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Fire Risk Assessment

- Common sense and a little mathematics?

Dr David Charters
Director of Fire Engineering

Why Assess Fire Risks?

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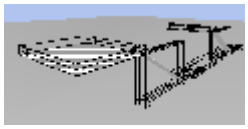
Equivalency:

"…demonstrate that a building, as designed, presents no greater ***risk*** to occupants than a similar type of building designed in accordance with well established codes."

Why Assess Fire Risks/Manage Business Risks?

Fire Engineering Design Brief

1. Structural design of building
2. Fire safety objectives
3. Fire hazards & consequences
4. Trial fire safety designs
5. Acceptance criteria & method analysis
6. Fire scenarios for analysis



Fire Safety Order 2005

Fire Risk Assessment

Which fire risks are highest priority?

Hazard frequency

Occurrence frequency, F	Range	Rating
Never	< 1 in 10,000 years	0
Remote	1 in 1,000 to 1 in 9,999 years	1
Rare	1 in 100 to 1 in 999 years	2
Infrequent	1 in 10 to 1 in 99 years	3
Occasional	1 in 1 to 1 in 9 years	4
Frequent	Once to 10 times per year	5
Common	> 10 times per year	6

Hazard Severity

Severity (Life safety), S	Rating
None	0
Minor injuries	1
Major injuries	2
One fatality	3
Multiple fatalities	4

Prioritised fire risk ratings

Location	Risk rating
Link Works	10.0
Food Prep Basement	9.1
Retail Outlets	9.0
East Side Offices (including Station Control Room)	8.3
Non-Public Areas – West side offices and South West offices	8.3
Platform 9 - 11	8.3
Platform areas 2 to 8	8.3
Concourse and forecourt	8.0
Platform 1 and Access Road	8.0
Clothes store (above 9 - 11)	7.0
Car Parks	6.3
Parcel Post	6.3
Underground Station	5.0
Public Highway	5.0
Hotel Way	4.0

Largest fire safety experiment in the world

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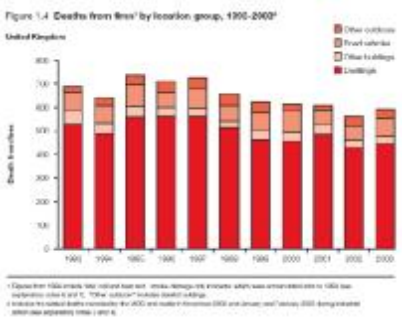
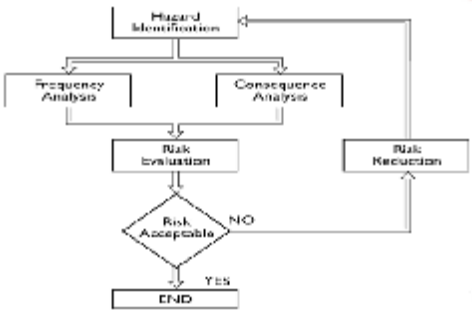
UK Fire Statistics



Quantitative fire risk assessment



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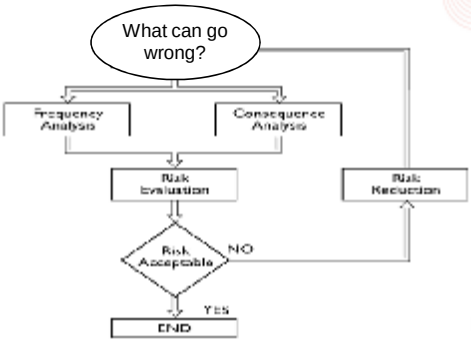

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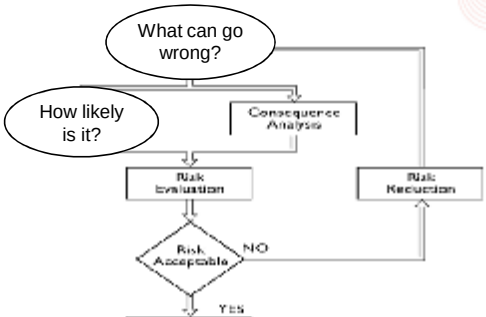
Quantitative fire risk assessment



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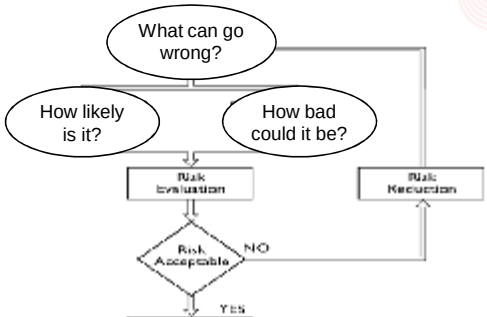

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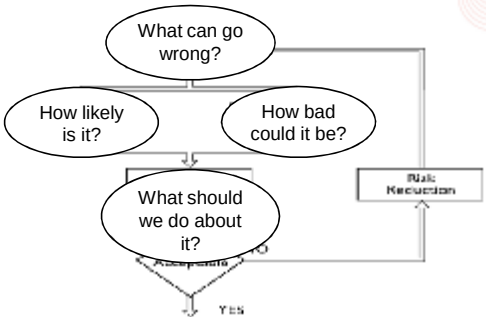
Quantitative fire risk assessment



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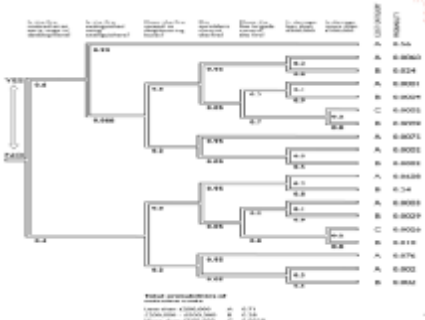
How often will it happen?



