

COMPETENCE ASSURANCE IN THE MAJOR HAZARD INDUSTRIES

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INTRODUCTION

Competence Assurance as a management concept and practice is gaining acceptance and increasing use though it remains relatively novel.

This paper addresses Competence Assurance, and is intended to reflect our practical experience of the topic as safety and risk management consultants. We discuss our approach to the review and development of clients' Competence Management Systems (CMS), including how the reviews were undertaken, the key issues, findings and potential problems in implementing and using a CMS. In addition we discuss how failure to ensure a robust Competence Management System may have contributed to a number of serious accidents.

WHAT DO WE MEAN BY COMPETENCE AND ASSURANCE?

All organisations have a series of management processes that require staff to conduct a range of tasks. Each task must be done within specific parameters to a required standard. This implies that staff assigned to carry out particular tasks should have an acceptable level of competence to ensure the task is conducted and completed correctly i.e. in line with the relevant standard. In high hazard industries in particular this assumes tasks are conducted *safely*.

An idealised CMS cycle is illustrated in Figure 1 below. Once in place the CMS should become part of a wider management loop.

Our preferred definition of competence is selected from a publication regarded as "best-practice" guidance by the Health and Safety Executive (HSE), namely "Developing and Maintaining Staff Competence" (Railway Safety Publication No. 1, 2007), issued by the Office of the Rail Regulator and found on their website for public consumption. This was previously published by the HSE as Railway Safety Principles and Guidance Vol. 3A RSPG-3A). The rail industry was among the first to adopt and develop Competence Assurance among their stakeholders, and the guidance is suitable for implementation in any industry. The motivation for initially publishing this guidance was the perceived contribution of poor competence management as a significant contributory factor in several major UK railway accidents.

We define individual competence as "the ability to undertake responsibilities and to perform activities to a recognised standard on a regular basis. Competence is a combination of practical and mental skills, experience and knowledge." The awareness, knowledge, and competence should be appropriate for the job level and process safety responsibilities of the particular individual. It is important to note that competence is fluid, intimately linked to a

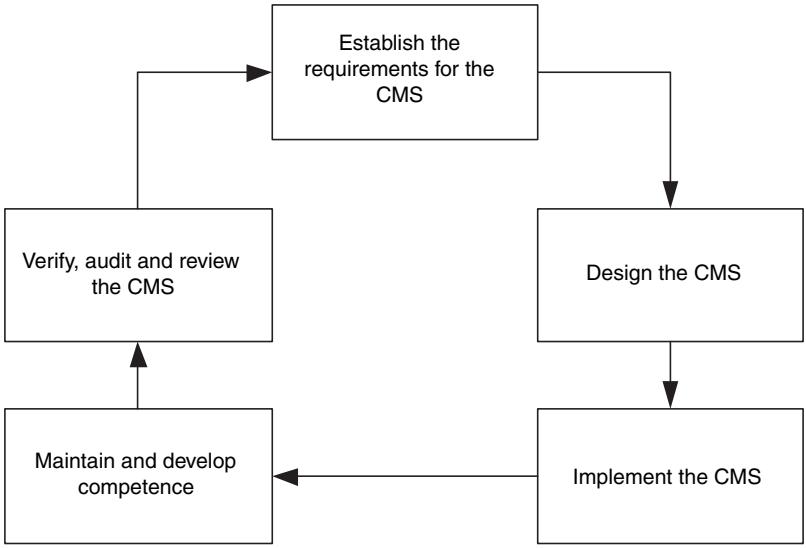

Figure 1. The Competence Management System Cycle (Railway Safety Publication No. 1 2007)

variety of factors including circumstance and individual characteristics such as age, personality and health/well being. In light of this Figure 2 summarises how individuals' competence may become inappropriate and not always increase with experience.

Competence Assurance is the process of ensuring and demonstrating that all staff's competence is properly managed at all times. The CMS should in theory and practice link all existing competence related elements of the management system. These elements include:

- policy;
- links to organisational strategy;
- job definition;
- selection and recruitment of staff;
- risk assessments;
- training, including induction, vocational (task) and refresher training;
- staff supervision;
- development, implementation and management of procedures and standards;
- performance monitoring, review and change;
- management of sub-standard competence.

