Hydrogen Safety and training for airport rescue and fire fighting: an immersive training programme

TRILEMMA workshop- May 2022

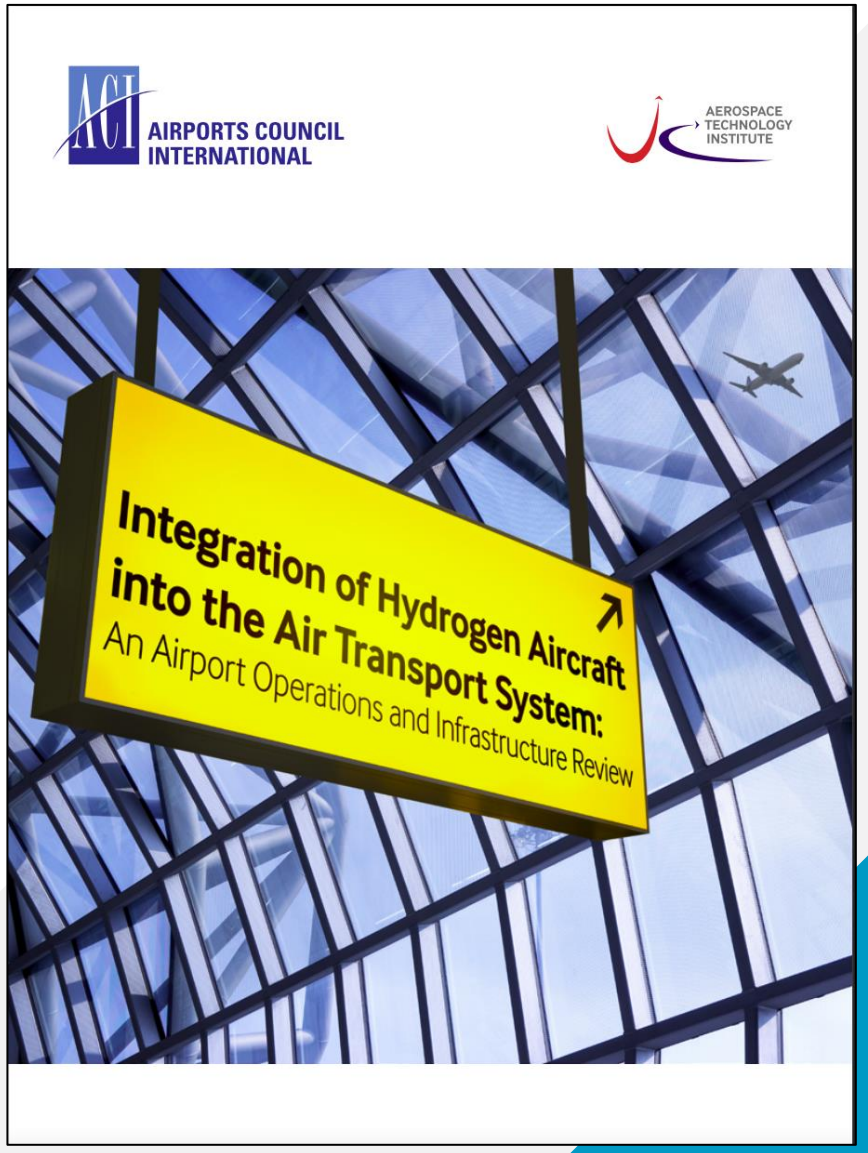
Dr Thomas Budd

www.cranfield.ac.uk

Current gap in knowledge

“The review highlighted areas where more information needs to be gathered to inform analysis and pursuit of hydrogen infrastructure, including but not limited to;

Qualification and training for rescue and fire fighting services, ground handling service providers and fuel service providers.”



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Key questions

1. What are the properties of H_2?
2. How will H_2 aircraft vary compared with current technologies?
3. What are the key hazards/mitigating measures associated with H_2?

The aim

Using immersive 360 video and XR (extended reality) technologies, the project aimed

to deliver an immersive training scenario for airport personnel covering an ‘awareness level’ overview of hydrogen safety in aviation.

