Safe adoption of emerging technologies: review of the skills needed and readiness of the engineering sector

March 2021

Lloyd's Register Foundation is seeking to commission, via a grant, research into the **skills needed for safe adoption of emerging technologies in the engineering sector, and the plans in place to delivery these skills.**

The findings of this research will be published by the Foundation to contribute to the body of knowledge on skills for safety around emerging technologies and will also inform the implementation of the Foundation's strategy in this area.

Interested applicants are asked to respond to the brief below with a proposal by **21 May 2021**. The deadline for the project's completion is **22 December 2021.** Please see below for full details. Please note that, with the exception of our small grants scheme, we are unable to award grants to individuals.

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.

Background to the brief

Emerging technologies can be defined as technologies whose development, practical applications, or both are still largely unrealized, in that they are emerging into prominence from a background of non-existence or obscurity. The adoption of emerging technologies in engineering, across geographies and industries, will vary, and it is therefore critical to understand if the sector has the required skillset and capacity to operate and maintain its infrastructure in a safe manner. The absence of a regulatory framework for many new technologies amplifies the importance of skills and education in this area.

In recent years, the Foundation has published a portfolio of Foresight / Insight Reviews where emerging technologies were either the principle focus, or emerged from the research. The Foundation is interested in the role and impact such technologies are likely to have in the engineering sector and across industries, particularly on skills and jobs. In particular, we want to understand how industries can enable the transition to a safe adoption and use of these technologies, through increasing capacity and capability. Please see Appendix 1 for a summary of the relevant Reviews and recommendations. A number of emerging technologies are identified that are likely to impact the engineering sector, and jobs as a consequence. The skilled workforce (both in terms of capability and capacity) required to adopt this raft of technologies in a safe manner, and the supporting education structure required, are vast.

This work sits under the Foundation's strategic priorities of Skills for Emerging Technologies and is part of the long-term foundational skills and education programme. Through work

funded in this area the Foundation aims to accelerate the safe adoption of new technologies through thought-leadership and engineering education programmes that address emerging technology skills needs, relevant to the global workforce.

Task outline

The Foundation is keen to understand:

1. What new jobs / skillsets will be required for safe adoption of the emerging technologies identified by the Foundation?
2. What plans are in place to identify the requirement for new jobs and skillsets?
3. Are these plans appropriate to ensure that engineers are skilled to support the adoption and ongoing use of these technologies, or does a gap exist?
4. What level of education / training investment is required to address this gap and through what educational means (e.g. industry training / structured knowledge transfer frameworks / university / school education)?
5. What programmes are already planned, or underway, that will meet these needs, and how effective are they?
6. What future activities or programmes would support the safe transition to emerging technologies?

The resulting report should document clear recommendations that will ensure the safe transition to emerging technologies.

With a global assessment required to undertake this work, the approach needs careful consideration. We are seeking proposals that will explore these questions through:

- a review the Foundation's Foresight and Insight work to scope relevant emerging technologies. The focus is on the following 3 emerging technologies:
  - Robotics and autonomous systems (RAS)
  - Cyber-security – Industrial Internet of Things (IIoT)
  - Data-centric engineering

- exploration and feedback with existing LRF grant holders is welcomed:
  - Data Centric Engineering programme (skills programme)
  - National Structural Integrity Research Centre (NSIRC)
  - International Consortium of Nanotechnology (ICON)
  - the Assuring Autonomy International Programme (University of York)
  - safer complex systems
  - decarbonisation

The Call invites suggestions of other approaches that could include an assessment of the strengths and gaps for safe adoption by job type, or by country profile (low / middle / high income).

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 summary of the work; an executive summary (approx. three pages) and then the report proper (approx. 25 pages). Further detail can be included in appendixes, for example:

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

The grant-holder should work with the Foundation to identity, as far as possible, communications narratives emerging from the research and keep this need in mind when writing up the research to ensure that its key messages are clear and easily digestible.

Timescale

Webinars	**26 April 2021 – 1pm to 2pm** **28 April 2021 – 9.30am to 10.30am**
Deadline for applications	**21 May 2021**
Applicants receive response by	**21 June 2021**
Deadline for draft outputs for review	**Mid November 2021**
Final deadline for completed outputs	**22 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 **21 May 2021**.

The Foundation may share anonymised applications with third-party reviewers.

A budget of up to £70,000 is available for the work. The successful applicant organisation will receive 50% of agreed funding upon agreement of a research protocol and 50% upon project completion.

Name of organisation:	
Description of organisation:	
Number of employees (approx.):	
Address of organisation:	
Name of primary contact:	
Email address of primary contact:	
Phone number of primary contact:	
What is your proposed approach to the tasks outlined?	
What input would you need from the Foundation - e.g.	

advice on organisations and publications to consult? (The Foundation and grant-holder will schedule regular communications for advising and updating.)	
What capacity and capability does your organisation have for this work?	
What experience does your organisation have in conducting similar work?	
What (approximate) budget would you need to complete this work? Please include a detailed breakdown of costs including, for example: staff time and day rate, travel, databases or other subscriptions:	

Questions?

Please contact info@lrfoundation.org.uk with the email subject '**Safe adoption of emerging technologies: review of the skills needed and readiness of the engineering sector** brief'.

Appendix 1

The following table highlights a few of these Reviews and summarises relevant recommendations:

Review	Brief details about what the emerging tech does	What are the skills / capability angle? (Examples)	Foundation's supporting programme/s
Robotics and autonomous systems (RAS) Explored the contribution robots will make to society that serve a safer world	**RAS:** Smart, connected machines, or RAS are acting as tools to support humans, working alongside us or alone, making independent decisions and even learning	- Skill impact will be felt at all levels of expertise from shortages of researchers to shortages of technicians and skilled operators. - Work is needed to establish the likely skill mix and more importantly the	University of York: The Assuring Autonomy International Programme

		change in skill mix that the introduction of RAS will bring both in the manufacturing and service sectors. - Few teachers are able to teach engineering, RAS or design. - Create continuing professional development (CPD) in engineering and design for teachers at all levels.	
Foresight review on Cyber Security for the Industrial Internet of Things Focus of this review is the Industrial IoT (IIoT). IoT-enabled industrial control systems (ICS) are becoming a significant proportion of current and future critical infrastructures, with high uptake in areas like energy, transport, the built environment and manufacturing facilities. The consequences of failure can be high in these environments. It is essential to understand how to deliver secure and resilient infrastructures	**Industrial IoT (IIoT). IoT-enabled industrial control systems (ICS):** Set to benefit society through a range of smart platforms and has been undergoing huge expansion	- There will be a need to invest more resources in creating cyber security skills and awareness than ever before (and for some organisations this may be the first concerted effort). - Awareness and training approaches will need to scale up, improving the pipeline of people who understand cyber security in the industrial space, and to cover the full breadth of IIoT applications. - Challenge may be particularly acute in developing countries, some of which are now rapidly adopting IIoT.	
Big Data – Towards data-centric engineering	**Data-centric engineering**, recognising the value of data as an asset in itself, puts data considerations at the core of engineering design. It improves performance, safety, reliability and efficiency of	- The future value of big data will only be realised if there is organisational and cultural change, accompanied by appropriate	Data-Centric Engineering

	assets, infrastructures and complex machines.	analytical tools, skills and practices. - Big data needs analytics; not only the techniques of statistics and machine learning, but also the human skills of insight and pattern recognition to find genuine meaning in the data	