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**Identification of safety good practice in the
construction and deconstruction of temporary
demountable structures**

ES/FE/11/01

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KEY MESSAGES

This report is an assessment of current practice relating to the management of temporary demountable structures (TDS) within the UK events sector. Each year, the UK holds a number of 'events' including sports, live music and corporate events. Requirements for temporary demountable structures can vary widely between events.

The events sector is primarily made up of small companies and self employed freelancers. Management chains are fluid and often unique to a specific event. Individuals may operate in a variety of roles depending on the requirements of the event. While individual management chains can perform effectively, this lack of consistency could result in over-complexity and confusion, having a potentially negative effect on safety. Similarly, role definitions may be vague and contractual arrangements nebulous.

Management of an event can be a significant contributory factor to incidents. A review of those larger incidents, investigated by HSE, identified failings in planning, procedures and competence as being common primary causes of incidents.

The events sector prides itself on its ability to get the job done. However, there are advantages and disadvantages to this approach. The 'last minute' approach has become the norm and has led to a potential reduction in the effectiveness of the planning process. It is difficult to extend the same rigorous scrutiny to short notice alterations as was extended to the original plans.

Identification of suitable organisations and individuals for an event appears to be based primarily on informal personal contacts. While there is a high level of competence within the sector, a 'history' in events appeared to be accepted as the primary proof of this at all levels (from management to crew) and there was little requirement to provide evidence. Emphasis was placed on getting on with the job (learning as you go) and HSL witnessed little evidence of site briefings or toolbox talks during these visits.

Familiarity or knowledge of a structure or system appeared to hold most importance in the erection of the structure and may supplant (rather than support) erection plans. Construction of the structure tends to take place as a fluid process, with little division between separate activities. In some cases, systems for structural sign-off or handover appeared to be weak (or non-existent).

HSL have prepared a suggested model for managing temporary structures. Many of those working in the events sector have already identified issues in the way they work and have developed their own systems to overcome these flaws; this report includes examples of good practice currently used within the events sector.

EXECUTIVE SUMMARY

Objectives

Each year, the UK holds a number of large 'events' including sports, musical and corporate events. These events require extensive provision of temporary demountable structures. In 2012, London will host the Olympic and Paralympic Games. The requirement for temporary demountable structures at the 2012 Games will be beyond anything undertaken in the UK for previous events and is likely to extend beyond the venues to include cultural and other events. This will put pressure on the associated supply chain in terms of capacity and experience. The structures required and levels of control may differ significantly at events remote from the Olympics themselves.

HSL considered existing guidance and regulations, past experience and current sector practices. HSL sought to use this information to clarify the good practice standards required for the design and construction management of temporary demountable structures.

This work forms an assessment of management practices and attitudes within the events sector as it currently stands, particularly with respect to temporary demountable structures.

In parallel to this work, HSL have proposed a model for managing temporary demountable structures (which is published separately as Annex A). This is intended to assist those responsible for procuring, designing, supplying, constructing and managing the use of temporary demountable structures (particularly during the 2012 Games).

Main Findings

Ad-hoc management hierarchies are commonplace in the events sector. Management teams are often comprised entirely of freelancers, who may undertake a variety of roles. Management chains may be complex, with vague role definitions and nebulous contractual arrangements. The sector lacks a recognised management framework similar to that used in conventional construction, which could potentially lead to weaknesses in the management of the event.

Conventional construction is covered by the Construction (Design and Management) Regulations 2007 (CDM)¹, which define the roles and responsibilities of those involved in construction projects. Perceived differences between conventional construction and the erection of temporary demountable structures have meant that CDM has not been proactively enforced in the events sector.

While there is some acknowledgement of the imperfect nature of current management systems, there appeared to be a general acceptance of the flaws as an inherent part of the events sector.

Current guidance for the events sector, while providing sound technical information, does not provide details of a management approach suitable for the specific application considered during this work. The imposition of systems from comparable industries was not widely regarded as a positive approach.

Planning an event takes place over an extended period. Many decisions (particularly early ones) will be based on 'best guess' and not 'set in stone'. Contractors are willing to be flexible and adapt to changes in the plan, even at a relatively late stage. However, this 'can do' attitude encourages poor (and late) communication of plans and a willingness to push the limits on restrictions.

Selection of suppliers / providers / contractors is primarily based on a network of informal personal contacts. 'Experience' is considered to be the primary proof of competence at all levels (from management to crew). There may be little requirement to provide evidence of competency.

The modular nature of the structure places limitations on the variation in design (and therefore construction methods available). Familiarity with or knowledge of a structure or system appeared to be a more powerful driver in the erection of the structure than drawings or erection plans. While undeniably important, system specific experience should be used in support of the erection plan rather than in replacement.

Construction of the structure tends to take place as a fluid process. Structures can pass between different phases of the build (and come under the control of different contractors) without any formal handover. Systems for structural sign-off appeared to be weak (or non-existent).

The sector is highly dependent on local crew with unknown (or unmeasured) competence. Emphasis is placed on learning on the job and there was little evidence of site briefings or toolbox talks prior to commencing work. There are a number of basic safety training schemes (notably the event specific safety passport scheme, introduced by the sector trade body PSA) but take up at crew level was variable.

A review of those larger incidents investigated by HSE supported the findings from the visits. The principal causes of accidents were failings relating to planning, procedures and competence. Investigation indicated that there were general failures in predicting foreseeable events and that contractors showed willingness to act beyond their competence and ignore set procedures in getting the job done. For less severe incidents, falls from height and manual handling were significant sources of injury.

Recommendations

As described, HSL identified several potential strengths and weaknesses during this investigation. Of most significance was the lack of a framework on which to base a coherent management hierarchy. While the loose structure allows the development of management hierarchies to fit individual events, it has inherent disadvantages which were acknowledged during this work and which, it has been argued, have contributed to incidents.

A suitable management framework would include recommendations to strengthen control over areas of concern such as competency, identification of suitable contractors and the tendency to rely on 'last minute' action.

The identification of such weaknesses, by no means implies an absence of 'good practice' within the events sector. Many of those working in the events sector have developed their own systems to overcome these disadvantages. What is lacking is a commonality of approach.

HSL have suggested a model for the safe management of temporary structures. This has been published separately as Annex A of this report. This includes examples of good practice that are currently applied, to a limited extent, within the events sector.

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1 INTRODUCTION

Each year, the UK holds a number of large ‘events’ including sports, musical and corporate events. These events require extensive provision of temporary demountable structures (TDS) such as staging, seating, temporary buildings, video screens, camera platforms, etc.

The Olympic and Paralympic Games will take place in London in 2012. The requirement for temporary demountable structures will be beyond anything undertaken in the UK for previous events and is likely to extend beyond the venues to include cultural and other events. This will put pressure on the associated supply chain in terms of capacity and experience.

The provision of temporary demountable structures is influenced by factors that may have less significance in other industries such as speed of erection and deconstruction, limited use, adaptability of design, transportability and use by the public.

A number of incidents have occurred involving these types of structures, both in the UK and beyond, both during construction and while in use. There is evidence to suggest that management hierarchies in the events sector are often less formalised than in other parts of the construction sector and may have contributed to these failures.

To assist those responsible for procuring, designing, supplying, constructing and managing the use of temporary demountable structures (particularly during the 2012 Games), the work described in this report was undertaken to propose a model for the safe management of temporary demountable structures. This includes recommendations for designers, clients, event managers and those workers involved in erection/deconstruction to help to ensure that good practice is followed and work is undertaken safely.

In developing the suggested model, HSL has gathered information using the following routes:

- Examining existing guidance and regulations relating to temporary demountable structures.
- Reviewing past experience of accidents.
- Sampling management practices within the events sector.

The recommendations are published separately as HSL report FE/ES/11/01/A - Annex A “Suggested model for the safe management of temporary structures”.

2 SCOPE

2.1 THE REQUIREMENTS OF THE LONDON 2012 OLYMPIC AND PARALYMPIC GAMES

HSL contacted the London Organising Committee of the Olympic Games (LOCOG) to gain insight into their particular requirements for the temporary demountable structures at the 2012 Games. The types of structures likely to be required include:

- Seating.
- Temporary Buildings.
- Temporary Stadia.
- Ancillary Structures (many of which will be custom structures, fabricated from scaffolding) including:
 - Broadcast Towers.
 - Flying Cameras.
 - Video Screens.
 - Cable Bridges.
 - Access and Walkways.
- Special Structures (such as staging for equestrian events).

The Cultural Olympiad is likely to require other types of structure but these were not defined.

In managing safety, LOCOG have decided not to differentiate between TDS and conventional structures, hence all structures will be covered by Construction (Design and Management) Regulations (2007) (CDM)¹. Each venue will have its own design team and be managed by a principal contractor (from a construction or events background, depending on the nature of the work). The principal contractor will manage the erection, modification and disassembly of all of the TDS at that venue.

On completion of the London 2012 Olympic Games there will be a three week long window prior to commencing the Paralympic Games. During this period, some venues will change and may host different sports. Minor changes to temporary demountable structures are expected, principally as a result of the differences in playing area requirements.

Of potentially greater significance, are transitions in usage during the Olympics Games period itself, which will result in changes to seating layouts overnight. There may also be potential pressure as a result of events preceding the Olympics such as Trooping the Colour.

These requirements are known and should be included in the event plans. However, changes will still need to be achieved within relatively short timescales.

2.2 LIMITS OF THIS WORK

This work focuses on the management of health and safety during the construction and deconstruction of TDS rather than their structural integrity and stability during the event itself.

This work focuses primarily (but not entirely) on the types of structures that are likely to find use as part of the London 2012 Olympic and Paralympic Games (as defined in discussion with LOCOG) and the associated Cultural Olympiad.

Certain types of structure have been specifically excluded from this work. These are:

- Very large temporary buildings (such as temporary stadia). This scale of this type of construction is considered to be more appropriately managed by the direct application of CDM.
- Overhead rigging including suspended lighting, video and sound equipment.
- Barriers.

The erection of marquees and other large tented structures, while not conforming to the definition of 'structures' under CDM¹ has been included because of the frequency of use of this type of structure within the events sector.

Incidents involving the management of health and safety during construction are of principal concern (rather than those involving issues of in-service stability). However, it is acknowledged that the root causes of both types of incident may be linked and provide equal illustration of issues associated with managing the events. Therefore, both types of incident have been included but they have been separated by category.

3 OBSERVATIONS

This section summarises observations covered in greater detail in Section 5 ‘Findings’, and originating from assessment of regulation, incidents and current practice.

3.1 APPLICABLE REGULATION AND GUIDANCE

1. Current available guidance (including standards) relating to TDS concentrates on technical aspects rather than managing the safe delivery of the structure.

3.2 REVIEW OF ACCIDENTS INVOLVING TEMPORARY DEMOUNTABLE STRUCTURES

2. A review of major accidents in the events sector identified deficiencies in planning, procedures and control of competence as being the principal factors leading to accidents. Principal failings included:
 - A failure to identify foreseeable events (such as weather conditions and audience behaviour) at the planning stage.
 - A failure to follow the appropriate procedures during the event or to use procedures that were sufficient to achieve the intended objective.
 - A willingness of contractors and individuals to make decisions and undertake actions beyond their area of expertise, in order to deliver the work.
3. Falls from height and manual handling were significant sources of injury.

3.3 SITE VISITS

3.3.1 Nature of the Events Sector

4. Different types of event have significantly different requirements. The events sector is not homogenous.
5. The events sector consists of small companies and self-employed ‘freelancers’. Site management teams can comprise entirely of freelancers, who may undertake widely different roles at different events.
6. In many cases, the contractual details between the event organiser and freelancer are vague.
7. Events are generally a year (or thereabouts) in the planning.
8. Many decisions (particularly early ones) will be based on ‘best guess’ and there will be numerous modifications right up to completion.

3.3.2 Developing the ‘Concept’

9. The design concept should be defined at the start of the design process to encapsulate all of the requirements for the structure. The lack of ‘buy in’ to the design concept

among those specifying the structure, and the willingness to make modifications to satisfy the customer, undermines the principle of the design concept.

