Collaborating in a changing world.

Lloyd's Register

2018

SMART SOLUTIONS SHAPED WITH HUMAN INTELLIGENCE:

Collaboration, the key to future proofing.

The environment in which we and our customers operate is changing rapidly. New technologies, geopolitical activity and environmental issues are disrupting the global landscape, posing new challenges and creating opportunities.

At Lloyd's Register we strive to share our expertise to solve our customers' problems; combining our 258 years of experience with our investment in the application of new technology; serving businesses operating complex critical infrastructures.

This year's review showcases how we are collaborating to design and deliver solutions to keep our customers, their businesses and their customers safe, while managing their risks and optimising performance.

2018 HIGHLIGHTS

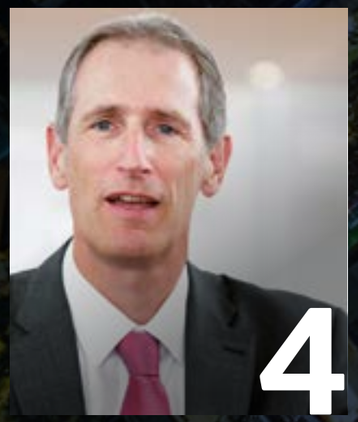
£868.0m
Turnover

195
Offices worldwide

6,745
Employees worldwide

60,000
Customers – from SMEs to Fortune 500 companies

- Lost Time Incidents down by 60% over five years.
- 5% increase in global fleet since June 2016.
- ISO 45001 launched in March 2018 – the new international management system standard for Occupational Health & Safety.
- Nettitude acquired in March 2018.
- LR AllAssets, our new software product suite, launched in 2018.
- Marine Asset Survey Tool (MAST) launched in 2018.
- Be the Change culture change programme deployed to more than 50% of employees.
- Signed up to the United Nations Global Compact in July 2017.



Digital innovation

Sustainable environments

Business resilience

Connected supply chains

Ready for growth

Creating a sustainable future

Governing & directing our activities

Working together for a safer world.

We stand alongside other world and industry leaders in enabling a transition to a cleaner, more sustainable world.

Our purpose remains resolute – working together for a safer world. Our expertise across safety, security and sustainability, combined with the work of the Lloyd's Register Foundation, are leveraged to make a positive impact on society within a business model for the 21st century.

Strategic progress

Challenging economic conditions have continued to affect our traditional markets in maritime, shipping, offshore and in oil and gas. While the global Marine & Offshore order book continues at low levels the emerging general sentiment is cautiously optimistic.

Our new strategy is progressing well. We have strengthened our traditional businesses by investing in adjacent markets, with innovation and by focusing on commercial effectiveness, cost and operational efficiency. And this has positioned us well for future growth.

Safety and culture

Safety underpins all that we do and remains a priority for the Board, executive team and colleagues. We are pleased to report another year of improvement in our health and safety record including a further reduction in the number of lost time incidents.

Every incident is a reminder of the challenges we face to achieve our aspiration of Zero-Harm. Progress this year is testament to our focus on high-risk activities such as ship-to-ship transfers, the introduction of our life-savers' programme and intuitive safety behaviours. The Board is increasing its focus on diversity and inclusion to fulfil our purpose and help our customers do great things; we know we need to nurture a diverse and inclusive workforce where everyone has the chance to thrive.

Sustainability

In July 2017 we became a signatory to the United Nations Global Compact; the guardian of the UN Sustainable Development Goals and the world's largest corporate responsibility initiative. As part of our commitment to the achievement of the Sustainable Development Goals, we became a founding member of the United Nations Global Compact Action Platform for Sustainable Ocean Business which launched on World Oceans Day in June 2018. Our leadership is driven by our belief that the long-term health of the ocean is vital to ensuring societal safety and well-being.

Our Technology Radar report highlighted growing optimism about moving to a low carbon world. The environmental impact of shipping and greenhouse gas emissions continues to raise its profile aligned with the publication of the International Maritime Organisation's (IMO) decarbonisation strategy. We continue to support the sector in understanding what low and zero-carbon options are available to help the IMO strategy. We have also provided services to the first large-scale energy storage project in Australia that will accelerate the maturity of energy storage technologies across the world.

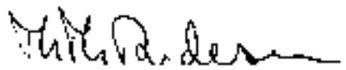
Societal impact

Our purpose remains resolute – working together for a safer world. Our expertise across safety, security and sustainability, combined with the work of the Lloyd's Register Foundation, are leveraged to make a positive impact on society within a business model for the 21st century. This year we launched a joint initiative, the Lloyd's Register Safety Accelerator, bringing together start-ups and industry to work together to test innovative digital solutions for the world's toughest safety and risk challenges.

Board changes

I would like to thank my fellow Board members for their support, enthusiasm and commitment to strong governance throughout the year, and take great pleasure in welcoming Mark Kelsey and Ishbel Macpherson as non-executive directors of the Lloyd's Register Group Limited Board. Mark is the Chief Executive Officer for RELX Group plc's Risk and Business Analytics division, responsible for Lexis Nexis Risk Solutions and Reed Business Information (RBI). Ishbel has spent more than 20 years in corporate finance in the City of London and since leaving the City has become an experienced non-executive director. She currently holds senior independent director positions at Dechra Pharmaceuticals plc and at Bonmarche Holdings plc.

Finally, on behalf of the Board, I would like to thank our Group Chief Executive, Alastair Marsh, his executive team and all our dedicated colleagues around the world for navigating us through such a challenging yet exciting year. We have great confidence in the ability of our exceptional people to continue the transformation of our unique organisation to meet the needs of tomorrow.



Thomas Thune Andersen
Chairman

Meeting today's global challenges.

We have maintained the improvement in our market position in marine new construction, acquired further capabilities in the field of business assurance and established a sound platform from which to grow our energy business.

Delivering the strategy

This has been a pivotal year in executing the strategy that we set out in April 2016. Our unique ownership model has allowed us the flexibility to invest for the future while, in parallel, having to shape our workforce for the future, reflecting market economic conditions and the introduction of new technology. Consequently, we are well placed to make the most of the early signs of optimism in our traditional markets. Our customers have commented that they are benefiting from the changes we are making. All our change programmes remain aligned to our strategy and we will continue our progress and plans in coming years.

People and culture

Safety remains our number one priority and we continue to employ best practice to improve our record and look after our colleagues and our customers' employees. We have made good progress on our Zero-Harm aspiration. Having simplified our processes, strengthened the way we learn from incidents and introduced a new set of behaviours for our life-safety tasks, we are pleased to see that these measures are contributing to a reduction in the number and severity of incidents. Colleague engagement continues to rise as evidenced by 7,400 colleague safety reports and training 7,200 colleagues on our new life-safety behaviours. Our Lost Time Incidents rate has declined further over the past year; reducing by 60% over the past five years and the number of High Potential Incidents has declined by 36%.

We have also taken more than half of our colleagues through our 'Be the Change' programme, intended to create a greater sense of ownership, accountability and confidence coupled with strengthening the capabilities of our leaders. The first phase is reaching conclusion with deployment to all colleagues globally.

Strengthen and grow

We have maintained the improvement in our market position in marine new construction, acquired further capabilities in the field of business assurance and established a sound platform from which to grow our energy business.

In addition to strengthening our current businesses, we have continued to cultivate new markets in the Middle East, India and China and in our customised assurance programme in the food sector, building upon the acquisition of Acoura last year, and in cyber security following the acquisition of Nettitude in March 2018. Nettitude is a leading cyber security assurance, risk management and managed detection and response services business, supporting customers across many sectors including Financial Services, Technology and other high threat environments. This acquisition is a significant milestone in meeting our growth aspirations that will help knowledge transfer to our traditional markets.

Smart solutions shaped with human intelligence

£64.2m

Donation to the Foundation in past three years

Digital innovation

Much has been said in recent years about 'big data' but it is already clear that the gloss has come off the idea that simply aggregating vast amounts of data and applying advanced analytics will unlock a treasure trove of benefits. We have chosen a different path – focusing instead on working in close collaboration with our customers, subject matter experts, digital innovation and products team and an increasing number of technology partners. This approach has led us to several exciting new initiatives such as:

- the launch of our new software product suite, LR AllAssets, which is serving a cross-industry need for more advanced asset management solutions – reducing operating expenditure while increasing reliability and availability;
- the development of new risk insight tools such as Lloyd's Register's Safety Scanner; the early demonstration of Human Analytics as a further step in improving human related risk factors;
- further progress implementing our sales channel strategy with the establishment of partnerships with IHS and SAP;
- growth in our portfolio of customer-focused pilot projects with more than 30 in execution or completion spanning; blockchain, operational efficiency, risk detection and mitigation;
- several early stage venture investments to support digital innovation particularly in the maritime and shipping sectors.

It is an exciting time – these programmes and initiatives are already demonstrating how the power of digital is helping customers better manage the risk and performance of their complex assets and business activities. We are achieving this together through extracting improved insight from complex and fragmented data – moving from a relatively static to a more dynamic view of risk and performance.

Operating model

We have made major investments to modernise our systems and tools optimising the operational efficiency of both customers and colleagues. Following the successful introduction of the people module in 2016/17, the first phase of the wider Enterprise Resource Planning (ERP) solution including our finance systems was implemented over the current financial year in two of our geographic areas: Southern Europe and the United Kingdom & Ireland. The key benefits of the system are associated with the delivery of a more automated, efficient and responsive service to both our colleagues and customers, enabling improved business performance throughout the organisation. This phased approach has allowed us to progressively apply lessons learnt from one area to the next. The system roll-out will touch all areas of our business.

The newly launched Marine Asset Survey Tool (MAST) and the new customer portal, LR Class Direct, makes it easier for surveyors to complete jobs and deliver better services for our customers. We have started rolling out the Windows 10 digital workspace to our estate and have trained all colleagues on cyber security.

Our focus on commercial effectiveness is building with projects across sales transformation, product management and pricing.

Customer centricity

We continue to enhance our customer experience aligned to our new brand promise – 'Smart solutions shaped with human intelligence'. With the aim of delivering a frictionless experience along all customer journeys we have created a global continuous improvement programme that rigorously analyses the insight provided by customers. Our brand refresh was driven through analysis of our customers' needs and the impact of Industry 4.0 on their environment. 'Smart solutions shaped with human intelligence' encapsulates how we work with customers and assist their evolution by connecting them with new thinking and opportunities. Launching our new website provides a future platform for customer engagement across our solutions and service portfolio.

Market conditions

2017/18 has seen continued challenges in our traditional markets. While the oil and gas industry remain cautious, confidence levels are slowly increasing after a sustained period of low oil prices. However, the associated investment in the oil and gas sector has lagged this upturn, most significantly impacting our Energy business but also on our other business divisions. At the same time the general sentiment in the maritime industry is one of cautious optimism. Themes from last year such as industry consolidation, lower contracting levels and tight financing have been replaced by a more positive new build sentiment. Our Business Assurance business has experienced a less volatile environment, while the transition to new international standards has led to an increase in activity in the year. This is expected to recede in the next period. All these industry specific factors have been experienced against an increasingly uncertain political and economic backdrop with strained global political tensions and threats of protectionism. But we remain cautiously optimistic that we are well placed to benefit from improvements in market conditions.

