consider the Major Accident Hazards (MAH) on their sites and how they are controlled. It requires site managers to demonstrate their understanding of their site and its MAH, and to consider the competence of their staff, both individually and collectively across the site. It is not easy for either managers or assessors but does provide a regular point of focus on each site's MAH and how their associated risks are kept at an acceptable level. It is certainly not perfect but it does offer an approach which others could adopt, suitably modified to their own circumstances.

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