3.3.3 Managing Delivery of the Event

10. Event management teams tend to be ad-hoc, changing on an event-by-event basis. The significance of this can depend upon the nature of the event; changes in management would be more significant in a series of short linked events (such as a touring show) than in a single longer-term event.
11. The management hierarchy is often complex.
12. Many of the job titles in global usage do not have a consistent definition. The responsibilities these roles entail may vary widely.
13. The events sector lacks a consistent management framework, which may lead to weaknesses in event management.
14. Ensuring that all responsibilities are sufficiently covered may be difficult without a suitable framework.
15. CDM is often cited as a successful management approach in other parts of the construction sector. The lack of alignment between roles in the events sector and roles specified under CDM has been cited as an obstacle in the application of CDM.
16. The enforcement of CDM is not generally regarded as a positive approach by the events sector, however there are events companies that work (or have worked) in accordance with CDM.
17. The land (or venue) owner has a responsibility to ensure the site is safe for its intended use. This responsibility may be discharged by the provision of appropriate information relevant to the event site (or by facilitating the gathering of that information). Venue owners may also have additional responsibilities placed upon them.
18. Selection of suppliers / providers / contractors is primarily based on a network of informal personal contacts.
19. Providing proof of competency does not appear to be considered as particularly important.
20. A 'history' in the events sector is considered to be the primary indicator of competence at all levels (from management to crew).

3.3.4 Design

21. The designer should design for both structural integrity and safety during construction.
22. The design of the structure should give specific consideration to the requirements of its environment.
23. The modular nature of the structure places limitations on the variation in design and construction techniques available to TDS contractors.

3.3.5 Construction

24. The event plan and TDS erection plan are inter-linked and cannot exist in isolation.
25. The erection plan encapsulates safe methods of working while erecting the structure. However, familiarity with or knowledge of a structure or (modular) system appeared to be more important in the erection of the structure than drawings or erection plans.
26. Emphasis is placed upon learning on the job and there was little evidence of site briefings or toolbox talks prior to commencing work.
27. The sector is highly dependent on local crew with unknown (or unmeasured) competence.
28. There are various approaches to basic safety awareness including an industry specific passport system.

3.3.6 Change Control

29. The events sector prides itself on a 'can do' attitude. However, this could encourage poor (and late) communication of plans and a willingness to ignore set limits or restrictions.
30. The unplanned placement of advertising and other types of ancillary material can be a potential source of risk and should be carefully managed.
31. TDS contractors have developed a capability to implement changes to the structure design.
32. Late changes to the structure design will invariably result in deviation from the erection plan and more hazardous working methods. The erection plan should be reviewed to identify the appropriate safe method of working when introducing these changes.

3.3.7 Handover and Sign Off

33. Sign off and handover are the principal mechanisms for communicating the capabilities of the structure and the presence of any residual hazards.
34. Management of documentation tended to fall within the remit of the Health and Safety Manager. The holding and sharing of documents online can be a good method of overcoming the disparate nature of the events sector.

3.3.8 Deconstruction

35. The deconstruction process is not simply a reversal of the construction process.

4 METHODOLOGY

4.1 LITERATURE REVIEW

HSL initiated a review of national and international regulation, guidance, standards and incidents in the events sector through the HSE Information Service. This search used the following terms:

- Temporary Structures.
- Demountable Structures.
- Temporary Seating or Grandstands.
- Stages.
- Floodlights, Speaker Towers, Loudspeakers, Video Screens.
- Sound Desks.
- Press Boxes.
- Tents and Marquees.

4.2 REVIEW OF ACCIDENTS INVOLVING TEMPORARY DEMOUNTABLE STRUCTURES

4.2.1 HSE Accident Statistics

A review of major accidents in the sector was undertaken and a parallel search was commissioned from the HSE Statistics Team who provided a summary of accident figures as well as notifier comments for incidents occurring during the previous 10 years (to date).

It should be noted that the data provided by the HSE Statistics Team was identified using a text search and is not statistically reliable. There are a number of things that can affect the outcome of the search (e.g. correct spelling, words used, capitals, punctuation etc). RIDDOR notifiers have freedom to express the details they supply in the way that they feel is most appropriate. As a consequence of this flexibility during notification, it is very difficult to identify and group incidents with common causes and there is no easy way of ensuring that all records are accounted for.

4.2.2 Review of Accidents using HFACS

HSL researchers carried out a series of six interviews with lead inspectors for six incidents involving temporary demountable structures during both the construction phase and in service. The incidents covered were:

- Earls Court - Pink Floyd 1994 (Grandstand collapse in service).
- Earls Court 2001 (Fall from temporary seating during construction).
- Bearded Theory 2009 (Stage collapse in service).
- Millennium Point 2006 (Large screen collapse prior to the event).
- Grapevine 2004 (Grandstand collapse in service).
- Guilfest 2007 (Collapse of speaker tower prior to the event).

The objective of these interviews was to:

- Obtain base facts about the incident;
- Collate information about human and organisational factors in the incidents;
- Identify and code the root cause(s) of the incidents.

To structure the interviews and ensure that appropriate information was collected, HSL researchers used a revised version of the Human Factors Analysis and Classification System (HFACS) to identify the root causes of the incidents.

HFACS was originally developed by Wiegmann and Shappell² to be used in the US Navy, but was subsequently tailored for use in the construction sector³ and utilised, by HSE, in a review of construction fatal accidents⁴. The HFACS tool applied in the current research was a more recent revision of the tool by Damian Walker (HSE Specialist Inspector) to address some of Olsen and Shorrock's⁵ criticisms, whilst retaining a tool that is easy and quick to use.

The interviews lasted up to an hour and were structured as follows:

- Background to the incident;
- Human performance issues – weighting and assigning responsible parties;
- Categorisation of causes.

A full copy of the interview schedule including the HFACS categories can be found in Appendix A.

4.3 DETAILS OF SITE VISITS

The HSL team visited six large UK events during their construction or deconstruction phases. These were intended to provide a sample of representative events involving temporary demountable structures. Details of the events visited are given below.

Table 1 Types of structure encountered at each event		<i>Staging</i>	<i>Seating</i>	<i>Ancillary Structures</i>	<i>Tentage</i>	<i>Temp. Buildings</i>	<i>Other Custom</i>
1	3 Day Festival	✓		✓	✓		
2	2 Day Festival	✓		✓	✓		
3	Edinburgh Festival	✓	✓		✓		✓
4	Stadium Tour	✓					
5	One-off Stadium Event	✓					
6	Sporting Event		✓			✓	

HSL's objectives for these visits were:

1. To gain an understanding of the nature of the event and the structures involved.
2. To identify the key players (at all levels), identify their roles and the relationship of these roles to the safe management of the event.
3. To evaluate the management systems in use.

The primary source of information was unstructured interviews with as many different participants in the event as possible. To ensure consistency, HSL prepared a visit checklist detailing key areas that needed to be covered.

Interviews represent a flexible research technique, however, the responses given may not be accurate and may not represent actual behaviour. The interviewee may present what they think the interviewer wishes to hear or may simply forget (or be unaware of) significant details. In this instance, information on perceived good practice was considered to be as important as information on actual behaviour.

During the visits a number of organisations and individuals indicated that they had actively sought to supply to the London 2012 Games (either by submission of tenders or demonstrations of product). At the time of the visits, none of those spoken to had made firm contractual arrangements.

1. Three Day Festival

This was a three day rock music festival with an expected audience of 80,000. This was a closed arena event (i.e. public are excluded from the arena outside the hours of formal entertainment). HSL visited seven days before the event. The arena contained one main stage structure and four large marquee structures, each with smaller internal stages. All staging / scaffold structures (including front of house incorporating a sponsored audience viewing area) were supplied by a single contractor.

Site preparation took about four weeks with a further three weeks required to clear the site after the event. During that period crew worked a standard 12 hours per day (08:00-20:00), 7 days per week single shift pattern. During the event there was 24 hour working.

2. Two Day Festival

This was a dance music festival, taking place over two days with an expected audience of about 70,000. HSL visited two days before the event and just as load-in for basic (i.e. non-artist specific) sound, light and video was beginning.

This was a closed arena event (i.e. public is excluded from the arena outside the hours of formal entertainment). The arena contained one main stage structure and a number of large marquee structures, each with smaller internal stages. All staging / scaffold structures were supplied by a single contractor.

Site preparation took about two and a half weeks with a further week to clear the site after the event. During that period crew worked a standard 12 hours per day, 7 days per week single shift pattern.

3. Edinburgh Festival Fringe

The Edinburgh Festival took place over three weeks in August and consisted of hundreds of comedy, cabaret and musical events at numerous permanent and temporary venues around the city.

HSL visited a temporary venue consisting of a Spiegel Tent (a free-standing traditional design which does not rely on a central pole) erected on a stage structure with a bar incorporated underneath. The structure was erected on a stepped terrace. The structure is shown in Figure 1. Separate companies erected different elements of the structure.

HSL attended the site on conclusion of the event and witnessed a significant part of the load out, including removal of parts of the bar, tent and underlying structure. Site preparation for the event took one and a half weeks. Deconstruction was scheduled to take three days (constrained by a subsequent event). During this period crew were working a 24 hours, double shift pattern.

While in Edinburgh, HSL visited a number of other venues including a custom designed temporary theatre structure incorporating cosmetic inflatable elements, temporary seating and additional Spiegel tents.

In Scotland, TDS are subject to a separate approval by the relevant local authority.



Figure 1 The Spiegel Tent and supporting structure

4. Stadium Tour

As part of an international tour, an artist was scheduled to play the venue (a sports stadium) for two consecutive nights. The artist had previously played at another UK venue and was subsequently commencing an American tour. The HSL visit coincided with the handover of the basic stage and the commencement of work on the touring stage including sound, light and video.

The event used a single stage consisting of basic and tour specific elements. However, control of the event appeared to be split with the tour management covering the stage and production, whilst the promoter covered all other areas (including the installation of the basic stage).

Site preparation took a week with a further three days to clear the site after the event. During that period crew worked a standard 12 hours per day, single shift pattern.

5. One-off Stadium Event

This was a one-off televised musical / corporate event. The event consisted of a meal served to special invitees followed by a musical event that was open to the ticket buying public. The event used a single stage, located centrally within the arena; because of the unique nature of this event it had different aesthetic considerations to other live music events visited (i.e. television friendly).

Site preparation took a week and a half with a further three days required to clear the site after the event. During that period crew worked a standard 12 hours per day, single shift pattern. During the HSL visit, work was well underway on sound, light and video installations, although the stage was incomplete (awaiting a hand-rail component from America).

6. Sporting Event

This was a major sporting event, requiring extensive temporary seating. All of the temporary demountable structures were provided, and fitted out, by companies within the same group using additional local crew. This included nineteen separate seating grandstands and temporary buildings housing media and hospitality suites. Seating units were distributed across a wide area.

Site preparation took eight weeks with a further four weeks to clear the site after the event. During that period crew worked a standard 12 hours per day, single shift pattern.

When HSL attended site, work on clearing the site was well underway but removal of the broadcasting equipment had taken priority. Work on stripping out temporary buildings was almost complete and grandstands were being deconstructed, unit by unit.

4.4 OTHER CONTACTS

In addition to the visit programme, HSL made contact with a number of key individuals and organisations within the events sector. HSL held discussions or meetings, asking questions about events sector practice and raising and discussing issues resulting from the visit phase.

5 FINDINGS

This section details the findings for each of the three approaches undertaken by HSL; (i) review of regulation (Section 5.1), (ii) review of accidents (Section 5.2), and (iii) a sample of current management techniques witnessed during site visits (Section 5.3).

A model for the management of temporary demountable structures is published separately in Annex A. Where findings from the visits have informed and directed the content of this Annex, this is indicated in separate text boxes at the end of each section.

5.1 BRIEF SUMMARY OF APPLICABLE REGULATION AND GUIDANCE

The principal sources of guidance on temporary demountable structures for the events sector in the UK are the Institution of Structural Engineers “Temporary Demountable Structures”⁶ (commonly known as TDS) and HSE’s “Events Safety Guide”⁷ (known as ‘the purple guide’). The HSE guide is currently under review prior to an expected re-issue in 2012. Representatives of the events sector have been active in contributing to both of these documents. These documents do not have a specific focus on the safety of the workforce engaged in construction or deconstruction, instead concentrating on issues of structural integrity and stability.

The Department for Culture, Media and Sport (DCMS) have published guidance on safety at sports grounds⁸ (“The Guide to Safety at Sports Grounds (fifth edition) known as ‘the green guide’). This includes alternative usage (such as music events) and states that overall responsibility for health and safety is retained by the venue owner. Many of those involved in organising events use the green and purple guides in parallel depending on the nature of the event.

Broad parallels have been drawn between the temporary structures involved in events and those used by other parts of the construction sector. Management of projects within the construction sector is covered by the Construction (Design and Management) Regulations 2007¹, which have not been proactively enforced in the events sector.

