Safety Culture-Gap Management for Designers and Contractors

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Preface

In his seminal work 'Safety Can't be Measured', Andrew Townsend challenged the Construction Industry to reconsider its current understanding of accident causation. He pointed out that although construction fatalities had fallen steadily since the 1980s, in recent years, they had plateaued, a feature shared with other European countries and the US. He suggested that whilst the relationship between different types of accidents is changing, we don't fully understand the reasons. Andrew presented his ideas to the ICE Health & Safety Expert Panel in June 2012, which supported his book launch (courtesy of Scott Brownrigg Architects) in September 2013; Andrew died later that month.

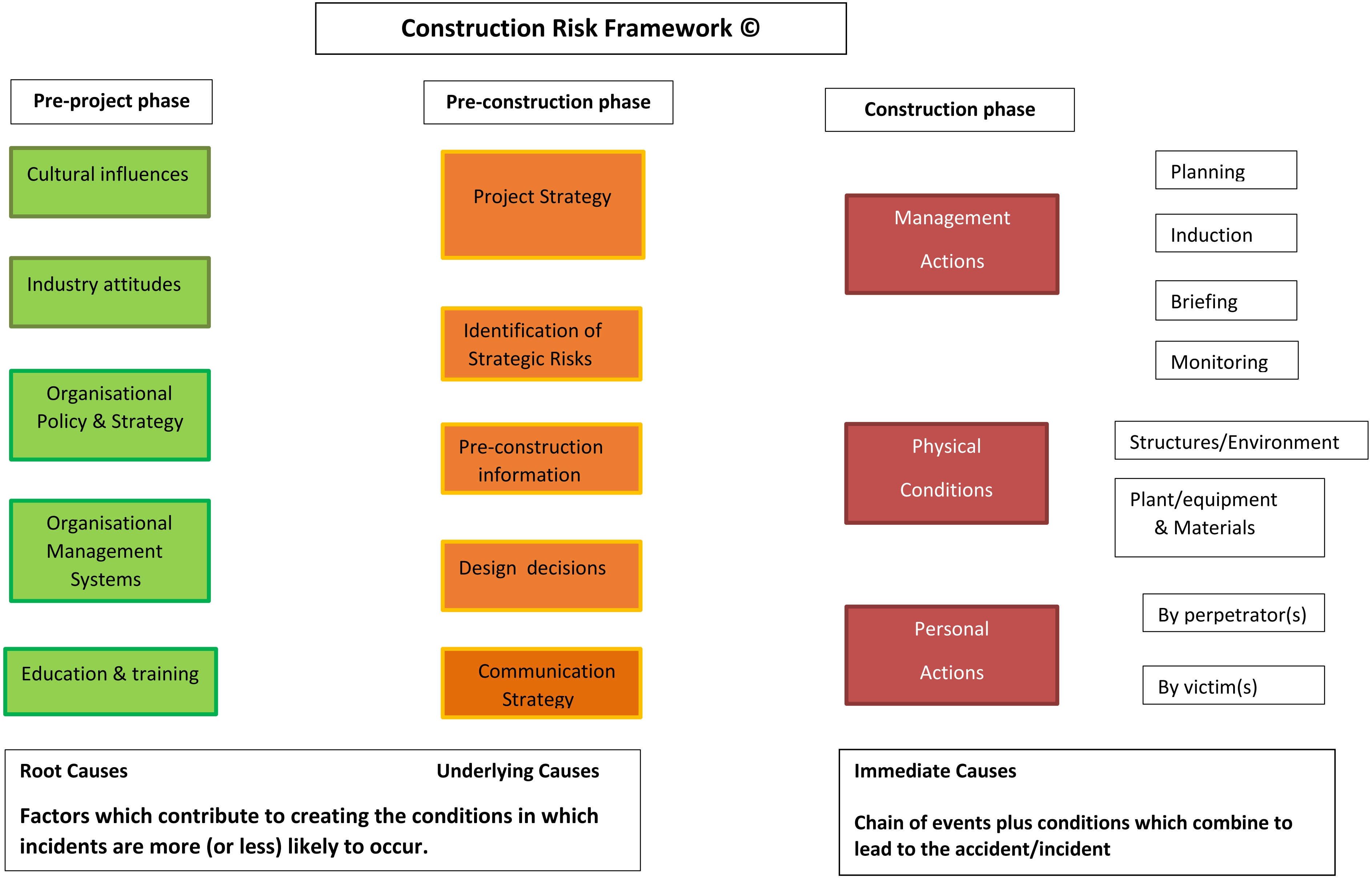
Inspired by Andrew, Tony Putsman presented a Construction Risk Management Framework to the Expert Panel in June 2014 (summarised in the chart shown below) and then developed it in conjunction with Bob Arnold in the summer of that year. The intention of this chart was to map and relate the various factors that influence the likelihood of accidents/incidents occurring on construction sites in a way that had not been done before. It may be the case that accident causation theory is not readily understood by many construction professionals; the general theories that will be familiar to Health and Safety practitioners are not construction specific and of limited value in a project environment.

Based on this framework , Bob Arnold began to develop the outline of a standard for establishing and maintaining a successful health and safety culture in construction organisations – including both design and contractor set ups.

Graeme Walker, John Carpenter, David Ackerley and Peter Crosland joined the working group in late 2014.

This group recognises that wherever construction projects are carried out in the world, irrespective of the local Health & Safety legislative framework, there is a need for project teams to manage risk in a coherent and collaborative manner. The safety performance of project teams is a function of the safety cultures the participants bring from their parent organisations.