Financial results

Turnover of £868m is behind that of last year (2017: £887m) at actual exchange rates. Turnover at last year's exchange rates was £11.5m higher than at actual exchange rates (1.3%).

Operating profit before exceptional costs was £18.0m (2017: £49.3m), £31.3m lower than last year as a result of continued headwinds in the Energy and Marine & Offshore markets, increased amortisation costs associated with our new IT systems, investments in staff training and our external and internal websites.

Statutory operating profit, including exceptional costs was £8.9m (2017: £16.6m).

Net assets for the Group at 30 June 2018 were £532.4m (30 June 2017: £431.1m), an increase of £101.3m from last year mainly because of a £152.0m decrease in net pension liabilities. Net current assets have decreased by £32.9m reflecting cash consideration paid on the acquisition of Nettitude and other working capital changes.

The Group made a £60,000 donation to its parent, Lloyd's Register Foundation, during the year (2017: £44.0m). The £44.0m of gift aid paid by the Trading Group in 2016/17 reflected a particularly strong UK profit performance in 2015/16 which was not repeated. As the Foundation held sufficient levels of unrestricted funds to be able to continue its immediate planned grant making activity, the Trustees agreed that the profits generated by the Trading Group in 2016/17 should be reinvested to secure long term growth and increased profitability in the future rather than be paid to the Foundation as a Gift Aid return on investment.

Marine & Offshore – performance

The Marine & Offshore business generated turnover of £407.5m (2017: £445.6m). Using 2016/17 foreign currency exchange rates turnover was £413.0m. It has been a solid year for the Marine & Offshore business, against the context of a weaker new construction market. Our Type Approval and consulting business is also performing well and continuing to grow year on year. Although the outlook for new construction contracting is positive, our performance is still down from last year reflecting the very low level of new build contract activity in 2016.

We continue to take the lead in new contract wins and have widened the gap between us and our competitors. This means we are still top of the global order book for new construction in terms of gross tonnage with a significant market share of 23%. Our share of the world fleet has once again increased. Looking at how this share has changed over the past two years, since we merged our Marine & Offshore businesses, it is clear we are on the right track. In that time we have had a substantial fleet increase of 331 ships and 25.7 mGT.

The acquisition of Nettitude has strengthened our existing broad portfolio of cyber security services, spanning certification, compliance, training, auditing and security consulting and now including penetration testing, information security consulting, managed security services and incident response. With Nettitude we now provide a complete suite of cyber security assurance services to help our customers identify, protect against, detect, respond to and recover from these types of threats.

Energy – performance

The Energy business generated turnover of £144.2m (2017: £144.3m) or £147.8m using prior year exchange rates. The Energy business turnover is consistent with last year as the upstream oil and gas market remains significantly impacted by ongoing activity reduction. Revenues in certain parts of our business have fallen by 75% since the oil price collapsed in mid-2014 as operators put sustained pressure on their supply chains to reduce costs. However, we are maintaining our market share, albeit of a significantly reduced overall market size.

Although we have had to adjust our cost base on a number of occasions over recent years in response to market conditions, our over-riding strategy remains to retain our key capabilities so that when markets recover we are in a strong position to take advantage of the opportunities that arise.

Our software and downstream businesses have generally fared much better than our upstream ones. We are seeing evidence of improvement in some of our oil and gas services markets, supported by a notable improvement in bidding activity together with good win rates, allowing us to build confidence in future revenue delivery.

Business Assurance & Inspection Services – performance

Business Assurance & Inspection Services generated a combined turnover of £316.1m (2017: £297.6m), a 6.2% increase on the previous year. At last year's exchange rates turnover was £318.6m, a 7.1% increase on 2016/17.

Our strategic focus on growth has seen considerable progress. We have enjoyed double digit revenue growth in our target areas of food, cyber security and medical and, with the acquisition of Nettitude in March, we have significantly widened our service offering. This expanded cyber security offering will have value across the Group and will allow us to focus on new growth opportunities across a wide range of sectors.

Customers, particularly those with complex global supply chains, are increasingly asking us to help them manage the associated risks and as a result we are seeing growth in our customised assurance revenue. This has been reflected in the increased adoption of LR Assist which provides tailored real-time insight based on supply chain data. With consumers demanding better quality food and supply chain transparency, we are committed to delivering added-value customised assurance, certification and training services, underpinned with technology, to the many thousands of customers that we serve in the food sector.

Revenue in certification services has continued to benefit from customers transitioning to the new revised ISO 9001 and 14001 standards and there is still some work to complete in 2018/19 to meet the September 2018 deadline, with activity levels peaking during 2017/18. Elsewhere in certification, March saw the publication of ISO 45001 - the new international management system standard for Occupational Health & Safety (OH&S). With the introduction of a global standard we anticipate a significant increase in the number of organisations that will include an OH&S management system in their portfolio. As safety has been at the core of LR for 258 years, our goal is to be the service provider of choice for ISO 45001 certification.

Our business operating system is now fully deployed, helping to deliver a more positive customer experience via a new dedicated portal. With a common system, we have been able to implement consistent ways of working globally and drive improvements in operational efficiency.

Inspection Services has had a challenging year and while revenues have begun to stabilise they are still marginally below last year. Significantly reduced capital investment in the oil and gas sector has been particularly challenging and this continues to affect purchasing decisions of operators in the supply chain with a consequential impact on demand for our inspection services. We continue to reduce exposure to this sector, diversify the business and develop new services.

The launch of Vendor Passport, a co-developed service with SupplHi is complementary to both our existing vendor assessment service and SupplHi's Vendor Registration platform and it is now delivering revenue.

Alastair Marsh
Chief Executive Officer

Resilience through change.

1760

Edward Lloyd founds Lloyds Register.

1914

The First World War sees significant improvements in welding and, gradually, shipbuilders begin to look at welding for the construction of ships.

1920

Our Chief Ship Surveyor, Sir Westcott Abell, sees an opportunity to help our customers and in 1920, Lloyd's Register class the world's first fully welded ocean-going ship, the Fullagar.

1940

The Cold War brings huge advances in our understanding of nuclear power.

Seeing new opportunities as well as new risks we turn our attention to power generation.

1950

The beginnings of containerisation have huge impacts for the shipping industry.

1956

Seeing new opportunities as well as new risks we turn our attention to power generation.

We provide consultancy and inspection services to Calder Hall in the UK which would become the world's first industrial scale nuclear power station.

1961

We are at the forefront of change and class the William Holyman as the first ship specifically designed to carry container cargoes.

1970

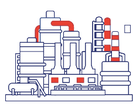
Petroleum companies are benefiting from an oil price boom and start to research the exploration of oil and gas reserves in deeper waters.

1977

Knowing that this could radically change the industry forever we develop our expertise and class the world's first floating production storage and offloading (FPSO) unit, the Shell Castellon in Spain.

1990

Quality systems become increasingly popular with businesses needing a consistent way to meet quality requirements.



1995

Wanting to meet new customer demands, we review how we offer better support and were the first certification body to gain accreditation for issuing quality management system (QMS) certificates. We still hold registration number 0001 with UKAS.

2000

The wind farm industry is growing, driven by an increase in demand for cleaner energy.

2017

Seeing a change in the world we adapt our offering and provide risk management services to Statoil for the construction of the world's first commercial floating wind farm, Hywind in Scotland.

2010

Additive manufacturing is beginning to make huge progress.

2017

We see a big opportunity and, working with the LR Foundation, we announce the first certification of a part produced through additive manufacturing for the oil and gas industry.

The Future.

It's hard to say what the future will hold.

But one thing is certain. We'll continue to adapt to meet the changing needs of our customers, responding to new challenges in order to stay relevant in Industry 4.0.

Meeting the challenges of the 4th industry revolution.

Economic instability
Driving performance and reducing operating costs.

Technology and the digital economy
Harnessing disruptive technology, big data and the internet of things.

Resilience and the global supply chain
Ever more complex global trade in goods and services.

Resource scarcity
Population growth, urbanisation and prosperity.

The world of work
Transforming the way we live and work.

Climate change
Environmental leadership and regulatory compliance.

1784
1st revolution
Steam engines for mechanical production.

1870
2nd revolution
Electricity for mass production.

1969
3rd revolution
Information technology for automated production.

Today
4th revolution

Who we are.

We are a professional services company specialising in engineering and technology solutions that improve the safety and performance of complex, critical infrastructure. Our technical expertise is supported by more than 258 years of heritage from our beginnings as a marine classification society. We now operate across multiple industry sectors in more than 75 countries employing 6,745 employees.

OUR PURPOSE

Working together for a safer world lies at the heart of why we exist and what we strive to achieve.

OUR SHAREHOLDER

Lloyd's Register Foundation has at its heart a mission to enhance the safety of life and property through its strategic themes of: supporting excellent scientific research; accelerating the application of research; promoting safety and public understanding of risk; and promoting advancement of skills and education. Successfully and effectively meeting our customers' needs generates the capital to reinforce this mission.

Our businesses.

Marine & Offshore

We are a leading international provider of classification, compliance and consultancy services to the Marine & Offshore industry, helping our customers design, construct and operate their assets to the highest levels of safety and performance.

We are shaping the industry's future through the development of novel and innovative technology for the next generation of assets, while continuing to deliver solutions for our customers every day.

Energy

We are a technology-enabled global leader, helping customers and regulators across the energy industry – including oil and gas, wind, solar, wave, chemical, petrochemical and nuclear power – design, construct and operate their capital intensive assets and deliver projects to the highest levels of safety and performance. Our independent expertise is applied to resolve and share solutions to the most complex challenges and operational requirements, providing the confidence demanded by engineering principles, government regulations and industry codes and standards.

Business Assurance & Inspection Services

Our Business Assurance business is a recognised, world-leading professional assurance services organisation. We specialise in management systems compliance and expert advice across a broad spectrum of standards, schemes and business improvement services to include customised training and assurance. In Inspection Services we certify safety critical industrial equipment according to recognised codes, standards and regulations. We also partner with companies to provide tailored high-quality inspection services throughout their manufacturing supply chains, making sure equipment is built safely and to their requirements.

Find out more about our strategy on page 16

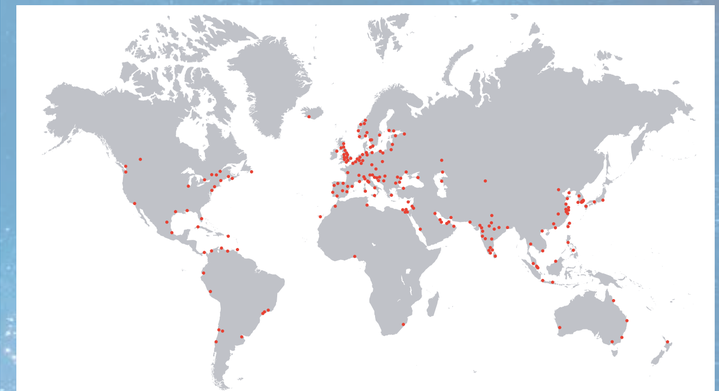
Delivering value along supply chains and across business sectors

We offer a joined-up service to companies with international operations and supply chains. The critical infrastructure assets we work on cover a wide range of business sectors – at sea and on land – from ships to power plants, manufacturing to food processing, from design, through operation to decommissioning and recycling. With a ruthless focus on innovation, we are ever improving the way we carry out work, from assurance using real time data and remote audits to surveys using drones. Our powerful software family flows across sectors and is trusted by industry leaders, academics, regulatory bodies and technology innovators.