Regulations such as the Health and Safety at Work etc Act 1974⁹, the Management of Health and Safety at Work Regulations 1999¹⁰, the Lifting Operations and Lifting Equipment Regulations 1998¹¹, the Provision and Use of Work Equipment Regulations 1998¹², the Manual Handling Operations Regulations 1992¹³, the Personal Protective Equipment Regulations 2002¹⁴, the Work at Height Regulations 2005¹⁵, the Working Time (Amendment) Regulations 2003¹⁶ and the Workplace (Health, Safety and Welfare) Regulations 1992¹⁷ apply equally to the events sector as to other industries.

5.1.1 European Standards

Compliance with a European Standard is not a legal obligation (although, it may be a route to discharging legal obligations). There is a Publicly Available Specification (PAS) for outdoor events¹⁸, but its content on temporary demountable structures is sourced from the IStructE document⁶. Some structure types, such as grandstands¹⁹ and tentage²⁰ can be designed according to specific European standards. There are also standards for the specification²¹ and use²² of lifting equipment including truss and tower structures. Other general standards (such as scaffolding – for which there are numerous standards covering both material and methodology) may have some limited relevance.

5.1.2 Other Guidance

The Olympic Delivery Authority (ODA) has published a Health, Safety and Environment Standard at London 2012 sites for which it is the construction client²³. This is aimed primarily at permanent structures and very large temporary structures (such as temporary stadia). CDM is specified for the management of permanent construction projects but no specific reference is made to TDS and their management. LOCOG have produced their own guidance²⁴ based around the ODA document. This also specifies CDM but additionally includes the requirement that temporary demountable structures are designed and constructed in accordance with TDS⁶ and MUTAmarq²⁵ as appropriate.

MUTA (the Made-up Textiles Association) the trade association for performance textile products (including marquees) have developed and published guidance specific to their part of the sector. This includes guidance on the use of marquees²⁵ and textile covered temporary buildings and guidance on safe working practices²⁶. MUTA operates MUTAmarq an internal code of practice, supported by an inspection scheme.

5.1.3 Other International Guidance

HSL undertook an Internet based literature review of other international regulation and guidance relating to the management of temporary demountable structures. This identified specifications from USA, South Africa and Europe. Information retrieved was predominantly technical in nature with little useful guidance on the management of TDS projects.

5.1.4 Licensing of Events

Public entertainment, at both permanent and temporary venues (including green field festival sites), is regulated by the Licensing Act 2003²⁷. The system of issuing licences is administrated by local authorities. Licences are generally issued to the premises.

The approach to TDS is not common across Europe, or even the UK. For example in Scotland, TDS are subject to local authority approval under the Civic Government (Scotland) Act 1982²⁸.

5.1.5 Enforcement

Enforcement responsibility for event specific issues resides with the relevant local authority. Historically, construction of TDS has also been within the remit of local authorities, however, recently responsibility has passed to HSE's construction division.

An understanding of the full range of relevant safety regulation is critical in informing safe methods of working on site and discharging legal responsibilities.

5.2 REVIEW OF ACCIDENTS INVOLVING TEMPORARY DEMOUNTABLE STRUCTURES

HSL have carried out a review of the health and safety risks associated with major sporting events²⁹, this found little in the way of peer reviewed literature on the risks facing construction workers. It did find that temporary demountable structures might pose potential risks, citing a tower collapse during preparations for the Atlanta Olympics.

5.2.1 HSE Accident Statistics

The following tables provide a summary of the 115 reported accidents for all injuries from the events industry.

5.2.1.1 Accidents occurring During Construction

Table 2 shows 59 accidents that occurred during the construction or deconstruction of the temporary demountable structure, of these the majority related to ‘manual handling’ (n=19), ‘falls from height’ (n=17) and ‘hit by moving/ falling object’ (n=12).

	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	Total
<i>Hit by moving/falling object</i>	2	2	2	2	1	3			12
<i>Walk into structure etc</i>			1			1			2
<i>Cuts or trapped fingers</i>	1	1			2	1			5
<i>Manual Handling</i>		1	7	2	2	1	3	3	19
<i>Slips and Trips</i>			2						2
<i>Falls from height</i>		3	3	2	4	3	1	1	17
<i>Collapse or overturning</i>						1			1
<i>Fire or fumes</i>									0
<i>Other</i>					1				1
Total	3	7	15	6	10	10	4	4	59

A review of the accompanying RIDDOR ‘Notifier Comments’ showed that of the 19 manual handling accidents reported during construction / deconstruction, most related to moving equipment that was awkwardly shaped and / or heavy, either alone or with insufficient staff. Incidents classified as ‘walking into structures’ and ‘cut or trapped fingers’ also tended to relate to manual handling incidents.

The review also showed that 9 of the 17 falls related to individuals inadvertently ‘stepping’ off the stage edge while dealing with equipment or carrying out other construction or dismantling tasks. One fall resulted from guardrails being removed during deconstruction of seating. Notably, there was one report of a fall as a result of a temporary extension to the stage, which had left a gap between the original and new stage areas.

There was one report of a portable staging collapse that occurred during deconstruction

5.2.1.2 Accidents occurring In Service (or Pre-service)

Table 3 shows that 56 accidents occurred when the temporary demountable structure was in use. Of these, the majority related to ‘falls from height’ (n=28) with the remaining accidents being classified across a range of categories including ‘hit by moving / falling object’ (n=9), ‘walk into structure’ (n=9) and ‘slips and trips’ (n=5).

	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	Total
<i>Hit by moving/falling object</i>			1			3	3	2	9
<i>Walk into structure etc</i>			6	1	1	1			9
<i>Cuts or trapped fingers</i>									0
<i>Manual Handling</i>							1		1
<i>Slips and Trips</i>		1		2		1	1		5
<i>Falls from height</i>	2	3	7	6	4	2	1	3	28
<i>Collapse or overturning</i>									0
<i>Fire or fumes</i>				1					1
<i>Other</i>	1					2			3
Total	3	4	14	10	5	9	6	5	56

Of the 28 ‘falls from height’, a significant proportion related to stage edges, the orchestra pit, trap doors and steps leading from the stage.

5.2.1.3 Summary

The accident statistics provide an insight into the type of accident that can occur during the different phases of temporary demountable structures. During construction / deconstruction the reports tended to relate to activities associated with moving equipment and in some cases this resulted in manual handling problems. In others, the carrying / moving of equipment resulted in falls from the stage; presumably because the injured person lost awareness of the edge and / or had their vision obscured.

In comparison, the accidents that occurred when the structure was in use were primarily about individuals falling from the stage or steps while exiting the stage, as part of performance. Individuals were also injured by falling scenery, walking into parts of the structure or slips and trips.

The accident statistics provide an insight to the type of incident associated with temporary demountable structures but there is insufficient detail in the reports to draw any meaningful conclusions. Accidents that have been investigated by HSE are a rich source of information that can provide insight to the root cause of incidents, so these were the focus of the accident review.

It is possible that accident figures in the events sector (as in any other sector) are subject to an element of under reporting. The casual or self-employed status of many of those involved in the sector may contribute towards this. However, the level of under-reporting is impossible to quantify.

5.2.2 Review of Accidents using HFACS

The following sections provide a summary of the accidents that were investigated by HSE and analysed using the HFACS method. The italicised text in brackets relates to the specific classification given to elements of the accidents as part of the HFACS analysis.

5.2.2.1 Accidents occurring During Construction

Earls Court Fall from Seating

This incident involved a fatal fall by a worker employed in decking out a temporary seating structure. The seating configuration was one that was commonly used at these types of events and had previously been used at Earls Court.

A sub-contractor was employed by the seating suppliers to erect the structure at Earls Court. This type of seating is usually erected by putting layers/decks down and moving higher up the structure. This means that there is a constantly moving dynamic edge. In this instance the deceased fell whilst putting the last few decks down. The interviewee reported that this incident did not result in a prosecution, as the companies involved were dissolved/folded (although, to the interviewee’s knowledge, the individuals continued to work within the sector using the same employees). The interviewee reported that it had been very difficult to ascertain the facts in this incident as the team (and the industry as a whole) had ‘closed ranks’ after the event.

In this instance there had been no formal training carried out. Crew working for the contractor erecting the seating structure (*A.1.1.1 Personal – Training: Carried out,*) were expected to learn ‘on the job’. The interviewee also reported that questions were raised over the suitability of safety equipment provided. For example: while the crew should have been issued safety shoes,

the deceased was wearing trainers. The individual was also wearing the incorrect head protection (a standard safety helmet without chinstrap) (*B.1.1.2 Resources: Suitability*).

The interviewee reported that in this instance there were no issues relating to time pressures as they had sufficient time to complete the job with some spare capacity. The environment was not an issue as the venue was indoor with good conditions. However the interviewee did report that as the platforms were very dusty they were often cleaned which could have led to the boards being wet, although this was not attributed as a root cause of the incident. In addition it was suggested (but not proved) that the workforce had been to the pub at lunchtime.

5.2.2.2 Accidents occurring In Service (or Pre-service)

Earls Court Seating collapse

The incident at Earls Court involved the collapse of a temporary seating stand for up to 1000 people at a Pink Floyd concert. The stand used a proprietary system, designed and engineered to be erected without alteration. However once installed, it was apparent that the view from some of the front row seating was obstructed by a mixing desk. A decision was made on site to lift the stand by approximately 3ft using scaffolding. Alterations were made (without design consultation) and approved by a chartered engineer (who was a freelancer). Once the concert had begun and the stand was in use, the scaffold ‘unzipped’ and the stand collapsed injuring ~90 people.

In this incident the management systems were not in place. The potential obstruction of the view from some of the seats should have been identified during the planning phase (*D.1 Safety Management - Planning*) and appropriate measures were not in place to deal with any changes to the structure to ensure its safety (*D.3 Safety Management - Procedures*). Also in this instance the engineer who approved the changes did not realise the limits of their own expertise (*A.6 Personal - Competence, A.1.1.2 Personal - Training, A.2 Personal - Experience*), they thought they were doing the right thing but did not appreciate the impact of the alterations which had been made to the proprietary system.

Grapevine

The incident at the Lincolnshire showground involved the collapse of two blocks of temporary tiered seating (for ~500 people in each block) during the Grapevine religious festival. The organisers at Grapevine leased the showground for the event and employed external contractors to install the marquee and temporary seating etc. As this was a religious event it was exempted from the requirement for a local authority license and, therefore, details of the event were not passed onto the environmental health team in the LA. During the event a young rock band performed live; which was a change in format to previous years. Whilst on stage the band invited the crowd to stand and pray to God by holding hands and jumping together. As the crowd all stood, held hands and jumped simultaneously the temporary seating moved forward by approximately 1.5m and then collapsed, as it was not anchored. There were no fatalities although people were seriously injured.

In this incident the company who erected the temporary seating had been used for previous events and carried out the appropriate risk assessments, including considering the effects of inclement weather conditions on the marquee (August 2004 was a particularly wet summer). The structure itself was in good condition and well maintained, and statements from witnesses supported that there were no issues with the temporary seating such as ‘wobbling’. In this instance appropriate management systems were not in place. Planning should have identified the change in use of the temporary stand and this should have been communicated to the company erecting the temporary stand, to ensure the correct structure was being put in place (*D.1 Safety Management - Planning*).

Bearded Theory

The incident at the 'Bearded Theory' event in 2009 involved the collapse of the stage whilst the festival was ongoing. The structure was erected in a farmer's field (where the ground had previously been disturbed) and weather at the time of the incident was wet and windy. During the event the guys for the structure become de-anchored from the ground and the tent collapsed backwards as it was designed to do (no individuals should have been at the rear of the structure due to its design). There were no fatalities as a result of the collapse, however there were injuries to several individuals who were on the stage at the time. The structure involved in the incident was a 'SaddleSpan' Tent designed by Tentology in Canada.

There were a number of issues that could have been foreseen with better planning from both the local authority and the event organiser (*D.1 Safety Management - Planning, E.2 Regulation - Effective*). These included considering the local conditions where the event was to be held and the resulting implications for the erection of the tent. The original design of the tent did not provide information on how or where to place the guys for the tents, as it was dependant on the local conditions.

The event organisers employed another company to erect the structure. This company had not dealt with this type of structure before and were working outside of their usual remit and area of expertise (*A.6 Personal - Competence*). The structure was located in the most exposed area of the site (on top of a hill into a south westerly prevailing wind) with the guys being located too closely together. Additionally, safety procedures were not applied effectively to deal with the monitoring of wind speed level at the site (*D.3 Safety Management - Procedures*). In this incidence there was also an issue with a conflict of interest between the licensing and enforcement authorities (both the local authority) (*E.1 Regulation - Enforced*).

