Managing the influence of major emergencies on staff competence

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The focus of this paper is on the development of effective learning and development models which combine prevention, intervention and emergency response capability thereby offering opportunities for improvements in competence through the use of existing resources.

There is a growing body of knowledge on the subject of the interaction of Non-Technical Skills (NTS) competencies with the real environment and the implications this may have for safety and emergency training.

Our observations across organisations from different sectors indicate that many remain fixed with a traditional learning and development model focused on the "normality" of a job/position. By separating "normal" and emergency programmes in to different compartments problems are created which fail to address key issues in the evolution of major incidents from a normal operating regime to high risk situations.

We believe that this separation barrier is false and that it needs to be removed, that NTS and other skills are common to competence based training and that effective learning programmes can be developed at lower cost for improved safety and risk management.

Keywords: Competence, Leading indicators, Process Safety, Non-Technical Skills, Major incidents

Introduction

Skills, knowledge and experience have long been accepted as cornerstones of competence programmes in high-hazard industries. In recent years these have been adapted for safety-critical roles to encompass Non-Technical Skills (NTS). These NTS capture the behavioural, cognitive and behavioural skills that influence the way staff respond and deal with a range of different situations.

There is a growing body of knowledge on the subject of the interaction of NTS competencies with the real environment and the implications this may have for safety and emergency training.

As complex situations and problems unfold, the demands on individuals escalate and the competences associated with NTS play an increasing role in the ability of an individual to function effectively. However these skills are influenced by external factors including organisational culture, team interactions and a range of human/stress factors.

By examining the influence of these factors on competency and considering the changing demands and expectations on individuals, when disruption to normal operations escalate to major incidents, a series of straightforward, bespoke and minimal-change processes and tools can be identified and applied.

The paper starts from three basic premises:

- That the notion of 'normal' is a myth and that the situation is always influenced by the potential failures of barriers which protect the individual and the process.

- That organisations already have many of the tools, systems and processes which support safety but their effectiveness is often reduced at the point of application.

- That competence programmes must reflect the real challenges faced by personnel by integrating the management of routine operations and major incidents.

The focus of this paper is on the development of a more effective prevention capability through a greater understanding of:

- The skills, competences and behaviours of individuals in terms of the Non-Technical Skills (NTS) as a situation escalates

- The organisational systems, processes and culture that allow:

    - the individual the space and working environment in which to apply and display the required skills, competences and behaviours

    - the organisation to learn from previous and imminent incidents and apply that learning in a meaningful way

There are significant lessons to be learned in these areas from the Oil and Gas Industry where there is now substantial evidence of the development, application and effectiveness of NTS.

The subject of NTS has an increasingly positive image as organisations, and their employees, start to recognise the benefits.

The links between the individual behaviours, the working environment and organisational culture are explored through interrogation of current models.

Normal is a myth

What does 'normal' mean when we refer to a Process being in a normal state? Does it mean that our barriers (leading indicators) are all in place and that we have no barrier failures (lagging indicators) present? Does it mean that everything seems to be ok? Does it simply mean that we are meeting our productivity/throughput targets? The answer is that normal is open to interpretation whether that's site by site, product by product, individual by individual, shift by shift, supervisor by supervisor or employer by employer.

Normal also implies controlled change over a period of time which remains within acceptable parameters and where there is no need for specialist intervention. Common sense suggests otherwise: we live in a world of continual change where individuals, plant and processes are expected to respond and adapt. At the forefront of this are people and the teams they work in: the continual updating of skills and competencies becomes an ongoing challenge and our study of the growing importance of NTS has highlighted a number of advantages which are discussed in this paper.

Mearns et al (1) found that the most effective supervisors, in terms of safety performance, utilise interpersonal skills more often than less effective supervisors. Quoting in his report "By way of illustration, the effective supervisor's value their subordinates more, visit the work site more frequently, and encourage participation in decision making".

Such research helped to promote techniques such as behavioural safety which is now a well-practiced and well established tool for many companies, embracing as it does the concepts of personal ownership and engagement with safety as a cornerstone of effective management. The approach helps to control hazards and reduce risk often as a result of improving the communication and understanding of linkages between management systems, people and risk controls.