In addition to compliance, assurance and performance services to help our customers, our training services are designed to meet the knowledge and skills development of their workforce; part of our commitment to improving the safety and performance of companies worldwide. On environment and sustainability, and within the climate change arena, our services help customers to both meet regulations and go further by implementing voluntary improvements that can have significant business and environmental benefits.

Where we work.

We support 60,000 customers who operate with complex and critical infrastructures across the global supply chain, predominantly in the maritime, shipping, offshore, oil and gas, nuclear, renewables, food and beverages, manufacturing, financial services and medical sectors.



OUR STRATEGY

Strategic priorities.

Our strategy is to strengthen our position in our traditional markets: maritime, offshore, oil and gas, and business assurance; and to grow in adjacent markets and sectors: cyber security, food, renewable energy, China, the Middle East and India.

Extend our value proposition from compliance to assurance and performance optimisation.

Build digital products for asset performance and risk management.

Transform our operating model to become more commercial and efficient.

Improve customer centricity.

Invest in our people and culture.

WHAT SETS US APART

Creating value.

1 Deep technical and industry knowledge
We understand the potential of cutting-edge ideas and know how to apply them pragmatically - guaranteeing impact today and in the long-term.

2 Dedication to assurance
We explore every problem thoroughly with exact, analytical precision. We leave no stone unturned and no questions so that we can draw accurate conclusions.

3 Independence
We are committed to doing things the right way reaching the highest standards and best outcomes for all, giving our customers confidence in our decisions every time.

4 Understanding and empathy
We take time to understand the needs and unique circumstances of our customers and their businesses, acting with judgement, sensitivity and care.

5 Social business
We have evolved into the 21st century model for social business – not only funding the Foundation through our profits but also discharging some of the Foundation's charitable objectives through our work by assuring the safety of critical infrastructure worldwide.

6 Our values
We know that how we deliver is as important as what we deliver. Our values help shape our spirit, attitude and they are what guides us. They build on our strong foundations but always look to the future.

Our Values

We care

We share our expertise

We do the right thing

Digital innovation.

Our strategy is to strengthen our current business and extend our portfolio of products and services into new markets created by the global challenges impacting complex critical infrastructure and global supply chains.

“New partnerships and fresh approaches to innovation can give businesses the chance to reap the rewards offered by Industry 4.0.”

Dr. Maurizio Pilu, VP
Digital Innovation

Industry 4.0.

In digital innovation we're working with customers on several projects spanning a wide range of technologies and customer challenges.

How does insight power disruptive industry 4.0 innovation?

The fourth industrial revolution is here. 'Industry 4.0' links the physical world to new digital advances, forging a path of rapid transformation and innovation in business, industry and wider society.

While the 'Internet of Things' isn't exactly a new idea, technology advances such as ubiquitous connectivity and the cloud means that it's now part of everyday life. More and more physical assets are now, or could be, connected from home appliances, to heavy machinery, entire production lines or even container ships. At the same time, and often because of these connections, big data is being generated like never before, and data analytics and machine learning technology are evolving very fast .

In this environment, harnessing the value of data and interconnectedness is becoming critically important to help businesses gain an advantage. It can provide immediate insights into operational performance and help make real-time decisions. Or it can provide practical solutions to help improve safety or make working processes more efficient.

The challenge for businesses is how to take advantage of the smart solutions that come from Industry 4.0 when the pace of change is so fast and complex.

What does it take to successfully innovate?

Maurizio Pilu, our VP for Digital Innovation, is working with customers to help them bring the latest data and digital solutions into their businesses. His team has found that many successful businesses share common traits. "Companies that innovate successfully in the digital era adopt certain approaches", he explains. "The first one is agile innovation. This is about working with small-scale pilots, which are easier to start and execute, and minimise the risks if things go wrong. It might also mean using rapid iterations and feedback loops, ideally involving customers, to trial ideas and learn as you go."

Alongside an agile approach his team has also found that collaboration can be critical. "Perhaps, most importantly, a culture of open innovation is key. That means collaborating with customers, partners, best-in-class technology providers and other innovative organisations."

This experience has had a significant effect on the way we approach innovation projects with customers. "To support our customers' needs and aspirations we decided to take a two-pronged approach. First we consolidated various software products and teams across the organisation into a single Digital Products division, now operating and serving our customers in a more integrated way. Second we established a Digital Innovation function to work with our customers to co-create innovative, cutting edge digital solutions to the challenges they face."

In digital innovation we're working with customers on several projects spanning a wide range of technologies and customer challenges. Data science and machine learning projects are a key focus. Many leading firms, including several of our customers, consider data science to be absolutely core to Industry 4.0 so we're working with them to co-create solutions that can extract insights from the data generated by their operation and assets. Some of the applications we are working on are improving asset performance through predictive analytics, applying cutting-edge data science to analyse large volumes of safety reports and to extract deep insights on operational risk.

We also have ongoing projects to explore the disruptive potential of blockchain in supply chain assurance. Our current focus is on the supply chains of ship components, marine fuel and food.

One key area of Industry 4.0 that has tremendous relevance is additive manufacturing. It has huge potential to transform entire supply chains and disrupt markets. The wider market is recognising this and is considering how to use it for spare parts on ships, oil rigs and even aircrafts. We are starting to work on these topics internally and through collaboration. For example, we are working with the Turing Institute on the integrity of the world's first 3D printed bridge, using a digital twin created with data from fibre optic sensors.

As our innovation efforts gain pace and our technology capabilities in industry 4.0 grow the more we realise the value of human insight.

What's the potential of open innovation?

When it comes to innovation in something as complex as Industry 4.0 an open and collaborative approach is essential. Alongside technology ventures activities, we are now working with partners from the start-up community, industry, academia and other institutions to address big industry challenges.

In late 2017 we set up a collaboration with Bordeaux-based drone specialist, Be Tomorrow, to co-create and develop a platform to support our remote inspection innovations. This involved collaboration between our internal inspection experts, customers and our digital innovation team.

And in the spring of 2018 we decided to develop a demonstrator to show how to register ships into Class using blockchain technology. We partnered with London-based blockchain specialist, Applied Blockchain, our Class specialists, marine innovation specialists and digital experts collaborating with them.

We set up a joint venture with The Welding Institute in the UK, Fullagar Technologies, to deliver innovative inspections systems, products and services.

We also support the LR Foundation with their activities. We helped them set up the Lloyd's Register Safety Accelerator in partnership with Silicon Valley's specialist, Plug & Play Tech Centre, to connect cutting edge startups with our customers to test innovative digital solutions for the world's toughest safety and risk challenges.

What role does human intelligence play in adopting digital innovation?

As our innovation efforts gain pace and our technology capabilities in industry 4.0 grow, the more we realise the value of human insight. Experience is critical to success and Maurizio Pilu believes that a good starting point for adopting new technology is to learn from customers and those who have walked the path before: "As an engineering-oriented professional services firm, we work alongside customers every day to discuss their pain points and business challenges", he says, adding: "We're trying to capture this practical, real-life experience as a precious source of insight to help us and our customers innovate better and faster."

So how does his team put this insight into use? Maurizio explains: "One example that comes to mind was a shipping customer that told us they would rather let pumps break than adopt expensive condition-based maintenance solutions. This suggested to us that cost disruption really matters for certain equipment."

He also refers to one example where smart technology actually exposed unexpected knock-on risks. "One ship captain told us that too much trust in technology on the bridge may actually increase risks. It can lead to captains not paying as much attention as they should to what's happening to the ship and the surrounding environment. This pointed to the need to help customers adopt new thinking around how their staff interact with Digital innovation and how to design effective human-computer interfaces."

His team has also learned from examples where past experiences can improve safety and performance elsewhere. "We were hearing that a customer had a huge amount of data from accident reports they weren't analysing in detail as it was really complex and expensive to do. This meant they were missing an opportunity to spot correlations that could prevent accidents. By adopting a higher degree of automation using natural language processing and tailored visualisations we have been able to work with two customers to overcome these challenges and improve overall insight into risks and causes of accidents."

This all suggests that, to be successful, Digital innovation need to be supported by experience and human intelligence. While there's no doubt that technological innovation offers huge potential it can be daunting and complex to take the leap. By embracing agile and open collaboration and drawing on the experience of others businesses can put themselves in pole position to reap the rewards of Industry 4.0.

Maintaining a pipeline of profitability.

New software offers an innovative pipeline monitoring system for US oil and gas facilities.

As pipeline lengths increase and cover more hostile and unpredictable environments than ever before, the challenges of maintaining integrity, pressure, flow and an aging network of pipelines intensify. Weather, tidal conditions, terrain movement and corrosion damage are just a few examples of the many issues facing pipeline operators. Repairing defects, dents, gauges, corrosion and leaks in pipelines can be a costly and resource-intensive task that often results in halted production. The operational and liability costs borne by operators over the years run into tens of millions of dollars.

Real-time insights for pipeline operators

Sensors have long been used to monitor pipelines for breaches and leaks. But with pipeline expert, Western Specialities, we have developed a novel solution by merging structural steel sleeve and composite overwrap repair with fibre optic sensing technology.

Our Smart Sleeve solution uses 24/7 sensor monitoring and advanced data analytics to provide pipeline operators with a clear picture of what's going on with a pipeline at any time. The system can record and timestamp all movement, including the actual direction of movement, pressure, temperature and strain detected in the structure. This data can be stored in the LR Cloud which regulators, operators and technical engineers can access from any location. If variances are detected, the anomaly is characterised and triggers a response for inspection, providing the operator with options to minimise disruption. By reducing costs and the risks associated with the impact of pressure reduction and pipeline rupture, SmartSleeve helps operators maintain safety and a pipeline of profitability.

Predicting future wind power production.

Our partner, University of Bristol, has a new initiative to improve how the energy industry predicts wind speed.

Wind speed variability remains one of the most pressing issues for developers and operators of wind farms. Accurate, clear and concise information about wind speed can help the industry increase its understanding of its impact on the financial returns of projects.

A unique platform to investigate wind speed

Second-year Computer Science students studying for bachelor and master degrees at the University of Bristol are working with us to develop our new wind energy initiative. Combining the latest technology and the brightest scientific minds, the 'windiness dashboard' will increase the quality, accuracy and access to data used in monitoring and predicting wind trends. The aim is to offer investors, developers, owners and operators of wind farms the most reliable information to assess and predict energy production – from planning and development through to operation.

Looking to the future

A wide range of future wind farms – offshore and onshore – stand to benefit from the data we can share through the 'windiness dashboard'. The data will help to build up year-on-year trends offer better understanding of the siting considerations for wind farm developments, and provide a reliable and quality-driven index of wind data.