Conventional accident investigations tend to focus on 'Immediate', and, to a lesser degree, 'Underlying' causes. Little attention is paid to the latent safety culture of the organisations involved , or the leadership (or lack of it) shown by the Principals (Partners, Directors, owners), The working group set out to demonstrate that , only by focussing on the strategic leadership of construction organisations , and helping individual Principals to take a more proactive role in Safety Leadership, can we hope to continue the downward trend of reduced fatalities and major injuries, as well as tackling the health related harm from which so many workers suffer.


Construction Risk Framework ©
Pre-project phase
Cultural influences
Industry attitudes
Organisational Policy & Strategy
Organisational Management Systems
Education & training
Pre-construction phase
Project Strategy
Identification of Strategic Risks
Pre-construction information
Design decisions
Communication Strategy
Construction phase
Management Actions
Planning
Induction
Briefing
Monitoring
Physical Conditions
Structures/Environment
Plant/equipment & Materials
Personal Actions
By perpetrator(s)
By victim(s)
Root Causes
Underlying Causes
Factors which contribute to creating the conditions in which incidents are more (or less) likely to occur.
Immediate Causes
Chain of events plus conditions which combine to lead to the accident/incident

1 Introduction

It is often the case that it takes a serious accident to focus everyone's mind to the importance of safety. This concept where safety performance generally drifts downwards, largely through complacency, but is boosted now and again following such an incident, is referred to by James Reason in his book, "Managing the Risk in Organisational Accidents", as the Safety Space. In the Safety Space, performance levels oscillate between good and poor. Whilst the concept is widely accepted, there are few tools designers and contractors can call on to manage this phenomenon in a satisfactory way.

This paper sets out a summary of a technique which has been developed for managing safety culture performance levels in projects and organisations, typically involving designers and contractors. We refer to the technique as **Safety Culture-Gap Management or SC-GM** ©

The driving principle behind **SC-GM** is that the safety culture of an organisation, from the top to bottom, determines its health and safety performance. However, the "gap" between the actual safety culture, compared to what an organisation aspires to, is often very significant. This Culture-Gap, between actual "safety culture" and "aspirational safety culture" is critical. This is because, in the event of a serious accident, directors and senior managers are held accountable for the management of the safety culture of their organisation. Therefore it is imperative that they are aware of any shortcomings that may exist.

To manage the safety culture, as with managing any subject, it has to be measureable. **SC-GM** puts forward a simple and practical approach that takes into account the influences from the top of the organisation down to the workface, including the supply chain if appropriate. The technique deals with the influence and management of organisational values, behaviours, knowledge and systems, **VBKS** ©

To measure **VBKS**, the **SC-GM** technique requires the critical investigation of a mock fatal accident, preferably based on a recent near miss that may have occurred. This tests the ability of the project or organisation, firstly, to cope with such an emergency in the short term, and secondly, to withstand a rigorous accident investigation which will take a comprehensive look at the way in which the project or organisation is managed and how it performs in practice.

Undertaking an investigation means studying the factors involved in much more detail than carrying out an audit. There are similarities here with the approach taken with Root Cause Analysis (RCA), although the **SC-GM** investigation technique is undertaken with much greater predetermined framework than is usually the case with RCA. An investigation entails checking particular records and understanding exactly why certain decisions or behaviours were undertaken. It can be conducted over a relatively long period of time. Audits on the other hand have a wider scope and generally are undertaken in a predetermined amount of time.

It is recommended that mock accident investigations are undertaken several times a year. In this way the scope of activities under investigation becomes wider. Further to this, from the perspective of the project team, the prospect of a forthcoming mock accident investigation will sharpen up performance levels.

With the investigation complete, an analysis of the findings will enable a good understanding of the safety culture to be undertaken. Further to this, the shortcomings that have been identified will enable the gap between the planned and actual safety cultures to be analysed and appropriate remedies developed for implementation.

The benefits that can be gained from this approach are:

- The investigation of the health and safety culture spans the full range of the organisation – from the directors and senior managers through to the workface.
- The **SC-GM** technique enables changes to be made that will improve the health and safety performance, and reduce accidents. Note, if the technique is repeated over time, it will put each project on “alert” in anticipation of the arrival of mock accident investigation, which will add further to effectiveness of the initiative.

2 What is a health and safety culture in the eyes of the industry?

Some industrial safety culture definitions

It will be noted that the term "culture" features in the process charts (pp19 to 23). We have linked it with the concepts of Root Culture, Underlying Culture and Immediate Culture. However, the definition of culture has, over the years, still not settled down into a term that we can depend on both in the judgement of the courts and nor for the practical use of managers.

First, let us look at how culture has been used in high profile accident enquiries.

A 1988 definition of safety culture was used in the Summary Report on the Post-Accident Review Meeting on the Chernobyl Accident -

"That assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance".

This spells out clearly what is required, but does not make any reference to the role and responsibility for bringing such a requirement into effect. Nor does it refer to the measurable techniques that would be needed to manage such a culture.

In 1993, the UK Health and Safety Executive suggested the following definition:

"The product of individual and group values, attitudes, perceptions, competencies, and patterns of behaviour that determine the commitment to, and the style and proficiency of, an organization's health and safety management".

Again, this does not refer to the techniques required to bring such a requirement into being. It does though recognise that a safety culture is a product of a number of factors.

Perhaps the most user friendly definition came from the Cullen Report into the Ladbroke Grove rail crash in 1999.

"The way we typically do things around here".

This perfectly captures the output of safety culture in the simplest way. It will capture the situation where procedures are in place but they are not put into effect, or the way things are done because there is no guidance on what should be done. Unfortunately, we are looking for a definition that captures the roles of the guiding minds of the organisation – usually the board of directors or partners – and also whether or not the arrangements made in their name are effective or whether they are indeed implemented or not.