In a similar context the BOW-TIE helped visualise the relationship between the causes of accidents, their escalation and the controls preventing the event from occurring.
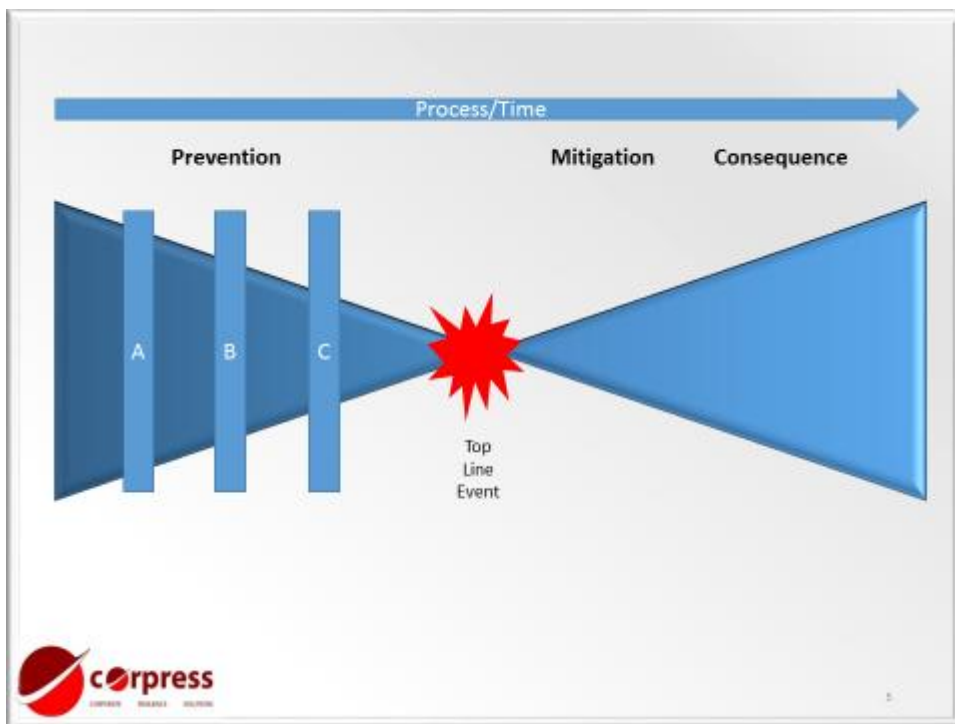
Figure 1: The Typical Bow-Tie

If we consider the typical bow-tie representation of risk (see Fig 1) then, in some interpretations, normal can exist at any point on the left hand side (LHS). Before Barrier A is normal. Between Barriers A and B is normal relative to the barriers. Between Barriers B and C is also normal relative to the barriers. Even after Barrier C can be considered normal as long as it doesn't go as far as a Top Line Event. Even events on the right hand side (RHS) can be considered normal relative to post-incident processes and procedures.

Clearly, normal is a relative term which is open to interpretation.

The bow-tie aids in demonstrating how the continuum between cause and impacts is influenced by preventative controls prior to the event and recovery preparedness post event, helping to reduce the exposure to accidents by strengthening the preventative controls which companies establish whilst building effective capability and competence to manage disruption at any stage.

By linking cause and impact through a continuum of elements as visualised by the bow-tie, the step between what can be called normal or routine and the trigger events which result in incidents is small. Whilst barriers and preventative controls are in place, many are hidden (or appear passive) when viewed from the normality of yet another day.

By way of example, how many people check their car tyres and brakes on a daily basis? We rely on them to protect ourselves and our families but they are part of the scenery, the backcloth we accept to our daily lives. Similarly, when conditions deteriorate, there may be ice on the road and warning indicators show on the dashboard, how many drivers really slow down and leave more room between themselves and the car in front? Just take a look on a busy road on a cold morning.

We forget that:

- The notion of 'normal' is a myth and that the situation is always influenced by the potential failures of 'barriers' which protect the individual and the process.

In the case of the car drivers the protective measures are there, the investment has already been made:

- Organisations already have many of the tools, systems and processes which support safety but their effectiveness is often reduced at the point of application.

But in terms of *competence* how many learner drivers are instructed to check tyres, test brakes and leave space on cold days? The UK driving test does not appear to take these protective measures in to account:

- Competence programmes must reflect the real challenges faced by personnel by integrating the management of routine operations and major incidents.

