Quality assurance with water mist systems

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Introduction to FFSB

- Specialist engineering consultancy firm – Fixed Firefighting Systems:
  - Specification
  - Hazard review
  - Design review
  - Inspections

Also:

  - Expert witness / failure / independent investigations
  - Standardisation

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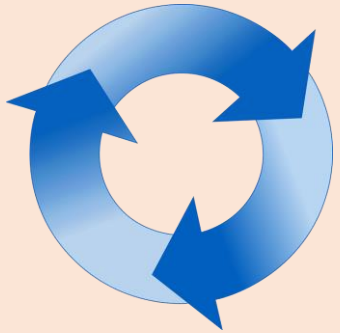
Preventative



Also:

- Expert witness / failure / independent investigations

after-the-event

- Standardisation

capturing knowledge & lessons learned

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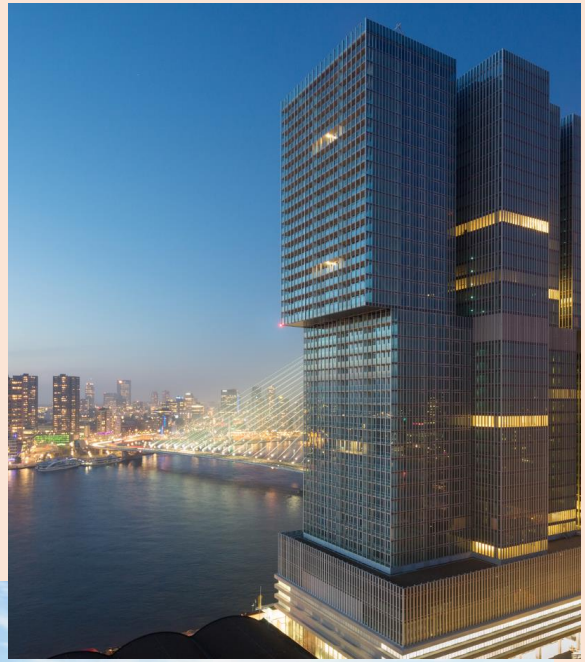
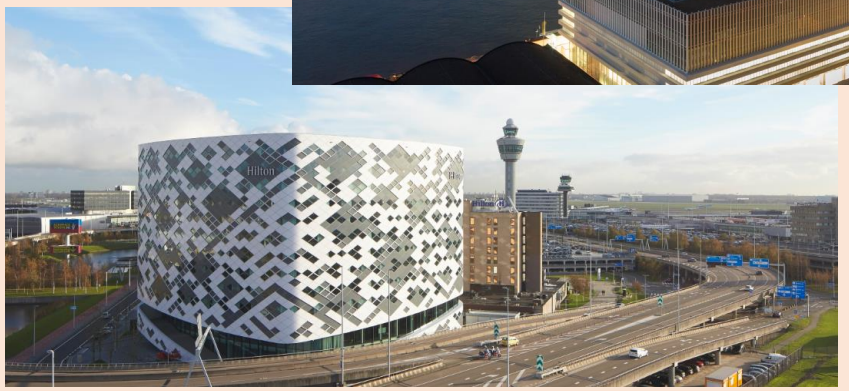
Introduction to DGMR

3 offices
200+ employees
2,000 projects per year
15,000,000 turnover





Consultancy services
Acoustics and sound
Building Physics
Fire safety and security
Sustainability and Health
Facade Technology
Spatial Planning and Environment
Vibration
Software

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Definition: Quality Assurance

- *Methods of preventing mistakes, defects and avoiding problems when delivering products or services to customers*
- The product should be suitable for the intended purpose: *fit for purpose*
- QA (assurance) is more holistic [whole process] than QC (control) [late stage] ***References: ISO 9001, Wikipedia and others***
- *"The task of **engineering** is to make it work once, while the task of **quality assurance** is to **make it work all the time**"* ***References: Prause et al,. Journal of Software: Evolution and Process***

Quality Assurance

*"The task of **engineering** is to make it work once, while the task of **quality assurance** is to **make it work <u>all</u> the time**"*

- There is no such thing as a 'all the time'.
- But what reliability should it have?
- Big gap in fire safety: no measurable requirements laid down (for e.g., 1 failure every 100 years?)

