Lloyd's Register Foundation

Strategy
2014–2020

Impact and excellence

Cover image: View looking down into carbon nanotube

Contents

Find out more about the Lloyd's Register Foundation online at **www.lrfoundation.org.uk**

Foreword

Societies and communities around the world face major challenges linked to issues such as climate change, population growth, energy security, and food and water availability. Technology is advancing rapidly to tackle these challenges in hand with education and training to ensure the availability of the necessary skilled people.

The critical infrastructure on which modern society relies is however under increasing pressure to satisfy growing demand while innovating safely and protecting lives and the environment.

With our mission to protect the safety of life and property and to advance transport and engineering education and research, the Lloyd's Register Foundation has an important role to play in meeting these challenges. Through our strategy in this document, we aim to connect science, safety and society, so that the fruits of our activities can enhance the safety of the critical infrastructure on which modern society relies, for the benefit of everyone.

Our approach is to be inclusive, acting as a catalyst and working with partners and others with similar aims to ourselves, focusing our funding in the areas of supporting excellent research, education and training, accelerating the application of research, and public engagement.

We have worked hard since our formation in 2012 to build up a governance structure that is fit for purpose and consistent with our charitable vision. Much of our time has been spent in determining how best to use the Foundation's charitable funds in order to fulfil our objectives and provide the best return from a public benefit perspective. The result is this six-year strategic plan, focused on excellence and impact.

Through our grant making we aim to connect science, safety and society by supporting research of the highest quality and promoting skills and education.

PROFESSOR RICHARD CLEGG
Managing Director of the Lloyd's Register Foundation

About the Foundation

OUR VISION

Our vision is to be known worldwide as a leading supporter of engineering-related research, training and education, that makes a real difference in improving the safety of the critical infrastructure on which modern society relies. In support of this, we promote scientific excellence and act as a catalyst working with others to achieve maximum impact.

THE LLOYD'S REGISTER FOUNDATION CHARITABLE MISSION

- To secure for the benefit of the community high technical standards of design, manufacture, construction, maintenance, operation and performance for the purpose of enhancing the safety of life and property at sea, on land and in the air.
- The advancement of public education including within the transportation industries and any other engineering and technological disciplines.

A NEW CHARITY

The Lloyd's Register Foundation is a new charity set up in 2012, which became fully operational in 2013. We draw on a long and distinguished history dating back to 1760 through our trading arm, with its tradition of public benefit.

We are funded by the profits of our trading arm, Lloyd's Register Group Limited, a professional services organisation working mainly in the transportation and energy sectors, which also delivers part of our charitable objects. In 2012, Lloyd's Register converted its status from an industrial and provident society to a company limited by shares, called Lloyd's Register Group Limited (LR), with all shares owned by the Lloyd's Register Foundation. This change was needed to meet the evolving law around public benefit. Under the new governance structure there is a clear separation between the Foundation's charitable activities and the profit-making activities of LR.

LIFE MATTERS

Importantly, the objectives and mission of the Foundation are the same as those of Lloyd's Register previously, to protect life and property and to advance transport and engineering education and research… because life matters.

Working on this strategy, we have taken time to identify areas where we can make the best possible contribution to help tackle society's challenges of the future.

THOMAS THUNE ANDERSEN
Chairman

A new strategy

Our new strategy sets out how we will focus on key objectives under four strategic themes: promoting safety and public understanding of risk; advancement of skills and education; supporting excellent scientific research; and accelerating the application of research.

We seek to maximise the impact of our research and other activities for the wider benefit of society. At the inception of work, we will work with the researchers and projects we support to identify how our work will benefit society, who the beneficiaries will be, and the pathway to impact. We believe that the researchers and organisations we support are best placed to identify this, which will then form the basis of their agreement with us.

PROMOTING SAFETY AND PUBLIC UNDERSTANDING OF RISK

We will make a recognised, distinctive impact on enhancing safety of critical infrastructure important for society through building scientific knowledge, promoting technology application, and enhancing the uptake of research evidence into policy and practice. We will also support organisations where activities enhance the safety of life, property and the environment.