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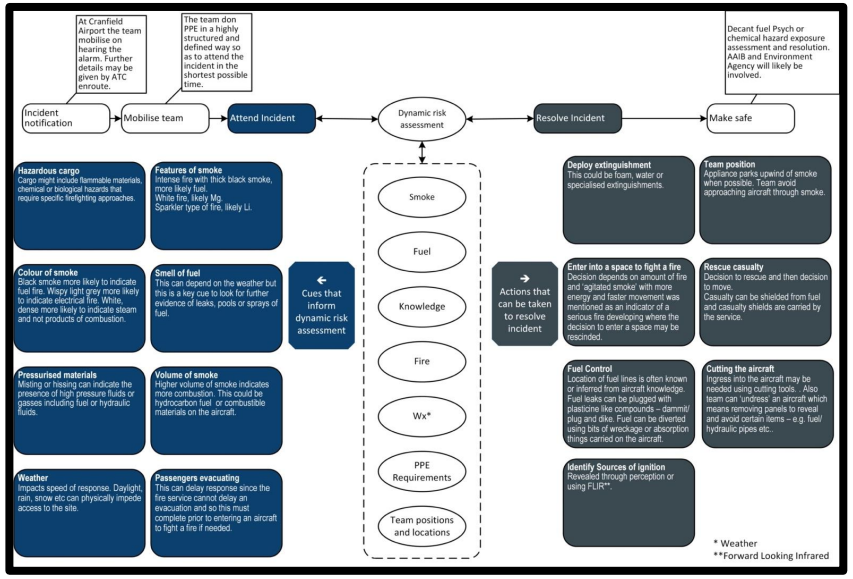
The process



1. Define scenarios and develop learning material

2. Conduct live simulations

3. Create immersive training programme

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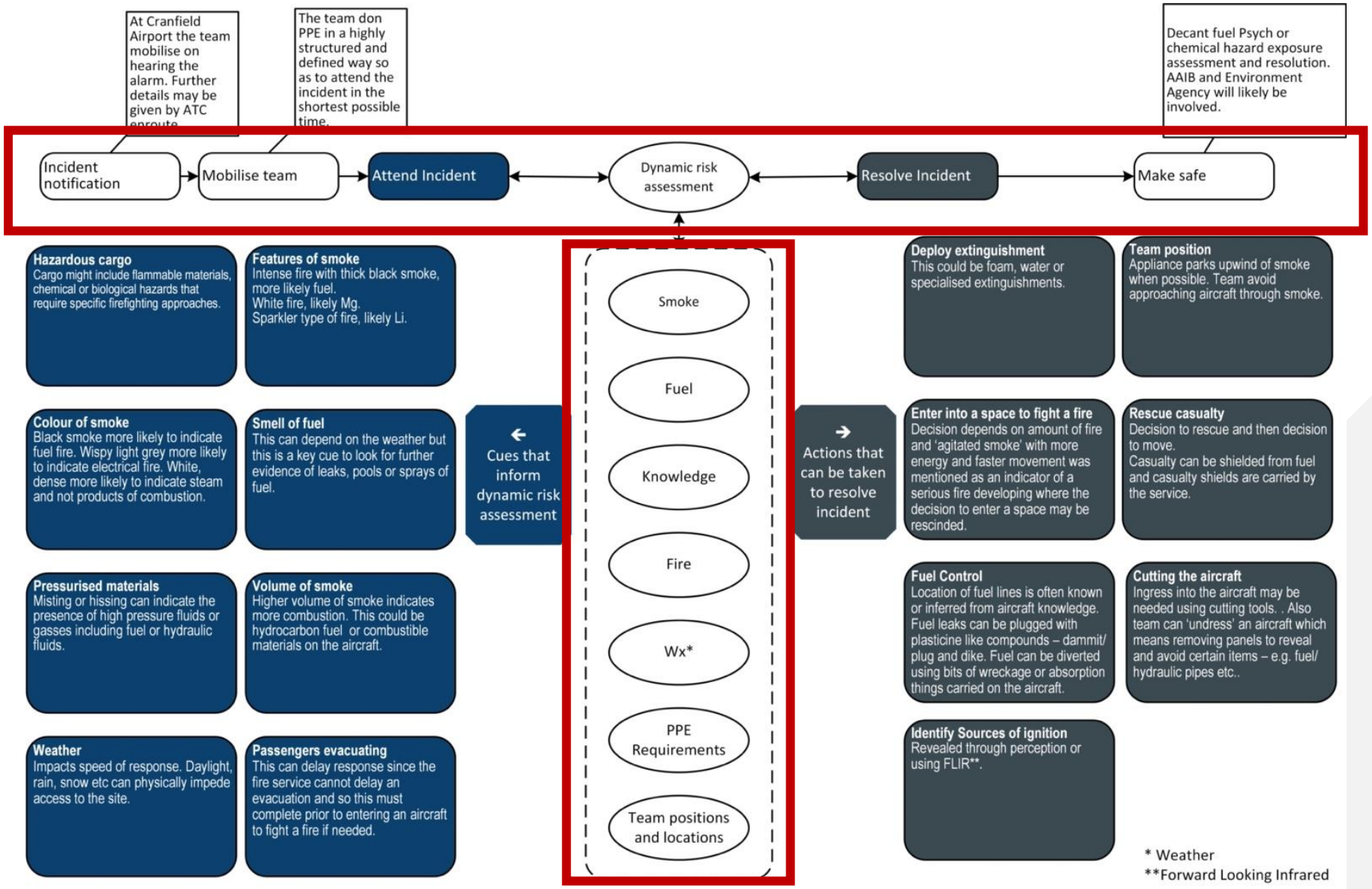
1. Define scenarios and develop learning material