The following comments made during the enquiries into two great disasters of modern times give an indication as to the way the courts might see the place of safety culture in an organisation. Mr Justice Sheen, leading the enquiry into the 1987 Zeebrugge Ferry Disaster, said:

"From top to bottom the body corporate was infected by the disease of sloppiness".

This definition does not spell out where the blame lies, but it certainly embraces the idea that sloppiness caused the accident and it involves the board as well as the operating crew.

Sir Anthony Hidden led the enquiry into the 1988 Clapham Junction Train Crash. He was moved to say -

"A concern for safety which is sincerely held and repeatedly expressed but which is not put into practice is as much protection from danger as no concern at all".

In those days, the idea of a third party certified documented management system was still relatively new. Running a huge organisation without the benefit of the established rigour that a complete and fully implemented quality management system would bring must have been very difficult. "…expressed but not put into practice …" is a frustration that surely most senior managers have to live with. This comment expresses frustration at the state of organisational management theory as much as any condemnation of the responsible personnel involved. However, the situation was reversed in 2005 when Gordon MacDonald, Chair of the COMAH Competent Authority Strategic Management Group said of the Buncefield Explosion and Fire –

"Buncefield is a stark reminder of the potential result of a poor attitude towards safety".

At the time of this incident, the use of third party certified documented management systems were commonplace. Senior managers depended on them to make sure that what they expressed (or at least "approved") was carried out into practice. Yet here is a situation where one of the organisational management flaws is that there is a poor attitude towards safety.

This compares poorly with the Clapham Junction Train Crash, where the attitude at the top was good, but it was not carried through into practice. Here, by virtue of the published ISO standards for Quality (ISO 9001) and the health and safety management standard (OHSAS 18001), a range of management tools are available, but because of a poor attitude, they were not effective.

An enlightened view

Then there is a special case. An investigation led by a person who had the insight to see the importance of the roles required throughout an organisation and the disastrous consequences that can follow if the perception at the top of the organisation of the in-house operational standards is flawed.

Carolyn Merritt was the United States Chemical Safety and Hazard Investigation Board Chairman and CEO who was ultimately responsible for the investigation into the B.P. Texas City Fire and Explosion in 2005.

When the report was released she said:

"Corporate leadership at the highest level is accountable for the safe operation of facilities that use hazardous chemicals. Safety culture is created at the top, and when it fails there, it fails workers far down the line. That is what happened at BP".

She puts forward a definition of safety culture as follows:

"A good safety culture is the embodiment of effective programmes, decision making and accountability at all levels. When we talk about safety culture, we are talking first and foremost about how managerial decisions are made, about the incentives and disincentives within an organization for promoting safety".

In this definition, she places the role of the directors as key to the creation of a safety culture. She went on to say –

"One thing I have often observed is that there is a great gap between what executives believe to be the safety culture of an organization and what it actually is on the ground.

Almost every executive believes he or she is conveying a message that safety is number one.

But it is not always so in reality".

This approach is supported by the introduction of the Corporate Manslaughter and Corporate Homicide Act in 2007 which places the directors in the spotlight during the investigation into a fatal accident.

Further to this, there are numerous examples internationally where the directors of a company have been punished following the accidental killing of one of their employees, although there is a great debate in legal circles about the "path of influence" (1 University of Aberdeen) and the difficulties proving a director's guilt when he plainly was not at the scene of the crime and the organisation under investigation has several layers of management (or even companies) between the work face and the board room. This legal debate continues.

Conclusion.

However, from a practical organisational management perspective, the argument is now clear. The directors or partners of an organisation are responsible for the safety culture. Further to this, they have two sets of responsibilities –

1 Ensuring the desired culture is defined and then put into effect
2 Ensuring the actual culture is in line with the defined culture.

3 A proposed definition of health and safety culture which is measurable

The most commonly used definition of "organisational culture" is "the way we do things around here". This definition could be applied to health and safety too. However, from the examples given earlier, and the causation diagrams, it can be seen that this definition is an "output" of culture but not the culture itself. For a practical definition, the role of the senior management team (usually the board of directors, or partners) as well as the middle managers and workforce need to be taken into account. Our definition is the combination of values, behaviours, knowledge and systems.

Further to this, safety culture exists in two states, the planned safety culture and the actual safety culture. Let us refer to values, behaviours, knowledge and systems as vbks. We then have vbks planned, and vbks actual. It is the role of the senior management team to align the two states of safety culture in their organisation. This definition applies to both design and contractor organisations. (See examples pp 19 to 29)

In line with the investigation process, culture can be explored in more detail by looking at vbks in the root, underlying and immediate conditions. Each condition will have a planned and actual state.

I Values (published company or design practice values)

As defined by the directors or partners, these are the published values of the organisation. They do not need to be original or demonstrate some powerful unheard of pearls of wisdom that might represent the perfect paradigm. Instead, they need to represent a small number of things that employees, associates and other stakeholders can understand and accept.

Published values are usually of most value in times of adversity. For example, it might be decided by individuals in the underlying culture section of the organisation, to skip carrying out hazard reduction exercises on the design, or risk assessments on parts of the construction. Most times, taking the resulting risks would pay off since the usual outcome would be no accident, no delays and no penalties. Occasionally though an accident will happen, and if it turns out to be serious, then the people at the root culture end of the organisation, design or construction, might be subjected to an accident investigation by the regulator.

Without published values, everyone is likely to develop their own way of doing "their best for the business" including taking risks to meet deadlines or budgets that might, for example, damage the reputation of the organisation.

An example that illustrates the pressures that workers face given conflicting messages on production and safety.

> A specialist groundworks subcontractor was excavating trenches in preparation for the underground drainage system for a residential development. The team was under pressure to complete one section of the site by the end of the week. If they fail to achieve this, they knew there would be a big

row with the main contractor and everyone knew that the work on site would become more unpleasant. They knew also that their director will be visiting the site the next day and that was also likely to result in an argument. The groundworks team did not like to upset their boss.