While the implications of this incident are both interesting and valid, it should be noted that the erection of tentage is not defined as construction work under CDM¹ and that distinction must be made between tented structures and other temporary demountable structures.

A further note of interest is that the HSE investigation report recommended that the findings from this event, and other incidents involving temporary demountable structures, be considered in relation to the Olympic Park.

Millennium Point

The incident at 'Millennium Point' in Birmingham involved the collapse of a large screen in the fan park. The screen that had been erected on site fell over backwards during a gust of wind and collapsed onto the area immediately behind. Some of the structure was stopped from falling flat by an existing lamppost. The fan park was set up for the World Cup 2006 as part of a T-Mobile sponsored event to enable up to 3000 spectators to watch matches on the big screen. At the time of the incident no members of the public were in the fan park and only a limited number of workers were on site working in the immediate area behind the screen. The area was due to be full with members of the public a few hours later.

In this incident the design of the structure had not been fully or independently checked prior to installation, or once erected on site, by either the contractor organising the event or the designers themselves. The design company were working outside of their usual remit and area of expertise (*A.6 Personal - Competence*). The design company did employ an external consultant to check certain elements of the structural design but not the entire design or the structure once *in situ*. In addition, the local authority did not ensure adequate procedures were in place to assess competency of the contractors involved in the event (*E.2 Regulation - Effective*). Safety procedures were not applied effectively to deal with the monitoring of wind speed level at the site (*D.3 Safety Management - Procedures*).

Additionally, the Standing Committee on Structural Safety (SCOSS) (an independent body supported by IstructE, ICE and HSE) has produced a topic paper on the risks associated with the use of large video screen structures³⁰. This paper identified that contracts between client and contractor often contained little in terms of requirements for information transfer, liaison and inter-face responsibilities. Their report identified shortfalls involving:

- Information flow between designers
- Checking of designs
- Establishing a single point of responsibility

Guilfest

The incident at the Guilfest music festival involved the collapse of a speaker tower prior to the public entering the event. Both of the speaker towers had been erected and signed off. The event sponsor subsequently provided the event organiser with two scrim (an advertising banner made out of acoustic mesh) to be hung over the speakers. The scrim were then placed over the speaker towers without any additional checks and subsequently one of the towers blew over.

The original plans / design had not anticipated the attachment of a scrim to the speaker tower and there were no procedures in place to sign off such a change (*D.1 Safety Management - Planning*). Nor had this requirement been communicated between the event organiser and the sponsor. In addition, there were no safety procedures in place to deal with the monitoring of wind speed level at the site (*D.3 Safety Management - Procedures*) nor did the regulator ask for evidence of checks (*E.2 Regulation - Effective*).

5.2.2.3 Summary

The HFACS categories offer some structure to the categorisation of the incident factors. The following is a summary of the categories from the incidents explored in sections 5.2.2.1 to 5.2.2.6:

- Personal
 - A1.1.1 Training: Carried out – 1 incident
 - A.1.1.2 Training: Appropriate – 1 incident
 - A.2 Experience – 1 incident
 - A.6 Competence – 3 incidents
- Resources
 - B.1.1.2 Resources: Suitability – 1 incident
- Safety Management
 - D.1. Planning – 4 incidents
 - D.3 Procedures – 4 incidents
- Regulation
 - E.1 Enforced – 1 incident
 - E.2 Effective – 3 incidents

In general the interviewees commented on the nature of industry as being very fast moving because they are always working to very tight deadlines and are pressured by the financial and emotional (to the public) consequences of not putting an event on.

5.2.3 Accidents outside the UK

Where accidents occurred outside the UK, HSL were limited to publicly available information. It was, therefore, not possible to perform a detailed analysis.

Madonna, Marseilles 2009

In July 2009, during the preparation for a Madonna concert in Marseilles, the stage roof collapsed resulting in two fatalities. The roof was partially complete and was being lifted into position by four cranes.

Reported information indicates that there were oscillations in the roof prior to collapse (which enabled some workers to reach a position of safety). It has been suggested that the incident may be linked to slippage on the winch of one of the cranes.

Rolling Stones, Madrid

In June 2007, two workers were killed while deconstructing a stage after a Rolling Stones concert in Madrid. The workers were working on a 10m tall scenic structure that they were in the process of dismantling. The subsequent collapse of the structure caused them to fall.

Other international incidents identified included stage collapses at the Big Valley Jamboree 2009 (due to high winds in service), Rocklahoma festival 2008 (due to high winds in service), Elton John at Chichen Itza, Mexico 2010 (rigging collapse during construction), AR Rahman, Pontiac, Michigan 2010 (rigging collapse during construction), Guns 'n' Roses, Rio de Janeiro 2010 (due to heavy rain) and Christina Aguilera and Justin Timberlake, Atlantic City 2003 (rigging collapse during construction).

5.3 DISCUSSION OF SITE VISITS

This section summarises the information gathered during HSL visits (and follow up contact) and considers its implication for the management of TDS in the events sector.

5.3.1 Nature of the Events Sector

5.3.1.1 Types of Event

The events sector is not a homogenous cohesive whole; it encompasses a wide range of event types with differing aims and methods of operation. There are differences in the requirements and management of temporary demountable structures between different types of events. The principal types of large event encountered were:

1. Multiple artist live music event (such as festivals and large one-off shows).
2. Single artist touring event.
3. Sporting event.
4. Corporate event (such as a large opening ceremony or ship launch).
5. Heritage event.
6. Other event.

Generally, the event 'drivers' will be financial (and, therefore, management hierarchy will be based along financial lines), although this may take different forms, such as ticket sales, television rights, etc. However, an event may have objectives other than financial gain.

The public nature of the events industry means that there is an ongoing pressure to deliver a 'good show'. For regular events, this is embodied in an expectation that each year the event will both outdo previous events and push creative boundaries, the primary limiting factor being available budget.

Any management strategy employed across the events sector must retain sufficient flexibility to cope with a range of different event types.

5.3.1.2 The Nature of Employment in the Events Sector

The events sector is seasonal (particularly with respect to certain types of open air event) and individual engagements are relatively short. While the full lifespan of an event may be considerable, the duration of many of the necessary activities is relatively short. It can therefore make financial sense for companies to employ personnel on a short-term basis and for individuals to operate as self-employed ‘freelancers’. Often, the event management team will be entirely freelance. Some freelancers will provide a wide range of services and may undertake very different roles at different events.

Contractual arrangements between event organisers and freelancers or contractors can be nebulous. Anecdotal evidence indicated that there is often little more than a verbal agreement. Verbal agreements may be incomplete or subject to misunderstanding. This could lead to confusion and the loss of critical detail during construction (requirements relating to liaison and communication are particular examples³¹).

The contract formalises the working relationship between the various parties involved in delivering the event, including identifying the specific responsibilities of individuals and organisations. The absence of a contract means that there may be no formal agreement of roles and responsibilities (unless an alternative route to defining roles has been taken). A review of UK incidents has argued that poor contractual arrangements can result in the dilution of responsibilities through the procurement chain³².

Contractual arrangements are the primary means of establishing a formal agreement of roles and responsibilities. Clear contractual arrangements could help to ensure that all individuals adequately understand what is required of them.

5.3.1.3 The Lifespan of an Event

The lifespan of an event, from inception to completion, can be significant and an event will generally be a year (or more) in the planning. Table 4 gives estimated timescales, from development of concept to removal from site for the six events visited. All times were quoted (or are derived from information supplied) during the visit. These estimates do not consider resource intensity, during this period.

Table 4 Estimated timescales for the events visited

		<i>Estimated Timescales</i>			
		<i>Planning</i>	<i>Build</i>	<i>Event</i>	<i>Take Down</i>
1	3 Day Festival	unknown	28 days	3 days	21 days
2	2 Day Festival	270 days	16 days	2 days	8 days
3	Edinburgh Festival	365 days	10 days	25 days	3 days
4	Stadium Tour	240 days	7 days	1 day	3 days
5	One-off Stadium Event	150*	10 days	1 day	3 days
6	Sporting Event	280 days	56 days	4 days*	28 days

* Change in management with resultant change to previous plans

The Events Sector is dynamic and fast moving therefore time pressures are inevitable. Artists and promoters want to hold as many performances as possible, while TDS contractors want to make optimum use of their equipment (particularly during the short summer season). However, it is critical that sufficient time and resources are allocated at every stage of the process. Otherwise unacceptable pressure may be placed on individuals and organisations and tasks may not be handled with the rigour they require.

For short events in fixed venues requiring little additional infrastructure, the duration of the TDS build can become the limiting factor. Sources quote an accepted limit of three days on the build for a touring stage. This is factored into event plans and any suggestion to exceed this limit is unlikely to be accepted.

It is important that sufficient timescales are allowed for all activities, and that consideration is given to the potential for unforeseen delays.

5.3.1.4 The Requirement for Temporary Demountable Structures

The type of event often defines the type of structure required. For example, festivals primarily require stages, tentage and ancillary structures whereas a sporting event is more likely to require seating, camera platforms and possibly temporary buildings.

This means that contractors supplying different types of TDS will supply to different market sectors, with different working environments. The experience gained will influence their methods of working (i.e. a seating provider will have a different ethos from a staging contractor or a supplier of tentage).

5.3.1.5 Management of Resources

For outdoor events the season is relatively short and consists of a large number of events. TDS contractors will understandably aim for the best possible utilisation of resources. In effect, this means that there is a potential for maximum (or even over) commitment of resources, particularly if problems are encountered at one of the events.

Problems with the availability of equipment and resources will have an effect on the construction process, potentially causing delays, resulting in structures remaining incomplete for extended periods and ultimately affecting work practices. The implications of this should be considered in developing the erection plan.

This, combined with the geographical separation of events and the requirement to minimise travel and subsistence costs, can reduce the opportunity for rest and recovery of crew and the repair of equipment.

The implications of problems associated with resource availability should be recognised.

5.3.1.6 Phases of the Temporary Demountable Structure Build

The preparation of the TDS for the event can be divided into separate phases:

- ‘Build-up’, ‘steel build’ or construction – covering the erection of necessary temporary demountable structures.
- ‘Load in’ – covering rigging and installation of sound, light, and similar equipment (including artist specific stage equipment).
- The event.
- ‘Load out’ – removal of sound, light, video, etc.
- ‘Break down’ or deconstruction – dismantling and removal of temporary demountable structures.

While these phases are distinct, in practice the delivery of an event is fluid and there will often be overlap between the phases. For example, ‘load in’ may begin before a stage build is complete or for events lasting more than one day there will be a ‘load in’ phase and possibly structural modifications overnight. This could potentially result in conflict between the activities of separate contractors, with the activities of one contractor presenting a potential risk to another.

The development of a TDS is fluid and separate phases may overlap, resulting in different groups of contractors accessing the structure at the same time.

5.3.2 Developing the ‘Concept’

The structure design concept defines the structure’s objectives (i.e. what the structure must achieve given specific limitations (such as location, budget etc.)). While those specifying the structure should have fully identified their requirements, they are unlikely to have a good understanding of the technical issues involved. Without access to technical expertise, developing a realistic concept becomes problematic.

Ideally, the structure concept will be as fully realised as possible and will incorporate the full requirements for the structure. Where change is unavoidable, it should be considered at the earliest opportunity.

However, the events sector seemed to have little expectation that an early decision would have any form of longevity and there was a general assumption that any plan would inevitably be subject to numerous modifications (one promoter argued that the principle of the design concept had become “*useless*”). Anecdotal evidence indicated failures, particularly by end users, to adequately communicate their requirements in a timely manner and a willingness to ignore (or at least challenge) restrictions placed upon a structure’s use (notably for music events). This lack of ‘buy in’ among those specifying the structure and the willingness of the TDS contractor to make modifications to satisfy the customer can undermine the principle of the design concept, such that it is often incomplete and sometimes little more than a ‘best guess’.

If the starting point for the design is not well defined it could have several potential effects:

- It will increase the difficulty in creating a structure that adequately achieves its objectives.
- It will increase the difficulty in designing the structure for safe erection and dismantling.
- It will increase the level of change required.
- It will place inappropriate emphasis on the change control process as the structure is subsequently modified.

The value of the structure design concept should be acknowledged. Effort should be expended in ensuring that the structure design concept is as fully realised as possible.