Critical Decision Interviews conducted with Cranfield Airport Fire and Rescue Service

Cue	What may change?	What may remain the same?
Smoke	Hydrogen fires do not produce the large volumes of black smoke produced by the carbon content of hydrocarbon fuels like kerosene.	Smoke will still be produced by combustible materials on the aircraft or the aircraft itself.
Fuel	Hydrogen cannot be seen and is buoyant unlike kerosene fuels. Sources of hydrogen are likely to be under pressure and as such, new technology may be required to identify temperature differentials that would indicate that hydrogen is present. Explosive atmospheres may also be produced by concentrations of hydrogen gas representing new threats and different management techniques.	Fuel will still present a key fire risk and threat to life.
Knowledge	Hydrogen aircraft may differ significantly from hydrocarbon powered aircraft. Firefighters may need to evolve their procedures to respond to new structures, supply arrangements and pressurised, cryogenic storage of the new fuel.	Principles will likely remain the same. Fuel still needs to be stored and distributed to powerplants.
Fire	Hydrocarbon fuels burn in a visible and well-known way. No such assumptions can be made with hydrogen. Hydrogen may dissipate rapidly prior to combustion or indeed be manually released by the aircrew in response to a predicted crash-landing. Hydrogen fires do not burn with a visible flame and so more use of FLIR technology may be needed.	Fire will still present a key risk and threat to life. Fire will still be produced by combustible materials on the aircraft or the aircraft itself.
Weather	Wind direction may inform the assessment of risk from pressurised hydrogen and any hydrogen leaks identified by the fire service.	Smoke and fire will still be produced by combustible materials on the aircraft or the aircraft itself and as such assessment of weather will remain important.
PPE Requirements	As hydrogen has a very low minimum ignition energy and is easily ignited, anti-static and fire retardant PPE will be required when responding to hydrogen incidents. This could include; - Cryogenic eye protection - Gloves - Boots and anti-static overalls	Risks that include fire, falling objects, heights, unsurvivable environments will still be present in the fire service role. PPE will still need to mitigate these risks and protect crew.
Team positions and locations	New procedures associated with hydrogen aircraft may require team members to adopt new default locations or positions as required by the incident commander. There may be scenarios that require specific distributions of crew to mitigate risks and resolve an incident.	Current team positions and communications will likely evolve but not change radically due to well-developed team working skills.