The groundworks ganger noticed that a particular trench had been over excavated and was not yet propped. This had been carried out in a way that was contrary to their method statement and training and so the ganger then had to decide what to do. It was quite deep, around 2m, but he knew that he could save a lot of time by jumping into the trench and cleaning it out prior to pouring some blinding concrete to protect the bottom surface. This would save a day on the programme instead of waiting for the sides of the trench to be propped and making the situation safe.

He knew that his employer publishes a poster which says “Safety is the most important part of our work”. He knew also from his training that he should not jump into the trench because it might collapse. But he was also under pressure to catch up on the programme and that he would only be in the trench for ten minutes at the most.

He took the chance and jumped into the trench. Five minutes later, the driver of the excavator which had carried out the excavation, moved the machine closer to the trench in final preparation for placing the blinding concrete. The movement and vibration of the machine triggered the collapse of the trench. The emergency services were quickly called but the ganger’s life was not able to be saved.

During the course of the subsequent official investigation, the other members of the groundworks team were asked if they thought the directors would want them to take these type of risks. All of them said that despite the poster and the training, the directors would expect them to take the initiative and take short cuts if needed although they also said that they knew the directors would never say so.

Conclusion: If the directors truly believed that their employees should not take short cuts that may have safety implications, and that it was better to face the consequences of running behind programme, then they needed to show more leadership to ensure their employees are totally convinced about the sincerity behind their company values.

II Behaviours

Behavioural safety can be a complex subject since it deals with difficult aspects of why individuals take the actions that they do. The subject applies to directors, managers and supervisors as well as those carrying out operations in the workplace. One of the many tools that are employed for site workers is the adoption of a code of conduct which might be introduced during a site induction programme and which sets out such behaviours as “The obligation on everyone to report an unsafe action by others, or to report possible faults in machinery if suspected. It is not acceptable behaviour to simply turn a blind eye and ignore it, even if the problem lies with a totally different organisation.

Clearly, if it is possible to persuade everyone on a site to comply with a common set of rules that describes the required behaviours, then large areas of safety risk would be reduced. Note though that the introduction of a Code of Conduct is only a small part of an effective behaviour programme.

An example that illustrates the conflicting pressures arising from a schedule of work and the need to adopt defined behaviour

> A hoist driver was operating a hoist which carries people to all of the thirty three floors of a new tower block under construction. The day's activities included taking wheelbarrow loads of concrete to the top floor where a small slab of reinforced concrete was being poured. The concrete pour was scheduled to last three hours. Half way through the pour, the hoist driver noticed a loud noise and strong vibrations as the hoist passed by level 20. Steel ties connecting the hoist to the building were in place at this level.
>
> The hoist driver had been trained in the site Code of Conduct to report any mechanical issues that were outside the normal functioning of mechanical equipment. However, the pour had been started, the concrete was hardening and the gang and their supervisor were adamant that the pour had to be completed.
>
> Despite the pressure, the hoist driver stopped the hoist and consequently the pour was stopped. He was not popular after this since the stoppage created a considerable amount of extra work for the concrete gang. The hoist was repaired and no-one was injured. After this, he was generally regarded as being negative by those that used the hoist, which in turn created more pressure on him when the hoist was put back into service.

III Knowledge

Training, undertaking Continuous Professional Development, having a subscription service that provides access to industry standards are generally accepted ways of ensuring managers keep up to date with their responsibilities. However, pressures of work are often used as a reason not to attend training or pursuing the other activities that would ensure managers keep up to date.

An example that illustrates how the lack of research into a Quality Inspection and Test Plan (QITP) for a specialist subcontractor can lead to a serious accident.

> A specialist subcontractor was appointed by a main contractor to install false ceilings. Contrary to the requirements of the main contractor's Quality Management System, nobody asked to check the proposed QITP to be adopted by the specialist subcontractor. The subcontractor had hired a new gang for the subcontract and had not provided any training prior to the start on site. The gang were not aware of the QITP requirements. Consequently the work on site started without a QITP being in place.
>
> In the event, the ceiling hangers were not installed at the correct centres. Nobody checked the work that had been undertaken.

Three weeks after the ceiling had been completed, a section of ceiling in a corridor collapsed onto two people who were working in the corridor at the time. The emergency services were called and the injured people taken to hospital. One person recovered very quickly, the other was unable to work for six months.

IV Systems

This section includes: 1) documented management systems for Occupational Health and Safety 2) Temporary Works Management Systems including design and construction 3) Quality Management Systems, including design, design management and construction activity 4) Safety Critical Management Systems.

The Occupational Health and Safety Management System

It is suggested that managers would look to an Occupational Health and Safety Specialist to advise on preventing accidents arising from the following specialist categories of work:

- Misuse of plant or equipment e.g.
    - Management of cranes, dumpers, abrasive wheels
- Misuse of chemicals or materials e.g.
    - Manual handling, chemical inhalation, burns to skin
- Entry into or adjacent to hazardous situations e.g.
    - Crossing roads, unfinished work areas, areas where explosives are being prepared
- Poor housekeeping e.g.
    - Slips, trips, safe storage
- Falls from height e.g.
    - Working on roofs, temporary work platforms, next to an excavation
- Inadequate fire prevention or emergency escape arrangements e.g.
    - Burns from fire, trapped in tower crane cab

- Excessive noise e.g.
  - From using road breakers, accumulation of other work activities

- Lack of behavioural awareness or control
  - Not aware of or complying with site rules, not complying with established procedures, tiredness or boredom through repetitious work

The Temporary Works Management System

The Temporary Works Engineer will ensure that at each stage in the construction sequence, the stability of earthworks and structures within the site are operating within recommended factors of safety. If as a result of mistakes in the design or checking of the design, or a misunderstanding of the sequence of works by the managers or supervisors, failures may occur which result in numerous and serious injuries.