We will promote the dissemination of our research activities and findings to the wider general public in an accessible and understandable format in order to inform a balanced, informed debate on matters concerned with risk and safety and the questions they raise for societies. We will pursue this neutrally to promote public trust, without any motivational bias and not promoting any particular technology or agenda.

Read more on page 9

ADVANCEMENT OF SKILLS AND EDUCATION

We will raise interest and generate enthusiasm around engineering, stimulating and sustaining young people's interest in the field and attracting them to study it from an early age. We will particularly focus on disadvantaged and under-represented groups in society.

Read more on page 10

SUPPORTING EXCELLENT SCIENTIFIC RESEARCH

We will work to optimise our global network of researchers, recognising talent and celebrating success. Through establishing long-term relationships, we will build research capacity and, working with our partners, develop key research facilities and environments to enable world-leading researchers to do their best work. We will focus our support on building research leaders of the future, performing the highest quality work that delivers maximum impact.

Read more on page 11

ACCELERATING THE APPLICATION OF RESEARCH

We will accelerate the uptake and application of research and breakthrough technologies to enhance safety concerned with the critical infrastructure important for society. We will support the translation of ideas and research outputs from the laboratory to industrial application, and enhance the uptake of research evidence into regulation and standards.

Over the coming years we will be directing our research efforts into four key areas: structural integrity and systems performance; resilience engineering; human and social factors; and emergent technologies. We believe that the Foundation can achieve real impact in these areas, with the focus on emergent technologies future-proofing our approach.

By the end of 2014, we should be assessing the first grant applications under the new strategy. And we will be looking to invest in 'white space' research topics for which there is currently little or no funding available, and where the Foundation can make a significant contribution.

We have many stakeholders in science, industry, academia, the third sector and the policy community, and we look forward to working with them all as we strive to help make the world a safer place.

Read more on page 12

The Foundation's strategy map

OUR MISSION

To secure for the benefit of the community high technical standards of design, manufacture, construction, maintenance, operation and performance for the purpose of enhancing the safety of life and property at sea, on land and in the air.

The advancement of public education including within the transportation industries and any other engineering and technological disciplines.

STRATEGIC THEMES:

PROMOTING SAFETY AND PUBLIC UNDERSTANDING OF RISK

ADVANCEMENT OF SKILLS AND EDUCATION

SUPPORTING EXCELLENT SCIENTIFIC RESEARCH

ACCELERATING THE APPLICATION OF RESEARCH

OBJECTIVES:

- Promoting the safety of life, property and the environment
- Enhancing public understanding of risk
- Maintaining and promoting a memory bank of safety and risk management developments

- Inspiring the next generation
- Enhancing the knowledge and skills of the workforce
- Widening access to disadvantaged and under-represented communities

- Striving for excellence and impact
- Promoting technology foresight
- Building world-class research teams

- Accelerating technology uptake
- Informing standards and policy
- Facilitating the mobility of researchers

FUNDING PRIORITIES:

- Supporting safety organisations
- Communication and public debate of scientific research
- Developing the Lloyd's Register Foundation Information Centre library and archive

- Pre-university education
- University education
- Vocational training and professional development

- Structural integrity and systems performance
- Resilience engineering
- Human and social factors
- Emergent technologies

SECTORS WE SERVE:

- Aerospace
- Automotive
- Built environment

- Food
- Healthcare and medical
- IT and communications

- Manufacturing
- Marine
- Oil and gas downstream

- Oil and gas upstream
- Power and utilities
- Rail and metro

Delivering public benefit

Monitoring our impact

At the Lloyd's Register Foundation, we are developing our process for monitoring and tracking the outcomes arising from our support in order to be able to demonstrate that our grants represent value for money, are achieving their charitable objectives, and delivering benefit to wider society. It also serves as an important evidence base to inform future strategy.

We are cognisant that our monitoring process needs to be balanced and proportionate, and is not an unnecessary reporting burden. We therefore work closely with those we fund, at the early stages of awarding grants, to identify what the targeted outcomes are and how they will be monitored and tracked.

In the case of the research we fund, we are aware that it may take some time for benefits to emerge and that the direct link to enhancing safety may be difficult to track. Recognising this, we have developed the following set of high-level indicators to monitor and track the progress we are making.

