Safe Event Management

Theatre Managers Association Conference

Birmingham 10th June 2008

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Abstract
This paper argues that safe event management planning is only fully effective when an in-depth event risk analysis underpins a risk assessment for crowd safety. Furthermore, a purely quantitative approach to risk assessment can divert the practitioner's attention away from important staff training needs. A current popular likelihood x consequence model for risk assessment is reviewed and a critique of the limits of mathematical modelling is considered. Finally an overview of the level of fatal accidents at concert events is considered as a basis for risk analysis.

Introduction
The introduction of legislation in the form of the Health and Safety at Work Act (1974) made it mandatory for all employers to conduct a risk assessment for their work activity. At the time there was perhaps a popular belief that this new legislation was intended for industrial and commercial workplaces not entertainment events and venues. The full impact of the Act was realised however when the Head of the Policy Branch of the Health and Safety Executive explained in an important seminar paper that a mandatory requirement for risk assessment was intended for *all* employers. Naturally this included event organisers and venue operators (Graham 1993). In response to questions on how a risk assessment might be conducted, Graham explained that the basic principle of assessing risks were essentially identify hazards and then evaluate the risks, i.e. the likelihood of the hazard arising and the harm it could cause. Furthermore, provided the assessment is carried out in a structured way, taking into account the known and foreseeable hazards, there should be no difficulty in identifying the significant risks and establishing the relative priority for action.

Possibly in support of Graham's 1993 seminar paper, the Health and Safety Executive (HSE) published a report that provided a formula for risk assessment (Au *et al* 1993). The report advised that a numerical figure could be applied to the likelihood of an accident occurring and the consequences, in terms of severity of injury, if it did. A risk factor is then established by multiplying the likelihood figure by the consequence figure and the result transposed into high medium or low risk. The likelihood x consequence model for risk assessment remains today as possibly the most popular method.

Critique

On face value the likelihood x consequence model appears to be perfectly logical. It is possible to measure some risk in this fashion, for example the integrity of structures or temporary structures. A quantitative approach therefore has a valid place in the risk assessment process. The big question however is, can a purely quantitative approach predict human behaviour?

A numerical risk assessment model was initially adapted from a commonly used industrial quantitative method intended to predict the possible failure rate of mechanical objects. The model was therefore developed by engineers to satisfy a political need to introduce a system that would fit health and safety legislation.

When dealing with crowd activity however, awarding a numerical figure becomes the personal opinion of the assessor rather than a scientific system of measurement. Another assessor might have a different opinion and therefore award a different number to the same activity, an assessor may in fact introduce any form of numbering they chose as there is no mandatory requirement to use the HSE suggested system. Where individual assessors can, and often do, invent their own numerical system confusion might result. In a scenario where the assessor and the local authority officer (the recipient) are using different interpretations of a numerical system it is not difficult to imagine that the proposed risk assessment might be completely misunderstood by the recipient.

In fairness to the researchers that published the numerical system it should be noted that at least one of them later changed his mind. Zachary Au was a researcher for the 1993 report and he later published a second report in which he favoured an alphabetical system (Au 1997). The A,B,C categorisation of risk, with A representing high risk, once again appears to be a logical system, that is until you consider that some sport events categorise their events in reverse order. In other words C becomes the highest category of risk not A. It follows therefore that the assessor needs to explain the methodology used to construct the assessment if confusion is to be avoided.

One year before Au had published his second report recommending an alphabetical system, Brian Toft (1996) had in fact published a critique of the limits mathematical modelling of disasters. Toft made a very important point when he argued that individuals create their own sets of criteria against which risk is interpreted. Toft was emphasising the fact that risk perceived by a given society or individuals are not objective but subjective. In other words, individuals perceive risk differently; consequently some people enjoy so called dangerous sports while others regard them as high-risk actions bound to lead to serious injury or even death. This is not to imply that the participant in a high-risk sport is unaware of risk, rather that they feel that they are in control and therefore managing risk. The fatal accident record for concert events however illustrates that crowd members are not always fully in control.

Fatal accidents

My own research into concert crowd related accidents/incidents during the period 1974 – 2007 produced the following data:

- 34 died during ingress
- 42 in front of a stage
- 5 during egress
- 53 ingress related
- 13 fell from balconies (seated areas)

A total of 147 deaths in thirteen countries. The figure of 147 is not claimed to be a definitive level of the accident rate, rather it is an example of the type of accident suffered at concert events. The figure of fifty-three ingress related does require further explanation, it was a single accident in a situation where a crowd leaving a venue entered directly into a public transportation system. I include it because it raises the question of boundaries of responsibility.