- Demolition
  - Typically involves analysing the structure, determining demolition sequence, maintain structurally safe building throughout process
- Earthworks
  - Typically involves analysing ground stresses and designing temporary ground conditions, designing practical devices such as access ramps or crane foundations, ensuring that each step is safe
- Substructure
  - Typically involves transfer of lateral loads from around the site into the permanent works, design of shoring and propping schemes.
- Superstructure
  - May include formwork for structural cores, external safety screens, propping system for fast turnover floor slabs.
- Cranes, hoists and other access equipment
  - This will include the design of foundations, erection of plant , adaption and dismantling

The Quality Management System

Prior to specialist activities starting on site (such as constructing concrete or steel frames, installation of cladding units, fixing ceilings) a Quality Plan including Quality Inspection and Test Plans should be established which sets out the measures that need to be taken to give an assurance that the standard of work has been carried out in accordance with the specification. This is usually established in line with a Quality Management System.

Inspections and tests need to be carried out in accordance with the manufacturer's instructions. This will involve some research into specifications, industrial standards, manufacturers instructions etc.

The success of a QITP will therefore depend on the quality of the research undertaken prior to work commencing.

If components do not meet their designed capabilities, for example bolts that fail their strength tests, or that do not meet the specified inspection criteria, then failures may occur. In this event, depending on the nature of the failure, injuries may be sustained.

Examples of failures in the QMS which might result in injury

Reinforced concrete: Substructure and superstructure:
Incorrect reinforced steel selection and/or placement can result in structural collapse

Facades:
Lack of QC during manufacturing, for example, the connection of different materials, can result in a connection failure and an element of the façade panel falling to the ground

Ceilings:
Lack of suspension wires, incorrect hangers etc can result in a collapse of a false ceiling

Prefabricated floor and wall panels.
Incorrect connections can result in a floor panel collapse

Using incorrectly certified nuts and bolts
These can result in structural failures. This may apply to numerous types of structural elements

Inadequate control of floor slab reinforced concrete thickness
This may result in changes in level creating trip hazards

Safety Critical Management Systems

These systems are often put into place as an extra set of management controls over and above the other systems. Usually the technique involved is to introduce a series of hold points on the critical activity so that critical work can be signed off at each stage, thus reducing the risk of critical hazards being realised.

V Conclusion

Together, values, behaviours, knowledge and systems might be known as vbks, the key ingredients of a safety culture. Using this framework, the first stage in defining a safety culture might be:

The product of organisational values, behaviours, knowledge and systems

However, in practice, there is often a difference between the planned and the actual safety cultures. It is suggested therefore that the safety culture of an organisation is:

The product of organisational values, behaviours, knowledge and systems as represented in both planned and actual conditions. These two states of health and safety culture (planned and actual) can be further itemised as root safety culture, underlying safety culture and the immediate safety culture

4 Safety culture as a contributor to cause and effect

Working backwards

In the UK and many other countries, the convention in carrying out an accident investigation is to start with the immediate cause, that is, what actually happened on site. For example; the injured person fell into a hole; a brick fell from the top floor and hit a person on the ground floor, or a gas bottle exploded and several of the fragments hit passers-by. The investigation then moves back to study the underlying (or secondary) causes. This will involve looking at the safe systems of work, the documented management systems and processes that were in place, how the work was planned, how the work was supervised, the competence levels of those involved and all the other factors within the local area of management that contributed to the accident.

Finally, the investigation moves further back to establish the root cause. It may well be that those involved in the root cause were nowhere near the operations on the site at the time of the accident. In fact, they may never have been to the site. The root cause relates to those people in the organisation who are responsible for authorising the policies and safety management arrangements in the organisation and keeping themselves informed as to whether these policies and arrangements were in place at the time and whether they are effective or not.

Of course, the root cause is directly connected to the root culture discussed in the last section. The Root Culture is the safety culture that has been defined by the board as its requirement for the organisation. Further to this, the Root Culture reflects the actual behaviour of the directors in the way they are perceived by the managers and workers within the organisation.

Working forwards

If the accident investigation process is reversed, it can be seen that an organisation can classify its safety culture at three levels: a root culture, an underlying culture and an immediate culture.

The underlying culture is the approach to safety culture that is being enacted by the managers of the business. In construction and civil engineering, this may involve senior managers, contracts managers, project managers, foremen and supervisors. Usually, the underlying safety culture on a project is the safety culture of the site as managed by a main or principal contractor and those associated with the project including designers and subcontractors.

The immediate culture is “the way things are done around here” as undertaken by those carrying out the work on site and their immediate supervisors.

In summary, accident causation is influenced by three organisational levels known as the immediate cause, the underlying causes and the root causes. The safety culture of an organisation can also be considered on three cultural levels regarded as the combination of the root culture and the impact it has on the underlying culture and, in turn, the impact this has on the immediate culture.

5 Causation diagrams

The diagrams in the following pages illustrate factors involved in accident causation; working their way back from the factors involved in the immediate cause, through underlying causes and eventually back to the root cause. We have also shown charts which in effect are the reverse of the causation charts and which illustrate the influence on the organisation of the safety culture types; from root culture, through underlying culture to the immediate culture.

We also include a project (civil engineering or construction) based chart which is made up of numerous disciplines such as designers, consultant advisors, main or principal contractors and subcontractors. Further to this, projects are affected by factors outside the participating organisations and we have attempted to include these as well.

