EngineeringX

Exploring the safety of super-sized structures

Royal Academy of Engineering

bre

UCL

Lloyd's Register Foundation

Exploring the safety of super-sized structures (short summary)

1 Introduction

The Royal Academy of Engineering, University College London and BRE (Building Research Establishment) held an Exploring the Safety of Super-sized Structures (4S) workshop on Monday 11 May 2020 on behalf of Lloyd's Register Foundation, which looked in detail at whether the size of structures across a different set of domains had some generic features that needed exploring with respect to safety engineering.

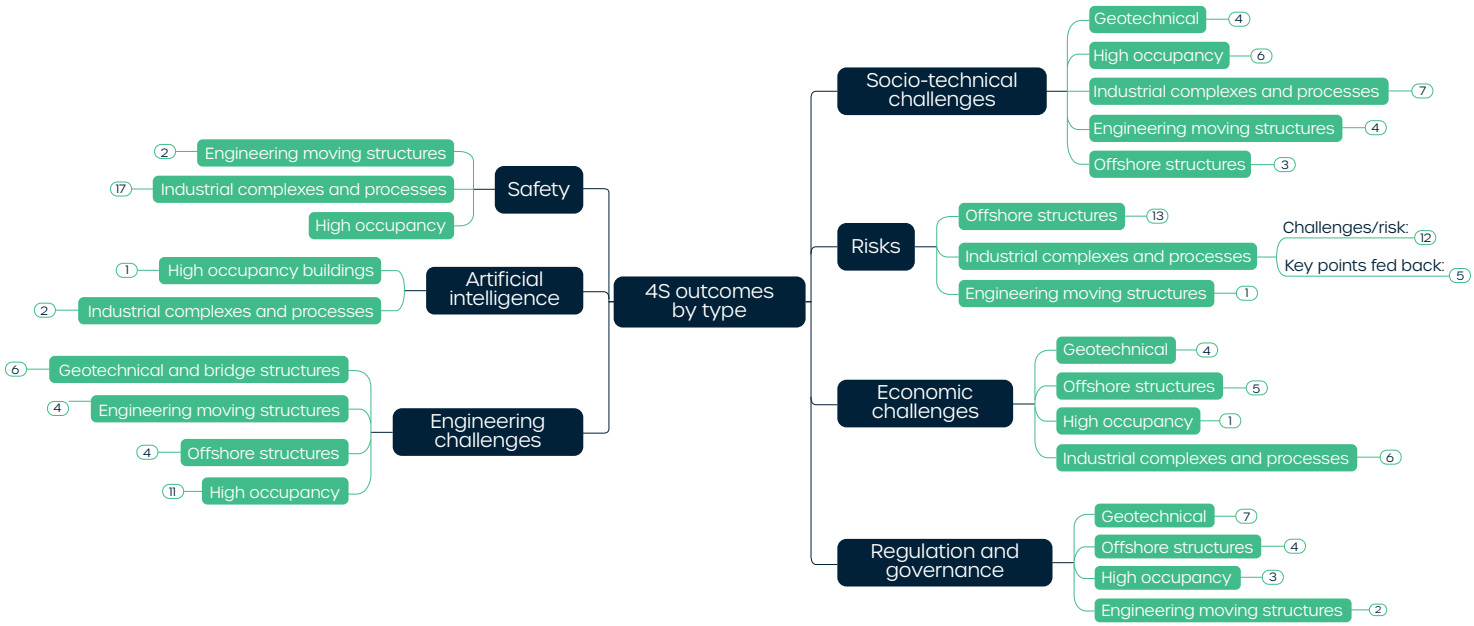
The 4S workshop brought together more than 30 experts to report on five theme groupings, which were representative of the safety issues around super-sized structures:

- **Industrial complexes and processes** (manufacturing and process industries)
- **Geotechnical structures** (dams, tunnels, bridges)
- **Engineered moving structures** (aircraft, ships)
- **Offshore structures** (oil platforms, wind farms)
- **High-occupancy buildings** (residential and commercial)

In each of these theme groupings, we explored the following generic and cross-cutting challenges:

- **Competency –** of engineers responsible for signing off engineering projects and who are working with clients to properly apply cost engineering principles while not losing safety features.
- **Engineering –** turning design into constructable structures that must maintain the design intent where it includes safety.
- **Socio-technical issues –** how the ease of creating safe systems through new technologies could help, how people viewed risk from a behavioural point of view, and how transparent engineers needed to be with the client and society in general.
- **Economic –** there is an economic factor with respect to cost versus benefit and as low as reasonably practical (ALARP) precautions.
- **Regulatory and governance –** the role that regulations and governments can play in ensuring correct and better outcomes from the overall process.

2 Mind map methodology



The above mind map shows the complexity of the issue being discussed. Particular topics that came up multiple times in conversation were grouped. These included safety, artificial intelligence, engineering challenges, socio-technical challenges, risks, economic challenges, and regulation and governance. The full report contains details on each topic, including quotes from participants.

3 Key recommendations

From the discussions described above, the following three key recommendations were formed:

- **Outcomes-based regulation –** placing responsibility with the owner/risk creators is most effective, but we must recognise that with complexity comes the significant challenge in identifying a single point of responsibility and maintaining a clear sightline of accountability.
- **Competency –** the Engineering Council and the professional engineering institutions need to consider competencies required of registrants for CEng. They need to be fit for contemporary purpose, including the practical considerations around cross-disciplinary working, systems-thinking and a sound appreciation of ethics in engineering practice so that professionals deliver work with honesty and commitment.
- **Research –** understanding low occurrence, high consequence 'Black Swan' events that impose risks on engineered structures, particularly high-occupancy buildings and geotechnical and bridge constructions. We need to understand how to quantify and articulate this for people deciding budgets so that the correct safety engineering can be built in.

For additional recommendations, please refer to the full report: www.raeng.org.uk/super-sized-structures

4 Participant list

Dame Judith Hackitt DBE FREng (Chair)
Professor Jeremy Watson CBE FREng, BRE and UCL
Professor José Torero Cullen, UCL
Professor Bridget Eickhoff FREng, Rail Safety and Standards Board
Professor Kelvin Higgins FREng, Geotechnical Consulting Group LLP
Professor Lord Robert Mair CBE FREng FRS, University of Cambridge
Tim Chapman FREng, Arup
Lila Tachtsi FREng, Highways England
Professor Dracos Vassalos FREng, University of Strathclyde
Professor Jeom-Kee Paik FREng, Pusan National University and UCL
Professor Chris Binnie FREng, Independent Consultant
Professor John McDermid OBE FREng, University of York
Emeritus Professor David Blockley FREng, University of Bristol
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