Across an organisation, adoption of a CMS will result in new and/or amended management procedures. Some procedures will be generic with applicability across the

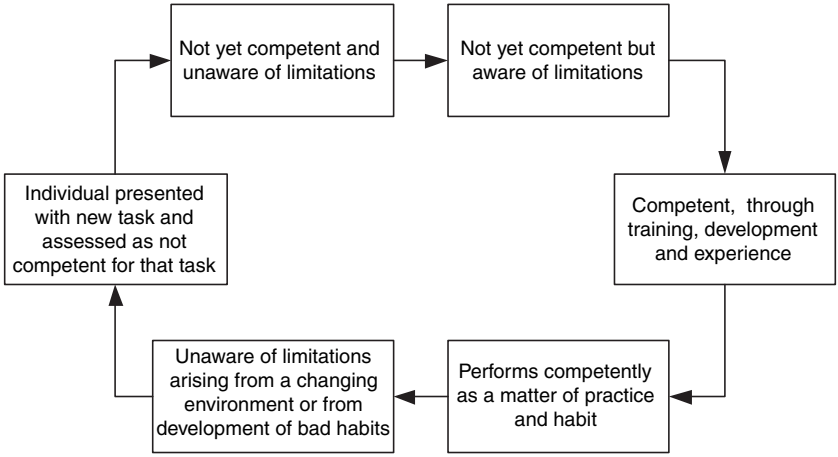

Figure 2. Competence stages for the individual. (Railway Safety Publication No. 1, 2007)

organisation e.g. competence monitoring and assessment while others will be department or area-specific e.g. HR procedures for the preparation of job descriptions. In parallel with this there should be appropriate staff briefings, for example describing and explaining the entire CMS, as well as training and other forms of communications to introduce new CMS related strategies and procedures.

WHY BOTHER?

Perhaps the most useful recent example of a large, successful organisation suffering catastrophic loss partly due to the absence of an effective and coherent CMS is the BP Texas City refinery accident. The accident on March 23, 2005 was one of the most serious US workplace disasters in the last 20 years. The Baker report (2007) emphasises the role that a lack of competence assurance played in the Texas City incident noting that 'BP has not effectively defined the level of process safety knowledge or competency required of executive management, line management above the refinery level, and refinery managers'. Further 'BP should develop and implement a system to ensure that its executive management, its refining line management above the refinery level, and all U.S. refining personnel, including managers, supervisors, workers, and contractors, possess an appropriate level of process safety knowledge and expertise'. (Baker report, 2007)

During follow on research during the process safety technical review at Texas City investigators found more failures in other refineries. A case study now referred to as the 'Whiting Rupture Disk Case Study' (Baker Report, Appendix D 2007), reported 'a breakdown in management oversight of training or assigning personnel to jobs with

adequate technical knowledge relating to rupture disks.' The Baker report identifies a key root cause of this failure as 'a fundamental lack of knowledge about the safety implications of pressure between a rupture disk and a relief valve. Given this lack of knowledge, all the other actions BP personnel took (or failed to take) appeared to be reasonable and logical. However, this lack of knowledge raises the question of why personnel at every level—hourly staff, supervisors and managers—and in every work group—operations, maintenance, engineering, and management—lacked that knowledge. This lack of knowledge points to a breakdown in that portion of the management system that is responsible for ensuring workers have adequate technical knowledge' the CMS.

A 2001 incident investigation at a Toledo refinery on the release of reformate and water to the atmosphere notes training program deficiencies at Toledo. The investigation report concluded that "[the] current training system does not fully assess if a person has mastered the material being taught. . . . [The] operator had passed the written training test with a 100% and passed the field test with good ratings on the first try in 2000." Following these tests, the operator had been taken off shift for retraining due to an earlier incident. The retraining consisted of reviewing procedures and walking through systems. A formal training plan or written field test was not given. (Baker Report, 2007).

Clearly an important motivation for ensuring competence is the contribution of competence to safety. Competent staff play a fundamental role in achieving safe and effective performance.

An effective CMS should bring together the competence assurance aspects of various management systems that are often distributed throughout an organisation e.g. selection and recruitment may be facilitated by the Human Resources department while the actual recruitment and selection is undertaken by the relevant operational line managers. The often isolated elements in a management system dealing with competency must be developed or modified to support each other so that efforts in one area complement and facilitate the time and effort spent in another. This contributes to a coherent and comprehensive approach that can bring significant benefits, including the increasingly important ability to demonstrate to regulators, auditors and, occasionally, customers that staff competence is being effectively managed.

Not least, and as shown in Appendix 1, there is a significant list of UK legislation which requires competence to be formally managed.

THE CMS DEVELOPMENT OR REVIEW PROJECT

This section addresses what we consider to be an effective method of carrying out a CMS development or review project. We have selected a refinery as representative of a medium to large size organisation or business unit including the overarching complexities of corporate requirements and regulatory expectations.