It has been argued that in percentage terms 147 fatal accidents in thirteen separate countries over a thirty-year period is not that high. But the figure does not include the 'near miss' occasions that we have all experienced and, it should be remembered that the figure is merely a snapshot of concert event risks. If sport events and incidents of fire are added, the fatal accident rate increases by leaps and bounds. In America one hundred and twenty people died in just two fires at venues in Rhode Island and Chicago. The overall accident rate has in fact prompted politicians in the UK to call for the regulation of social events.

Regulation v education

In the UK there has been at least six attempts by politicians to introduce Bills to the House of Commons aimed at either regulating entertainment events or licensing promoters and security staff. Only the Private Security Industry Act 2001 became legislation. The 2001 Act is however aimed primarily at door supervisors; it offers nothing to aid the crowd safety practitioner. After over thirty years of accidents at concert and sport events, health and safety legislation supported by guidance still underpins our approach to crowd safety. It was for this reason that Buckinghamshire New University (BNU) introduced a two year distance learning Foundation Degree course within what is the Centre for Crowd Management and Security Studies.

The course is supported by the United Kingdom Crowd Management Association (UKCMA) and the Production Services Association (PSA). It encourages students to use case study to underpin legal frameworks and published guidance in an approach to crowd safety planning. Much use is made of Extreme Value Analysis (EVA) which requires the assessor to demonstrate a scientific approach to risk analysis. The EVA system considers accidents and incidents in terms of:

- **Low frequency – high intensity**
- **High frequency – low intensity**

A classic example of low frequency – high intensity is the 1989 Hillsborough football disaster that claimed ninety-six lives. It might be argued that had the EVA system been applied to the risk assessment for the match it would have revealed a remarkably similar football accident in 1946, which claimed thirty-three lives at Bolton. The lesson learned is that time can lull us into a false sense of security. In the forty years between these accidents the circumstances were simply forgotten.

A high frequency – low intensity incident is one that happens often but does not necessarily result in a high casualty rate. An example being a large number of distressed people being extracted from a crowd at the front of a stage at a rock concert and treated by in site medical teams. This second category might perhaps be referred to as *near miss* situations and arguably the best source of learning if incidents are recorded. The key factor here is that high crowd density situations are being allowed to develop.

The primary aim of crowd safety planning therefore is to control crowd density. The American safety planner C.B. Berlonghi provided a graphic description of the effects of high density, as follows:

> *" A dense crowd is one in which individual physical movement is rapidly becoming less likely or possible due to the density of the crowd. People are attempting to move but they are either swept along with the movement of the crowd or are falling on top of each other. The results of this compression of people are fatalities and serious injuries due to suffocation".* (Berlonghi 1993)

Reports on the Hillsborough disaster tell of forces so powerful that people were propelled several metres and in one case a police officer mounted on a horse was actually moved a metre. In high crowd density it is also common for people to have clothing torn off or loose their shoes.

Approach to planning

It would be impossible here to fully explain a two-year university course approach event safety planning. Briefly, the students use EVA to evaluate each of the stages of arrival and ingress, attendance, egress and emergency evacuation for their chosen venue and event.

Crowd arrival & queuing

Turning first to crowd arrival and queuing, every crowd safety practitioner should be familiar with a queue theory that argues that there are five considerations to queue management. The five considerations are:

1. Pedestrian approach to a queue
2. Standing space within a queue
3. Unrestricted forward movement
4. Passing through an ingress system
5. Dispersal

An assumption is made that where arrangements are made appropriate to the needs of a queue, ingress will be achieved smoothly. The weakness with queue theory however is that it implies that a crowd will always act rationally. The key factor is '*where arrangements are made appropriate to the needs of a queue*'. If we accept that risk perceived by a given society or individuals are not objective but subjective then queue management needs to consider how the psychology of people queuing might affect a risk assessment. Evidence of the emotional state of some crowd members that attend rock concerts can be found in an article written by fifteen year old Terri Sigmon, a student at Western Hills High School, U.S.A. In her school paper Sigmon anticipates a forthcoming concert event and describes her previous experience at rock concerts. Under the headline "Concerts, a real trip", Sigmond wrote*:*