Co-creation of cloud-based regulation compliance.

CO_2 Verifier is a one-stop compliance solution for EU MRV and IMO DCS regulations.

To reduce global shipping's carbon footprint, the EU and the IMO introduced parallel regulations to monitor and analyse fuel data. The EU's monitoring, reporting and verification (MRV) regulation requires a monitoring plan, while the IMO's Data Collection System (DCS) requires a SEEMP Part II. Compliance with both regulations is mandatory. But both regulations run on different timelines, take differing approaches, and neither specifies exactly how to achieve compliance. This not only leaves scope for confusion; operating tandem compliance plans also becomes inefficient for our customers – both in terms of time and cost.

Implementation of these regulations presents a significant compliance challenge for shipowners and operators – our CO_2 Verifier offers one simple way to comply with them both. It will save our customers time and effort, helping them focus on their day-to-day business.

Nick Brown
LR Marine & Offshore Director

Two plans, one simple solution

Our technical experts collaborated with ship managers to design CO_2 Verifier. This secure cloud-based application provides one place for customers to manage their fleet compliance and submit data to comply with both the EU and the IMO regulations.

We are an accredited third-party verifier for EU MRV and a Recognised Organisation (RO) for IMO DCS. When data is submitted to us we carry out the necessary checks and verification procedures; we also issue the respective certificates to keep onboard for Port State Control inspections. CO_2 Verifier features streamlined multiple data uploads with a fast turnaround and can also integrate with ship managers' existing reporting systems. Users can access online support or contact one of our technical experts directly.

Looking to the future

CO_2 Verifier is a powerful tool for customers who have vessels that must comply with one or both regulations. Our aim is to relieve the administrative burden on busy teams and help reduce significant overheads. As well as enabling the submission of electronic data, the application allows remote verification of uploaded paper documents such as bunker delivery notes. This removes the need for an assessor to carry out physical checks at your offices and could put an end to site visits all together.

Smart ships with cyber security.

The new level of connectedness in the marine industry presents opportunities to improve safety, but it also introduces new areas of risk. Assets are now more vulnerable to incidents of cyber attack.

A risk-based approach

Daewoo Shipbuilding and Marine Engineering Co., Ltd (DSME) has been focusing on developing a cyber security governance system. The company has worked closely with SEANET Co., Ltd. – a supplier of ship's computer network systems – to mitigate the risk of security breaches. It has now received approval in principle from LR for its Smart Ship Solution (DS4®). The system's functionality ranges from simple remote monitoring of a ship with crew, to a fully autonomous vessel with no crew on Board.

Looking to the future

DSME Senior Executive Vice President, Mr. Odin Kwon comments: "We're glad to receive LR cyber security AiP. It ensures that our smart ship system can provide a reliable and competitive service to our customers with minimum security risk. Our aim is to embed cyber security seamlessly within our Smart Ship Solution, to communicate between the asset and shore safely, maximise ship operation benefits, and manage the risks presented by connectivity."

Innovation effectiveness for DEWA.

DEWA provides all its employees with the opportunity to enhance and develop their knowledge and creativity in an environment that stimulates innovation. It has raised the importance of innovation to 40% in its strategic plan, in line with its vision of being a sustainable, innovative, world-class utility.

HE Saeed Mohammed Al Tayer
Managing Director and CEO, DEWA

We help bring innovation strategy to life for the Dubai Electricity and Water Authority (DEWA)

In 2010 HH Sheikh Mohammed bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE and Ruler of Dubai, launched the 'UAE Vision 2021'. It outlined six national priorities to elevate the importance of innovation, science, research and technology and make them central to the strategies of all organisations in Dubai. To demonstrate the commitment to these priorities, the Vision is supported by an AED two bn fund.

Responding to the call for innovation

As a Government body, DEWA recognised the importance of adopting a forward-thinking strategy and began embedding a culture of innovation throughout their organisation. They understood that following innovation management system guidelines could offer significant benefits such as enhanced creative capabilities.

To find the right management system to help bring their innovation strategy to the forefront, DEWA engaged us and we identified European management system standard CEN/TS 16555-1:2013 as the right solution.

The guidance within CEN/TS 16555-1:2013 offers DEWA a new approach to assessing and reporting. This involves site visits to evaluate effectiveness and detailed reporting to highlight potential system improvements and corrective actions.

The result

DEWA successfully achieved a statement of verification to CEN /TS 16555-1:2013. Since then it has gone on to accomplish several milestones including the launch of an innovation policy across the organisation and the implementation of a cultural programme, encouraging employees to pitch their innovative ideas.

An industry first in additive manufacturing certification.

In taking on this initiative, our Additive Manufacturing group has truly opened a gateway to the future. Our pivotal role is to guide suppliers through the codes, standards, controls and best practices to manufacture AM parts so that end users will have full confidence that an AM part meets the required level of criticality for that part.

Ciaran Early
Technical Director, Safer Plug Company

We announced the first certification of a part produced through additive manufacturing (AM) for the oil and gas industry in September 2017.

The Safer Plug Company (SPC), who designed the titanium gateway manifold part for use in pipeline isolation tools, approached us to provide independent assurance of the manifold's manufacture. The project was overseen by assessors using an LR framework produced alongside global industrial research organisation, TWI – an industry first that guides manufacturers on AM processes to certify components.

Confidence in new technology

The manifold, produced by AM production company, 3T RPD, using powder bed fusion would have been almost impossible to make using traditional manufacturing techniques due to complex internal channels. Our certification ensured industry pioneer SPC could provide customers with confidence in parts produced this way, paving the way for future adoption of the technology by the oil and gas industry.

Next steps

We are now working on certification for the next batch of manifolds and developing a Type Approval certification which will enable the manifolds to be produced on demand.

Fullagar Technologies employ digitilisation.

Delivering high-tech innovative inspection systems, products and services based on the very latest industry Research and Development.

To keep pace with the rapid advances being made in technology we teamed up with TWI, the leading independent research and technology organisation, to launch Fullagar Technologies.

The joint venture is named after the world's first fully-welded ocean-going ship, successfully demonstrating how new technology can be deployed in a traditional industry.

A commitment to new technology

The joint venture combines TWI's expertise in advanced welding and non-destructive testing techniques (NDT) with our technical inspection and verification experience. Together we're aiming to deliver innovative inspection systems, products and services globally using the very latest industry research from the National Structural Integrity Research Centre (NSIRC).

Our collaboration with TWI has already seen the publication of the first industry guidelines on additive manufacturing in 2016. Fullagar Technologies will continue to lead its industrial development, including in-process (rather than end product) verification and certification.

Moving forward Fullagar Technologies will be focusing its efforts on deploying the latest digital technologies in remote inspection, additive manufacturing and digital manufacturing.

Looking to the future

This partnership continues to support our work to enhance the safety of life and property. We hope it can also establish us as a leading supporter of worldwide engineering-related research and help us to improve the safety of the critical infrastructure on which modern society relies.

Sustainable environments.

We have set out to produce research reports looking at fuel and technology trends for the marine industry, aimed at developing new knowledge and tools that can contribute to policy debate.

Katharine Palmer
Global Sustainability Manager

At the end of 2017 the Antwerp maritime group, Compagnie Maritime Belge (CMB), launched its first hydrogen-powered vessel, Hydroville. The catamaran crew boat was the first vessel to use hydrogen to power a diesel engine, classed by LR. Because the novel concept of hydrogen-injected diesel engines isn't covered by our standard rules we needed to take a risk-based design approach to the approval process.

"The project is a showcase for LR as well", says Ed Fort, Global Head of Engineering Systems. "It demonstrates our capabilities in hydrogen risk assessments and is a stepping-stone towards the wider use of hydrogen as a fuel for combustion engines and alternative power generation technologies such as fuel cells. We are taking a leading role in assuring the safe deployment of alternative fuel sources for shipping."

Exploring how we can work with shipping companies and wider partners to find viable solutions to decarbonising the industry.

How will the shipping industry rise to the challenge of decarbonisation?

Fossil fuels provide us with a high density, low-cost energy source that is comparatively easy to store, handle and transport. In terms of shipping we have had decades to optimise the design, maintenance and operation of the shipping system around these fuels. As the world's attitude towards fossil fuels is changing, shipping is working to find a non-fossil, zero-emission and sustainable energy source but it's a complex task to undertake. At the end of 2015 the Paris Agreement confirmed that it was not a question of whether climate change should be addressed but a question of how and it was clear that everyone will have to contribute.

The greenhouse gas (GHG) emissions of shipping are a consequence of the carbon intensity of shipping's energy supply, the energy efficiency of shipping and the demand for shipping. Shipping is the most efficient mode of transport and currently accounts for 2.3 % of global CO_2 emissions. However, all the future scenarios in the International Maritime Organisation (IMO) Third GHG study 2014 anticipate rising emissions; from 50 to 250% by 2050 under a 'business as usual' scenario. The temperature goals of the Paris Agreement, to stabilise temperatures to below 2°C and aiming for 1.5°C, place a challenging burden on all sectors. There will be no space in the carbon budget to allow the emissions of shipping, currently approximately 1Gt a year, to be ignored.

Is evidence the starting-point for action?

Katharine Palmer, our Global Sustainability Manager, explains our role in this area and the work she is leading: "We have set out to produce research reports looking at fuel and technology trends for the marine industry, aimed at developing new knowledge and tools that can contribute to policy debate. The first piece of research specifically addressing the decarbonisation challenge was Low Carbon Pathways 2050, which asked the question: given the best available evidence, what is a reasonable estimate of how shipping might be required to change and what does this look like?"

To help address the challenge we have been working alongside Shipping in Changing Climates, a $4m multi-university and cross-industry research project, funded by the Engineering and Physical Sciences Research Council (EPRSC).

This evidence-based research study contributed towards the discussions in the industry and, in particular, those within the IMO's Marine Environment Protection Committee (MEPC). Expanding on the value of an evidence-based approach Katharine Palmer believes that data and insight can help the industry decide how best to address the issues it faces. She explains that, consistent with the Paris Agreement, the study gives particular focus to the technological and operational specifications of the global fleet and how these may change in relation to a given rate of decarbonisation. It provides necessary understanding on the potential pathways to the decarbonisation of the global shipping industry.

"The study made it clear that we needed to advance thinking beyond marginal gains in energy efficiency and alternative fossil fuels if we are to identify the sector's least-cost decarbonisation pathways. The report also underlined the need for shipping to start its decarbonisation imminently. As stringency increases over time, increasingly high-cost mitigation steps are then required. The later we leave decarbonisation the more rapid and potentially disruptive it will be for shipping."

How do we get from low carbon to zero emissions?

The research indicated that, to achieve at least a 50% reduction in CO_2 by 2050 and to be on course for a CO_2 pathway consistent with the Paris Agreement, zero-emission vessels (ZEVs) need to be entering the fleet around 2030. What's more, a significant portion of new-builds will have to be zero emission to compensate for the non-zero emissions of the existing fleet.

After Low Carbon Pathways 2050 was published we saw a transition in mindset, with broad industry buy-in to take action. But the question became: 'How are we going to do this in practice?' The answer was to look at what threshold levels are needed to make zero emission technologies viable and how to support this change.