The project may be led by either a competent senior/middle manager (better if they are from another site for independence) or an external consultant. For our purposes we will assume the client is the Site Manager.

FRAMING THE REQUIREMENTS

The first stage of the process as always is to decide on the scope of the project. An early strategy meeting with the client is useful to explore their expectations and determine which CMS model may be helpful and appropriate as a benchmark. This enables the project leader to ensure that the scope of the exercise is understood, agreed by all parties and therefore 'fit for purpose'.

It may be that instead of addressing the whole site organisation, a pilot study of one department or one plant area is chosen. This approach is recommended as it allows time to refine the methodology before addressing the entire organisation. It is important to emphasise that the effort required must never be underestimated. Although the initial project may only address one part of the organisation other parts of the organisation are inextricably linked and will invariably be drawn into the project to some degree.

To facilitate the project and foster positive and productive relationships it is always useful to have a local manager or individual with sufficient authority nominated to assist for example in organising interviews, providing local site information, and generally coordinating project requirements such as assigning meeting rooms and occasionally getting 'hand on' i.e. collecting individuals for interview as necessary.

PROJECT KICK OFF

The outline approach described here assumes that there is no formal CMS in place. If the existing site safety case and other arrangements such as risk assessments have provided adequate task identification and complementary/supporting risk assessments, it may be possible to start at step 5.

This list itemises the steps to include in a CMS project. It is at the discretion of the project team to amend and adapt the steps as appropriate for example conducting steps in parallel to increase efficiency.

For the organisational unit(s) to be addressed:

1. Inform all staff before and throughout the process about the project. The project may result in a significant organisational change while "competence" or rather "incompetence" is an emotive word. To support a healthy safety culture it is important to ensure staff are aware of what is happening, why it is happening, and feel their role and potential contribution to the project is recognised and valued.
2. Arrange the unit into functional groups, including any term contractors. These groupings should be vertical (e.g. between differing plants, administration staff, cleaners, etc.) and horizontal (e.g. plant operator, Control Room operator, Plant Supervisor, Shift Supervisor, etc.) The objective is to arrange the groupings so that those with the same roles, tasks and risks are identified.
3. In the analysis process include one or more representatives per group.

ANALYSIS

4. Conduct a Task Analysis and Risk Assessment on normal, degraded, and emergency operations by group. These will ensure that all tasks are identified and then prioritised

to address the most important first in terms of both cost and consequence. Ensure major hazards are addressed as well as Occupational Health and Safety hazards in all activities.

5. For each task, define all competencies which are required to carry out the task correctly:
   - Skills (e.g. welding);
   - Qualifications;
   - Knowledge;
   - Experience;
   - Training.
6. Identify and/or develop standards that define the correct method of carrying out the task and can be used to assess competence. (These may be standards, procedures, specifications, etc.)
7. Define monitoring and assessment requirements. Task observation is the simplest approach to ensure that task analyses are accurate and usually suitable for operator and some supervisory roles. Managers have more abstract competencies particularly in emergency roles. The use of simulators or more frequently interviews may be more appropriate.
8. Develop a procedure for monitoring of competence and ensure that contractors and sub contractors are included as appropriate.
9. Develop a procedure for managing sub-standard competence.
10. Develop a supplier assessment CMS and monitoring approach for visiting contractors.

HUMAN RESOURCES

11. Develop Job Descriptions.
12. Review induction training.
13. Review recruitment methodology.
14. Develop procedure for competence assessment.

OUTPUT

15. Train competence assessors and managers to manage the CMS.
16. Monitor, develop and assess competence.
17. Audit the CMS.
18. Address CMS changes.

The typical deliverable for this type of project is a report addressing:

- The current situation regarding the CMS;
- The strengths and weaknesses of the existing system when compared with a best-practice CMS model;
- A detailed development strategy, which will include:
  - What must be done;
  - Who must do it;

- When it must be done by;
- How changes will be managed;
- Identification of post-change responsibilities related to the CMS.

ISSUES

Different organisations will encounter different issues to address and resolve during the project. We discuss some of the most significant issues that we have experienced during CMS projects.

ORGANISATIONAL CULTURE

A hot topic at the moment is safety culture, arguably just one aspect of a wider organisational culture. A significant aspect of culture in this context is that awareness and understanding of staff attitudes and motivation will help projects efficiently and effectively target both organisational and staff requirements. With the best will in the world if staff are not engaged in a project or process success will be limited.