IMPACT AND OUTCOME	INDICATOR
PROMOTING SAFETY AND PUBLIC UNDERSTANDING OF RISK	• Demonstrable examples of achieving safety enhancements stemming from the work we support • Examples of work we fund being communicated through various media routes to reach different parts of the wider general public • Enhanced informed debate on safety and risk in society
ADVANCEMENT OF SKILLS AND EDUCATION	• Evidence of those we support progressing through engineering education and training • Development of a cadre of women in engineering and evidence of significant career progression amongst those we support
SUPPORTING EXCELLENT SCIENTIFIC RESEARCH	• Significant examples of co-funding to provide financial sustainability and gearing • Contributions to the growth of centres of excellence
ACCELERATING THE APPLICATION OF RESEARCH	• Successful examples of uptake of research findings into policy and standards • Practical examples of research knowledge and ideas being translated into applications

Page 6:
An apprentice scheme at Berthon Boat Company is being supported by the Foundation.

Strategic themes

The following section describes the strategic themes and their objectives taken from the strategy map.

1 Promoting safety and public understanding of risk
2 Advancement of skills and education
3 Supporting excellent scientific research
4 Accelerating the application of research

Strategic theme 1

Promoting safety and public understanding of risk

The Lloyd's Register Foundation is able to work with its trading arm, Lloyd's Register Group Limited (LR), in the delivery of the first of its charitable objectives concerned with enhancing the safety of life and property at sea, on land and in the air. Accordingly, LR is very important in the attainment of this strategic theme.

The field of safety and risk, particularly pertaining to high-hazard industries and critical infrastructure, can be an emotive subject. Sometimes the wider public possesses personal beliefs and anxieties that can lead to the perception of risk being far greater than reality. This can lead to society allocating more resources to reduce certain risks than scientific cost-benefit analysis alone would warrant. Our motivation is to build trust through dissemination of the results of our work, and provide independent technical commentary to inform a balanced debate in society.

We are the custodians of the Lloyd's Register Foundation library and archive, which is operated by a specialist Information Centre. This is a unique resource spanning more than 250 years of Lloyd's Register's history, which we make freely available for education and research purposes worldwide.

OBJECTIVES

PROMOTING THE SAFETY OF LIFE, PROPERTY AND THE ENVIRONMENT

We will work with organisations carrying out programmes which enhance safety on land, in the sea and in the air, and protect the environment. This can be achieved through the funding of vocational training. The programmes will be focused on enhancing the effective management or regulation of safety and protection of the environment in the widest sense, in the application of transportation, science, engineering and technology.

We will support voluntary organisations in the sectors in which we operate that have a public service ethos connected with the infrastructure important for society, to help them with the safety, reliability and quality of their activities.

ENHANCING PUBLIC UNDERSTANDING OF RISK

We will work with researchers to support dialogue and informed debate about safety and risk in society. We will promote open publication and communication of the results of our work in order to build trust and wider public understanding.

The Information Centre will continue to encourage interest in Lloyd's Register's heritage, present and future work, and how we work together for a safer world. We will promote wider access to our library and archive resources to enhance public understanding in science and engineering.

MAINTAIN AND PROMOTE A MEMORY BANK OF SAFETY AND RISK MANAGEMENT DEVELOPMENTS

Through the Information Centre we help to advance and enhance research and education. The Information Centre is a unique resource of current and historic information concerning maritime history, engineering science, naval architecture, offshore engineering and ocean technology, available to all researchers. We will strive to add to this resource, increase access to it, make the archive and library catalogues more widely searchable, and digitise unique items from our heritage collections so that they can be viewed online. We will also develop collaborative partnerships with libraries, archives and universities around the world to further the use of our resources, to help engage the public in research, and to support students conducting research projects.

Page 8:
Non-destructive qualitative and quantitative testing of surfaces of a micro surface using an electron microscope.

Strategic theme 2

Advancement of skills and education

We are committed to widening access and bringing engineering-related skills and education to previously disadvantaged or under-represented groups and communities and inspiring the next generation of engineers. Our particular focus will be on tackling the underlying structural issues and barriers inhibiting opportunities across all ages, gender and nationalities, helping people achieve their full potential for the broader benefit of society.