Weaknesses in handling difficult situations, many of which fall outside the accepted 'normal' day to day operation, and place pressures on personnel to make decisions in complex situations have contributed to major accidents such as Deepwater Horizon, Buncefield and Texas City.

Crew Resource Management (CRM) was developed to reduce human error in such difficult circumstances, where CRM encompasses NTS topics such as team work, leadership, situation awareness, decision making, communication, and personal limitations.

In studies by Flin (2) it has been demonstrated that human error occurs on offshore installations and other high-hazard occupational areas. A significant proportion of incidents are not technical in nature but are due to weaknesses in the NTS. Therefore, the type of skills that NTS training (and awareness) aims to teach should lead, in the longer term, to improved safety performance in the offshore environment. Such reports help to promote the link between NTS in routine and emergency management situations.

Whilst this is still in the early stages of implementation, NTS has been an implicit component of the assessment associated with the OPITO (3) competence standards (see www.opito.com) relating to Control Room Operators' emergency response training and their emergency response teams.

What is important in the context of this paper is to signal the evolution of behavioural and NTS approaches to a reduction in accidents and improved decision making in complex situations. There continues to be research in to the benefits of engagement with CRM as a means of enhanced mitigation and response. Concentrating on the emergency or points of inflection/intervention close to the trigger point for an incident, this takes us close to the centre of the Bow Tie diagram and effectively links the left hand and right hand sides.

By extending the process back to the roots of day to day operations we start to break down the potential barriers between routine and emergency situations.

We suggest that it is time to review the bow-tie representation to reflect the realistic picture where a number of factors ensure that every aspect of the process is constantly changing, sometimes by very small amounts, and so everything is being continually pulled to the right. See Fig 2. This is a more urgent and 'uncomfortable' representation which challenges the risk paradigm. **If we really must define normal then perhaps this is where we should start.**
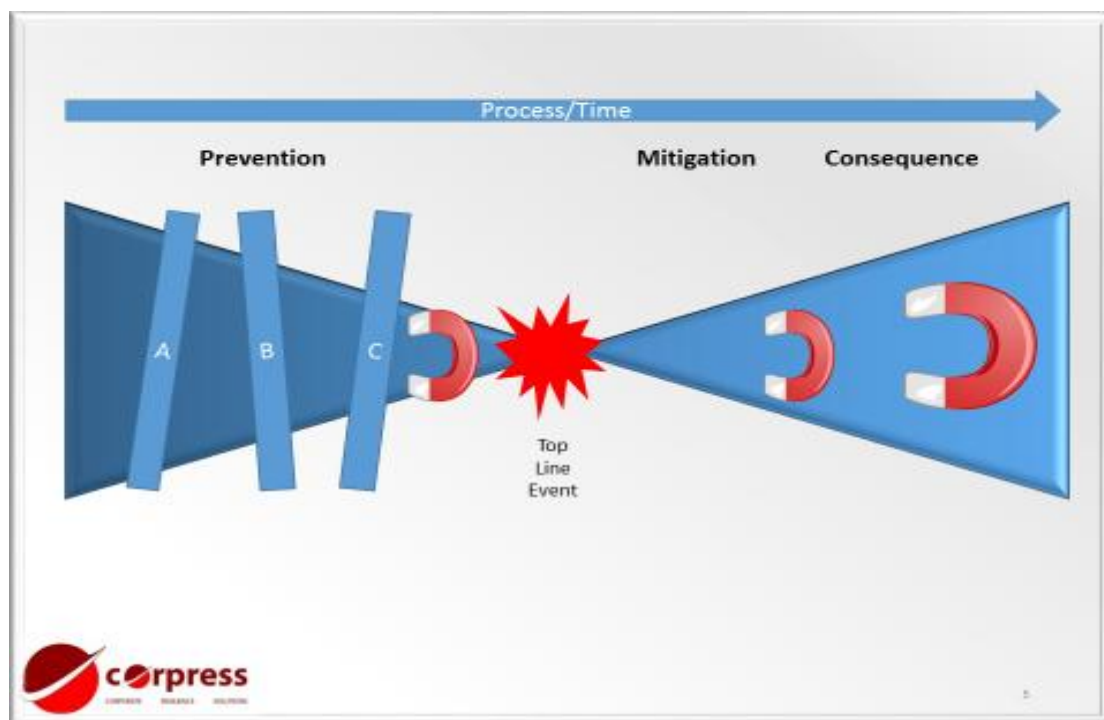
Figure 2: The Suggested Reality Represented by the Bow-Tie

This raises a number of questions.