> *"You lost sight of the people you came in with as soon as you entered the crowd, but that doesn't matter now. Nothing matters except for your fight to get to the front of the crowd. But that is everyone else's goal and it's every man for himself as you shove, claw, and push your way forward. Covered with sweat, you feel as though you may faint at any moment, but you keep going …..*
> *All sense of reality has disappeared in the struggle to move forward"* (Sigmond 1979)

The concert that this student was looking forward to was an appearance by The Who at the Riverfront Arena, Cincinnati in 1979. This event turned out to be the worst concert disaster in the history of rock 'n roll when eleven people died during a queue management and ingress failure caused by a high-density bulk queuing situation. It is interesting to note that there were at least three serious bulk queue incidents previously at the Riverfront. In 1976, 1977 and again prior to the Who disaster in 1979 the police responded to bulk queue situations that caused high crowd density situations and serious crushing outside the venue prior to doors opening (Fuller 1985).

Moving forward in time, on the 18th July 1995 a sixteen year old young woman and a seventeen year old young man died and many others were injured as a result of an ingress failure at the Atrock Rock Festival in Israel. Two days later a fifteen-year-old young woman also died as a result of injuries she received during the disaster. The lessons of 1979 had again been forgotten with time.

If we want to conduct comparative studies for queue management and ingress failures, case studies can easily be found. It might be argued that both Burden Park and Hillsborough are examples. More recently, in 2005 it was reported that police and ambulances had to respond to a serious queue management and ingress failure at the opening of a new IKEA store in North London (BBC News 2005). In 2007 police and ambulances were called to a serious queue management and ingress failure at a sale at a Primark shop in Oxford Street, London (Roche & Myall (2007). In both cases it was reported that security staff had been employed specifically for queue management and ingress control.

Simply employing contract security staff is clearly not planning for queue management. The term '*appropriate to the needs of a queue*' should take a very broad view. Queue management is underpinned by the formation of a linear queue system early on. Sufficient staff trained to recognise and control changes in density should supervise systems. The correct use of crowd control barriers is also essential, as is efficient communications. Licensed security staff should be on hand to deal with anti social problems but it must be remembered that current qualification for a security license does not include crowd safety management.

Once doors are open an efficient processing system includes clear signage and conditions of entry well publicised. Surprisingly, current published guidance for concerts and events does not provide calculations for ingress flow turnstiles. The reader is referred to the Guide to Safety at Sports Grounds (Green Guide) for sample calculations. The flow rate quoted for turnstiles is 660 persons per hour. This figure naturally assumes that the turnstiles in question are well maintained and in excellent working order. It is emphasised that the rate quoted is maximum flow, where searches or ticket purchasing is taking place this rate will obviously be reduced dramatically.

The foyer is important, it is the distribution area. People unfamiliar with the building will pause to read signs to find their way and at large venues signage should be at high level. Program sellers often want to be immediately in front of an ingress flow, this is where they can sell the most programs and the practice must not be allowed. A key issue is the admittance of people in wheelchairs. How do they enter, where do they go and how do they get there.

Non turnstile systems

For the venue that has a free flow ingress system, supervisors should be trained to calculate pedestrian flow rates. Flow rates for turnstile and non turnstile venues should be regularly passed to management and logged for use in the event of a necessary emergency evacuation being needed before ingress is complete. If you don’t know how many people in a sudden emergency situation are in how do you know how to evacuate them? Flow data can also be useful after the event to aid venue merchandisers in future planning.

Attendance

The data provided above reveals a surprising number of falls from balconies during rock concert events. The need for good stewarding in these areas is therefore obvious.

At least forty-two people have been the victims of a front of a stage accident. In the majority of cases victims were crushed as a result of high-energy cultural activity. Where front of stage pits are used to control these situations it is essential that pit teams receive specific training for their role and responsibility and training records kept. At the university we also run a course that offers a certificate in pit training. In America at least one contract security company has been forced to pay compensation for injury to a young woman in what was alleged to have been the mishandling of a front of stage incident.

Density

Current guidance for a ‘safe density‘ for standing audiences is 0.5m2 or two persons per square metre, with an acceptable level of three persons per m2 directly in front of a stage. Controlling density within a standing audience is however very difficult at rock concerts. Current cultural behaviour can range for pop hysteria to rock cultural behaviour that can easily create intolerable pressure loads. Activities such as mosh pits and wall of death make a mockery of $0.5m^2$ as people move out of the way or people migrate from seated areas to join in. Natural laws of crowd dynamics then produce lateral or dynamic surges that can become static loads in a crowd collapse. Activities such as surfing, stage diving and skanking can also cause a crowd collapse in which case response teams have a maximum time frame of three minutes to extract people in distress. Any longer and victims can suffer brain damage or death.