The event organiser should actively seek out information, which could contribute to the structure design concept. Those holding information, such as end users, venue or landowners and TDS contractors should be active in contributing to the structure design concept.

5.3.3 Managing Delivery of the Event

5.3.3.1 Responsibility

Participants in the delivery of an event, hold a level of responsibility related to their work activities. Subcontracting an activity will share the responsibilities relating to the activity but not necessarily fully transfer them to the contractor. The original holder must still ensure those responsibilities are adequately discharged.

Ideally the holder of specific responsibilities will have a sufficient sphere of control to discharge their responsibilities. However, in many cases, the holder may lack an element of control (such as technical knowledge) and therefore be unable to discharge their responsibilities.

5.3.3.2 Roles

The events sector uses a number of role or job titles including production manager, site manager, and event manager. While these terms are in global usage, there does not appear to be any consistent definitions of the roles. In some cases, jobs may be defined for political rather than practical reasons. This will hamper the attachment of responsibilities to individuals by role.

This ambiguity in the description of roles is particularly significant when combined with the absence of contractual agreement of specific responsibilities.

The Client is a critical role defined under CDM¹. IStructE TDS⁶ describes the client as “*the person or organisation who procures the temporary demountable structure*”. The client will not necessarily be the customer who requires the event but is defined by contractual obligations, control of the project and ownership of risks. It will often be the budget holder or financial risk bearer. At most of the events visited, the **Event Organiser** would be most qualified (in terms of knowledge and contractual information) to hold this role (rather than the final customer).

However, at some events identification of who holds the client role can be difficult. For a single artist touring event both band management and the promoter could potentially be identified as clients, both receiving portions of ticket income and controlling different aspects of the event. Events at different venues on a tour may be promoted by different promoters (even in the same country) and there may be more than one version of the structure (with associated crew), being used at different venues to allow for increased set up time.

The successful delivery of an event is a complex process, which requires the involvement of numerous organisations and individual freelancers, each with a different focus. It is necessary that these disparate participants work together effectively, particularly when contractors are working on related activities or in close proximity (often sharing the same structure). Clearly a ‘lead person’ is required to manage and co-ordinate activities on behalf of the client. The duties of this lead role are synonymous with the **Production Manager** role (however, it should be noted that this term was not always associated with the same role and the role itself was given several alternative labels such as; ‘Festival Director’, ‘Tour Technical Manager’ and ‘Site Manager’). The production manager will be actively involved from the development of concept through to delivery and completion; it is this role that is often linked to ultimate control on site. Other role titles were similarly mis-applied.

The Site Manager becomes involved in the event at a much later point, managing the activities involved in the development of the site (including construction and deconstruction). The site manager is unlikely to hold direct financial or contractual power over contractors. On site, the division of control between the production and site manager was particularly abstruse, with much apparent overlap.

The Health and Safety Manager appeared to be an optional role, which may not be in use at all events or which may be combined with other roles (although H&S managers were present, in various forms, at all the sites visited by HSL). Alternatively, there are a number of Health and Safety consultancies operating in the events sector. At one event the promoters had their own Health and Safety Manager plus additional support from a consultancy during the critical “event week” before the event. Contractors and crew may also have individuals operating as a safety function.

This role appeared to be an advisory one and the key duties appeared to be control (and / or preparation) of paperwork including risk assessments and interfacing with regulatory bodies such as HSE or Local Authorities.

Consistent definition of roles would simplify management chains and allocation of responsibilities.

The event organiser is the most likely holder of the knowledge and financial power of the client role.

The production manager role was the principal holder of control at the events visited. On site there was apparent overlap between site and production manager roles.

The health and safety manager acted as a safety co-ordinator controlling paperwork and liaising with enforcing authorities.

5.3.3.3 Management Chains

The fluid nature of the events sector means that these roles are often organised into an ad-hoc management chain, varying on an event by event basis. Different management chains may be used at different venues on a single tour or during different phases of a build. There did not appear to be significant commonality between the different structures in use, suggesting an absence of consistency rather than the application of unfamiliar models.

The management chains for individual events were often complex, with individual roles having significant overlap. This is illustrated by the sample chains taken from two of the events visited by HSL (Figures 2 and 3). Touring musical events can be particularly complex with the band’s management, the promoter (the financial risk bearer) and the venue (normally the license holder) all exerting variable influence on the management of the event. In these circumstances it can be difficult to determine where ultimate control lies.

The ad-hoc approach to management chains could have potential advantages and disadvantages:

- It provides the flexibility to tailor the management chain to the requirements of a particular event and to deal with rapidly changing situations.
- However, if the roles are not well defined (by contract or consistent definition) it could result in overlaps in, or gaps between, responsibilities.
- It could lead to confusion among the workforce as to where ultimate control lay.
- Individuals operating in a variety of roles could potentially suffer a dilution of specialist expertise.

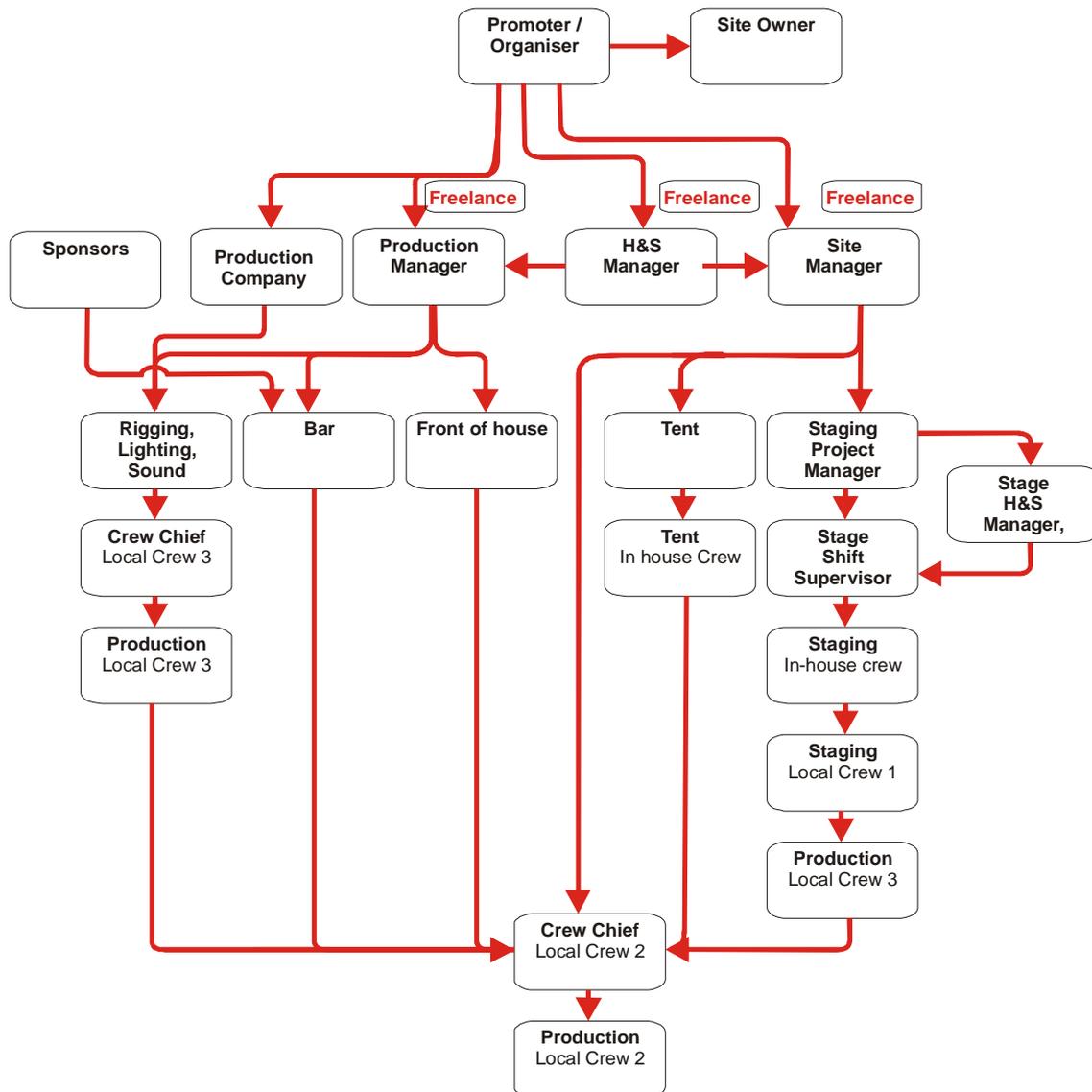


Figure 2 A sample management hierarchy derived from HSL site visits

Complexity in the management chain can obscure lines of communication, particularly where there is no direct vertical relationship (such as liaison between different contractors).

HSL consider the early creation and dissemination of an organisational chart or ‘Health and Safety Communication Chain’, specific to that event, to be good practice. The example witnessed by HSL was created by the Health and Safety Manager and was prominently displayed in a public location. This document helped to clarify the management chain for contractors and crew, identifying the holders of specific roles and responsibilities and outlining agreed lines of control and communication.

In some cases a single TDS contractor (or group) may be able to perform several roles (at the sporting event all temporary seating, temporary buildings and fixtures and fittings were provided by companies within the same group, using shared resources). This approach can offer advantages, in terms of simplifying the chain, but does not represent a realistic model for all events.

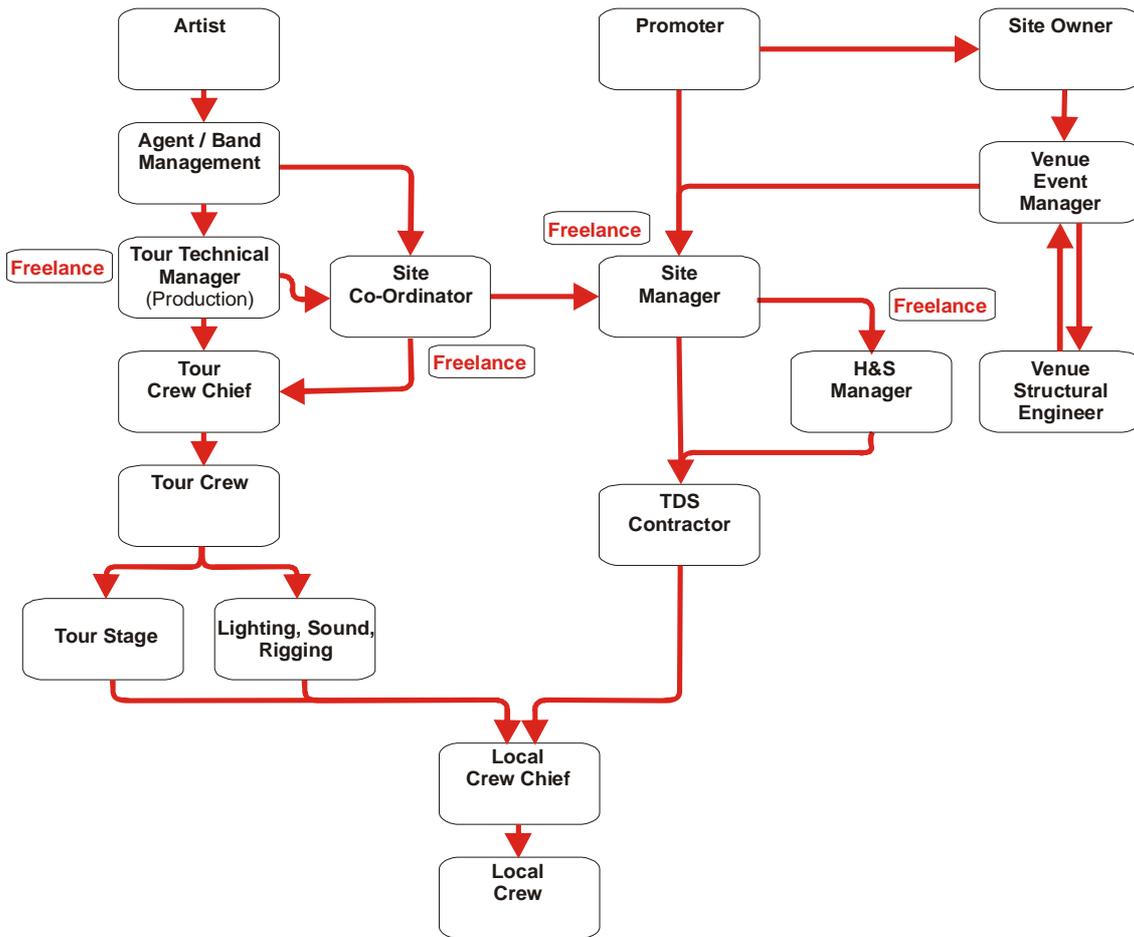


Figure 3 A sample management hierarchy derived from HSL site visits

Ad-hoc management hierarchies can be problematic, particularly in conjunction with undefined roles and responsibilities. A consistent approach could result in clarity of lines of communication.

