Fire strategies – strategic thinking

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Fire Strategies - Strategic Thinking
About the author

• Worked with the UK fire insurance industry in the 1980s

• Was Head of Fire Engineering for London Underground in early 19902

• Formed Kingfell in 1995 and grew it to a $8m company prior to changing business model.

• A chartered fire engineer, MBA and Freeman of the City of London.
About the book

- Published in 2013
- Incorporates ideas Paul first developed in the 1990s.
- The book was written from Paul’s concern that not enough common sense thinking goes into fire safety engineering.
Concept No. 1

“Every Building has a fire strategy – it may be implicit or explicit.”
Concept No. 2

“Every Person holds a fire strategy within them – it automatically plays out when they are confronted by a fire.”
A “Fire strategy” is?

• A plan?
• A set of tactics?
• Something else?
The term “Strategy” …..

- A long-term plan of action designed to achieve a particular goal.
- A broad, non-specific statement of an approach to accomplishing desired goals and objectives.
- An elaborate and systematic plan of action.
- A long-term plan for success, to achieve an advantage.
The 5 properties of a fire strategy ...

1. To be specific
2. To be clear and concise
3. To have the necessary level of detail
4. To have realistic and achievable goals
5. To remain organic
When is an explicit fire strategy warranted?

1. If the building is of “non-standard” design, e.g. does not directly conform to national building regulations.

2. If the building layout is such that it may not be easily understood by its occupants.

3. If there are any special processes that could lead to an above-average threat of fire.

4. If there are any circumstances where the application of management, systems, and procedures could be open to misinterpretation.

5. If the relationship between fire safety management and other building functions unclear.
Promoting strategic thinking in fire safety engineering design …..

The Qualitative Design Review (QDR) Process of …..

The story of Caroline .....
The story of Hugo .....
What do these stories tell us?
It is not just about education, knowledge, and experience. Attitude plays an important part in the eventual success of the fire strategy.
The fire strategist

• Should be involved at the onset of the project. Why is this not always the case?
• The role should be properly understood, especially how it can add value.
• The scope should be clarified at the beginning – no surprises.
Opinion or fact?

- A real fire does not always conform to fire science.
- This opens the door for opinion engineering
- This can lead to less objectivity – loudest voice gets heard.
- This moves away from strategic thinking.
Who is a fire strategist?

- The profession is changing.
- Barriers to entry are increasing due to more sophisticated engineering.
- Memorizing and reciting paragraphs from standards is now not enough.
- The ability to think around issues is becoming important.
- The issue of competency is not resolved.
Who is a fire strategist? – profiling ....

We need to understand how our background affects our attitude to risk.

- The firefighter
- The academic
- The graduate and postgraduate
- The engineer
- The risk assessor
Competency – who is most competent?

• A doctor of fire safety engineering with many scientific papers?
• A command level firefighter who has advanced fire safety tactics?
• A vastly experienced risk assessor for fire insurers?
• A writer of international standards in fire safety and protection?
Working in a team ....

- The fire strategist
- The end client or their representative
- Architects / building engineers
- The enforcing authorities
- Insurers
- Sector based authorities
- Those involved / affected by the fire strategy – e.g fire protection maintainers.
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Question… Is the value of the fire safety engineer fully understood?
Why a fire strategy?

• Because we are required to by the enforcers?
• Because Standards recommend it?
• Because we need to demonstrate compliance?
• Because it is a sensible idea?
• Because we want to demonstrate that the overall fire safety and protection provisions meet with the objectives set?
A strategy needs …

• A clear idea of its purpose.
• An understanding of what we are trying to achieve.
• To provide a driver to get the right answer.
• To state succinctly what are its aims.
The prime reason for a fire strategy ..

..”To achieve national compliance”
The mandatory framework …

• This is what every fire strategy must cater for.

• This will include national legislation, regional or sector based regulation and insurers requirements.