Our experience in innovative zero emission technologies, such as wind, hydrogen fuel cells and batteries, shows that the possibilities are there. But the next step is to demonstrate that these are viable alternatives to hydrocarbon propelled shipping, at least by 2030.

We formed a collaboration with academic partner, University Maritime Advisory Services (UMAS) - a partnership between the University College London (UCL) Energy Institute and MATRANS. The aim was to demonstrate the viability of ZEVs and identify what needs to be put in place to make them a competitive solution. The result was a study titled Zero Emissions Vessels 2030. It drew on modelling capabilities to enable us to look at different scenarios in the future by looking at the world's fleet today, adjusting different parameters to see what needs to happen.

Specifically, the study looked at seven technology options for ZEVs and applied them to five different case-study ship types, across three different regulatory and economic scenarios. The options included various combinations of battery, synthetic fuels and biofuel for on-board energy storage, coupled with either a fuel cell and motor, internal combustion engine or a motor for energy conversion.

We wanted to demonstrate the potential solutions for shipping's zero-emissions transition. By sharing the findings we hoped to inspire the shipping industry to ensure that zero emissions happen swiftly and with minimal cost and disruption to trade.

"There isn't one solution that works better than another", remarked Katharine Palmer. "We're not yet at a stage where we can narrow down the options in that way. But what we are able to show is that different solutions have different benefits for different types of ship. Hopefully, this creates a robust source of information to help businesses within the industry to start exploring the different options and consider the best approaches in their particular case."

How do we turn ambitions into reality?

In April 2018 the initial GHG strategy was adopted by IMO's Marine Environment Protection Committee (MEPC) during its 72nd session at IMO Headquarters in London. This sector deal represents a significant ambition for the shipping sector, by setting an ambition to reduce GHGs by at least 50% by 2050, based on a 2008 baseline. There is also a strong emphasis on reducing to 100% by 2050 if this is shown to be possible.

This puts the shipping sector on course for a 2°C pathway, as shown in Low Carbon Pathways 2050 and in line with the Paris Agreement, while aiming for 1.5°C. This deal provides a clear signal to the industry that the overarching aim is to end the use of fossil fuels.

So what does this mean for ship owners and operators? From a practical perspective, if ZEVs need to enter service by 2030 anyone planning to finance, design or build a ship in the 2020s will need to consider how it can switch to non-fossil fuel later in its operational life.

Katharine Palmer believes the industry is ready for change but needs support to take action: "The industry response to the IMO GHG strategy has been very positive. But now we're moving into a phase of 'what do we need to do and how do we do it?' So the question is: 'How do we encourage action, maintain momentum and come up with measures that the industry can implement?'"

Our work in this space is about demonstrating 'the art of the possible' and providing evidence to encourage action, as Katharine explains: "Using our technical expertise, research capability and insight we look to facilitate the development of the solutions needed or validate those proposed. It is important that solutions are not only viable from a commercial perspective but are also technically feasible and can be safely adopted and operated. Our next research study is already underway. The objective is to show what's needed to enable the transition, on a ship and supply infrastructure level, to support the action planning programme. We hope to demonstrate to industry stakeholders that they can start taking action now."

The next piece of the current puzzle is to help the industry answer the next questions in this complex challenge: what needs to happen for ship deployment? And what needs to happen to develop the supply infrastructure? We are currently developing a Transition Pathway study, looking at the milestones, barriers and enablers, based on cost implications, operating profile and how policy measures such as carbon pricing could influence this. This work is due to be published in late 2018.

Sustainability through data.

Ferry operator, Red Funnel, is the first company to sail with our connected assets platform, Fuel Monitoring and Analytics application.

Red Funnel operates three Raptor Class ro-pax vessels between mainland England and the Isle of Wight. They clock up an amazing 45,500 miles each year so improving efficiency and maintaining high reliability are key objectives for the company.

Finding intelligent solutions

The first thing we did was to supply Red Funnel with a low-cost, turn-key solution that connects to legacy systems onboard. The system transmits all data to our secure connected assets platform in the cloud. From there we can use analytic tools to discover how, why and where fuel is being consumed on the vessel. Red Funnel stakeholders can also access the data and tools through a secure web portal.

Our application identified that running their Voith Schneider propulsion systems with a high pitch and low RPM was consuming more fuel at a given cruise speed, compared to operating at a low pitch and high RPM. Since running engines at a higher RPM to reduce fuel is counter-intuitive, this would never have been identified without our technology and the human intelligence behind it.

Looking to the future

Red Funnel has now installed data systems on all its Raptor class vessels. The insights and intelligence will be a valuable asset in helping Red Funnel make investment decisions for their new ships and technology. As a result of maximising asset performance Red Funnel will also be meeting the challenges involved in reducing emissions and will be able to provide transparent, verifiable reporting on environmental emissions to their stakeholders while demonstrating a commitment to their community.

This application allows us to analyse trends in engine or hull performance, using valuable telemetric information to ascertain if any adjustments are needed to improve performance.

Mark Slawson OBE
Fleet & Technical Director,
Red Funnel Group

Reducing underwater noise at source.

Testing the latest and quietest, underwater pile driving technology.

Underwater noise is a big issue when installing offshore wind farms as it can disrupt the ocean's ecosystem by causing disturbance and damage to marine life. To address this issue the offshore foundation company, Fistuca, started developing its BLUE Piling Technology in 2011. This technology focused specifically on driving large piles into the seabed.

Huge potential for the industry

To avoid using conventional hydraulic hammers, Fistuca's ground breaking technology uses a water column, accelerated by the combustion of a gas mixture, to drive the pile into the ground. Computer modelling of the prototype has suggested promising results both in terms of reducing underwater noise and extending asset life.

Fistuca needed to test and validate these assumptions to prove that the BLUE Hammer Technology met the most stringent noise pollution regulations. Our team of Engineering Dynamics experts assessed and combined test data and pressure calculations with a carefully adapted vibro-acoustic model and performed numerical simulations of the expected underwater noise from the prototype device during operation. According to these simulations, the BLUE Hammer Technology has the potential to produce far less noise than the current widely-used method of hydraulic hammers.

Looking to the future

Our prediction tool will continue to improve as the customer gathers more offshore data. And it also has tremendous relevance for the utility companies Fistuca are seeking to work with as it will help provide a high degree of confidence in future underwater noise predictions.

Reforming ship recycling.

forum for the future

Forum for the Future and the Sustainable Shipping Initiative have announced the launch of the Ship Recycling Transparency Initiative (SRTI).

Transparency across ship recycling policies and practices is currently insufficient. Existing legislation, enforcement mechanisms and international standards are either applied inconsistently or circumvented altogether. Bad practices are not being scrutinised; good practices are not being rewarded; and stakeholders aren't able to make well-informed business decisions. Shipbreaking is a hazardous process and, when it comes to safety and pollution, more responsibility needs to be taken as the shipping industry's customers are becoming increasingly concerned about the environmental and social integrity of their supply chains.

Increasing transparency

We have worked with major vessel owners to develop a responsible recycling service. This involves working with them to plan for the recycling and select a responsible yard including investigating the facility's health, safety and environmental operational standards. These assessments provide invaluable information when customers are selecting a facility to dispose of the ship. We also support owners throughout the recycling process, undertaking independent safety and environmental audits and verifying that end-of-life disposal was conducted in accordance with the regulatory requirements.

sustainable shipping initiative

This work and other work carried out through the Sustainable Shipping Initiative ship recycling working group contributed to the concept for the Ship Recycling Transparency Initiative (SRTI). The SRTI launched in March and we are a member of the steering committee. It is hosted by the independent charity, the Sustainable Shipping Initiative. It brings together leading ship owners, banks and other key stakeholders from across the industry with the aim of accelerating a voluntary market-driven approach to responsible ship recycling practices.

Looking to the future

Nick Brown, our Marine and Offshore Director, welcomes the SRTI as part of our commitment to drive industry change, by supporting responsible ship recycling practices and initiatives. He says: "We believe that increasing transparency is an essential step in this process which will, hopefully, accelerate the industry wide implementation of safe and environmentally sound ship recycling practices for the benefit of all."

Business resilience.

“In uncertain times, business and society needs to be able to adapt and respond quickly to threats. While it’s not always possible to predict the risks, we can better prepare for them.”

Paul Butcher
Director, Business Assurance & Inspection Services

Can resilience become the best form of defence?

The pace of political, social, economic and environmental change means the world looks very different today than it did just five years ago. Some of these changes have been unprecedented and unforeseen while some of them have happened more slowly and with greater predictability.

Whether the changes have been known or unknown, businesses have had to adapt to face the challenges of operating in shifting landscapes. They've had to deal with external threats like terrorism, cyber attacks and natural disasters; operational risks posed by advances in technology; and internal challenges such as changing workforce demographics and human error.

Paul Butcher, Director, BA&IS, believes that the connected nature of business and society adds to the problem: "The rapid evolution of technology has made systems more interconnected. This interdependency means we're more exposed. When we bring financial systems, supply chains and infrastructures online they become vulnerable to the type of cyber attack that, until recently, were confined to IT departments. And creating a network of interdependent systems means that if one fails the others are impacted too."

Some businesses have navigated these challenges with minimum disruption while others have failed under adverse conditions. What is it that causes some to survive when others don't?

In the face of unpredictability and instability resilience engineering could be the answer.

Can resilience engineering help us 'get ahead' of risk?

Resilience is about an organisation or country's ability to keep its systems, structures and communities operating in a dynamic and stable way during a major disturbance. Whether due to natural events, operational failure or human attack, a resilient organisation doesn't simply batten down the hatches and wait for the threat to pass - it remains functional while managing to protect itself and stay productive.

Currently, resilience isn't always a given. In recent years countries around the world have had to deal with an increasing number of natural threats such as Hurricane Katrina in the US and multiple typhoons in the Philippines and South-East Asia – causing major damage and long-term instability. In the UK the National Health Service suffered significant reputational, operational and financial damage after the 2017 Wannacry cyber attack on its systems. We've also experienced unseen infrastructure failures such as the widespread power outages in the US and Europe in 2003. These led to cascading failures in essential services such as water and food supply.

As an emerging approach to dealing with these problems resilience engineering aims to enhance the safety of life and property and improve the resilience of engineered structures and systems.

Data will arguably become the most important component. On the one hand the ability to collect and analyse data will help to give as much visibility of risk as possible. On the other hand it will also help to measure resilience. Applying the right methodologies, metrics and processes will deliver valuable insights to help shape the resilient systems and structures of the future.

Where are the resilience challenges today?

Cyber security

The World Economic Forum recently placed cyber attacks as one of the top three global risks for 2018. This means that cyber security has become a 'must have' consideration for any resilience solution.

To assure the safety of our customers and the users of their services we acquired cyber security specialists, Nettitude, in March this year. While we've always provided assurance and risk management using a range of cyber security systems this acquisition offers greater scope to provide broader assurance in increasingly complex networks.

Specifically, Nettitude's core focus is on threat-intelligence and it takes a holistic approach to cyber security which includes penetration testing, information security consulting, managed security services and incident response. It already has a very strong footprint in the financial services sector and now protects the market leaders in the UK and the US.