OBJECTIVES

INSPIRING THE NEXT GENERATION

We aim to help schoolchildren and young people engage with science, engineering and technology and understand how they can contribute to solving many of the critical issues facing the world. We will use our funding to help promote understanding of careers in science, engineering and technology to young people, their parents and teachers. We will fund national or international programmes, supporting organisations that reach large numbers of children at school and university level.

ENHANCING THE KNOWLEDGE AND SKILLS OF THE WORKFORCE

We will support educational and training establishments and institutions that provide vocational training and professional development. The programme is focused on enhancing the level of knowledge and understanding for people working in engineering and technology industries or actively involved with ensuring the safety of life and property, for the benefit of the public.

In the professional development field, our funding is aimed at providing high-quality lectures and courses, fulfilling the need for continuing professional development and for specific educational effort in the above subjects.

Support will be extended to major public educational facilities and initiatives. The aim of the programme must be to provide an educational resource of wide accessibility to fulfil a perceived need.

WIDENING ACCESS TO DISADVANTAGED AND UNDER-REPRESENTED COMMUNITIES

We will strive to work with other partners, education providers and governments on targeted ways to enhance accessibility to, and raise the standard of, engineering education. Our interest is in widening access to previously disadvantaged or under-represented groups in society. Our motive is to enhance and strengthen the talent pool in engineering-related professions within the broad range of sectors that Lloyd's Register operates. We will do this with a global perspective, but favouring targeted projects at the country or regional level that will deliver practical results.

Strategic theme 3

Supporting excellent scientific research

We believe that the safe design, quality and performance of high-hazard assets and the infrastructure important for society have to be underpinned by a detailed scientific understanding of how materials, components and systems perform in their operational environment. This underpinning knowledge needs to be kept modern and relevant as new technologies, materials and manufacturing techniques emerge.

We also recognise the importance of research in connected fields including human factors, environmental impact, quality assurance and sustainability. It is this philosophy that we have used to design our four research themes.

We work with international expert advisory groups to inform the direction and priorities of our research funding.

OBJECTIVES

STRIVING FOR EXCELLENCE AND IMPACT

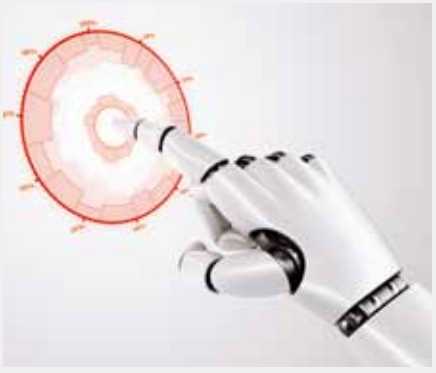
We are driven by excellence and impact from the research we sponsor. Excellence is concerned with such factors as quality, originality, significance and rigour. Impact is concerned with benefit, value and return on investment from the research. The impact of our research can be felt societally as well as economically, reflecting our objectives. We will work with our researchers at the outset of work to target the intended outcome and beneficiaries, and ensure that the routes to impact are understood and managed.

BUILDING WORLD-CLASS RESEARCH TEAMS

To ensure stability and that researchers can work and train in world-class environments, we cluster our grants in centres of excellence and advocate long-term programmes with ambitious aims rather than short-term projects. These centres of excellence will consist of teams or networks that are renowned for their competency and capability. They will serve as global hubs for research and capability-building in our focus areas. We will work with other partners, including governments, research organisations and funding bodies, to build sustainable research teams with the necessary infrastructure and resources to support their work.

PROMOTING TECHNOLOGY FORESIGHT

We will promote innovation and seize emerging strategic opportunities. We will focus on the safety considerations and applications of emerging technologies. Our horizon-scanning activities will look three to 10 years into the future.



Strategic theme 4

Accelerating the application of research

Our driver is to maximise the uptake and application of the fundamental research we are engaged in. This is one way of providing us with the practical evidence that we are delivering clear benefits to society and achieving our objectives. Our aims are to enhance safety benefits rather than any requirement to generate a financial return, enabling us to focus on the most promising opportunities for the wider benefit of society.