• Is it right, or correct, to question the requirements given in the mandatory framework?
The objectives matrix ....
Rules, standards and regulations…
The purpose of rules ...

• To regulate the way we operate.

• To ensure consistency in our approach.

• To ensure best practice, whether technological, practical, ideological or ethical, is appropriately incorporated in what we do.

• To ensure fair play.
“Blessed” with so many rules, standards, regulations, codes, specifications, etc.

Rules can be regional, national and/or international

Rules can also be sector based.
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Negotiating the maze …

• Divide rules, standards etc. into two tiers.
• Tier one is the mandatory framework – you have to use.
• Tier two is the advisory and guidance documentation.
• Plan how you should use both tiers.
Codes, Rules, Regulations and Guidance Documents – what comes first?

- Different countries use different terms.
- “Regulations” typically carry legal powers.
- In one country, a “Code” may be mandatory and another, for guidance or for best practice.
- A “standard” may be either advisory or mandatory.
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• Prescription
• Performance based solutions

And we have two design methodologies...

• And of course the hybrid where both options are used.
Design methodologies ...
And where do rules come from?

- Quantitative rules may have a very simple and non-scientific beginning.
- Travel distances, spacing of detectors, fire zoning figures may have started as a rule of thumb but experience can prove them...to seem about right.
- Rules are written by people, often by committees, and thus may not always be perfect.
- Normally standards are written as a full document...taking clauses or sections in isolation may lead to a wrong interpretation.
And finally … a challenge

The rules, standards and codes you use, day in, day out …

Make it a point to read them, at least once, cover to cover. Then you will understand the spirit and rule of what is being said.
Using intelligence...
Intelligence ...

• Vital part of strategy in war and business.
• Do fire strategists use intelligence to develop better fire strategies?
• We need to avoid “cut and paste” fire strategies.
• The clues are out there – find and use them.
Where the clues are ....

The following slides will help provide clues as to the potential for a successful fire strategy and help identify where there may be problems or issues to resolve...
Previous fire strategies?

• For an existing building, there may have been fire strategies written in the past which can save time and resource when developing a new strategy from scratch.

• For new build projects, Client’s strategies for similar buildings may provide a useful insight.

• For new build projects and existing buildings, similar building functions or profiles may provide some additional information.
The management culture....

- Check responsibilities for fire safety and where it sits in hierarchy?
- Is there a healthy budget for fire protection system maintenance?
- How do issues such as incidents and false alarms get treated?
- Check minutes of meetings.
Fire safety policies and procedures.

- Hot works policies
- Snagging procedures after work on the building (to ensure maintenance of the fire strategy)
- Fire safety audits
- Risk assessments
Fire protection systems

- Operations and maintenance manuals
- Specifications
- Cad Layouts / Drawings
- The cause and effect matrix
Intelligence gathered can...

- Identify potential issues that may impact on the success of the fire strategy.
- Highlight factors that may have already been considered in the past.
- Help focus the strategy on what is known to work and what is not.
Know the enemy…
Understand the enemy …

- All types of strategy need to understand what they are up against.
- Understand the enemy’s weaknesses and strengths.
- Understand how the enemy will react in a given set of circumstances.
- A successful fire strategy will need to adapt similarly, to understand how a fire may ignite and spread.
- A fire strategy will need to identify the most likely and/or dangerous scenarios.
Fire science ....

- Fire science is established throughout the world.
- We understand the basics of fire ignition, growth and decay.
- We have formula, equations and models to help us to predict fire.
- But fire in a real situation can sometimes behave in an unpredictable way.
- Live situations create a near infinitesimal number of permutations.
- It is analogous to a living being.
The fire strategist and the weatherman.