- Does the revised bow-tie suggest/imply that every system is inherently unstable?

- Do the industry bodies, employers, regulators and unions accept this representation?

- If so, then how do we communicate and embed this 'difficult' representation into the consciousness of the industry?

- How could this representation be refined? Could we use a Mobius Strip to illustrate the iterative/cyclical nature of how organisations learn from experience?

- What is the appropriate balance between safety training on the prevention side (i.e. the LHS) and the response side (i.e. the RHS)? How do we know?

Many organisations will state that their greatest asset is their people. This is often challenged in the competitive world of business when greater efficiencies/productivity is required, internal budgets and staffing levels reduced and high levels of safety are still demanded. It is easy to overlook the fact that a competent and suitably trained workforce can be the greatest barrier to process/system failure that the organisation will ever have. That competence should encompass both the technical aspects of the occupational role AND the Non-Technical Skills (NTS) associated with working in a high hazard environment.

Existing tools, systems and processes

Many of the tools, systems and processes which underpin Process Safety are already in place. These tools tend to be driven by high-level regulation and legislation which provide a framework for compliance. Which in turn is supported through research and the evolution of standards

By way of example: Corpress recently contributed to the development of the new British Standard for Crisis Management (4). The recognition in the standard of the increasing complexity of information management and the need for the establishment of skills relating to situational awareness, decision making and communications are echoed at a corporate level by the growing influence of NTS related ideas.

Generally, this approach means that the responsibility is on the employer organisation to prove to the regulators that they are running a compliant and safe site with a trained, compliant and safe workforce.

Thus, as soon as the standard is set it is open to interpretation and, arguably, supports the notion that employers train for compliance and not for competence. In addition, as mentioned earlier, a competent and suitably trained workforce can be the greatest barrier to process/system failure that the organisation will ever have.

The Compliance v Competence argument suggests that compliance is the bare minimum standard to the detriment of a broader and more complete level of competence. Compliance training tends to focus, quite rightly, on the technical aspects of the occupational role and occasionally (depending on the level of the individual) on the supervisory/management/leadership requirements.

Organisations will use a combination of external regulation/legislation, external/internal standards and external/internal courses and training packages to ensure the workforce is, as a minimum, compliant with external requirements. These (often costly) tools will have their own (often costly) associated systems and processes and may be working very well for employers.

This raises a number of questions:

- How do we know when the tools, systems and processes are working well?

- What does good look like and what does it cost?

- What does good look like and how do we get there?

- What is the return on investment (ROI) for these tools, systems and processes?

So far we have considered the existing tools, systems and processes which support the training function. One tool which is potentially underused is the Kirkpatrick Model of Training Evaluation which is essentially a 4-step approach:

- **Step 1: Reaction to the Learning** – How well did the learners like the learning process?

- **Step 2: Learning** – What did people actually learn?

- **Step 3: Behaviour change** – What changes in job performance/capability resulted from the learning process?

- **Step 4: Results** – What are the tangible results of the learning process in terms of reduced cost, improved quality, increased production, efficiency, etc.?

Step 1 is almost always undertaken because it is easy and can be used to justify the training in the first place. It tends to ask straightforward questions about the training provided. Similarly Step 2 is often done and sometimes can be merged with Step 1.

Steps 3 and 4 however are a different matter because they require a structured approach which will only yield results over the medium to longer term. It could be argued that the training is meaningless without Steps 3 and 4. It is only in Steps 3 and 4 that an organisation can identify 'how much bang they get for their buck' and the implications for their future investment in training.

It is important to set the criteria for Steps 3 and 4 very early in the training cycle (i.e. identify what good looks like for your own organisation) in order to be able to measure the outcomes in a meaningful way. Setting the criteria towards the end of the training cycle (i.e. just before the measurement and evaluation) tends to result in a false picture as the criteria can be hand-picked to yield a particular result. These false results teach an organization very little about the effectiveness and/or ROI of their training investment.

It is suggested that the current technical training is integrated (and assessed as appropriate) with the NTS and further, that the NTS are considered as an equally important component of the competence profile.