However if a suitable opportunity arises to benefit from the commercialisation of intellectual property then, on a case-by-case basis, we may pursue this if the proceeds enable us to subsequently fund further research for greater public benefit.

OBJECTIVES

ACCELERATING TECHNOLOGY UPTAKE

Our aim is to bring research ideas and innovations to industrial readiness and maturity. We realise that to achieve this there are many hurdles to be overcome. We will therefore work with other partners, follow-on funders, and end-users to successfully bridge the gap. We will support innovative projects and explore strategic funding opportunities that accelerate the translation of research outputs into applications, in the process crystallising value from arising intellectual property.

INFORMING CODES, STANDARDS AND POLICY

We will encourage the uptake of our research findings and data into policy and standards at local, national and international levels. Our driver is to ensure that the best science is made available and interpreted correctly to assist independent decision-making.

FACILITATING THE MOBILITY OF RESEARCHERS

We will work with our research community, LR, and other partners to facilitate the two-way interchange of technical experts between industry and academia. We will promote and sponsor schemes aimed at giving academics experience in industry, and vice versa. We believe that both sides will benefit from this experience, with industry providing guidance on relevant challenges and priorities, and academics facilitating know-how transfer.

We believe that this is an important mechanism that will enhance the relevance, uptake and impact of research for the ultimate benefit of society.

Image courtesy of The University of Manchester

Promoting scientific excellence

Research funding priorities

The major share of our grants will be targeted at sponsoring research. Our research is cross-cutting and supports a number of our strategic themes, as shown in the Foundation's strategy map.

This section expands in further detail our research challenges.

1 Structural integrity and systems performance
2 Resilience engineering
3 Human and social factors
4 Emergent technologies

Research funding priority 1

Structural integrity and systems performance

We will support engineering-related research to improve understanding of the physical behaviour, ageing and degradation of performance of the critical infrastructure important to society.

Our interests and objectives span the size continuum from materials and components up to systems and structures. They also span the full lifecycle of engineered assets from design through to operation, maintenance, life extension and decommissioning. Recognising that this is a multidisciplinary field, we will promote an integrated approach bringing together different fields of engineering and physical sciences. Our driver is to see practical improvements in safety in line with our objectives, so we will promote the uptake and application of our work to analysing, predicting, preventing and controlling structural and mechanical component failures.

Our interests span a range of sectors connected with energy and transportation. These naturally embrace different technologies, materials, components and manufacturing methods, which further broadens the scope and importance of this research area.

CHALLENGES

DATA
We will work to generate reliability and performance datasets and develop the informatics platforms needed to support safety applications

CONDITION MONITORING
We will support the development of new techniques for characterisation, fault detection and condition monitoring, and promote their application to optimise and better manage critical infrastructure.

SYSTEMS INTEGRATION
We will support work aimed at understanding how to integrate component subsystems into one dependable system and ensuring, from a safety and reliability standpoint, that the subsystems function as one system.

MATERIALS PERFORMANCE
We will support multidisciplinary research to better understand the relationship between the structure of certain materials, and the mechanisms of how they perform and fail in operating environments related to safety.

Research funding priority 2

Resilience engineering

We will support engineering-related research to better understand the safety implications and impact of disruptive events and extreme weather on structures, organisations and critical infrastructure.

This field of research complements the previous research topic (structural integrity and systems performance), as that topic focuses on the engineered structures and assets themselves whereas this topic concentrates on the natural environment in which they sit and operate. Through these two topics we will promote an integrated approach, studying engineering safety with real-world complexity.

This topic also encompasses the resilience of management systems and organisations, as these are equally important to safety and a plant's ability to recover from an acute or chronic stress event. Many high-hazard structures and critical infrastructure are sited in extreme locations of high temperature and pressure etc. Recognising this, and also taking into account the impact of extreme natural events (such as weather, earthquakes, tsunamis and the like), we will promote an integrated approach bringing together multidisciplinary teams to research this topic.

CHALLENGES

SUPPLY CHAIN RESILIENCE
We will support innovative projects aimed at translating concepts into action connected with building resilience into supply chains. We will foster work on identifying and analysing risk from external disruptive events, enabling critical infrastructure to sidestep and bounce back quickly when problems occur.