Details of the management chain should be published to assist in identifying control and lines of communication.

5.3.3.4 The Role of the Venue Owner

The contribution by the venue owner (or landowner) can vary. In some instances a landowner may only be required to provide the event site and sufficient information, such that users of that site are not put at risk.

Information relating to site layout, conditions and potential risks is critical to the safe erection of a structure, where this information is not directly available to the landowner (and in many cases, it may not be), the landowner should provide assistance (and access) to the TDS contractor in obtaining that information.

Landowners may provide additional services (such as the landowner's site services providing ground works or a venue providing its own barriers or seating) to the event. This contribution should be planned and managed in a similar way to other contractors.

In some cases a landowner may choose to further extend their involvement. For example, during the Edinburgh Festival, Edinburgh University provided multiple sites for a number of events organised by others. The University hired a specialist events safety consultant to act as safety advisor to these events organisers. This was particularly beneficial as these sites hosted a number of small events, which did not have access to their own source of safety advice.

The expectations placed upon venue owners are far greater than those placed upon landowners. Venues such as sports stadia are the legal license holders²⁷ for the events that they host. The DCMS Guide to Safety at Sports Grounds⁸ stresses that in all cases the provision of safe audience accommodation remains the responsibility of the venue management. This responsibility cannot be delegated to event organisers, designers or TDS contractors.

Anecdotal information indicates that a venue's level of involvement can vary to a considerable degree, depending on their previous experience of similar events. More experienced venues will have their own event manager(s), health and safety advisor and structural engineer to assess temporary demountable structures. Where the requirements of the event impinge on the venue infrastructure (such as rigging attached to roofs), an experienced venue may request their own approved contractor, who will have experience of working in that specific environment.

Other activities at a venue or site may impinge upon event related activities. For example, restricting access, reducing available timescales, introducing additional hazards (such as public access) or dictating practices during construction and deconstruction. These factors should be given consideration in developing the design concept

The landowner should provide information relating to the site or enable the acquisition of this information.

Venue owners retain responsibility for TDS erected at their venues.

5.3.3.5 Selection of Contractors

Identification and selection of suitable contractors within the events sector appears to be strongly influenced by a network of informal personal contacts. Personal opinion or previous contact was repeatedly cited as the main reason for selecting a contractor. Price, competence and specifics of the product were rarely mentioned.

In many cases this means that the event organiser will have first-hand experiences of the contractors' methods of work and their ability to deliver. However there is a risk that judgements based on familiarity may sideline important aspects of competence. During the HSL visits, one Health and Safety Manager expressed the view that an event organiser may select a contractor with whom they were familiar, even if they were not entirely satisfied with their performance. This was viewed as less risky than sourcing an unfamiliar contractor.

Lack of access to those informal contact networks disadvantages those event organisers with less experience (such as new entrants to the market). Their options are limited (to referring to an events specific supplier directory or hiring someone with their own contact network) and potentially, they may be operating from a position of comparative ignorance as to the competence of their contractors.

While working with known individuals and organisations may deliver benefits it should not replace the requirement for fully assessing their competence.

5.3.3.6 Control of Competence

To be competent an organisation or individual must have¹

- Sufficient knowledge of the specific tasks to be undertaken and the risks, which the work will entail.
- Sufficient experience and ability to carry out their duties in relation to the project, to recognise their limitations and take appropriate action in order to prevent harm to those carrying out construction work, or those affected by the work.

There are two separate elements to identifying and assessing competence: (i) qualifications and training, and (ii) experience and ability. Each of these elements is equally valid, however it should be recognised that in many industry sectors there is a dearth of accepted qualifications or training schemes and an entirely experience based proof of competence may be acceptable.

The events sector seems to place greater emphasis on the latter (even in those limited circumstances where there was recognised training). More significantly a ‘history’ in the events sector is regarded as the most important (if not only) element of competency. Familiarity with a contractor was used as justification for lessening the requirements for supporting paperwork.

While those involved had a considerable degree of experience, there appeared to be little importance placed on the act of verifying this and the relevant systems appeared limited. Management teams showed little ownership for the act of confirming competence and it was generally considered acceptable for a contractor to simply vouch for the competencies of themselves and their personnel. This remained true, at all levels, from management to basic crew.

Individuals or organisations exceeding the limit of their competence have been implicated in several incidents including Earls Court, Bearded Theory and Millennium Point. At both Bearded Theory and Millennium Point it was recognised that companies (the TDS contractor and designer respectively) had undertaken work outside of their normal sphere of operation and competence.

Some of the larger TDS contractors used training matrices to collate the job specific competencies of all of their in-house staff (both permanent and casual). This was a positive practice because it enabled the TDS contractor to select a team with the right mix of skills and experience for the task, to ensure that any training etc. remained current and to provide evidence of competency when required.

There should be formal systems in place to assess competence and determine a contractor’s suitability.

5.3.3.7 CDM

CDM¹ has been cited as a management regime, which has been successfully employed in conventional construction. While CDM applies to the TDS used by the events sector, the differences between this sector and conventional construction have been recognised and it has never been enforced.

The imposition of CDM as a means of improving management of construction phase and deconstruction processes is generally regarded unfavourably within the events sector. However, many of the critics have not regularly worked under CDM and this criticism is not qualified by experience.

There are companies within the events sector that have successfully worked in accordance with CDM, due to the nature of the events services that they provide (such as corporate events, opening ceremonies etc) or their other activities.

One contractor stated that CDM had clear benefits in ensuring that work was planned and any safety concerns were addressed in advance of undertaking work on site (making the work process run more smoothly). However, there was also an element of resistance and reluctance from contractors and a failure of clients to understand their responsibilities (particularly with respect to reviewing and acting on safety information).

Another contractor stated that CDM had given more focus to their design process, highlighting issues associated with safety during construction, “*how does it get built safely ?*” was now the first issue to be dealt with during any design. However, they found the application of CDM to “equipment hire” type projects more challenging and the inherent limitations of their equipment fleet (particularly issues associated with a progressive live edge) meant it was often impossible to fully comply.

CDM has been effectively applied in conventional construction.

The events sector is not positive about CDM however this may be (in part) based on a lack of experience of working under CDM.

While there are differences between conventional construction and TDS, some elements of CDM may be readily transferable to the events sector and may provide benefits in managing TDS.

5.3.4 Design

It has been argued that there is no role in the events sector analogous to the role of designer³², encountered in the construction sector, as defined under CDM¹. Those designing temporary works and auxiliary structures for conventional construction projects are specifically included in CDM. Elements of the design role are often distributed between other roles such as the production manager, TDS contractor and set designers.

Temporary demountable structures are almost universally constructed from modular systems, which can be erected in a variety of configurations. A considerable amount of design work will have contributed to the development of the original product. Where structures can be erected in different configurations, the TDS contractor should have their own in-house (or sub-contract) design function to undertake the design of each configuration.

The designer must create a design using the modular system that is appropriate for its intended use and location, that considers all necessary requirements, such as sightlines, etc. (a failure to anticipate obstructions to sightlines was the reason for the modifications that caused the Earls Court collapse) and which can be constructed using safe methods of working. The designer must consider both stability and structural integrity and safety during construction. The requirements of the former are covered by the recommendations of TDS. However, a consequence of the use of purchased modular systems is that it may constrain the methods of construction / deconstruction. In the short term, the contractor will need to develop methods of mitigating any risk associated with the system, in the longer term new product should be designed or sourced with consideration of safe methods of working.

The designer will create suitable drawings to allow the structure to be built, as well as a rigging layout identifying the location and magnitude of imposed loads. This information will be compiled into the erection plan.

The independent verification of designs and calculations is recommended in TDS⁶. However, interpretation of this requirement can vary, depending on the contractor and the requirements of the job (such as the nature of the design and available time and budget). The design of the structure that collapsed at Millennium Point had not been fully verified, nor had it received an independent erection check. Consequently it was unsuited for the proposed application.

Verification by an independent structural engineer (ie not part of the original design team) is supported by HSL as a good means of controlling hazards related to the design process. For more complex projects it may be appropriate to use a third party organisation for verification of the designs and calculations. The nature of the verification process including the identity of those providing it should be well documented.

Some smaller 'off the shelf' structures are operated without this flexibility or support (such as at Bearded Theory). The design of the final structure may require more or less consideration depending on its location and the complexity of its requirements.

Both structural integrity and safety during construction should be considered in the design.

Design may be constrained by the nature of the system. Safety should be the primary concern when sourcing new equipment.

An independent verification of designs and calculations is recommended by TDS⁶ and supported by HSL.

5.3.5 Construction

5.3.5.1 Managing the Site vs. Managing the Structure

Construction (or deconstruction) of the temporary demountable structure takes place in the context of the event as a whole. During the construction of the TDS, other work activities will continue and while it may be possible (and good practice) to place physical barriers between the TDS and the greater site, it will never be possible to completely separate them.

Certain situations may provide particular challenges in safely integrating the TDS into the greater site:

- Constricted sites, where separate activities are conducted in close proximity.
- Restrictive timescales, where multiple work activities must take place concurrently.
- Touring artists, where the stage and front of house may separately come under the auspices of the touring manager and promoter.
- Open arena events, where the public may be present during the final stages of construction.

Work on site will be guided by the content of the production manager's event plan, while construction of the TDS will be governed by its erection plan. However, for the safe construction and deconstruction of the TDS, these documents cannot exist in isolation and must

inform each other's content (such that the requirements of the TDS are fully accounted for in the event plan and the management systems and site safety rules are applied to the TDS). It is good practice for the production manager and TDS contractor to liaise on developing the relevant parts of each plan and integrating these documents.

Agreement between the TDS erection plan and event plan is important to the safe construction of the TDS.

5.3.5.2 Site Safety Rules

Site safety rules support and encourage the safe working practice defined in the site and erection plans. Site safety rules should cover global safety issues (such as PPE, work at height, driving, noise, working hours, welfare and drugs / alcohol policy) rather than those applying to specific aspects of an activity (which for construction of a TDS should be included in the erection plan).

All of the sites visited had basic site rules for generic activities, these rules were often 'advertised' by reminders and warning signs, however there was little evidence of site inductions to introduce these rules. This is significant, because safety rules that are imposed on a workforce without adequate support, explanation or supervision may only be partially effective³³.

During visits, HSL witnessed a number of instances of safety rules only being loosely enforced. While individual failures may not necessarily be indicative of a global systems failure, it was not always clear where the responsibility for enforcing these rules lay.

To be fully effective site safety rules should be supported by site inductions.

5.3.5.3 Communication

The construction and deconstruction phases of an event are dynamic and effective communication is vital in keeping track of developments and disseminating information. For events with a longer construction / deconstruction phase a daily update meeting appeared to be a good forum for information exchange and decision making. This system was in place at both festivals and the sporting event. Those holding meetings identified consideration of safety issues as being the first agenda item.

Communication is critical, for longer builds a daily update meeting may be an appropriate forum.

5.3.5.4 Erecting the Structure

The construction and deconstruction of a TDS should be governed by the content of the erection plan. This should be developed from the structure design and drawings and should fully identify safe methods of working, effectively acting as a 'how to' guide. For example, the erection plan may specify that a stage roof is constructed at ground level and lifted into place thereby minimising the requirement for working at height.

Many of the structures used in the events sector are unique. However, even for custom structures, the techniques used for construction remain similar to other structures. Common components such as truss are in regular usage. From discussions with crew, it appeared that in some cases they considered familiarity with (or working knowledge of) the structure (or the modular system used in its construction) to be more important in that structure's erection than the drawings or erection plan, particularly for structures where variability between configurations was limited.

While experience of the system or structure is important in contributing to competence, it should be applied in conjunction with design drawings and erection plans. There should be systems in place for referring any potential divergence from the plan back to the structure designer.

Where the structure is custom designed (or incorporates custom designed scenic elements or props), there will tend to be a 'rehearsal of the build' enabling the touring crew to familiarise themselves with the structure, prior to its first use. This does not remove the requirement for an erection plan. In one instance of good practice, components were both numbered and colour coded during the 'rehearsal' to improve the efficiency of the build and reduce the potential for confusion between similar components during subsequent erections.