It is further suggested that the same NTS are equally applicable on the LHS and RHS of the bow-tie outlined earlier. Only the nature of the exercising and the timing of the assessment, as required, will differentiate between the two sides.

This is **evolution NOT revolution**. We must learn the lessons from recent history. Investigation of the recent major incidents including Texas City, Buncefield and Macondo (to name only 3) identified that Human Factors played a significant part in the chain of events (barrier breakdown) that led ultimately to a catastrophic event.

It is therefore suggested, again, that workforce competence should encompass both the technical aspects of the occupational role AND the Non-Technical Skills (NTS) associated with working in a high hazard environment.

Corpress can advise employers on this and, using the Minimum Change Maximum Impact (MCMI) model, bring meaningful positive results to employers and their workforce. Note that the Minimum Change (MC) aspect refers to the fact that the Corpress approach works with the existing tools, systems and processes already in place within an organisation and seeks to augment these to yield a bespoke Maximum Impact (MI).

The MCMI model is based on a belief that organisations already have many of the tools, systems and processes which support safety but their effectiveness is often reduced at the point of application.

Corpress is fascinated by the way strategy and operations are linked and how this reflects the culture of an organisation/site, the relationship between senior and middle management and how the practical and real challenges of implementation impact on organisational effectiveness.

Real challenges

So why do many well-intentioned well-structured Process Safety (and associated training/competence) approaches still yield unsatisfactory results? The reasons are many, varied and often interlocked in a way specific to an organisation/site. The simplest way of looking at this is with a top-down approach. This reflects the reality of most organisations and it starts with Leadership.

In short, Leaders develop and 'sell' the vision and those within the organisational structure make it happen. The challenge here is that often the Leadership Team (or similar) has identified what they want everyone to do and they delegate the implementation to others and so believe their work is done until it is time to pull in the results. This is a 'restrictive command' approach where the workforce is simply given the 'what' to do. Modern thinking on Leadership (in organisations, combat and general management) tends to support the 'directive command' approach. Don't be put off by the use of the word 'command'. This approach - see Fitz-Gibbon (5) - allows the workforce to understand the objectives and so be able to adapt and be innovative and thoughtful in order to achieve them. This is one aspect of the Leadership challenge in high hazard industries.

The Corpress Process Safety Model can work in either the Restrictive Command or Directive Command Environment and blends together the key components of a High Reliability Organisation and a Learning Organisation.
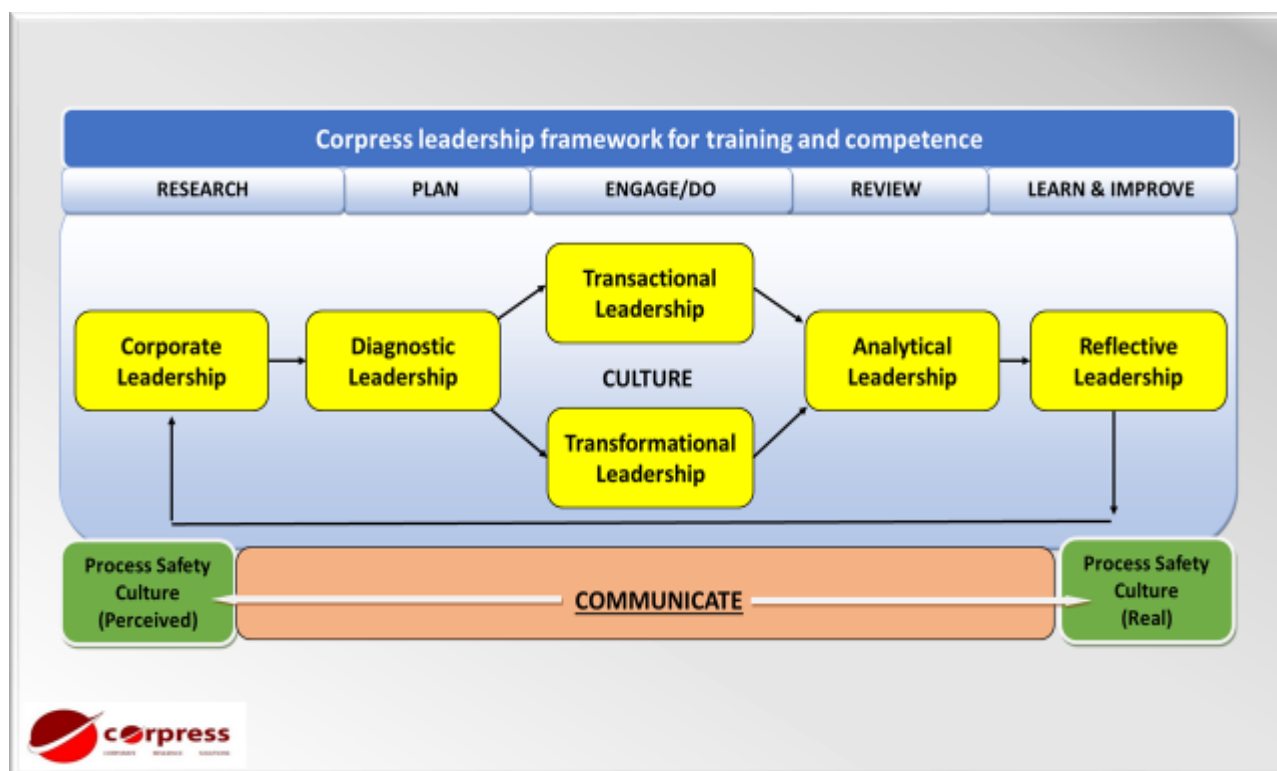