During one project we produced a CMS development strategy and participated in the Steering Group as advisors and to provide oversight of the implementation. We had an excellent CMS Project Manager who was very keen to communicate the project to all staff. We also had a very engaged Operations Manager who ensured that the project was presented to all shifts during a weekly session of 'tool-box' talks. As part of our oversight role, we carried out an audit of the organisation to investigate how staff were learning about the introduction of the CMS. We were disappointed to learn that ~20% of the operations staff knew nothing about the project and said they were not interested. More worrying was the ease with which they had avoided the tool-box talks simply by finding an excuse to be out on the plant. The lack of awareness by management regarding the reality of staff perceptions could quite simply undermine plant safety. If competence assurance is Safety Culture needs constant development, and people need to know that any change is an advantage (or at least no loss) for them.

BUY-IN FROM SENIOR MANAGEMENT

During the audit mentioned above, we also found an entire Directorate that had not been informed about the introduction of a CMS. A phased approach was being used to introduce the CMS. The Operations directorate was leading the project while the other Directorate was in a related but non-operational area. The latter Directorate did have a significant, if smaller, supporting role but was not included in the initial wave of communications and associated enthusiasm. The senior manager thus largely ignored the project and had not been encouraged to participate or support the work. As a result, other issues felt to be more pressing were given priority, and the manager did not attend key project meetings. The knock on effects included a significant and unexpected requirement to deliver the bulk of

CMS related communications a second time to Directorate staff and re-doubled efforts to ensure the Directorate felt involved and valued in the CMS project simply to avoid undermining much of the previous work.

PROJECT HIJACKERS

It is possible that some individuals may see change as an opportunity to enhance their role and/or status within the organisation. This is entirely natural and even necessary, as management should be motivated to improve. However, we have revisited organisations after delivering a CMS implementation strategy and found minimal progress with the resources allocated for the CMS project being used to promote an entirely different development plan. The best approach to manage this scenario is ensuring there is a strong, experienced and if possible senior project manager capable of coping with potential hijackers. Key to the project manager's success is the breadth and depth of their oversight. In this case they had no oversight and were thus vulnerable to manipulation as their lack of information provided through 'the usual channels' was severely limited.

PROCEDURES

It is not uncommon during a CMS review to find that procedures are not well managed. This may occur when they are not reviewed and updated appropriately, or may be missing, having never been developed. It is often the case that individual shift teams will develop their own ways of carrying out tasks, with the priority on ease of implementation rather than safety.

During one CMS review at a petrol refinery, operators reported that each of the four shifts on their plant had different ways of conducting plant operations. At the time of the review there were no formal procedures in place. The lack of procedures increased the risk of an individual doing something unsafe when working on a different shift that operated the plant in its own manner. An unambiguous, safe way of performing critical tasks that is accepted by all staff is clearly necessary. Formal procedures provide this framework. A substantial supervisory effort coupled with significant safety culture development work are also required to support implementation and embedding of the use of procedures. Often in a "no procedures" environment there is a prevailing negative attitude to the use of procedures that must be addressed in parallel with the introduction of formal procedures.

CONTRACTOR COMPETENCE

All organisations will use contractors, and many organisations have teams of contractors who are embedded into the site organisation as a long-term presence to carry out specific duties. These may range from supporting tasks such as cleaning, security and catering to the potentially higher risk activities such as plant maintenance and/or rail terminal operations. Other contractors will attend the site on a short-term basis to maintain or repair specialist equipment on breakdown or during a planned plant outage.

Major plants are commonly shut down for extended periods for a comprehensive maintenance outage. During this period there may be several hundred visiting contractors on the site, either to provide a general service (e.g. scaffolding, lagging, or painting) or specialist contractual support for specific plant maintenance and repair. The competence of every individual on site contributes to overall plant safety thus contractors' competence must be as well managed as permanent site staff.

However, at times, the ability to simply find, employ and manage such large numbers of contractors may be aggravated by the fact that major hazard sites are often found grouped together in relatively small and remote areas where there is a finite resource of contractors. In the absence of alternative suppliers and the potential severe cost and safety implications, significant effort may be justified to ensure they achieve acceptable levels of competence.