Contents:

1 Contractor focus – Accident investigation
2 Contractor focus – Accident prevention culture

3 Designer focus – Accident Investigation
4 Designer focus – Accident prevention culture

5 Wider industry and project factors – Accident prevention culture

Safety Culture-Gap Management for Designers and Contractors

Direction of Accident Investigation ←

<table>
<tr>
<td>Root cause – cultural issues

Culture generated, monitored and managed by the board of a Contractor Co.</td>
<td colspan="2">Underlying causes by management
Consider role of Principal Contractor and Contractors</td>
<td>Immediate Cause

Behaviour and Mechanical</td>
</tr>
<tr>
<td rowspan="7">Possible questions to gauge the safety performance of the board

Has the board created a risk management thread throughout organisation and specifically for the construction process?

Does the board have good intentions but settles for inadequate feedback on safety performance?

Is the safety culture of the board sloppy, allowing a “hit and miss” implementation?

Does the board have an unacceptable attitude to safety?</td>
<td>V Company / organisation values</td>
<td>Published and a) promoted b) not effectively promoted c) not published</td>
<td rowspan="7">Intentional:

Sabotage, malevolent damage, suicide?

Substance abuse without mitigation?

Unintentional:

Substance abuse with mitigation?

Possible reckless violation?

Management system induced violation?

Mechanical failure induced violation?

Possible negligent error?

Management system induced error?

Mechanical failure induced error?

Blameless error but corrective training or counselling recommended?

Blameless error?

Mechanical failure?</td>
</tr>
<tr>
<td>B Behaviour programmes</td>
<td>Published and a) implemented b) not effectively implemented c) not published</td>
</tr>
<tr>
<td>K Knowledge, training, competence & information being made available</td>
<td>Published and a) implemented b) not effectively implemented c) not published.</td>
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<tr>
<td>S OHS Management System</td>
<td>Published and a) implemented b) not effectively implemented c) not published</td>
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<td>S Temporary Works / Construction Engineering Management System</td>
<td>Published and a) implemented b) not effectively implemented c) not published</td>
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<td>S Quality Management System</td>
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<td>S Critical Health and Safety System</td>
<td>Published and a) implemented b) not effectively implemented c) not published</td>
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1 Contractor focus – Accident investigation ©

Safety Culture-Gap Management for Designers and Contractors

Direction of influence culture and leadership →

Root Culture Culture generated, monitored and managed by the board of a Contractor Co.	**Underlying Culture by management** **Consider role of Principal Contractor and Contractors**		**Immediate Culture** Behaviour and Mechanical
Possible questions to gauge the safety performance of the board	V Company / organisation values	Published and a) promoted b) not effectively promoted c) not published	*Intentional* Sabotage, malevolent damage, suicide? Substance abuse without mitigation?
Has the board created a risk management thread throughout organisation and specifically for the construction process?	B Behaviour programmes	Published and a) implemented b) not effectively implemented c) not published	*Unintentional* Substance abuse with mitigation?
	K Knowledge, training, competence & information being made available	Published and a) implemented b) not effectively implemented c) not published	Possible reckless violation?
Does the board have good intentions but settles for inadequate feedback on safety performance?	S OHS Management System	Published and a) implemented b) not effectively implemented c) not published	Management system induced violation? Mechanical failure induced violation?
Is the safety culture of the board sloppy, allowing a "hit and miss" implementation?	S Temporary Works / Construction Engineering Management System	Published and a) implemented b) not effectively implemented c) not published	Possible negligent error? Management system induced error?
Does the board have an unacceptable attitude to safety?	S Quality Management System	Published and a) implemented b) not effectively implemented c) not published	Mechanical failure induced error?
	S Critical Health and Safety System	Published and a) implemented b) not effectively implemented c) not published	Blameless error but corrective training or counselling recommended? Blameless error? Mechanical failure?

2 Contractor focus – Accident prevention culture ©

Direction of accident investigation ←

Root Cause – Cultural Issues Culture towards safety in design generated and monitored by the board / partners	**Underlying Causes by Designers and Design Managers** Includes permanent works and temporary works		**Immediate Cause** Design only
Possible questions to gauge the safety performance of the board, or partners. Has the board of director (or the partners), created a risk management thread throughout the organisation and specifically for the design process?	V Design practice / organisation values	Published and a) promoted b) not effectively promoted c) not published	Design induced violation? (i.e. deliberate non compliance) Concept or detailed design induced error?
Does the board (or partners) have good intentions but settles for inadequate feedback on safety performance?	B Behaviour programmes	Published and a) implemented b) not effectively implemented c) not published	Component failure
Is the safety culture of the board (or partners) sloppy, allowing a "hit and miss" implementation?	K Knowledge, training, competence & information being made available	Published and a) implemented b) not effectively implemented c) not published	Noting that failure can also arise from insufficient consideration of procurement / specification -
Does the board (or partners) have an unacceptable attitude to safety?	S Documented Safety in Design management Systems (to suit design discipline, for quality, OHS, engineering safety etc)	Published and a) implemented b) not effectively implemented c) not published	Has adequate information associated with hazard elimination or reduction in design been given to the contractors?

3 Designer focus – Accident investigation ©

Direction of influence, culture and leadership →

Root culture Culture towards safety in design generated and monitored by the board / partners	**Underlying Culture from the design process** Includes permanent works and temporary works Note also role of CDMC		**Immediate Culture** Design only
Possible questions to gauge the safety performance of the board, or partners.			*Do we know that our designs do not:*
Has the board of director (or the partners), created a risk management thread throughout the organisation and specifically for the design process?	V Design practice / organisation values	Published and a) promoted b) not effectively promoted c) not published	Induce a possible H&S safety violation through unclear, inadequate or incorrect presentation?
Does the board (or partners) have good intentions but settles for inadequate feedback on safety performance?	B Behaviour programmes	Published and a) implemented b) not effectively implemented c) not published	Cause a failure due to a concept or detailed design induced error?
Is the safety culture of the board (or partners) sloppy, allowing a "hit and miss" implementation?	K Knowledge, training, competence & information being made available	Published and a) implemented b) not effectively implemented c) not published	Cause a structural or component failure? (QA) Noting that failure can also arise from insufficient consideration of procurement / specification -
Does the board (or partners) have an unacceptable attitude to safety?	S Documented Safety in Design management Systems (to suit design discipline, for quality, OHS, engineering safety etc)	Published and a) implemented b) not effectively implemented c) not published	Has adequate information associated with hazard elimination or reduction in design been given to the contractors?