During one visit HSL encountered a custom structure without an erection plan (due to the unexpected closure of the manufacturer), which relied on the experience of a single individual for safe erection. Such reliance on individual knowledge increases the likelihood of human error. Additionally, critical information may be "lost" or simply unavailable when it is required.

TDS contractors also appeared to have the flexibility (within limits) to vary their work pattern, allowing them to cope with delays and disruption caused by poor weather or component faults (although this could potentially result in work taking place on incomplete structures).

Safe methods of working should be encapsulated by the erection plan. Experience should support the erection plan but should never supplant it.

The erection plan should have enough flexibility to deal with foreseeable events that may effect its successful completion.

5.3.5.5 Workforce

Workers in the event sector are drawn from two sources; in-house crew supplied by the contractor and casual local crew supplied by a crew agency. The use of local crew is a financial decision. It is almost universal within the events sector and most projects rely on the use of casual local crew to support in-house crew.

In-house crew may or may not be directly employed by the contractor. In some cases, the contractor may draw a team from a matrix of self-employed workers with past experience of working for that contractor. Individuals may be specifically selected for specialist roles within the crew.

Local crew may be hired by the production manager or event organiser on an event wide basis. In this case, the crew form a 'pool' and are allocated to activities as required. Individual contractors may have little influence over the competence of the local crew available to them. The practice of contractors directly hiring local crew is preferred as it provides a greater control of competence, allowing the selection of crew with previous experience of similar types of work and enabling skills (and training) to be matched to appropriate roles. An event may involve multiple local crew agencies working on behalf of different contractors or supplying different specialist services (such as plant drivers).

Local crew are generally managed by pairing them with experienced in-house crew. Ratios will vary (quoted ratios ranged from a maximum 2:1 ratio of in house to local crew, to a minimum of 1:6). Higher levels of experienced in-house crew are beneficial but may not always be practicable. The erection of tentage differs from other temporary demountable structures in that contractors tend to prefer in-house crew, so placing less reliance on casual local crew.

Crewing agencies provide crew chiefs for projects requiring larger numbers of crew (greater than 6 depending on the agency). The duties of the crew chief can range from simply acting as a first point of contact to assuming a more supervisory role, including site inductions and dynamic risk assessment. MUTA operate a certification process for foremen and supervisors.

The direct selection of local crew by TDS contractors allows a better control of competence.

5.3.5.6 Competence of Local Crew

Local crew will arrive on-site at the start of the work with unknown (or unmeasured) competence to be managed by in-house crew (who, while competent in their role, may have limited management ability or experience).

The ability of crew can range from unskilled to highly skilled. Some agencies may be able to provide crews with various specialist competencies such as plant drivers or working at height while others simply supply basic labour. Depending on the agency, crew competency may be well managed with in-house training and global take-up of safety passports.

At the events visited, little significance was attached to assessing the competence of local crew. From the event management perspective, responsibility was considered to start and end with the crewing agency rather than the TDS contractor. In effect this meant that crew may be allocated tasks without any knowledge of their competence or awareness of potential risk.

There should be formal systems in place to assess the competence of crew and allocate roles accordingly. The responsible contractor should ensure that local crew are sufficiently managed and supervised.

5.3.5.7 Working Patterns

During this investigation HSL encountered only once the 'hectic' working patterns traditionally associated with the events sector. Most sites were working a standard 12 hour day, 6 days a week system. However, production managers and event organisers were clear that longer hours were worked during the event itself. Although these are still very long working hours, there was little evidence of double shift patterns, night working or high worker densities. Planning of resources and timescales appeared to be relatively effective.

The European Working Time Regulations¹⁶ limit the working week to an average 48 hours, limited night workers to an average of 8 hours in 24 and gives workers the right to a provision of 11 hours rest in any 24 period. However, it is possible for workers to voluntarily opt-out of the weekly working time limit. The opt-out was preserved on the basis of maintaining flexibility within the UK labour market.

Tiredness could potentially introduce additional risks, but while it is desirable to control working time, it is recognised that workers may choose to opt out and that the decision is culturally as well as financially based.

5.3.5.8 Basic Training

An initial cornerstone of safety is an understanding of the type of risks likely to be encountered. There is an events sector specific safety passport scheme introduced by the sector trade association, the Production Services Association (PSA) and operated by the Safety Pass Alliance (SPA). While many of those interviewed on site were unaware of the SPA scheme, one crewing agency had their own in-house trainer and insisted that all of their personnel had taken the course. PSA state that over 3000 workers have taken the course and state that extending the scheme further would require additional commercial drivers (such as venues or event organisers insisting on it, or equivalent, qualifications).

The Made Up Textile Association (MUTA) runs a MUTAmarq skills card system, accredited through employers. They have also recently introduced (2009-10) a StructureSafe course similar to the SPA scheme in that it provides basic safety awareness in an events specific context. This scheme has processed 163 personnel since its inception.

The safety pass schemes are single day courses providing a basic level of safety and site awareness, tailored to those activities, which are of most significance to the sector.

One contractor, experienced at working under CDM, insisted that all crew have the Construction Skills Certification Scheme (CSCS) card. Although, generally the opinion was that sector specific schemes were more relevant and preferable.

Alternatively some organisations, such as contractors or crewing agencies, are providing their own training schemes for in-house personnel. One contractor used a four stage development process based on the PLASA rigging certificate.

0. Probation period (with mentor).
1. Beginner.
2. Working at Height (initially under supervision).
3. Supervisor.

Contractor based schemes have the benefit of being directly linked to that contractors policies, procedures and work activities. However, without a benchmark they may lack the consistency or transferability of a sector wide scheme (an important consideration in a sector with a preponderance of freelancers).

A basic level of safety awareness should be a minimum requirement to working on an event site. If that awareness is tailored to the specific risks associated with an event environment then it is likely to be more effective.

5.3.5.9 Site Briefings

There was little evidence of site briefings or toolbox talks, for either in-house or local crew, prior to commencing work. HSL were told that site inductions were unusual. Local crew were expected to slot directly into the TDS contractors team, emphasis being placed on subsequently learning on the job. Communication of information appears to rely on in-house crew knowing what to do and then being capable of instructing local crew on a task by task basis.

HSL witnessed a single example of a site induction at the Edinburgh Festival Fringe. This was undertaken by a contractor with experience of working under CDM and included both in-house and local crew (who were directly hired by the contractor). The erection plan was on hand and was referred to during the briefing.

A reliance on 'on the job' learning (without basic training or on site induction) was indicted as being part of the underlying causes of the fatal fall which occurred at Earls Court.

As an alternative to site briefings, one contractor supplied crew briefing packs. This may be an effective solution, if sufficient time and support is made available for the crew to fully understand the contents.

One crewing agency had recognised this need (and lack of provision) and compensated by requiring their crew chiefs to attend site early and perform a dynamic risk assessment. The findings of this were communicated back to the local crew at an independent briefing. This

assumption of responsibility while laudable should not absolve the TDS contractor (with their greater knowledge of the erection plan and potential risks) from the responsibility of providing their own briefing.

The importance of site briefings as a mechanism for communicating the requirements of the job, site specific safety rules and risks specific to the task should be recognised.

5.3.6 Change Control

There is a possibility that any structure as designed will be subject to change during construction, due to changes in the end-users requirements, damaged components or unforeseen flaws in the design. In the events industry this situation is exacerbated by the apparent lack of significance attached to the design concept and the willingness of contractors to make changes throughout the construction process in order to guarantee delivery of the event.

There are two primary issues relating to change:

- Divergences from the erection plan which may require changes in methods of work or introduce temporary or permanent hazards.
- Structural changes, which may have implications for long term stability and structural integrity.

In practice there is considerable overlap between these issues and a change to the structure will significantly alter the erection plan. There needs to be a robust system for managing change. Otherwise there may be safety implications:

- Design changes may not be subject to the same level of scrutiny as the original design and as a result the completed structure will be unsuitable for its intended application. The modifications to the seating structure that collapsed at Earls Court had not been verified by the designer. There was no system of change control to ensure that any such change was checked.
- The safe method of work may no longer be practical. Timescales may not permit adequate assessment of new working practices.
- Additional unscheduled work may have to be carried out to very tight deadlines and therefore, under pressure (when research shows that mistakes are more likely).

Any proposed change to the structure during the construction phase should automatically be referred back to the structure designer for them to assess the likely effects in terms of stability and structural integrity. Where appropriate, fresh calculations should be undertaken and verified as for the original structural drawings. One of the contractors interviewed maintained an emergency 'on-call' system so that designers were available to review proposed changes and undertake load calculations at very short notice. All changes should be documented.

From discussions on site, it was clear that there were adequate systems to allow issues encountered during construction to be communicated back to those responsible for the design (in one case by using mobile phone cameras to transfer images).

As well as structural change, the erection plan may also be adversely affected by poor weather or problems associated with the availability of equipment and resources. The erection plans encountered contained enough element of flexibility to deal with some change or delay,

however there were limits to this flexibility. Any deviation from the original erection plan can potentially result in a requirement to undertake the work in a less planned and more hazardous manner. In all cases, the plan should be reviewed to determine the safest way to achieve the desired objectives, given current limitations, and a new safe method of working should be agreed.

Changes to the erection plan may affect other aspects of the event. Temporary hazards may be created (such as floor voids or missing handrails) and it may be necessary for other contractors to access the structure while it is in an incomplete state. Where possible these should be protected and there should be clear and adequate communication of all such risks to those accessing the structure in its incomplete state. At one event where the fitting of the handrails was delayed by a missing component, the risks were clearly identified and 'handed over' to others using the structure.

Effort should be taken to avoid changes that can often require work to be undertaken in a more hazardous manner.

A robust system of change control is critical in a sector where changes can be required at very short notice. All changes to the structure should be subject to the same level of scrutiny as the original design.

Any late change will require a review of the erection plan to determine the safest method of undertaking the work.

Where an unavoidable temporary hazard is created, the existence of this hazard should be communicated to others using the structure.

5.3.6.1 The Positive and Negative Aspects of 'Can Do'

The events sector prides itself on its ability to successfully deliver events to timescale and budget, regardless of obstacles; "*How can we do it, not it can't be done*". The ability to be flexible, respond quickly and adapt solutions is valuable.

However, this 'can do' attitude may be counter-productive, creating problems such as (i) a failure to adequately communicate intentions and requirements in a timely manner and (ii) a willingness to push the limits or restrictions, on the basis that contractors will be able to adapt or improvise at short notice.

HSL were informed that while promoters specify cut-off dates for artists to communicate their requirements these are regularly ignored. TDS contractors are often asked to accommodate greater loadings than were specified in the original design concept at short notice, requiring modification of the structure (in some instances, such as stages used at festivals, the first indication of a deviation from the design may come at the overnight load-in, the night before the event). This means that rather than the preferred option of creating solutions at the design stage, contractors are required to retro-actively create solutions on site, often at very short notice (for example, stage roofs are assembled at ground level (for safety reasons) and lifted into position, any modification will inevitably require some fairly challenging work at height, to tight deadlines, often overnight).

At present, the nature of the sector is such that those responsible for managing an event may be ineffective in pressuring end users to rectify this situation. One TDS contractor stated that there was a widespread belief, among end users and production staff, that structures were built with safety factors sufficient to enable limits on roof loadings (for equipment such as sound and lighting) to be routinely ignored, i.e. there was an acceptable overload.

The “can do” approach can encourage late decision making (which has implications on planning for the work to be undertaken safely). Emphasis should be placed on reaching an early consensus on the requirements of the structure

5.3.6.2 Sponsors

Sponsors provide financial support to an event in return for an advertising opportunity. Promoters actively seek sponsors through sponsorship agencies. Common forms of sponsorship involvement include advertising on existing structures and operating separate events, areas or structures (such as bars, etc.).

Temporary demountable structures are a prime location for the placement of banners or shims (particularly larger structures or those placed amongst the audience). Modifications to structures (such as placement of banners) can be a significant issue if the original structural design did not take account of the imposed loading (e.g. due to factors such as wind). However, there is a general ignorance as to the significance of these effects. This has been directly linked to structure failures such as Guilfest, where a speaker tower collapsed due to the placement of a shim that was placed on it. The placement had not been in the original design, had not been agreed and took place after sign-off.