As an example: In the Netherlands, the law stipulates the maximum risk of becoming a victim of flooding but not of fire.

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Suppression systems

- What does **"*make it work*"** mean for a fire suppression system?
  - *1) Suppress a fire of any reasonable form if/when needed to do so.*
  - *2) Sit idle for many years [no unwanted activations, leaks, ready to operate automatically]*
- Often this will need to be for the whole life of a building and with minimal maintenance.

So what QA measures are going to be prudent for a suppression system?

QA examples

This one 5000 years old; QA of bowls not a new concern to humans

- Product: Bowl
- Purpose(s):
  - Store paperclips (?)
  - Prepare, store or serve food

- No significant consequences
- QA not that important (?) IGNORE

Considerations:

- Safe for contact with food
  - Toxicity of materials/finish
- Resistance to heat (maybe)
- etc

QA examples

A jet propelled semi-flexible flying tube full of fuel and people

- Product: Plane
- Purpose(s):
  - Transport
  - Military

Considerations:

- MANY; **consequences of failure are obvious to us all** ⚠

Meticulous QA model required in all respects:

- Design [electrical, mechanical, software, hardware]
- Materials [properties, suitability, repeatability]
- Construction [suitability, repeatability]
- Maintenance
- Operatives [competency, training, adherence]
- Operation [defined parameters, within limits]
- etc

All aspects are highly regulated within generally prescriptive frameworks

QA examples

Toxic chemicals which in just the right amount and formulation can have therapeutic properties

- Product: Pharmaceuticals
- Purpose(s):
  - Net-benefit to

Considerations:

- Human consumption of potent chemicals; can be toxic and lethal ⚠
  - Beneficial therapeutic effects
  - Adverse effects

Meticulous QA model required in all respects:

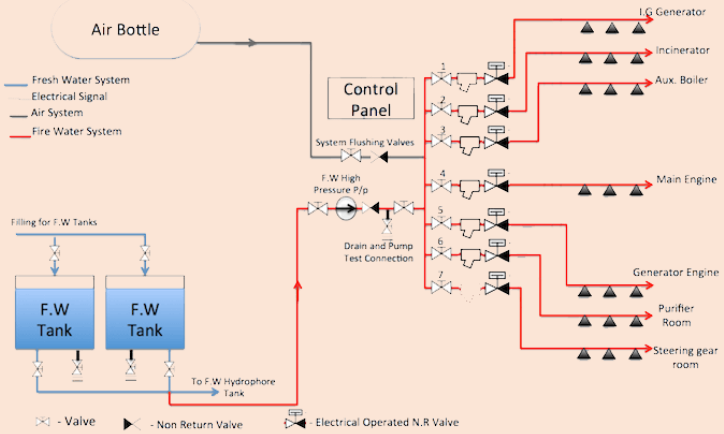
- Discovery, R&D
- Clinical trials
- Approvals
- Manufacturing

All aspects are highly regulated within generally performance-based frameworks

QA examples

Stored firefighting media and means of automatic delivery to a fire area

- Product: automatic firefighting system
- Purpose(s):
  - To suppress a fire



Considerations:

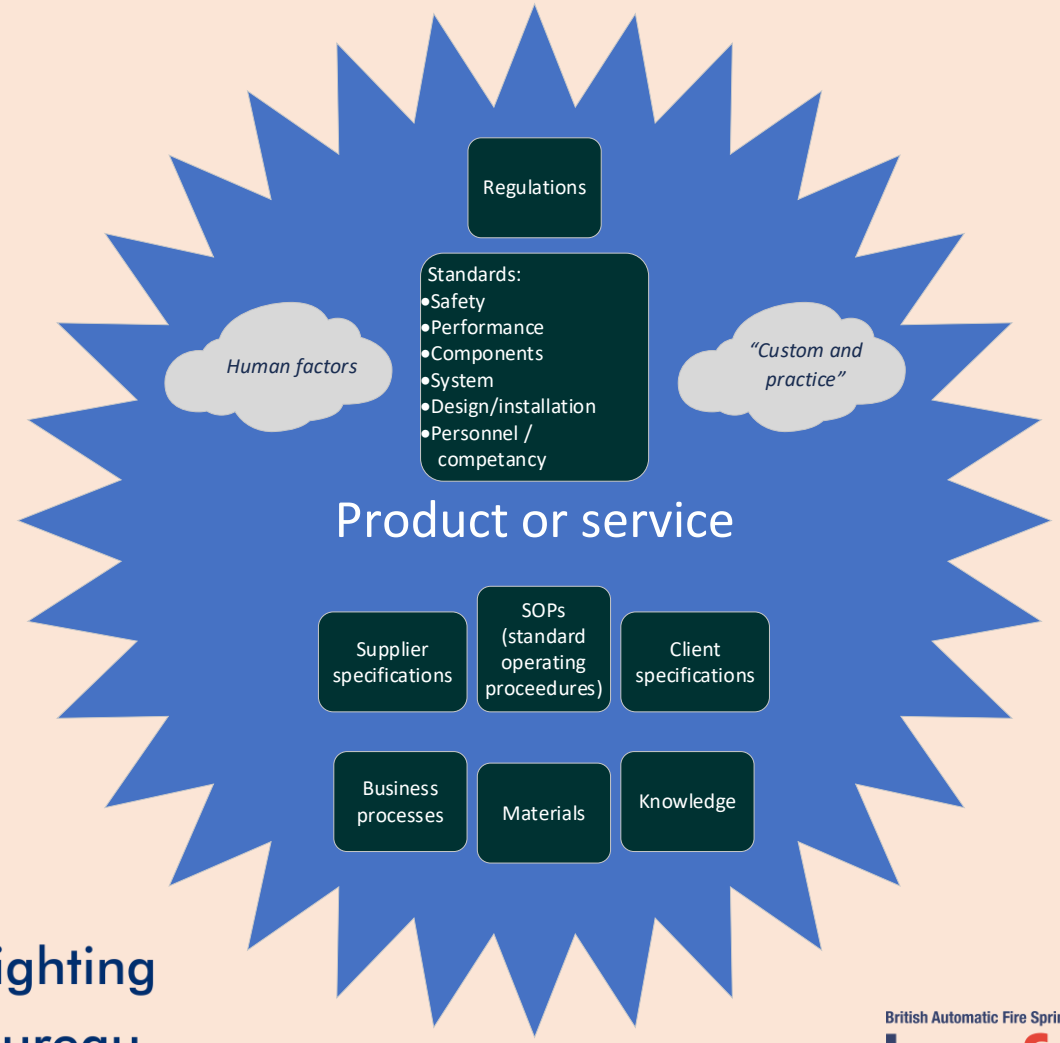
- Lives and property could depend upon satisfactory operation of the system ⚠
  - Likelihood of effective operation in any given scenario ? [critical function; needs to be highly likely]
  - Needs to reliably sit dormant (i.e. not leak, explode, seize, rupture, etc) [almost uniquely challenging]

Largely unregulated* QA model:

- Largely market-driven (e.g. not regulator) [systems needed to work to be financially viable; life safety came later]
- Sprinklers and Gas = most mature and evolved QA models [*but some significant gaps e.g. third party surveillance*]
- Other systems … evolving (?)

*Exceptions: e.g. PED/TPED (but nothing to do with system objective)

So what have we got?



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Quality Assurance: ‘Breaking the system?’

- Even a perfect system can be broken by not doing what you must do, experience:
  - not following manuals (DIOM)
  - working outside the scope of the product
  - use up your safety margins
  - *forget the relation with the fire test*

RTMS – "read the manual, stupid“
(and act accordingly)

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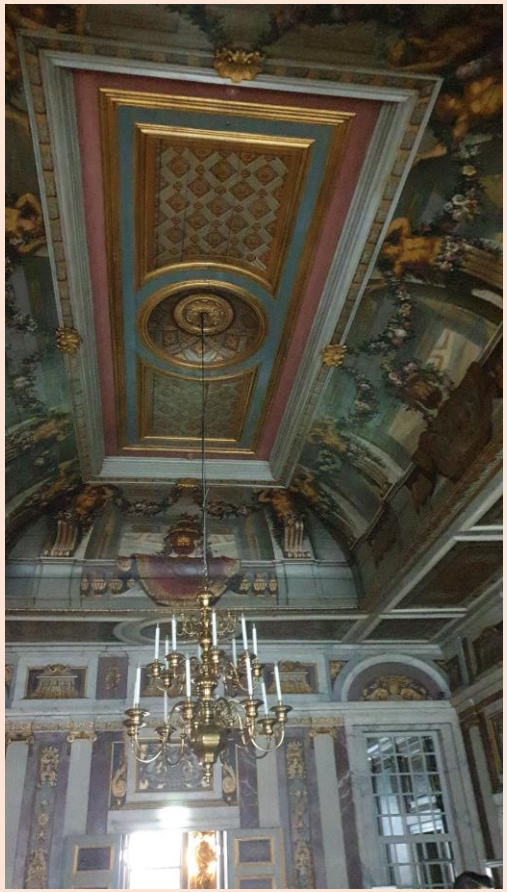
Relation with the fire test