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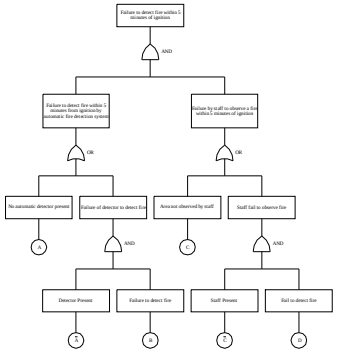
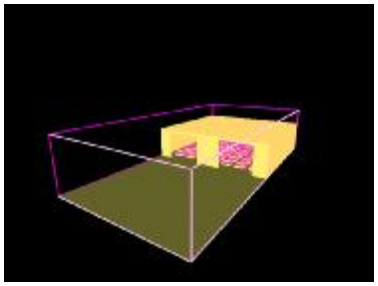
Frequency Analysis



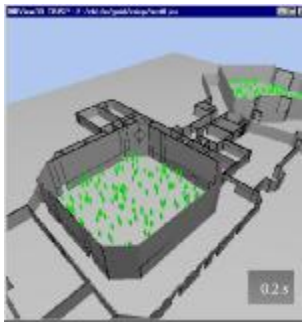
How bad will it be?

Full scale fire experiments

Computational fire models

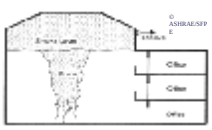


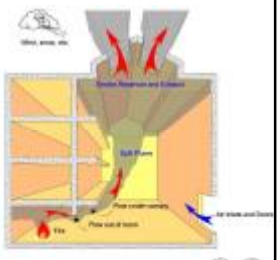
Computational egress models



Simple calculations

- Temperature?
- Depth?
- Toxicity?
- Visibility?
- Radiation?





Why do we accept or tolerate risks?

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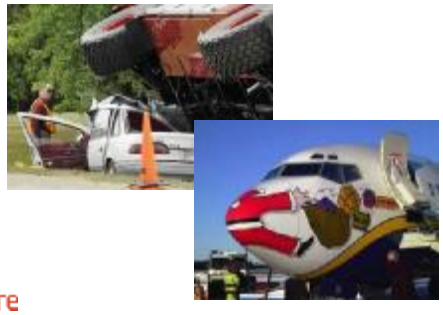
Why do some people who drive have a fear of flying?



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Why are fire risks higher in dwellings?

Occupancy	Probability of casualty/occupant year
Dwellings	1 in 910
Hotels	1 in 4,000
Banks	1 in 63,000
Government	1 in 7,100
Schools	1 in 240,000
Colleges	1 in 83,000
Hospitals	1 in 29,000

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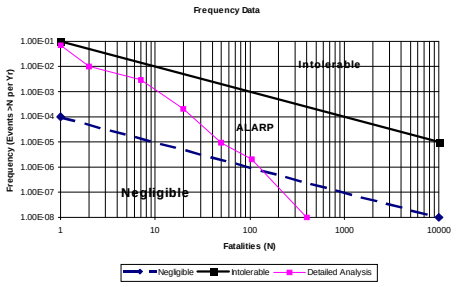
What level of risk will society accept?



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Where is fire risk assessment applied?

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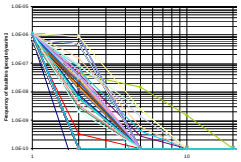
Shopping Centre design, Denmark

First shopping centre in Denmark:
- No risks intolerable or negligible
- Large retail units:
  - Risks are not as low as reasonably practicable!

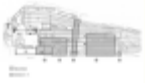
Improved safety!



Charters and Wu 2003

Network Rail fire risk management, UK

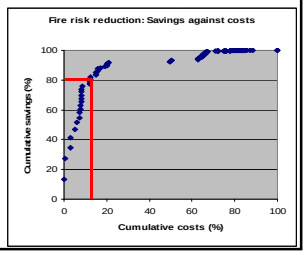
Quantitative Fire Risk Assessment of 90 assets



80% of benefit from 15% of investment

£3m investment:
- Avoid £22m of poor investment
- Savings of £14m **every year**

Improved punctuality!

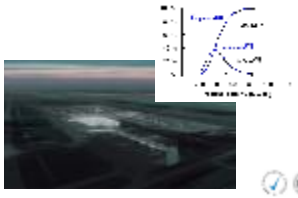


Charters and Wu 2002

Changes to Building Regulations Guidance

Regulatory Impact Assessment:

CRISP (Computation of Risk Indices by Simulation Procedures)
Monte-carlo Simulation



How can we innovate safely?

New designs:
- Larger
- Taller
- Deeper
- More complex
- Open plan
- Atria everywhere

New fire safety solutions:
- Alternative fire strategies
- Reduced protection
- Sustainability

Recent and immature?

1657 Probability theory — Pascal

1792 First quantitative risk assessment — Laplace

"…common sense and a little mathematics…"

Why quantify fire risks?

"What can go wrong, will go wrong."

Disraeli

"If you can not measure it, you can not control it."

Lord Kelvin

"If one would divine the future, then one must study the past."

Confucious