By coming together with Nettitude we can now provide a complete suite of cyber security assurance services to help customers identify, protect, detect, respond and recover from cyber threats. The combination of businesses also means we have been able to extend where we are able to offer our services to new and emerging markets.

> **The World Economic Forum recently placed cyber attacks as one of the top three global risks for 2018.**

> **Beyond cyber security, businesses are also starting to look at resilience within supply chains.**
>
> **Paul Butcher**
> Director, BA&IS

Supply chain

Beyond cyber security, businesses are also starting to look at resilience within supply chains. Consumers and organisations across all sectors of industry are dependent on the ready supply of goods, products and raw materials. Disruption to the supply chain at any point can have serious repercussions for international business.

Arla, one of the world's largest dairy companies, approached us to support its supply chain operations. The European dairy cooperative operates globally and is owned by 12,000 dairy farmers worldwide. The supply chain for the UK business alone relies on the cooperation of 2,500 dairy farmers.

We worked with Arla to improve resilience in two key areas of the business:

- Enhancing product quality.
- Providing real-time insights and compliance across the supply chain.

In six months the operations of all 2,500 dairy farmers were migrated onto a single technology platform, LR Assist. This customer portal lets users monitor the audit performance of their entire estate in real time. The level of visibility it offers is a huge benefit to customers like Aria who have thousands of sites across the country.

With instant access to the data through automated reporting and dashboards, Arla can check all their sites for overall compliance with their standards. They can also easily drill down into the detail and identify both common and specific issues as well as potential concerns. And the management team are able to monitor the data online for insights in regional trends and developments as well as potential risks.

How can we make resilience practical and achievable?

To help understand the threats and to help businesses prepare to defend themselves the Lloyd's Register Foundation (LRF) has collaborated with Arup to create the Resilience Shift initiative. The initiative's aim is to strengthen resilience within and between global critical infrastructure sectors through better understanding of the issues as well as through knowledge sharing.

Can resilience engineering benefit wider society?

While the initial purpose of resilience engineering may be to protect businesses and infrastructures from risk, its ultimate purpose is to protect the safety of people. Those who rely on the services provided by infrastructure suffer the most critical consequences if they go wrong.

Societies, like businesses, need to be resilient. By applying the approach of resilience engineering we can help organise and train people and enable them to switch in an instant from their daily task to handle emergency situations.

Nettitude acquisition strengthens security cyber services.

We acquired Nettitude in March 2018, strengthening our portfolio of cyber security services for a worldwide customer base.

Nettitude provides award-winning cyber security, compliance, managed security services as well as infrastructure and incident response services to organisations around the world. Today's interconnected environment can pose intricate regulatory issues. Our solution aims to provide tailored and pragmatic consultancy services, designed to meet our customer's unique challenges.

An enhanced cyber security service

As we move towards a more automated, integrated and interdependent data-driven economy the threat of cyberattack increases. Consequently, the regulatory focus on cyber security is growing with wide-ranging compliance requirements against standards, schemes and local legislation.

Businesses understand that cyber security needs to be an executive-level responsibility and not just the concern of the IT department. By adopting a risk-based approach with resilience engineering organisations are focusing on protecting their critical assets with the right technology and practices, allowing for early identification of breaches and a rapid response.

The Nettitude acquisition allows us to engage with customers across the whole spectrum of cyber security – from the procedure audit and vulnerability assessment through to managed security services and training. We now also offer ISO 27001 (security risk consulting), GDPR, Cyber Essentials, PCI Audit & PCI Certification, CBEST assessments (for the financial services sector), Penetration Testing, Vulnerability Research and Security & Risk Consulting.

Looking to the future

We aim to cut through customers' data noise, delivering smart risk management that enhances safety and asset performance. Whether they be financially or politically motivated we will continue to work closely with customers to identify cyber threats.

Our geographic reach and vision for how technology and data will influence industry will support our customers across all our sectors.

Rowland Johnson
Founder and CEO, Nettitude

Smart shipping, moving forward.

Huangpu Wenchong shipyard will continue to work on the development of smart ships and contribute more to the shipping industry. We wish the *Great Intelligence* a bright future and believe she will create miracles for the operating company and shipowner.

Wang Yi, Vice
General Manager, CSSC Huangpu Wenchong Shipbuilding Company

***Great Intelligence* has become the first smart ship in China to be presented with our Digital Ship descriptive notes.**

Great Intelligence is a 38,800 deadweight ton, modified version of the Green Dolphin fuel-efficient Bulk Carrier concept. This isn't just a ship with integrated smart system. The designers at Shanghai Merchant Ship Design and Research Institute (SDARI) aimed to develop and build a fully digital ship. The vessel's Ship Operation and Maintenance System (SOMS) uses intelligent technologies such as machine learning and advanced sensing technology to create the ship's network.

A milestone in the digital journey

We were the first to issue guidance on digital ships and pioneer a 'total-systems' approach to classification. This approach effectively provides the industry with a route map to understanding the elements that constitute a digital ship as well as the activities necessary to ensure this technology does not involve any safety risks.

After factory acceptance and sea trial tests we presented *Great Intelligence* with new digital ship descriptive notes: Cyber AL2 Safe (Navigation, Propulsion, Steering), Cyber AL2 Maintain (M/E, A/E, Boiler, Shaft) and Cyber AL2 Perform (Energy Management).

Looking to the future

This vessel is an opportunity to set the standard for digital ships going forward. And it's a landmark for smart shipping in China as well as for the industry as a whole. We are very proud to be helping our customers build more autonomous ships that are safer, more efficient and energy saving.

What 35 years of ship casualties has taught us.

We support about 25 to 30 real cases and 80 exercises a year for our customers and we're always looking at where we can enhance areas of response and training.

Looking back on our Ship Emergency Response Service as it approaches its 35th anniversary.

"Our bulk carrier has hit an iceberg and we have damage and flooding forward". This was one of the first calls that triggered the foundation of our Ship Emergency Response Service (SERS). We were the first classification society to establish such a service and since then have provided 2,000 responses to support our 850 customers worldwide, with 3,800 ships of all types, a third of which are not LR class.

Three decades on and still learning

Over the years we've applied the lessons we've learnt to develop the service into a highly advanced state of readiness with a pool of 25 naval architects and mariners, offering the most experienced service in the sector. We support about 25 to 30 real cases and 80 exercises a year for our customers and we're always looking at where we can enhance areas of response and training.

The most common findings from these exercises are weaknesses in ship communications and supply of casualty data. These are just some of the areas we are working to address to advance our levels of preparedness even further.

Looking to the future

We wish to establish more effective ship-to-shore collaboration such as web conferencing and look further into the use of remote, real-time monitoring along with data collection and analysis. Preparing for emergencies is an ongoing process of development and one that SERS will continue to pursue for the next 35 years and beyond with the aim of reducing the risk of incidents for ship operators.

Mitigating risk with ready rigs.

Working together with our customer we identified several business and operational risks during their rig intake process.

Our customer – an international oil and gas company – had contracted two jack ups and one semi-submersible to commence drilling operations. But during the rig intake process they discovered that three of the rigs were non-operational and two had never commenced drilling operations in the North Sea Continental Shelf meaning they would be under particular scrutiny from the regulators.

Assuring the rigs

We conducted assurance activities on the rigs and highlighted anomalies which could adversely affect their level of readiness to start drilling. A number of critical major and minor findings were raised that, if not rectified, would have had a direct impact and possibly cause delay to the rig going operational.

After completing these assurance activities we provided technical advice and assurance around people and crew management; systems safety and operation; and equipment compliance and readiness.

Looking towards the future

Our involvement in the rig intake process meant that the customer could identify and address operational risks and non-compliance issues. This enabled them to work with their drilling contractors to mitigate or remove risk, today and in the future.

Understanding risk reduces downtime.

Minimising downtime for site visits and testing without compromising safety standards.

Safety is the top priority for Shell and its installations are tested frequently. For more than 100 years Shell has had a research facility in Amsterdam which is inspected annually with an additional detailed test program executed every five years. But these tests often involve downtime running into multiple weeks which impacts on the laboratory's budget. To try to address this issue and optimise the testing process Shell Technology Centre Amsterdam (STCA) asked us to create a risk ranking for all their safety systems at the laboratory.

Analysing asset integrity and management systems

The five-yearly testing program has many protocols for each specific part of Shell's laboratory. However, the differences between the laboratory's numerous systems means not every part of the laboratory requires testing at the same frequency.

By using our Reliability Based Mechanical Integrity software we determined the risks for the laboratory's pipework. We also carried out Failure Mode Effect and Criticality Analyses for all other systems including fire detection. After that we could determine the likelihood and consequence of failure for the entire system. We compared the risks across multiple installations and presented them in a single risk matrix which supported our recommendations for improving the series of test protocols.

Moving forward

Comparing risks between different systems is hardly ever seen in this industry. But this project shows that comparing the risks for different systems is the best way to streamline maintenance and inspection. By using the risk ranking matrix inspection planning can be optimised and downtime significantly reduced.

Leading the way for logistics.

Helping Schenker Singapore successfully migrate to ISO 45001.

As the world's leading global logistics provider, Schenker Singapore is dedicated to maintaining high safety and health standards within the organisation and across supply chains.

Setting the new standard in safety

Schenker has become one of the first organisations to receive LR certification to ISO 45001:2018, the new international Occupational Health and Safety (OH&S) Management System standard.

As the certification body for Schenker's ISO 9001, ISO 14001 and OHSAS 18001, we worked closely with Schenker to develop their migration plan to the revised ISO 45001 (to replace the existing OHSAS 18001). We undertook a gap analysis to assess Schenker Singapore's existing OHSAS Management System against the requirements of the new international standard. This gap analysis gave Schenker's team valuable insights they could use to prepare the migration to the new system. It also helped them to focus on areas that were particularly relevant to their business objectives. The result was a smooth and successful migration across its 13 core operational sites within a four-month period.

Moving forward

The successful migration further strengthens Schenker Singapore's current competitiveness. With this additional feather in its cap of being ISO 45001:2018 certified, Schenker hopes to provide a healthy and safe work environment through elimination of risks and hazards for their employees, contractors, customers and all relevant stakeholders to prevent work-related injury and ill health. Overall, this should translate into better improvements and higher standards in their safety and health reputation as well as a higher staff morale. Ultimately, this new standard will be instrumental in ensuring that the organisation continues to maintain its position at the forefront of health and safety standards.

Connected supply chains.

“Trust is the bedrock of the global food supply chain.”

“When we sit down to eat our evening meals, buy a sandwich or salad from a shop or go to a restaurant we want to know that the food we’re eating is safe, environmentally and ethically responsible, and exactly ‘what it says on the tin’.”

David Butler

Innovation & Technology Director,
Business Assurance & Inspection Services

Can blockchain help rebuild consumer trust in the food industry?

To help nature keep up with demand, human interventions on an industrialised scale mean our food is handled by many people before it reaches us, from farmers and producers to processing plants, to distributors, to retailers. Consumer trust in the food supply chain has suffered. According to a report from retail insurer, NFU Mutual, only 7% of UK consumers have trust in the global food chain whereas, in a survey conducted in China by Ecolab and China Business News Group, almost 99% of participants said they would change their decisions on purchases because of food safety incidences.