- We fully understand the science behind both.
- We cannot always predict with accuracy, the outcome, even though we have a fair idea what will happen next.
- We need to identify the likely scenarios and analyse those.
The fundamentals of fire ....
Heat release rate

- Fire energy manifests in three ways – heat, light and sound.
- The amount of heat release is a key element in its measurement.
- The Heat Release Rate (HRR) is measured in Joules per second or Watts.
- As a small fire, such as a trash bin fire can produce a HRR of around 500,000 watts, it is normally measured in MegaWatts.
- The determination of the most appropriate HRR in a given set of circumstances could drive the type of fire strategy, particularly for performance objectives.
Fire load

- Another key determinant for an effective fire strategy.
- The fire load will determine the amount of heat, and smoke, generated.
- Fire load is the amount of heat generated per unit area if all combustible materials are burned.
- Measured in Kilojoules per square foot or metre.
Fire growth

- Ultra-Fast
- Fast
- Medium
- Slow

- Thin Plywood Wardrobe
- Stacked Wood Pallets
- 1.5 m (5') High
- Upholstered Furniture
- Methanol Pool
- Cotton/Polyester Innerspring Mattress
- Solid Wood Cabinets
Flashover

- A condition when head radiating from the ceiling ignites air borne gases.
- Condition increases when oxygen is allowed to fan the fire, i.e. by an open door.
- A deadly condition – feared by Firefighters.
- Fire strategist should seek to control circumstances to minimize conditions for flashover.
Fire modelling….

- Has come of age
- Two basic types – zone models and CFD
- Zone models can give simplified information but can be useful in specific circumstances.
- CFD provides a powerful tool to analyse scenarios and can illustrate how changing aspects of the strategy can affect fire growth and movement.
Fire modelling....
Remember ....

TRASH IN = TRASH OUT
Fire risk assessment

- For existing buildings – an essential input to a fire strategy?
- For new build – use similar profiles of risk.
- Various methodologies
- Simplified scoring systems or tick sheets may not reveal the
Fire risk assessment

- Probabilistic
- Comparative
- Deterministic
Risk profiling ....
The physical terrain
Examining the terrain ...

"Any form of strategy will only work if the terrain has been properly examined."
The building -

- The primary focus of the fire strategy
- Design and layout will dictate the fire strategy for
  - Life safety
  - Property Protection
- Something else?
Location

- Geographical features
- Access to building for emergency services – think of the possibilities for restrictions at certain times of day.
- Neighbouring buildings
- Obstacles and obstructions
- Affects of weather in causing adverse exit or entry conditions.
1. Structural fire engineering is a highly specialized subject
2. Outside the realms of many fire strategists
3. Modern building design is continuously pushing boundaries
4. There is a move towards performance based structural methods.
5. There is a need to look both independent and dependent methods of construction.
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Building structure 2

1. Performance approach – live fire tests of structures.
2. Even building buckling but not collapsing may impact on the evacuation and firefighting strategy.
3. Issues such as structural stability and minimum time to failure need to be carefully assessed in context.
4. Fire scenarios chosen need to be based on likely events.
5. Considerations to include external fire threat on structure as well as external fire growth up the structure.
6. Consequences for error much greater than for, say, fire detection and protection siting.
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Building layout and sub-division 1

1. Start with basic assumptions without using standards—what are the “no brainers”.

2. For life safety, redefine the fundamental requirements
   1. Escape routes are suitable for everyone
   2. All persons will be separated from a fire until they reach a place of safety
   3. Etc.

3. Then define—sub-principles, such as prescribing dimensions and layout, sub-divisions into fire compartments, etc.

4. Consider how the layout and sub-division strategy differs or agrees with conventional or prescriptive guidance, performance requirements set and match with building features.