It is good practice for TDS contractors to determine the requirements for advertising on structures at the earliest opportunity. One contractor includes the requirement for advertising as a standard question in agreeing the design concept, with the proviso that all negative responses will result in a strict ‘no banners’ prohibition. This helped the contractor defend their position if pressured by event organisers or sponsors. This contractor was also considering building in sufficient redundancy to all structures in anticipation of this problem (although this would clearly have pricing implications).

Separate areas operated by sponsors may themselves include novel temporary demountable structures, banners and other promotional displays. These should be expected to meet the requirements placed on other larger structures.

The activities of sponsors need to be co-ordinated and integrated into the management of the event. Some event organisers achieve this by absorbing the control for all aspects of delivering the advertising package. The sponsor is given a deadline for submitting their plans then the event production team source purchase and place the advertisements to the sponsors specification. This ensures that the banners are suitable for their application and that their application has been fully considered in the structural design.

The activities of sponsors must be co-ordinated, this may be achieved by the event organiser absorbing full control for delivering the advertising package.

5.3.7 Handover and Sign Off

The construction of the structure is a fluid process. Timescales dictate that it is often necessary for other contractors to access the stage before completion. Systems for handing over or transferring control between the various parties during the construction appear to be ill defined and there was little evidence of handover or communication regarding residual risks.

Similarly systems for signing structures off as complete were weak (or non-existent). Consequently, a structure could pass between different phases of the build without ever being signed off.

The structure, either complete or incomplete, will have inherent hazards (such as unprotected edges, floor voids, etc). There will be limitations in the capabilities and the use of the structure will be limited in accordance with the agreed design (and any subsequent modifications). Without a rigorous handover and / or sign-off procedure, there is a real risk that this information will not be adequately communicated or understood. For safety of the structure during construction and use, it is critical that details of performance envelopes and outstanding risk are effectively communicated to other users of the structure. In some instances a web based sign-off procedure may be advantageous.

During sign off, those procedures (such as wind speed measurement, control of access etc) necessary for the safe use of the structure should be made clear. At both Bearded Theory and Guilfest procedures for wind speed measurement were omitted, which may have contributed to the incidents.

To ensure that the structure has been erected in accordance with the structure designs, TDS⁶ recommends an independent erection check (by a competent person) and completion certificate. However, interpretation of this requirement can vary in a similar way to independent verification of designs. TDS contractors report that accessing suitable third party or independent in house expertise can be difficult particularly in the case of tight deadlines and 'last minute' modification.

While HSL support the recommendation in TDS, if independent expertise is not available then a suitably controlled and documented erection check should be undertaken by a suitably competent member of the contractor's team on site.

An erection check (independent or otherwise) would have identified the unsuitability of the structure at Millennium Point. This should take place prior to the TDS contractor signing the structure off and passing control to the event organiser. This was only witnessed by HSL on one occasion where it was undertaken on behalf of the venue (thereby discharging their duties under the DCMS guidance⁸).

To ensure that end users are fully aware of the capabilities of the structure and to prevent misuse of the structure, it is important that there is a clear signing off procedure for the structure.

Prior to signing off, an erection check is recommended.

Where the structure is accessed by others before completion, there should be a clear system for communicating any hazards to those users.

5.3.7.1 Documentation

Based on the HSL visits, the collation, control and dissemination of documents fell within the remit of the Health and Safety Manager. This role seemed to be relatively passive in nature. The documentation being held included:

- Event plan and site layout.
- Emergency plan.
- Risk assessments.
- Structure erection plan and associated drawings (including calculations).
- Limited records of competence (primarily certificates for driving plant and other specialised roles).

This is substantially less than the list in TDS⁶, which also includes details of the health and safety policy, design concept, permissions and licenses and structure sign off. However it is accepted that these may be held elsewhere.

Some health and safety consultants will create the required documentation on behalf of the event organiser. All documentation should be specific to the event to which it is attached. Generic 'pre-pack' safety documentation may lack specific technical detail and therefore not be appropriate.

One method of overcoming the disparate nature of the events sector was to host documents online and restrict access by using secure login. Access rights were then granted to participants and enforcement agencies. In another instance, a contractor mounted copies of structural drawings on or near the structure, to ease inspection and allow a quick response to any problem during the event.

Those documents viewed by HSL were generally satisfactory, however in one case a custom designed structure only had a technical manual (of limited use in a construction environment) rather than an erection plan.

Documents should be controlled and made readily available to those who require them.

5.3.7.2 In Use

Upon sign off of the structure the TDS contractor's involvement may be complete (until after the event). This means that any potential misuse (such as exceeding load limits) may not be identified. It is good practice for the TDS contractor to maintain a presence on site after handover to monitor the load-in and intervene if required. This is known as 'babysitting'. One contractor took accurate measurements of beam deflection during load-in as a means of ensuring that they remained within the calculated envelope (i.e. the structure was not overloaded).

The TDS contractor (or the structure's 'babysitter') may remain on site throughout the event, in case of problems. This approach is particularly relevant at festival type events, where there are likely to be multiple load-ins of different artists' equipment, but may be useful at other short-term events (for example where there is a risk of damage to the structure). Babysitters may be effective in ensuring that necessary procedures such as wind speed measurement (Millennium Point and Guilfest) are carried out. For longer-term events (such as the Edinburgh Festival Fringe where structures are erected and in use for several weeks) it is less practicable. However, there will still be a need for regular inspection by a competent person.

The provision of 'babysitting' to advise on problems encountered during the event is recommended.

5.3.8 Deconstruction

The process of deconstruction requires similar activities to construction. However, it should be noted that it is not necessarily a simple reversal of the construction process.

6 CONCLUSIONS

The events sector is a dynamic and varied environment employing some highly competent individuals and organisations. This is evident in its approach to the construction and use of temporary demountable structures. However, the nature of current practice is such that it can introduce unnecessary difficulties into the safe management of TDS.

- Common mechanisms of defining roles and identifying responsibilities, such as clear contractual arrangements of consistent job descriptions appear to hold less significance in the events industry than in other sectors. Without these mechanisms it becomes difficult to ensure that all individuals have a full understanding of what is required of them.

Without an understanding of what the specific responsibilities of each role are, it becomes hard to build a coherent (and easily understood) management chain. Management chains in the events sector vary widely between different events. While this can provide an element of flexibility, the combination of loose contracts, vague roles and ad hoc management chains can blur lines of control and communication and result in difficulties identifying who holds particular responsibilities.

Efforts to strengthen these areas would be likely to have a positive effect on the management of events as a whole.

- The dynamic nature of the events sector is reflected in a general acceptance that change is inevitable. Delay to the event is unthinkable, and the sector has developed a culture of delivering the event regardless of the obstacles placed in its way. While the sector has developed admirable systems for controlling change, this 'can do' culture increases the requirement for change, by devaluing early plans, particularly the design concept for a temporary demountable structure. Incidents such as Earls Court and Guilfest highlight the risks associated with poorly managed change.

The design should fully deliver the requirements of the design concept but must also give consideration to erecting the structure in a safe manner. Early decisions are important because late changes will often require work to be undertaken to tight deadlines and in a more hazardous manner than originally planned.

Recognition of the value of the design concept should be encouraged. It is important that all participants from landowners to end-users 'buy-in', providing accurate information in a timely manner and acknowledging limitations place upon structures.

The last minute placement of banners is a particular example of often unplanned change. There is a need to co-ordinate the activities of sponsors and this may be achieved by the event organiser absorbing full control for delivering the advertising package.

- The design for a 'safe structure' and appropriate safe methods of working should be encapsulated by the erection plan, such that it can be realised by those undertaking the work. The erection plan should allow enough time and include enough flexibility to deal with foreseeable events that may affect its successful completion.

To be safely implemented, the erection plan will require management, supervision and support. Communication is critical and the importance of site briefings or toolbox talks as a medium for transferring information on the requirements of the job, site safety rules

and specific risks, should be recognised. This is particularly important given the sector's reliance on temporary or casual local crew.

- In the events sector the potential requirement for last minute change cannot be removed. Experience is a valuable supplement to the erection plan but should never supplant it. Any change should follow an accepted change control procedure culminating in approval by a competent designer.

The provision of a 'babysitting' service to advise on problems encountered during 'load-in' and the event is recommended.

- There is a generally high level of competence within the sector. However, the sector should not be complacent about its management of this competence. Working with known individuals and organisations does not replace the requirement for fully assessing their competence and there should be formal systems in place to do this.

A basic level of safety awareness should be a minimum requirement to working on an event site. If that awareness is tailored to the specific risks associated with an event environment then it is likely to be more effective.

Contractors should assess the competence of both in house and local crew and allocate tasks accordingly. This becomes easier if crew are sourced directly by TDS contractors rather than supplied from a pool.

- In this environment, the development of the TDS is fluid and work phases may overlap. In effect this means that the structure can pass through the event without handover or sign-off.

The signing off procedure is more than a paperwork exercise. It is the primary means of communicating the capabilities (and limitations) of the structure, thereby preventing misuse or overloading. There may be residual hazards associated with the structure (particularly when accessed before completion) and these must be handed over to subsequent users.

To ensure that the structure as delivered is in accordance with the design, an erection check is recommended prior to signing off.

Management practices employed in the events industry would benefit from reinforcement in several areas and the introduction of an element of consistency. However, any management strategy employed across the events sector must retain sufficient flexibility to cope with the variety of events encountered.

CDM has effectively brought consistency to management practices in conventional construction, however the events sector remains unconvinced about its relevance to TDS. Differences between conventional construction and TDS are evident, although some elements of CDM may be transferable and provide benefits.

During this work, HSL have identified a number of areas of relative strength and weakness within current practices. The events sector needs some form of strategy or framework to 'standardise' good management practice with respect to TDS. A system, such as CDM, may not easily fit the current sector model. The annex to this report contains suggested 'action points', the implementation of which may assist in the safe delivery of TDS during an event.

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8 APPENDIX A: HFACS

1. Background to the incident

- A. When
- B. Where
- C. What happened

2. The 5 whys

- A. Why did this happen?
- B. Why
- C. Why...

3. Human Performance issues

- A. What would 'good performance' have looked like?
- B. Had the person deliberately chosen to not perform well?
 - i. Why? Morale, Horseplay, Suitability
- C. What explanation is there for the gap between their actual performance and good performance?
 - What had they intended to achieve?
 - Faster performance?
 - Cheaper performance?
 - Handling unexpected contingencies?
 - What priorities were they working to?
 - Why had they chosen these?
 - Peer pressure (real or perceived)
 - Production pressure (real or perceived)
 - Cultural issues
 - What information was available to them?
 - What information were they focusing on?
 - What would their situational awareness be?
 - What time pressure was on them?
 - Were there any relevant teamwork/relationship issues?
 - What limitations did they face?
 - Health
 - Training
 - Experience
 - How did they foresee the outcome of their actions?

[In other words, find out why their actions made sense to them at that time.]

4. List of causal factors

- A. If more than 5 – select the most important ones
- B. If not possible to select the most important ones then apply the weighting system to the causal factors.
 - i. Weighting = Causality x Risk Gap
 - Causality
 - 1 - Issue could only produce accident when combined with other failings(Contributory Factor)
 - 2 - Issue was sufficient to cause accident (Causal Factor)
 - 3 - Issue must have led to accident (Strong Causal Factor)
 - Risk gap
 - 1 - Issue would only be recognised as a problem with hindsight (not-foreseeable)
 - 2 - Issue could have been identified and rectified in advance (foreseeable)
 - 3 - Issue was a clear breach of regulation/standards/industry good practice (negligence)

5. Assign responsible party to the issue

- A. Individual
- B. Supervision/Line management
- C. Safety management
- D. Company Directors/Owners
- E. Designers (tools, machinery, buildings etc.)
- F. Training providers
- G. Regulator
- H. Market
- I. Policy-makers
- J. Society
- K. Unknown

6. Assign a category

A. Personal

1. Training
 - 1.1 Carried out
 - 1.2 Appropriate
 - 1.3 Maintained
2. Experience
3. Physiological State
 - 3.1 Intoxication
 - 3.2 Ill-health
 - 3.3 Fatigue
4. Teamworking
5. Attitude
6. Competence/Suitability

B. Resources

1. Physical Resources
 - 1.1 Availability
 - 1.2 Suitability
 - 1.3 Operability
2. Human Resources
 - 2.1 Available
 - 2.2 Suitable

C. Task

1. Tempo
2. Communications
3. Space/Lighting/Environment
4. Availability of Information

D. Safety Management

1. Planning
2. Organisation
3. Procedures
4. Implementation
5. Monitoring/Review/Auditing

E. Regulation

1. Enforced
2. Effective