ADAPTIVE SYSTEMS
We will foster high-quality research into enhancing the ability of materials, components, structures and systems to adjust their functioning prior to, during, or after external disruptive events or major incidents, so that they remain safe.

Page 14:
Scanning electron micrograph of leaf detail of Salvinia natans, a floating fern type plant, after which the 'Salvina effect' is named. The hairs on the leaves have hydrophobic surfaces and hydrophilic tips, which trap air. As a biomimetic, the Salvina effect is of great interest in the marine industry by reducing the drag between the ship's hull and the water, saving vast amounts of fuel.

Research funding priority 3

Human and social factors

One of the major sources of loss with respect to assets and lives emanates from human and social factors within work systems, especially within the high-hazard industries.

We will fund pioneering research, workshops or events committed to enhancing safety, health and productivity by using scientific disciplines that include human and social factors (for example, human factors and ergonomics).

CHALLENGES

HUMAN FACTORS ENGINEERING (HFE)

We will fund research (case studies, follow-up surveys and experimental study designs) that demonstrate the benefits of using HFE for the design of technology, workplace environments, jobs, tools, and work organisation processes. We will also promote new training courses aimed at embedding HFE within the design process that are evidence-based and evaluated.

HUMAN RELIABILITY

We will support the use of evidence-based practice for promoting safe behaviour. Our aim is to advance understanding of the complex interactions between culture, people, processes and plant, with respect to improving health, safety and productivity at work. Specific examples include job design, leadership, competence, team situation awareness, communication and safety culture.

OCCUPATIONAL HEALTH AND SAFETY

We will support work on the impact of physical and psychosocial workplace hazards on human performance processes and plant. Such physical hazards include manual handling, repetitive and static work, environmental stressors etc. Psychosocial workplace hazards include factors such as high workload, low control over work, poor social support, lack of recovery between shifts, fatigue/exhaustion, mental stress, lack of motivation etc.

ORGANISATIONAL DEVELOPMENT

We will support work aimed to:

- learn from incidents and accidents involving human error and organisational root causes
- investigate factors affecting change (barriers and/or facilitators) within organisations. Integrate this knowledge to understand design issues and failures in complex systems
- develop tools or methods for integrating human factors engineering, safety management, injury prevention, operability and maintainability into each stage of the asset lifecycle (human-system integration).

Research funding priority 4

Emergent technologies

Looking to the future, we believe that emerging technologies will play a significant role in enhancing the safety of critical infrastructure important for society.

Recognising the pace at which technology is developing and scientific breakthroughs occurring, we will stimulate work to evaluate emerging technologies and promote debate of their safety applications and potential benefits. In some cases, emerging science or technology areas with promising safety benefits might be held back because of uncertainties and unknowns about possible side effects, such as concerns over environmental or human health damage.

CHALLENGES

FORESIGHT RESEARCH

We will promote with our researchers that they identify and monitor emerging technologies in their field that could potentially have significant safety applications. We will work with others in the science community and assemble expert panels, where appropriate, to evaluate these technologies and sponsor targeted R&D to realise their potential.

In some cases, work may be required to address potential safety or environmental concerns about emerging technologies, as mentioned above. Recognising this, in such cases we will promote independent, authoritative research to help answer these concerns and provide clarification.

DEVELOPING SAFETY CODES AND STANDARDS

We see that in breakthrough areas of science there is potential for the emerging technology to run ahead of its licensing and regulation. Recognising this, we will sponsor targeted research where we can make a distinctive contribution, to develop the underpinning scientific data and advice to help inform decision-making connected with codes, standards and regulation. Our motivation is to maximise the safety benefit and impact of new technologies for society, rather than any vested interest in benefiting from the technology.

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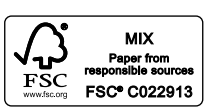

Lloyd's Register Foundation

Life matters

Lloyd's Register Foundation

Registered Office:
71 Fenchurch Street, London, EC3M 4BS, United Kingdom

T +44 (0)20 7709 9166
F +44 (0)20 7488 4796
E info@lrfoundation.org.uk