5. What about Trade-offs—e.g. compartmentation vs sprinklers?
Building layout and sub-division 2

1. Define further guiding principles. Whether they are covered in Codes or not.

2. Examples of guiding principles:
   1. Every occupant of the building should have two available routes of evacuation. Where this is not possible, additional fire safety and protection provisions may be required to protect the single route of escape.
   2. Horizontal travel distances to an escape route should be minimised and ideally, be on the same level.
   3. All means of escape should lead directly outside of the building (other than where there are designated places of relative safety). No means of escape should lead back into a potential fire affected area.
Building layout and sub-division 3

1. Consideration of smoke and heat control methods – natural or forced
2. Keeping the threat away from evacuees for a required period.
3. Consider the possible routes that fire/smoke may take. Identify possible paths.
4. Consider what you may not know as well as what you do no, e.g. hidden voids.
5. Sometimes, very old and heritage buildings have internal air paths built in to allow the building to breathe – you cannot simply block these up without affecting the building use.
Building internal risks

1. Internal Linings – walls, floors, ceilings. Considerations to include:
   1. Ease of ignition.
   2. Rate of heat release.
   3. Surface flame spread rate.
   4. Smoke production rate.
   5. Total potential heat release.

2. Furnishings and other building contents – assessed as part of a risk assessment.
Building plant & services

- Do they constitute a hazard? This will normally be part of the risk assessment and hazard analysis process?

- How susceptible are key services to a fire? In this case, we will need to consider how they are separated from other risks.

- Critical services in a fire scenario to be identified.
Internal processes

• All processes should be identified.
• How does each process contribute to risk?
• Processes will include manufacturing, test and inspection and computer processing areas.
• Handling of the general public in a building is a process.
The Hazard Matrix

- A
- B
- C
- D

Process Hazard

Environment Hazard
Use of the Hazard Matrix
The human terrain
The human element ..

It is likely that military strategists will evaluate the following parameters;

- What are the numbers of people involved?
- Where are those people likely to be – will they be spread evenly over the area or will they be concentrated in certain areas?
- What are their profiles (age, mobility, language, aptitude, etc.)?
- What is the likely reaction to events?
- What will be their speed of reaction and response?

Is this not the same considerations as for a fire strategy?
Guiding principles for the human terrain…

• Principle 1: All persons in the building need to be able to escape safely before the building collapses. This leads to two parameters:

  (i) the length of time that the building is likely to withstand a fire before collapsing, and
  (ii) the time required for all persons to safely evacuate from the building.

• (i) to be bigger than (ii)

• Leads to more principles ....
Guiding principles for the human terrain…

• Principle 2: All persons in the building need to be able to escape safely before the conditions for escape become untenable. This leads to the need to separate fire and its products from the evacuees.

• Principal 3: The building structure is to withstand a fire to allow for firefighters to perform their function(s). This requires an assessment of attendance time and time to be ready to fight a fire, wherever it may be.

• Principal 4: If persons cannot be evacuated to a place of ultimate safety, they will need to be evacuated to a place of relative safety. (e.g Refuges)

• And there could be more?
Evacuation analysis

- Prescriptive guidance uses a standard set of average units – movement speed, etc.
- Performance assessments – ASET/RSET
- Requires strategic thinking to get meaningful results.
- Need to move away from simplistic “average speed” calculations.
Evacuation issues

• Is there such thing as an average travel speed?
• Every type of human profile will travel differently.
• Every one of us has different travel speeds – in a hurry, on the phone, etc.
• What about mobility impairment?
• Are people under the influence of alcohol not mobility impaired?
• Concept: Our travel speed is dictated by the slowest person in front of us.
• The issue become extreme in crowded restricted environments – e.g underground stations.
More evacuation issues

- In a live emergency, issues such as confusion, anxiety and arguments may actually slow down evacuation times.

- If we considered the slowest person in such a situation dictating the speed of evacuation, what does this tell us?

- People tend to want to exit the way they came in.

