

Physical Infrastructure: Management and maintenance for Safety

March 2021

Lloyd's Register Foundation is looking to commission, via a grant, an evidence-based review of practice in the management and maintenance of infrastructure.

Interested applicants are asked to respond to the brief below with a proposal up to the value of **£100,000**. The deadline for the project's completion is **22nd December 2021**. The deadline for applications is **21st May 2021**. Please see below for full details.

Introduction to Lloyd's Register Foundation

Founded in 2012, Lloyd's Register Foundation is a UK charity with global reach and the sole shareholder of the Lloyd's Register Group. With a [mission to protect the safety of life and property](#), and to advance transport and engineering education, the Foundation has an important role to play in meeting the challenges of today and the future. For more information about the Foundation and the critical infrastructure-related challenges it focuses upon, read our [strategy](#).

Task Outline

The pace of infrastructural development has been rapid over the last few decades. Supporting a growing global population, enhancing connectivity between people and place, and serving as a means for transportation and trade, inevitably means the quality and quantum of infrastructure needed will continue to grow. What is deemed as 'critical' infrastructure –the body of systems, networks and assets that are essential to ensure the security of a nation, its economy and the public's health and safety – becomes even more pertinent. But do we know what critical infrastructure exists globally, where it exists and how it is currently maintained? How do countries plan to ensure their future needs are met?

Statistics highlight that:

- the cost of corrosion of critical infrastructure is 4% of global GDP (NACE, 2016)
- passenger transport will increase nearly three-fold to 2050, from 44 trillion to 122 trillion passenger-kilometres. Global freight demand will also triple (International Transport Forum in partnership with OECD, May 2019)
- global population is set to grow to 9.7 billion by 2050 (UN, 2019) and therefore the amount of infrastructure required is inevitably set to grow.
- at current projections we will be tripling the amount of anthropogenic mass (e.g. concrete, steel, plastic) compared to biomass by 2040 (Elhacham, Nature, 2020)

Against this background, the Foundation is keen to understand more about how critical infrastructure is managed globally. This work will provide broad insights into the state of current and future practice for managing and maintaining infrastructure to enable safe outcomes for society. This body of works sits under the Foundation's strategic challenge area of safety of physical infrastructure, where the overarching question is: *How do we ensure the future safety of the complex physical infrastructure on which modern society relies?* To date, the Foundation has invested over £60 million in the infrastructure portfolio. This includes research on fundamental aspects of materials and mechanical engineering to applied work on resilience, sustainability and the circular economy. The work funded under the current call will provide evidence and provide a direction for the Foundation to identify where future interventions need to be targeted to support the safety of physical infrastructure.

Scope

Interviews with leading experts has highlighted the need to focus on improving understanding of maintenance practice for infrastructure. In addition to this we are interested in understanding what evidence underpins these approaches and provides assurances that their use will be effective in practice. Therefore, this work will be guided by the following four high level questions:

1. What is the state of good practice for the management and maintenance of infrastructure to enable a safe outcome for society?
2. What does future safety practice look like for the management and maintenance of infrastructure?
3. What gaps are there in the provision of safe infrastructure for society and what opportunities are there to apply existing techniques from within and external to the sector?
4. What evidence is there for the effectiveness of existing and future practice for the management and maintenance of infrastructure?

The work will help us understand what approaches and techniques are used to assess and deliver a safe infrastructure. Ultimately, we want to understand the impact of good management and maintenance of critical infrastructure in enhancing safety. Detailed questions relating to this scope, which were identified whilst constructing this call, can be found in **Appendix I** below.

For this activity we define infrastructure as that which modern society relies upon. This includes in the broadest sense the systems of energy, water, waste, transport and communications, including their interactions with each other. The good practice is not confined to technical solutions but could also be interpreted broadly, examples could include societal, legal or financial solutions.

This work is not expected to provide a detailed review of all aspects of all sectors. Instead, we are seeking to identify specific examples or trends that are supporting the safety of infrastructure. Single examples could be confined to one industry sector or it

could be an approach which is being used in several. However, we would expect the breadth of infrastructure to be considered in the overall report.

Outputs

- Publication-ready text for a public-facing report (that the Foundation will have designed for digital platforms and / or print).

The submitted text should include a one-page handout summary of the work; an executive summary (approx. three pages) and then the report (approx. 25 pages). Further detail can be included in appendices, for example:

- outline of methodological approach
- list of interviews conducted
- databases and other sources searched / consulted
- bibliography

Please note publication strategy and timelines will be agreed upon completion and will be dependent on what we learn and how they could form part of a wider publication strategy.

Timescale

Webinars	w/c 3rd May 2021
Deadline for applications	21st May 2021
Applicants receive response by	w/c 21st June 2021
Deadline for draft outputs for review	Mid November 2021
Final deadline for completed outputs	22nd December 2021

Requirements

Interested parties are asked to outline their proposed approach using the question prompts below and submitted via the Foundation's online funding portal <https://lrfoundation.flexigrant.com/> by **21st May 2021**.

For this work the Foundation will convene an Expert Advisory Group (EAG) to act as periodic reviewers of the work at points throughout the research process.

A budget of up to £100,000 is available for this work. The successful applicant organisation will receive 50% of agreed scoping stage funding upon contract signing and 50% upon project completion.

Appendix I – Insight / questions developed during development of brief

1. What techniques and methods are used to deliver a well maintained and safe infrastructure?
2. What knowledge of assets, including location and condition, is recorded and how is this data strategically used by owners, operators and users?
3. How are infrastructure systems (e.g. multiple assets across different sectors) managed and maintained safely?
4. What approaches are used to mitigate and adapt against external shocks (e.g. such as climate change or failure) to ensure a safe infrastructure system?
5. What approaches to preventive maintenance are used to avoid infrastructure failure or to enable timely replacement?
6. What is the overlap of safety and maintenance with respect to infrastructure? What are the other factors for generating a safe infrastructure for society?
7. Who incentivises and implements maintenance approaches and what are the key drivers for delivering safe outcomes?
8. What new and emerging approaches are being used to enable the safe operation of infrastructure? Examples would include such topics as remote inspection and modular design.
9. What gaps are there in delivering a safe and well maintained infrastructure? What techniques or approaches could be used to fill this gap? What options are there for delivering these new approaches?
10. What evidence exists which provides assurance that existing and emerging maintenance practices are effective and useful?