2. Conduct live simulations

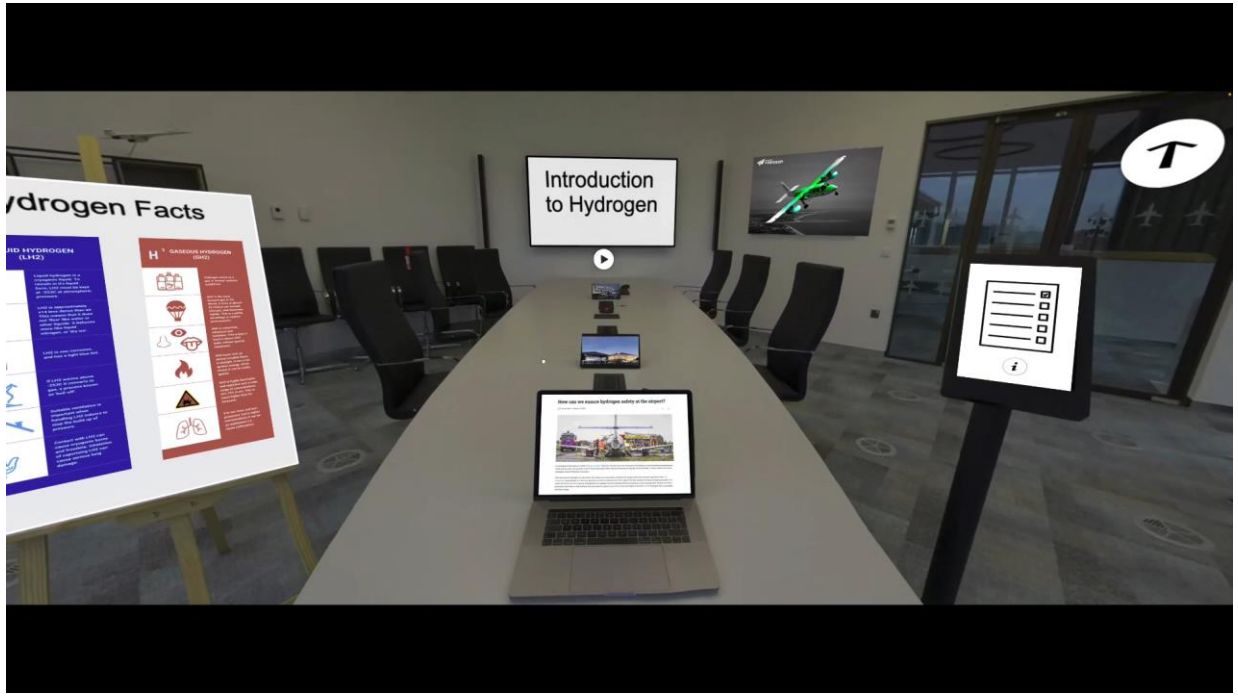
360 filming in the Ground Operations (Go) Lab, DARTeC

Simulated response to a suspected hydrogen fire

‘FRESSON’ aircraft

3. Create immersive training programme

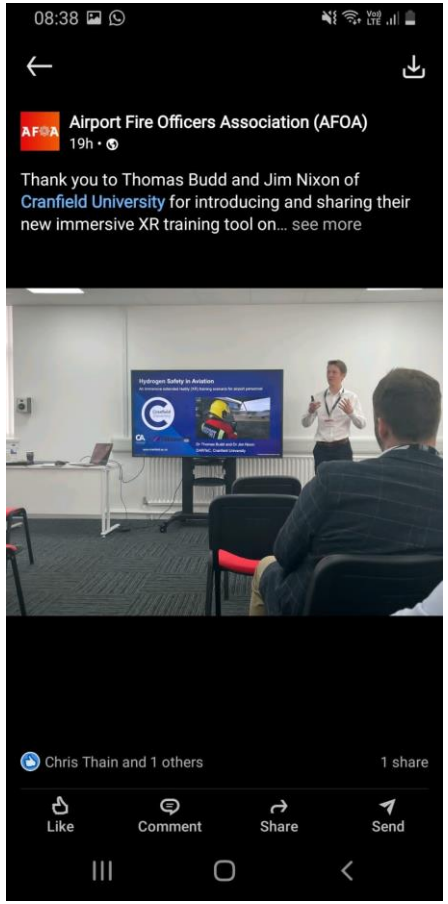
Module 1: Hydrogen Basics



Module 3: Hydrogen Safety

Dissemination

T-TRIG ZEFI showcase, London- March 2022



Airport Fire Officers Association annual conference- Cumnock, April 2022

Download for desktop free at the DARTeC, Seamless Journey website

https://www.cranfield.ac.uk/centres/digital-aviation-research-and-technology-centre/seamless-journey

Thank you

Thomas Budd, Jenny Kavanagh, Rob Abbott, Jim Nixon, Rhona Whitlock, Lindsay Grant, Romano Pagliari, Rob Marsh, Fillippo Pragliola

To learn more, scan the QR code

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