- Laboratory test with:
  - Certain ceiling height
  - Flat ceiling
  - Non obstructed ceiling
  - Noncombustible ceiling
  - Fire load



Use up your safety margins

- In engineering, a safety factor (SF), expresses how much stronger a system is than it needs to be for an intended situation.
- Many systems are intentionally built much stronger than needed for normal usage to allow for emergency situations, unexpected loads, misuse, or degradation.

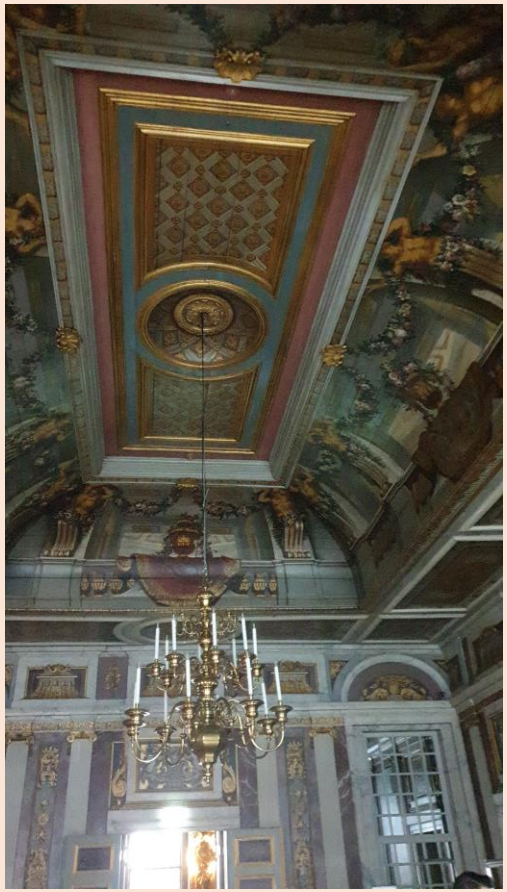
fire is not an emergency, for the system is its 'day job'

- Using up safety margins as compensation for bad or economically better design is a bad idea
- Some standards require a 50% safety in design area (4 vs 6 heads)

Example: Use up your safety margins

- Use safety margins for:
  - Ceiling heights more than tested
  - Larger spacing head to walls
  - Sloped ceilings
  - Obstructed ceilings

Can it work? Maybe a yes, but with additional proof



Conclusions

My opinions, based on my experience…

- Mist is an emerging technology with attractive attributes:
  - lower application rates of media (often, but not always)
  - therefore smaller pipes, smaller tanks
- Users need assurance on and understanding of the expected level of performance *[they often do not know this is what they need OR assume that all systems are equal – they are not]*
- With limited exceptions, current Mist QA frameworks do not deliver this.

Suggestions

Keep it simple

- Reduce the scope/complexity of the product
- Reduce the scope/complexity of the target application

Don't do it alone

- Create the necessary comprehensive third party certification schemes (components, systems, installers, designers, maintenance providers)
- Create more competent independent system assessors/evaluators

Do what you should do

- Follow the rules and guidelines

Suggestions

Define reliability and quality

- Define quality and safety in performance numbers
- Embrace safety margins

Strong standards:

- Embrace the benefits of standardisation (e.g. accumulation of knowledge, iterative improvement, interoperability and standards that positively influence products)
- Write more and better standards faster.
- Reduce the number of overlapping/conflicting/bad mist standards

Learn from the past

- Have a conversation about what success looks like (other than sales)
- Establish feedback loops (i.e. learn from successes and failures)
- Independent, credible water mist success (and failure) data collection mechanisms required. Open and transparent publication.

END

Thank you

Questions?

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