Figure 3: Corpress Process Safety Leadership Model

Other real challenges include:

- **Creating a genuinely shared vision.** What does good look like? This has been mentioned earlier in the paper and, crucially, is likely to be different (in terms of what is both achievable and desirable) for each level of management and operational staff.

- **Selling change.** Organisations and people who work in them are sensitive to change. Some seek and embrace it, others don't commit until they have seen the impact of the change, others tolerate it and others will work against it either passively or actively.

- **Measuring the right things and treating the results with respect and honesty.** Metrics for slips, trips and falls do not serve as a proxy for Process Safety. Organisations may wish to measure individual competence and team competence as well as the more traditional Process Safety metrics.

- **Recognising and dealing with confusion between training and competence**. One of the main differentiators between training and competence is that competence is assessed and hence has a useful measurable aspect (see earlier on Kirkpatrick Model). Many training courses are 'attendance only' and there is no way to identify how much of the information has been retained or how it could be applied in the workplace.

- **Recognising the importance of formal recognition.** People generally like to receive credit and recognition for their training/competence achievements. This is possible through a number of routes. There is generally a financial implication for this and this is often the main component of the challenge.

- **Learning from history.** There is significant case history in the public domain, supported by a rapidly expanding body of knowledge in the form of papers and books, which considers high hazard environments and the importance of NTS. The challenge here is to ensure that organisations have a learning culture and so can seek, identify, access and analyse relevant data and use it to inform operational and strategic decision-making.

- **Facilitating continual/regular exposure**. This also links to the idea of the modern Learning Organisation. It is suggested that employees at all levels need continual/regular exposure to realistic exercises which relate to both sides of the bow-tie. This exercising links directly to training and assessment opportunities.

  The paper asked earlier - What is the appropriate balance between safety training on the prevention side (i.e. the LHS) and the response side (i.e. the RHS)? How do we know?

  Experience suggests that organisations tend to do the simple (minimal resource required – LHS side of the bow-tie) often and the difficult (higher levels of resource required – RHS of bow-tie) is tested/exercised less frequently. **It is suggested that these are part of an iterative safety/learning continuum rather than two separate issues**. By dealing more with the difficult then we learn more about the simple systems and routines. In other words by developing a greater understanding of the RHS (through continual/regular exposure to testing and exercising) we develop a deeper and more useful understanding of the current and future systems/processes required for the LHS and vice-versa.

- **Staff/competence turnover.** When staff leave they take their competence and experience with them. New staff (generally) start from lower (or different) competence/experience base and the time spent on the 'learning curve' can be a high risk time.

- **Resource conflicts**. Is it as simple as Production v Safety?

- **Understanding why people make specific decisions**. Cognitive Bias is present in every individual in every workplace and at all levels and has a direct impact on the behaviours and actions. It is suggested that, as an absolute minimum, every staff member is aware of the existence of the range of commonly found Cognitive Biases.