The negative consequences of poorly managed contractor competence were evidenced in the Phillips Petroleum accident in Pasadena, Texas on the 23rd of October, 1989. An explosion and ensuing fire occurred that resulted in 23 known dead and one missing. In addition, more than 100 people were injured to varying degrees. The accident report notes that 'metal and concrete debris was found as far as six miles away following the explosion.' (FEMA, 1989)

Post-accident enquiries revealed that, during maintenance, a pneumatically operated valve used for isolation had opened when the intention had been to close it. This occurred because the contractor had connected an air hose to the wrong control port which opened, rather than closed, the valve. Company procedures however required that air hoses should not be connected to valves during maintenance.

The investigation found that contractors had not been provided with company standards and procedures covering their work, and there was no system in place to evaluate contractors' competence in implementing the standards and procedures even if they had received the documents. An audit of the arrangements for the control of contractors could have identified this assurance gap and allowed time to manage the issue.

UK legislation continues to emphasise proper management of such issues. Under sections 2 and 3 of the Health and Safety at Work Act (HSW) (2002) the client company remains responsible for occupational health and safety and operational safety on the site, no matter where its resources come from. The self-employed and companies supplying the contractor labour also have a duty of care under the HSW while there are specific legislative requirements for competence to be formally managed in a variety of UK regulations as detailed in Appendix 1. The client company who operates the site must therefore verify that all contractors, sub-contractors, agency or self-employed are competent and managed within a CMS.

There are three ways this can be achieved:

1. Ensure that the contractors' management has a CMS which is appropriate and equivalent to the client site's CMS arrangements. This is probably the better option for those contractors who will be on site for a relatively short period, such as non-term contractors. The validity and equivalence of the contractor's CMS should be assessed initially as part of the supplier assessment process. Competence monitoring by the client site organisation can then be defined as part of the contractual arrangements.

2. Arrangement by the contractors' management to have their staff included within the client site CMS, and subject to the site monitoring, training and record-keeping regime. This is probably the best option for the term contractors who are on site for extended periods effectively becoming site staff.
3. Reliance on national or local industry training and competence schemes. In some areas industry is further addressing competence assurance through a 'passport' style scheme. To receive a passport a contractor must have a certain level of awareness of site risks and the mitigating safety requirements. Such an approach is useful though limited as each site has its own unique risk spectrum restricting the scheme to basic specifications of knowledge.

CHANGE MANAGEMENT

In our refinery example the introduction of a formal CMS is considered a significant change. Selection of an appropriate method to introduce and manage changes necessitated by the development or modification of a CMS will have a great influence on the success of the system. This is a delicate job and to embed a CMS in an organisation is quite simply best handled by experienced, motivated staff and change management champions with the support of all senior management.

CONCLUSIONS

The incidents cited throughout this paper highlight how competence assurance plays a vital part in continuously encouraging and improving the safe operation of major hazard installations which are heavily dependent on the competence of the people operating, maintaining and managing them, including both site staff and contractors.

As noted in the Baker report (2007) 'The passing of time without a process accident is not necessarily an indication that all is well and may contribute to a dangerous and growing sense of complacency. When people lose an appreciation of how their safety systems were intended to work, safety systems and controls can deteriorate, lessons can be forgotten, and hazards and deviations from safe operating procedures can be accepted. Workers and supervisors can increasingly rely on how things were done before, rather than rely on sound engineering principles and other controls. People can forget to be afraid.'

We believe that developing and embedding a robust CMS within an organisation will help avoid such dire circumstances. Far from requiring organisations to re-invent the wheel most organisations will have many elements of a CMS in place that can be brought together in a formal, co-ordinated system as discussed here.

ACKNOWLEDGEMENTS

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APPENDIX 1 – RELEVANT LEGISLATION

Competence Assurance is a legislative requirement in a variety of regulations including:

- Health and Safety at Work Act 1974
- Provision and use of Work Equipment Regulations 1998;
- The Control of Major Accident Hazards (Amendment) Regulations 2005;
- Offshore Installations (Safety Case) Regulations 2005;
- The Offshore Installations (Prevention of Fire and Explosion, and Emergency Response) Regulations 1995;
- Quarries Regulations 1999;
- Railways and Other Guided Transport Systems (Safety) Regulations 2006;
- The Control of Substances Hazardous to Health (COSHH) (as amended) 2002;
- The Health and Safety (Display Screen Equipment) Regulations 1992 (as amended 2002);
- The Ionising Radiation Regulations 1999
- The Control of Noise at Work Regulations 2005
- The Lifting Operations and Lifting Equipment Regulations 1998
- The Electricity at Work Regulations 1989
- Offshore Installations and Wells (Design and Construction, etc) Regulations 1996;
- The Construction (Design & Management) Regulations 2007 (CDM 2007);
- The Diving at Work Regulations 1997.