- Are all exit routes used equally in the event of an emergency? Is there not skewing towards favoured exits or those that the majority are using?
Pre-movement time

- The time between hearing the alarm and responding to it as planned in the fire strategy.
- Do we properly account for this period in our calculations?
- Is there a relationship between the type of alarm and the speed of response?
- The herding affect – identify the shepherd in the strategy…
Evacuation modelling

- Requires objectivity and discipline – avoids opinion engineering
- Modern programmes have been properly validated.
- Key benefits may include –
  - Can use actual CAD layouts including 3D perspectives. Allows alternative layouts to be assessed.
  - Can allow for people profiling based on actual statistics
  - Can be combined with fire modelling to see impact of fire on evacuation, in real time.
Strategic vision
The fire strategist – a visionary!

- Concept: Every strategy should be based on a vision.
- To picture what the strategy is about and what you are trying to achieve.
- What do the indications tell you?
- Use wisdom at the front end of analysis.
- This is not opinion engineering but experience engineering!
Introducing – the strategy value grid
The strategy value grid – in use
What does the grid tell you?

Management strategy

Suppression strategy

Containment strategy

Active protection strategy
Use your resources.
Resources, resources
Resource usage.

• The fire strategist has a wealth of systems and concepts that can be used.
• This does not mean a belt and braces approach.
• Any strategy can be successful if every type of resource is used.
• The secret is to apply limited resources strategically.
Over-engineered solutions

- Pure prescription in the past allowed little flexibility – can force over engineering.
- Codes and standards can be typically risk averse.
- Over engineering may be corporate policy.
- Performance based solutions should prompt optimum engineering solutions.
- Risk of litigation can lead to over specification.
The marginal value curve
The allocation of resources

• Every form of fire protection will have strengths and weaknesses for a given application.

• The idea is to ensure that the most appropriate system or concept is utilised.

• The efficacy of system concepts can be evaluated in the following ways:
  • Performance
  • Logistics
  • Economics
Quantified assessment of options

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<th>Option B</th>
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Heading to victory
What does victory – or success look like?

• Victory is when you meet your objectives.
• But how should this look like for the fire strategist?
• Does the strategy meet the expectations of all stakeholders?
• How large a document?
• How detailed?
The fire strategy style

- Every organisation will have an in-house format.
- The style should ideally be agreed or understood at the onset.
- It should be clear and concise.
- Conclusions should be easily understood.
- Ambiguity should be avoided.
- All stakeholders do not need to understand the minutiae.
- It should be pitched at the right level of detail.
The right level of detail?

• “The fire detection system should be installed as appropriate.” (What does this mean exactly? – Too vague)

• “All fire separations should be constructed using two layers of “Manufacturer” board on a three inch wooden frame.” (This is a specification and not a strategy)
Have we forgotten something?

- What should be in, and not in, a fire strategy?
- How do we know if one aspect has been considered?
- How do we know if one element of the strategy has been mistakenly or intentionally left out?
- “Cut and Paste” fire strategies – can very easily lead to omissions.
The sub-strategy approach

- Divide, for internal purposes, the strategy into sub-strategies.
- This can assist with identifying every aspect has been considered.
- Incorporated into British Standard PAS 911
- The sub-strategies –
  - Management of fire safety
  - Evacuation
  - Fire fighting
  - Fire and smoke control
  - Fire protection
The fire strategy statement

• Every strategy should start with a statement
• This is an introduction and overview of the strategy.
• Can provide an historical perspective.
• It should give an overview of the background, objectives and assumptions made.
• Can assist with a subsequent audit trail.
Strategy handover

• Prior to handover – consider peer review.
• In any case, there should be a proper review process.
• The Client will need to be advised of his obligations to ensure the strategy remains effective.
• It is a live document.
• Should be reviewed on a periodic basis.
• Recommended that a full in depth review every five years.
Extreme events

• Usually excluded from the scope of a fire strategy.
• We often think of 9/11 when we think of extreme events.
• Two simultaneous fires in a building could be regarded as an extreme event.
• Sometimes extreme events need to be handled by a crisis management plan – which will be well outside the remit of most fire strategies.
Thank you

Can you identify three ideas that have changed your way of thinking?