Skills, competences and behaviours

We have referred throughout this paper to the Non-Technical Skills (NTS), how important they are in the modern workplace and how important they are specifically to barrier management. The authors have recent experience of working with major operating companies and drilling companies in the oil/gas industry and identified that although many organisations have an idea of what they want (in terms of NTS) they struggle to articulate the specifics. To a great extent, the 'heavy lifting' for this work has already been done in the form of research and development by Flin et al (6), and referenced by Hopkins (7), where they developed further the ideas around Crew Resource Management (CRM).

Crew Resource Management (CRM) is the combination of cognitive and behavioural abilities by which work is delivered safely and effectively. So what does that mean for skills/competence and the training/assessment programmes which underpin them?

Consider the **6 main NTS** associated with CRM:

- Communication

- Decision Making

- Leadership

- Situation Awareness

- Stress Management

- Teamworking

If we accept these as the NTS we need our workforce to have then we can identify the level required for each occupational role/level within the workforce in terms of:

- What the individual/team must be able to do (Performance Criteria)

- What the individual/team must know in order to do it (Knowledge and Understanding)

We can then develop a detailed specification which allows the development of appropriate training and/or (as per the MCMI model outlined earlier) the re-emphasis of current training provision. A genuine competence-based approach can be developed by including an assessment (and quality) component. Recognition of achievement can be internal or external.

The key point here is that the NTS can be developed in direct accordance with 'what good looks like' for each organisation going through the above process. Hence, every approach to the NTS is entirely bespoke to that organisation and owned by

that organisation. Note also that through the MCMI model existing programmes, systems and processes are used wherever possible.

The approach suggested by Cogent (8) provides a flexible basis on which to start the development of competences relevant to Process Safety at different levels. This is likely to be the first of a number of similar documents from the Sector Skills Councils/Organisations (SSC/Os) with a remit for skills/competence/qualification development across the range of high-hazard industries.

Wright, Turner & Horbury (9) suggest that competence is commonly regarded to be the ability to perform the activities within an occupation or function to the standards expected in employment. This definition makes reference to standards, which in the context of COMAH competence, is the continuing ability of individuals and teams to perform reliably the Major Accident Hazard elements of their roles, responsibilities and tasks, and for this to be demonstrable. Such roles of course include the ability to respond to and manage a wide variety of risks including the handling of emergency situations.

Case studies which are often referred to in the literature for the high hazard industries include Piper Alpha, Esso Longford, Three Mile Island all which illustrate root causations which include links to individual competencies. However the requirements for competency assurance systems are not restricted to high risk industries but can be applied to all work locations.

According to Kerstholt [10], decision making behaviour is considerably affected by the dynamics of environment, because most natural dynamic situations contain much uncertainty. He notes that a dynamic situation continually changes and, thus, a decision maker has to take temporal changes into consideration. The decision making process is different in high stress environments; Dorner and Pfeifer (11)] found that stressed subjects focused on the general outline of the problem, while non-stressed individuals relied on in-depth analysis. The Centre for Chemical Process Safety (12) identified a number of phenomena which occur under stress, such as rigidity of problem solving and polarisation of thinking, making individuals more prone to error.

The interrelationship of variables and the complexity of emergency situations combined with the demand for instant response and the desire for accuracy, all affect performance and contribute to a difficult environment in which the individual must perform. The development of competent standards for an emergency role must take into account not only the elements of core knowledge relating to the position but also the related demands of leadership, command and control and teams working in stressful environments.

The way forward

In the early phases of personal development there may be sound reasons for separating core skills and knowledge development from the complexity of handling disruption, higher risk situations and emergency management, limiting the exposure to awareness until the routine can be managed competently.

Our observations across organisations from different sectors indicates that many remain fixed at this point which results in separating "normal" and risk response in to compartments visualised as different sides of the bow tie rather than looking at the "totality" of the model.

We believe that this separation barrier into left and right hand sides is false and needs to be removed, that NTS and other skills are common across the bow tie continuum and that effective learning programmes can be developed at lower cost for improved staff competencies through:

- Using existing systems/processes/approaches but with a new focus

- Not aiming for normality but aiming for totality

- Remembering that handling the day job during good times does not make you competent

- Recognising that "Competent" requires you to be able to manage the storm as well as the calm

- And understanding that investing in wrong place gives poor value.

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