4 Designer focus – Accident prevention culture ©

Safety Culture-Gap Management for Designers and Contractors

Direction of influence →

Industry Wide	Designers and Preconstruction Phase	Principal Contractor	(Sub) Contractors
National culture arising from history, the media, technology, the courts, global competition Statutory requirements Academia Political aspects Industry attitudes Education and training	*External Influences* Influence of client. Organisational culture and individual behaviours Project characteristics: Location, geology, geography Influence of standards set by industry representative bodies e.g. ICE, RIBA *Internal Influences* Competence at Design Management and Supervision including Organisational Management. Ability to manage expert functions including H&S, Sustainability Management culture of Design team and consultants Behaviour (actions) of designers and consultants	*External Influences* Scale of project and physical conditions Location. Quality of logistics and communications Influence of Standards set by trade associations and professional bodies, e.g. UKCG, CIRIA, CONIAC, CIC *Internal Influences* Competence at Project Management and Supervision including Organisational Management Ability to manage expert functions including H&S, Sustainability Management culture of Principal Contractor team Behaviour of managers	*External Influences* Physical conditions for (sub)contractor Location and quality of logistics and communications for (sub)contractor Influence of standards set by specialist trades bodies plus CSCS scheme etc *Internal Influences* Competence at Project Management and Supervision including Organisational Management. Ability to manage expert functions including H&S, Sustainability, Environment Management culture of (sub)contractor team Behaviour of workforce.

5 Wider industry and project factors – Accident prevention culture ©

6 Examples of cause and effect using root, underlying and immediate classifications

Note that the following examples are purely hypothetical and do not relate to any real situations or people.

Example 1 A fatality occurred when a person fell from an external vertical metal ladder when climbing down from a plant-room at the eighth floor of a commercial building. The ladder had been installed close to the hand rail on the floor below. He fell from the ladder and over the handrail to the ground.

		Values	Behaviours	Knowledge	Systems
Immediate cause	Handrail too close to the ladder to prevent the risk of someone falling from the building should they fall from the ladder. Design flaw.			Handrail too close to the ladder to prevent the risk of someone falling from the building should they fall from the ladder. Design flaw.	
Underlying cause	*Summary:* Hazard elimination and risk reduction procedures were published by design firm but not fully implemented. *Detailed aspects:* Detailing carried out by a junior architect. He had not been trained in procedure. Procedure requires drawings to be checked by a (hazard reduction) trained architect. This did not occur. Wider investigation shows that there was little evidence that procedures were followed in the practice. The last training session was 18 months before. The last audit was 12 months ago (There was no evidence that identified non-conformances from the audit had been corrected).		Hazard reduction procedures were published by design firm but not fully implemented. Procedure requires drawings to be checked by a (hazard reduction) trained architect. This did not occur. Wider investigation shows that there was little evidence that procedures were followed in the practice. The last training session was 18 months before. The last audit was 12 months ago (There was no evidence that identified non-conformances from the audit had been corrected).	Detailing carried out by a junior architect. He had not been trained in procedure	Hazard elimination and risk reduction procedures were published by design firm but not fully implemented. Wider investigation shows that there was little evidence that procedures were followed in the practice.
Root cause	The Partners had authorised the system two years ago but had subsequently received no information	None of the designers when interviewed could recall any	The Partners had authorised the system two years ago but had subsequently received	The project architect was chartered and had recently joined the company. He had	

	on compliance levels from board reports or any other reports. The system had been produced by a health and safety consultant. The project architect was chartered and had recently joined the company. He had not been inducted or trained in the company hazard reduction system. None of the designers when interviewed could recall any of the Partners referring to Hazard reduction.	of the Partners referring to Hazard reduction.	no information on compliance levels from board reports or any other reports	not been inducted or trained in the company hazard reduction system	
Project level	The project did not agree any coordination standards for the hazard management in design. Each design firm operated independently.				The project did not agree any coordination standards for the hazard management in design. Each design firm operated independently

Example 2.

A glazing panel from 12th floor of a commercial building under construction fell from the building in high winds. No glazing had been fixed on the side of the building that was facing the wind. Consequently, the wind blew through the building and forced the panel of glass outwards.

		Values	Behaviours	Knowledge	Systems
Immediate cause	Glazing panel from 12th floor of a commercial building under construction. There were high winds. No glazing had been fixed on the side of the building that was facing the wind. Consequently, the wind blew through the building and forced the panel of glass outwards.			The site team had not anticipated this particular hazard.	The systems did not include information on the dangers of wind on buildings under construction.
Underlying cause	The designer of the proprietary glazing system had detailed the connections to the building. However, the designers only took into account a wind load blowing onto the building from the outside. This design condition represented the completed condition of the building only. The connections to the building were not strong enough to withstand a wind load being applied from the inside, as might be the case during the construction process.		Construction hazard reduction exercises were not carried out. The site team was aware of the CDM regulations, but assumed the designers had complied with their UK obligations. The Principal Designer did not raise the issue	The manufacturer and designer were based in China. There was no awareness to take into account the construction conditions.	The management system in the design office dealt primarily with administrative issues only. There were no references to safety in design.
Root cause	The main contractor had procured the glazing system from a Chinese based company. Whilst the main contractor had UK based, CDM Compliant management systems and a strong set of training programmes, they did not extend as far as international procurement	None of the designers when interviewed could recall any of the Chinese directors referring to Hazard reduction. There was no policy for dealing with international			

		procurement and risk reduction.			
Project level	A general lack of awareness, top to bottom, on the dangers of the situation – both re design and construction				
Root cause	The main contractor had procured the glazing system from a Chinese based company. Whilst the main contractor had UK based, CDM Compliant management systems and a strong set of training programmes, they did not extend as far as international procurement	None of the designers when interviewed could recall any of the Chinese directors referring to Hazard reduction. There was no policy for dealing with international procurement and risk reduction.			
Project level	A general lack of awareness, top to bottom, on the dangers of the situation – both re design and construction				