Food scandals have highlighted the risks involved. We've seen high-profile public health crises such as the outbreaks of BSE in 1990 and E. coli in South Wales in 2005. And the challenges aren't just about immediate health risks - we've also seen a breakdown in trust when the foods we were sold weren't what we were told they were such as the European 'horsemeat scandal' in 2013 and the increasing number of food recalls due to additives in processing.

For the food supply chain the big question today is how to restore trust when so many people are involved with differing ethical and regulatory approaches in so many places.

Can technology improve traceability?

Traceability is one of the main issues facing the industry. If we put ourselves in the position of a high-end restaurant, how much reassurance do they currently have about the 'chain of custody' in their own supply chain, from source to kitchen?

This is the kind of issue that the Marine Stewardship Council (MSC) is trying to address through its 'Product Provenance and Key Data Elements (KDE)' project. The aim is to provide greater information and oversight on 'certified product origin'. The product origin information will travel through the supply chain with a unique KDE code which is verified at certain points along the way. This will help ensure that there's information to link supplies back to an Aquaculture Stewardship Council-certified farm or MSC-certified fishery – and address the risks of illegal or uncertified fisheries entering their supply chains. In short, it will help reassure the industry that the seafood they buy meets their expectations for those standards. The question then becomes one of trust in the information. How do we make sure the industry gets this detail – and can we be sure that it's true?

One solution we're exploring is blockchain technology. As a decentralised register, blockchain works for two reasons: the data is transparent and unchangeable. As people add to the ledger we can see who added what, where and when they added it, with confidence that the information can never be manipulated. David Butler, Innovation & Technology Director for Business Assurance & Inspection Services, explains how his team are working with industry and academic partners to explore technology: "We're currently working to apply a number of different technologies to each part of the supply chain, with blockchain being the right technology to act as an intermediary to establish trust between all parties."

David and his team have been working with industry partners, like the MSC, to explore how this kind of technology can address transparency issues with big data in complex supply chains. "Often food supplies come from developing countries where technology isn't easily accessible. Along the way it mixes through market points where tracking is difficult. And the industry margins are low so any extra requirements can have a big impact on suppliers' livelihoods. We're working with the MSC and others to balance the need for trust and safety with the commercial realities – reassuring people that these new steps can be introduced without being a threat to the supply chain."

What are the applications beyond food supplies?

It's not just the food sector where this kind of solution is being explored. We are also exploring ways to share the learnings and take the solutions to other industries: "Our approach is to be industry agnostic. Our innovation teams are working with a number of industries, including Oil and Gas, to co-create new ways to improve trust and transparency."

One example is looking at log-book systems. The Oil and Gas industry is built on complex, high-value equipment and machinery which is often rented or resold during its lifetime. Blockchain can help make sure that businesses can trust the provenance and history of the equipment they're paying for. "If you introduce blockchain it's like a new version of an MOT logbook for a car. Users can be sure of the history of their machinery and that all maintenance has definitely happened at the right time", says David. His team has already worked on a proof of concept for this kind of approach, partnering with the University of Strathclyde in Glasgow.

Shipping is also an industry that could benefit. The Lloyd's Register Foundation is currently funding Maritime Blockchain Labs (MBL), exploring the potential of blockchain to solve real-world challenges through three main demonstrators. The first demonstrator, currently underway, aims to ensure a clear chain of custody and traceability of marine fuel quality.

> **We are designing our solutions to be 'platform agnostic'. They're compatible with other peoples' systems, based on the specifications they've supplied. That way we can either work with existing industry technology or introduce our own tools to support them.**

> **Our innovation teams are working with a number of industries, including Oil and Gas, to co-create new ways to improve trust and transparency.**

David believes that working in an open and collaborative way will be the key to adoption: "We are designing our solutions to be 'platform agnostic'. They're compatible with other peoples' systems based on the specifications they've supplied. We can either work with existing industry technology or introduce our own tools to support them."

What broader trust and ethical risks can technology help us address?

Going back to the food supply chain there are broader concerns beyond certification and provenance. One crop that often finds itself in the news is quinoa which has seen an explosion in popularity over recent years but is an example where new risks are introduced into the system.

David and his team are currently considering these new risks and how to use technology to help mitigate them:

"At one level there's a fairly traditional safety risk in quinoa as it often ends up in pre-prepared salads which could expose the industry to the risk of outbreaks of E. coli or listeria if something is poorly washed or badly atmosphere-packed. But there are also social and ethical concerns in the supply chain. The industry is concerned about 'slash and burn' in rainforests. Then there's the issue that whole communities used to eat the crops themselves but are now selling them. As commodity prices fluctuate, farmers often don't make enough money to replace the food they're now selling. These concerns are on the minds of retailers and food suppliers and are entering the public consciousness."

We are exploring a partnership with Global Surface Intelligence (GSI), a Scottish-based geospatial analytics company which specialises in the measurement of natural resources. Thanks to advances in LiDAR technology and cloud-penetrating radar, we now have access to images of the entire planet at 30m per pixel resolution and this information is refreshed once a week. This will allow us to give food suppliers the opportunity to check that the information they're getting from farmers is accurate. If a quinoa producer says that they harvested a crop from a particular field at a particular time we can now check satellite data to confirm their claims. Or suppliers can check the rate of deforestation to see how rainforests are being managed to address environmental concerns.

According to David, these technologies can help address some of these bigger trust issues in supply chains. "These sorts of capabilities are the tools that we want to bring to bear to solve information management challenges. You've got to be able to verify the data. Partnerships and collaborations give the industry the chance to plug innovative technologies into the supply chain to solve these new customer and industry problems."

Are we ready to cope with more data?

While technologies like blockchain and LiDAR help us to look in the 'rear-view mirror', verifying what's already happened, advances in data analytics mean that we can now get immediate insight into what's happening in real time. We can even start to look ahead and be more predictive.

"Ultimately, companies will continue to submit information into a classification society or supply chain system", says David. "Unfortunately, past crises have shown that people can't always be trusted to self-regulate. But if you're getting enough data points you can start to apply machine learning and anomaly tracking. The machine doesn't really care what the activity is but it does care about what normal activity looks like compared to abnormal activity. And you can even start to use this big data to predict what risks you could become exposed to."

As these advances come into play, regulation is one challenge that David sees on the horizon. As we generate more and more data and gain deeper insights, are regulators and society ready to deal with it all?

Businesses like Clear Labs, another partner, have developed a 'DNA testing lab in a box' which means that factories and production lines can test their facilities quickly and easily. It's as simple as taking a sample, streaming the data to the cloud and getting the results back.

The challenge with this, as with other big data and anomaly testing, is that we start to see things we didn't know about before. Previously, weekly testing might have exposed an issue, such as an outbreak of listeria, which could shut a factory down for deep cleaning. But constant, real-time testing could make this a regular occurrence. "If you're sampling all the time, you could pick up trace elements of listeria which have always been there but have never caused an issue", says David. "It might not be a problem and might not be dangerous but will the regulators and public see it that way? While the technology could be moving fast, the regulations about what 'safe' looks like might take years to update. And it will take a long time to educate the public about risk and promote a more proportionate reaction."

Ultimately, the information generated by advances in machine learning and anomaly tracking will help the industry to gain much greater insights into health and safety, and security. It could also help the industry move faster to deal with outbreaks or even predict when they might happen. We are now exploring ways to work with governments and regulators to help prepare for these advances. What should the new standards and regulations look like? How can we educate the public on risk, to prevent panic and unnecessary concern?

We believe the answer is, again, through collaboration. By bringing together the businesses creating the technology, the suppliers who need it and the regulators who will oversee it we can help pave the way for greater trust and safety without negative disruption to the existing supply chains.

Connected supply chains
in action

Three industry leaders: one global oil and gas decommissioning consortium.

The consortium covers every aspect of decommissioning, from late life management to planning, removal, waste management and monitoring.

Forecasts indicate that the oil and gas industry's overall decommissioning expenditure in the North Sea could be between £1.1bn to £2.6bn a year. And it is estimated to reach more than £25bn by 2022. Significant additional spend on decommissioning is expected in the Gulf of Mexico, Middle East and Asia Pacific as well.

A fully managed end-to-end solution
Industry leaders, WorsleyParsons and Ardent, have joined us to form a new global decommissioning consortium. The collaborative supply chain approach was formed following direct feedback from operators, including BP and Maersk, and it aims to reduce the decommissioning burden, risk and cost for operators. The consortium is underpinned by significant maritime retrieval experience and unrivalled engineering expertise. Uniquely, it can apply techniques and learnings from other sectors such as marine wreck removal and nuclear decommissioning to improve the way the increasingly important challenge of decommissioning offshore oil and gas infrastructure is tackled.

Looking to the future
The consortium's smarter decommissioning activities provides a new benchmark for the industry and will reduce costs, improve safety, and increase peace of mind for operators around the world.

Connected supply chains
in action

World's first ultra-deep water FLNG.

LR's involvement shows we're able to work anywhere in the world our customers need us to be, including developing countries. This is the first step into Mozambique for a major class society and an investment in the future of the country.

Simon Turpin
Overarching Project Manager on Coral South

We are undertaking detailed design appraisal and survey during construction to prepare the floating liquefied natural gas unit.

The Coral Sul Floating Liquefied Natural Gas (FLNG) unit will be Africa's first new-built FLNG facility. It has been developed and it will be operated by the Italian energy company, Eni, in Area 4 of the Rovuma Basin, off the coast of Mozambique.

The right team for bespoke support
The unit will be the world's first ultra-deepwater FLNG, operating in water depths of about 2,000m. We have put together a global team with exactly the right mix of skills, knowledge and experience. Our team's role is to make sure the FLNG is correctly designed and fabricated in accordance with our rules and as such it can be maintained in service without dry docking; it won't impact the environment and is safe for the people working onboard. It is designed, procured and fabricated in accordance with the LR Rules for Offshore Units and recognised industry codes and standards.

Looking to the future
The size, quality and position of the field's resources are set to transform Mozambique's economy and expected to produce around 3.4m tonnes of LNG per year.

Connected supply chains
in action

The benefits of insight.

We have helped Arla drive quality and gain greater real-time insight across their entire milk supply chain.

Arla is one of the world's largest dairy companies and is owned by a cooperative of 12,000 dairy farmers. The dairy business is based in Europe but operates globally. It initially approached us to support its UK supply chain operation - a supply chain which relies on the cooperation of 2,500 British dairy farmers.

A real-time overview in an instant
Over six-months we migrated Arla's UK dairy farms onto a single technology platform that functions as an online portal, allowing users to monitor the audit performance of their entire estate in real time. In parallel, we developed a bespoke offline audit application for farm inspections. We also trained a team of more than 40 dairy auditors to use the new system.

The project's success led to our further involvement in 'Arlagården', Arla's Quality Assurance Programme. This programme is now conducted by our auditors across the UK in conjunction with Red Tractor audits.