The known actions of performers should be researched and levels of responsibility established. Particularly where a performer(s) has a reputation for encouraging high-energy crowd activity that might result in a serious accident. Who conducts a risk assessment for such activities? My experience has been that lawyers acting for the performer will try to pin the blame on either the local security team or venue management or both. In which case the venue operator will need to ensure that they can produce unambiguous documented evidence of levels of responsibility, risk assessment and risk management strategies and staff training records.

Egress

This afternoon Keith Still will make a presentation on crowd flow systems that includes exit capabilities therefore I will restrict my observations on egress to that of emergency evacuation.

Egress planning is always based on the ability of a venue to evacuate its total capacity within an emergency evacuation time frame stipulated in published fire safety guidance. Recently the old `yellow guide` guidance for fire safety was upgraded to become a series of venue specific guides. The reason for the new guides is a requirement now for venue operators to conduct a fire risk assessment for their venue or place of work. Evacuation times for entertainment venues however remain unchanged.

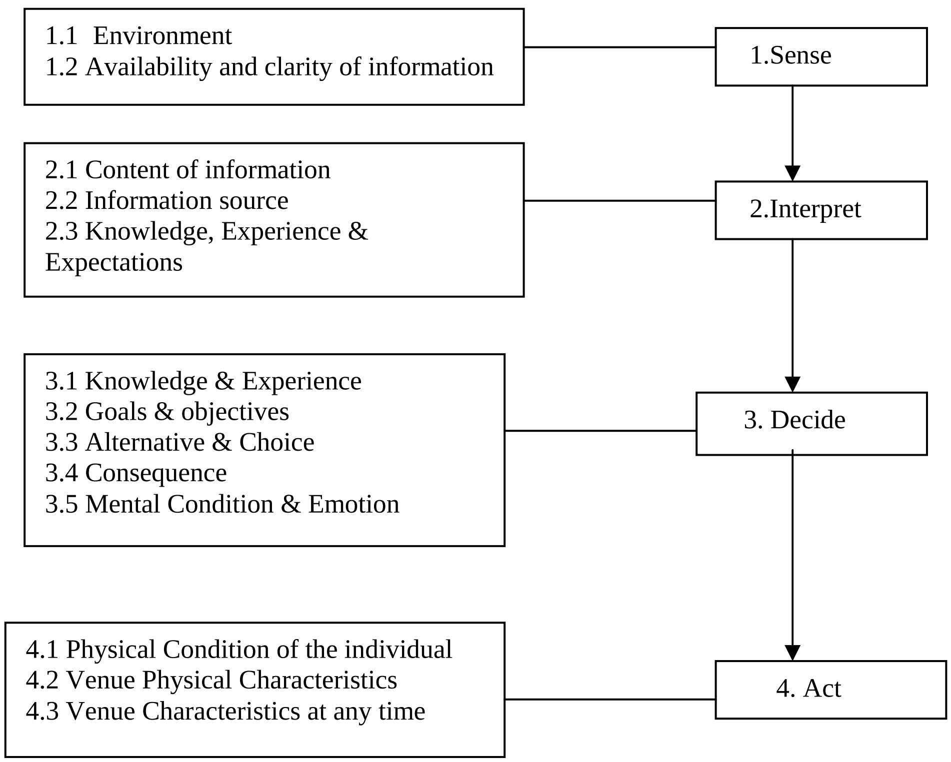
The notion that an emergency evacuation can rely on a theoretical calculation that a given number of people can exit within an agreed time is however a very simplistic approach in my opinion. In practical terms there are at least five key questions that need to be answered:

1. How will the event be stopped and stage sound cut in order to announce the need for an orderly evacuation?
2. At what stage of a potential alert is the crowd informed?
3. How will the crowd be informed?
4. At what point are lighting levels raised?
5. Are your staff trained to deal with the situation?

Stopping a rock concert when it is in full flight is no easy matter, it requires the full co-operation of the artiste and the production crew. Even the most placid performer is unlikely to welcome someone simply walking onto the stage and demanding the show be stopped. Research into serious incidents and fires such the Stardust Disco fire and the Big Day Out crowd collapse indicate that that stopping an event and taking decisive action can be very difficult.