Example 3

Whilst replacing a heavy piece of electrical switchgear in the plant room (situated in the basement of London offices) the equipment turned over and fatally injured one of the installers.

		Values	**Behaviours**	**Knowledge**	**Systems**
Immediate cause	Insufficient room had been allowed in the design for items of plant to be moved between plinths. Because of the lack of space, it was difficult to manoeuvre the panel into position. The process was improvised by the installers. Whilst the panel was being transferred from the platform trolley to the plinth, it turned over and fatally injured one of the installers.	The installers thought they were doing the right thing in improvising and pressing on.	The installers decided to improvise, because of the lack of space.	Insufficient room had been allowed in the design for items of plant to be moved between plinths.	The installers' risk assessments had not foreseen this problem
Underlying cause	*Summary.* Lack of adequate space had been provided by the designers between the plinths in the plant room. This was due to a lack of overall space which had been allowed for in the plant room. *Detailed aspects.* The design required coordination between the M&E engineers and the structural engineers. The principal designer was the lead architect. The architect delegated the design to the engineers and did not carry out any proactive coordination.		The clients cost advisors had advised the plant room space should be restricted to make savings. None of the designers objected to this.		The principal designer did not coordinate or become involved in the layout of the plant rooms. Each firm of designers had their own internal management systems for hazard reduction but there was not system in place between the designers across the project.
Root cause	None of the partners of the three disciplines (architecture, structural engineering, M&E engineering) discussed or agreed any programme for hazard elimination or risk reduction in design across the project. This lack of leadership from the top of the design firms was the root cause of the accident.	The design company were aware of the CDM regulations, but did not want to challenge the client's instruction to reduce costs and followed	The principal architects behaviour was based on appeasing the client and not on insisting on undertaking the duties set out in CDM	All parties had a reasonable knowledge of CDM, and had relevant procedures in place. But none of them wanted to challenge	None of the design partners insisted that their systems should be complied with.

		the lead of the clients cost consultant.		the approach set by the principal designer	
Project level	There was a lack of coordinated strategy. In the end, all designers followed the lead of the cost consultant.				

7 Outline Procedure for a Mock Accident Investigation

Mock Accident initial team meeting

1 Define the mock accident for the project. It will be useful to work around a recent near miss, which, on a different day, may have resulted in a fatality.

Describe the accident scenario, the location, those that are injured and the time it occurred.

Arrange for an introductory meeting with the project manager / director, the construction manager, project safety manager, site engineer or temporary works coordinator and possibly one or two more from the senior project team.

Set a meeting up with the senior project team and arrange for the time of the mock accident to be one hour before this meeting.

Immediate Team Response to Accident

2 Ask the team to list the actions they will have taken in the last hour, immediately after the accident. This will include managing P.R., making the site safe, contacting emergency services etc. Established emergency procedures should be followed.

3 If a near miss scenario has been adopted, and it is useful to do so, undertake witness interviews.

Establish the Immediate Causes

4 Establish any further information relating to the immediate cause. It is recommended that the checklist for immediate causes is referred to. Note, the immediate cause is probably going to be mostly defined in the description of the accident given to the project team. Refer to the accident causation charts under the “immediate cause” section.

Note, the causes may involve design and contractor issues.

Establish the Underlying Causes – Document Study

5 Ask the senior team to explain the processes and procedures that should be followed and ask for a copy of the relevant documentation, including forms. Look for compliance or otherwise with the specified arrangements. Enquire about further documentation and evidence of compliance as necessary.

6 Refer to the Underlying Causes section of the Causation charts, for both designers and contractors as appropriate. Note for contractors, the underlying causes may involve contractors, subcontractors and main contractors. For each designer and contractor identified, the investigation should progress from underlying causes to root causes.

Underlying Causes - Interviews

7 The investigation into the underlying causes may give rise to carry out interviews to help understand why certain actions were taken.

Take into account conflicts that may arise between company values or behaviour codes, which may suggest not proceeding with certain aspects of operations, and the perceived need to take other issues into account, such as pressure from supervisors or managers to continue to work to planned arrangements.

Take into account the degree to which company values are understood and taken into account (in the context of the accident).

Root Cause

8 Establish leadership by the board or senior management team and the degree to which the values, behaviours, knowledge and systems are defined for adoption by the organization and the degree to which they are complied with.

The Culture Gap

9 Establish the extent to which values, behaviours, knowledge and systems are planned (or defined)

Establish the extent to which values, behaviours, knowledge and systems are understood and complied with (actual)

10 Prepare Accident Causation matrices using immediate, underlying and root classifications against values, behaviours, knowledge and systems.

Proposal for the way forward following the analysis of the Culture Gap

11 Consider vbks planned and comment on areas of policy that need improvement

12 Consider vbks actual and comment on areas of implementation that need improvement.

13 Introduce changes as needed.

14 Distribute the report widely across projects. Prepare for next “mock accident investigation”.