In his study of human behaviour in emergency evacuation situations Jonathan Sime (1993) argued that venue emergency planers needs to address the relationship between (a) *design and engineering* x (b) *communications technology* x (c) *crowd management* x (d) *crowd behaviour and movement*. Sime‘s research led him to conclude that the time to escape (T) is a function of T1 (time to start to move) + T2 (time to move to and pass through exits) rather than T=2 alone.

Similarly, Au *et al* (1993) modelled four factors affecting likely human behaviour in an emergency evacuation scenario, each factor having a number of variables.



Summary

At an inquiry into a crowd-related accident lawyers for the victims will seek to establish blame because blame equals compensation. A submission of a risk assessment based solely on a quantitative method that argued that the event was low risk on the basis that it scored a risk factor of 24 is fundamentally flawed. A consultant is likely to be called to explain that a remarkably similar accident had occurred previously. The key question then asked is did you know of it?

The key to risk assessment is a risk analysis process that considers the phases of arrival and queuing, ingress, attendance, egress and evacuation as separate activities. The potential for accidents during each activity should be acknowledged and the management actions taken to eliminate risk shown. A risk assessment should also acknowledge the risks associated with engineering. In the past there have been accidents at venues that include: the collapse of a seating block; a fractured hot water pipe in an auditorium; pieces of ceiling falling onto an audience due to high volume noise and people falling into the orchestra pit when performers invited the audience onto the stage.

A crowd management plan should include venue ingress and egress crowd flow calculations and staff training levels of qualification which should be based on National Occupational Standards (NOS). In the event of a front of stage accident insurance companies will also want to see an acceptable qualification for pit team training. The plan should also provide details of emergency action drills for fire, bomb threat, crowd surge and crowd collapse and evacuation. It should also be shown that regular exercises had been carried out to test and upgrade planning.

Finally the question of who is responsible for a risk assessment for the performer and the production crew needs to be addressed, particularly with regard to one off concert events. It is very unwise to ignore the performer that has a reputation for encouraging high-energy crowd activity but it often happens.

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Dr Mick Upton

Following military service Mick began working as a close protection bodyguard for a wide range of clients. In the mid sixties he began to specialise in celebrity protection when he accepted work with the Beatles and then the Rolling Stones. Subsequently, as

Head of Security at Artistes Services Ltd he worked with celebrity clients that ranged from ABBA to Led Zeppelin. From 1974 on he took a keen interest in crowd safety management at events following the death of a young woman at a David Cassidy concert at which he was working.

In 1982 Mick formed ShowSec International Ltd, a company that specialised in celebrity protection and event crowd management at international level. Just some of the events that Mick has managed include all European Monsters of Rock events, Live Aid 1985, the Moscow Peace Festival, the V.E. Commemoration Hyde Park 1995 and Royal Ascot. He was also a consultant to the open space queue plan for the 2000 Sydney Olympic Games.

Mick has acted as a consultant to Bramshill Police Staff College and he has devised and delivered crowd safety training for U.K. police services, local authorities and foreign agencies. He has also acted as consultant to UK official published guidance on concert event crowd management. In addition he has served on government sponsored Lead Bodies set up to introduce NVQ qualifications for events, door supervisors and VIP protection.

During his career Mick was the recipient of a Silver award from the Event Services Association, three times winner of the Live Gold Award for crowd management planning, and the recipient of a Police award for designing and delivering training for the police service.

On his retirement from ShowSec in January 2002 Mick was presented with: a Lifetime Achievement Award by the Event Services Association, a Lifetime Contribution to Concert Safety Standards by Total Production Magazine and an award from the Mojo Barrier Company for his outstanding achievements in the field of Crowd Management. In 2006 he was presented with the National Outdoor Event Association (NOEA) Presidents Award and Lifetime membership of the association in recognition of his work in the development of crowd safety planning and training.

Mick continued his interest in crowd safety and security issues in retirement by working with Buckinghamshire Chilterns University College (now Buckinghamshire New University) where he worked with Chris Kemp and Iain Hill on the development the first ever Foundation Degree course in crowd safety management. Students on the first course graduated in 2005. In 2005 Mick was awarded a Doctorate for his work and he was appointed as Head of the Centre for Crowd Management & Security Studies at BNU. He retired from that position in September 2007. He is currently the Hon Chairman of the Event Industry Forum.