Looking to the future
Arla now has access to an instant, real-time overview of their dairy farms' compliance status. This new way of working has also helped to improve auditor consistency. And our bespoke solutions mean Arlagården not only benefits Arla; it will also reduce the number of site visits needed and save the supply chain farmers time, hassle and cost.

Connected supply chains
in action

Passport to a new categorisation system.

The Vendor PassportTM combines SupplHi's industry-leading categorisation method with our independent assessment expertise.

The SupplHi platform is unique in that it provides a detailed categorisation system for vendors. It can help buyers find specific vendors and services quickly and it gives vendors greater visibility and access to more opportunities.

What is the Vendor Passport?
The Vendor PassportTM (VP) gives another level of assurance to buyers. Through this independent scheme our surveyors personally visit and assess the vendor according to several criteria including quality, health and safety, risk management and corporate social responsibility.

It's a standard assessment and qualification process based on international best practices. The VPs are delivered online through SupplHi - a digital platform that's available around the world. It places vendors into more than 2,250 categories to produce a common 'user language' that makes it easier for buyers to find the right vendors.

Looking forward
Because the Vendor PassportTM simplifies the vendor management process it frees up senior resources and offers our customers sustained cost reductions for vendor assessment.

Buyers and vendors can connect on a global scale to develop opportunities through a single digital platform, confident that they are connecting with companies approved through our assurance standards.

Given the challenging market conditions we have continued to closely manage our cost base to protect our margins whilst ensuring that we maintain our long term capability and invest for the future.

Mary Waldner
Chief Financial Officer

Ready for growth.

Combined with the specific IT investments made in the Marine & Offshore and Business Assurance businesses we are seeing the benefits of improved performance and efficiencies as we move to more standardised, automated processes that help deliver an efficient, consistent service to both our customers and colleagues.

The challenging conditions of the markets in which we operate have continued to impact the financial performance in 2017/18. Although we have seen a recovery in oil prices, at one stage peaking at USD 80 per barrel, and investment and confidence beginning to return we are yet to see the benefit of this in increased activity levels. This continues to directly impact our Energy business and also our Marine & Offshore and Inspection Services.

The market sentiment in the maritime industry is cautiously optimistic. But the very low new build contracting activity in 2016 continued to impact the performance of the Marine & Offshore business in the year despite having the highest market share of the global new construction orderbook by gross tonnage at 23%. In addition, our market share of the global fleet continues to grow despite the increased competition and continued pressure on prices.

The Business Assurance business has grown in the year benefitting as customers have transitioned to the new ISO 9001 and ISO 14001 standards to meet the September 2018 deadline, combined with growth in the food, cyber and medical sectors. Our service offering in cyber security in Business Assurance and across the other businesses has been enhanced with the acquisition of the Nettitude business in March 2018.

Despite the challenging environment we have continued to invest in our people and back office systems. Following the global roll-out of an HR module last year we now have more than half of our employees operating on the new ERP system with the remainder due to go live next year.

Combined with the specific IT investments made in the Marine & Offshore and Business Assurance businesses we are seeing the benefits of improved performance and efficiencies as we move to more standardised, automated processes that help deliver an efficient, consistent service to both our customers and colleagues.

Given the challenging market conditions we have continued to closely manage our cost base to protect our margins while ensuring that we maintain our long-term capability. Average headcount has reduced further over the period across all business streams and in the back office support functions. As we balance meeting the needs of our customers along with driving efficiencies we have seen an improvement in the turnover per employee metric of £127,000 (2017: £119,000). This performance, aligned with the investments we have made, positions us well and will allow us to fully realise the benefits as we return to growth.

£18.0m

Operating profit before exceptional costs

£532.4m

Net assets for the group

Turnover of £868m is slightly behind that of last year (2017: £887m) at actual exchange rates. Turnover at last year's exchange rates was £11.5m higher than at actual exchange rates (1.3%).

Operating profit before exceptional costs was £18.0m (2017: £49.3m), £31.3m lower than last year as a result of continued headwinds in the Energy and Marine & Offshore markets, increased amortisation costs associated with our new IT systems and investments in staff training and our external and internal websites. Statutory operating profit, including exceptional costs was £8.9m (2017: £16.6m).

Net assets for the Group at 30 June 2018 were £532.4m (30 June 2017: £431.1m), an increase of £101.3m from the prior year mainly because of a £152.0m decrease in net pension liabilities. Net current assets have decreased by £32.9m reflecting cash consideration paid on the acquisition of Nettitude and other working capital changes.

Turnover £m

2017/18	868
2016/17	887
2015/16	881
2014/15	1,038
2013/14	1,028
2012/13	920

Normalised operating profit £m

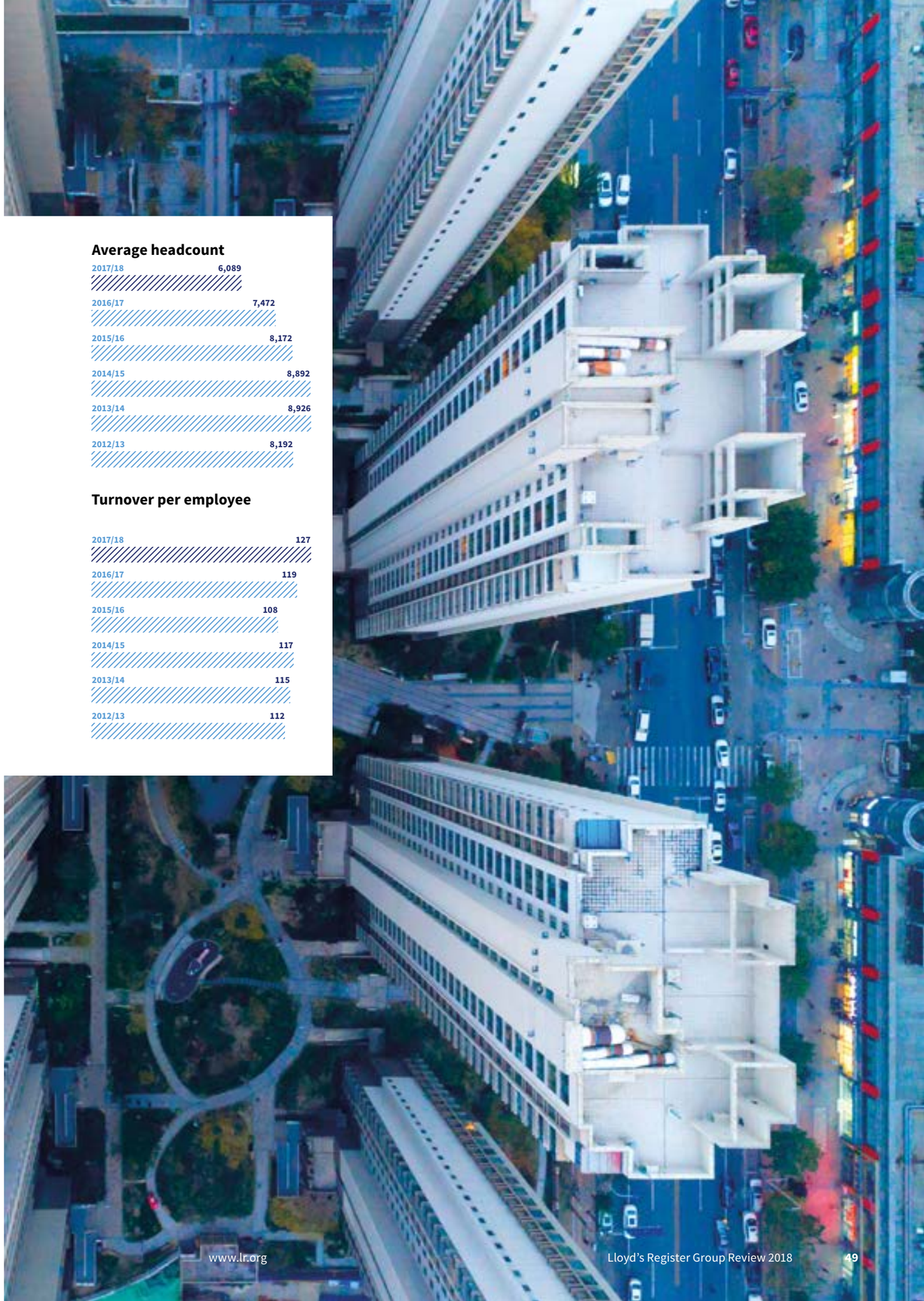
2017/18	34
2016/17	69
2015/16	79
2014/15	79
2013/14	88
2012/13	82

Average headcount

2017/18	6,089
2016/17	7,472
2015/16	8,172
2014/15	8,892
2013/14	8,926
2012/13	8,192

Turnover per employee

2017/18	127
2016/17	119
2015/16	108
2014/15	117
2013/14	115
2012/13	112



Marine & Offshore

Our world is experiencing significant change and we aim to maintain its relevance in this shifting world but also go beyond the traditional areas of class to have the vision and the tools to assist our customers in adapting and succeeding.

The market and business challenges

Our published research and studies have shown that there is a dynamic shift happening within the shipping industry over the next 30 years; this shift will be enabled by the accelerated application of technology into the maritime sector. Tangible signs of this shift are already being witnessed today. This will come at an accelerated pace as technology becomes proven and deployed more widely. The drivers of this accelerated shift are both commercial and regulatory. Climate change, air quality and clean oceans are dominating the global agenda; solutions in the form of new energy sources, systems, connectivity, remote control access, situational awareness etc are being explored and piloted to determine their viability in the commercial world.

The most immediate challenge facing the industry is that relating to the implementation of the MARPOL Annex VI Reg. 14.1.3 0.50% sulphur limit for fuel oil used on board ships operating outside emission control areas that shall enter into effect on 1 January 2020. We recognise this is presenting one of the greatest challenges to all stakeholders in the marine fuel oil market, from the producer to the user. After an initial period of scepticism and doubt was ended earlier this year, the debate has firmly turned towards the transition and implementation planning.

In addition to Sulphur 2020 the shipping industry is facing several upcoming environmental regulations such as ballast water treatment and improved ship recycling practices but this year has seen probably the most landmark decision yet with the IMO adopting its initial Greenhouse Gas (GHG) strategy, establishing a significant ambition for the shipping sector to reduce GHGs by at least 50 per cent by 2050, based on a 2008 baseline. There is also a strong emphasis on reducing by 100 per cent by 2050 if this is shown to be possible. This deal provides a clear signal to the industry that the overarching aim is to end the use of fossil fuels. In terms of shipping we have had decades to optimise the design, maintenance and operation of the shipping system around these fuels. As the world's attitude towards fossil fuels is changing shipping needs to work to find a non-fossil zero-emission and sustainable energy source but it's a complex task.

The technology that will enable the shipping industry to address the agenda will leave its mark on the way ships of the future will be designed, built, manned and operated.

Customer insights

While public pressure in relation to shipping emissions may be intangible, all shipowners are fully aware of the commercial pressure that is mounting from unpredictable fuel costs and a highly significant regulatory change coming into force in 2020. The drastic reduction to the sulphur content limit allowed in fuel oil used globally affects all ships, new and existing. Emission control areas (ECAs), with an even lower limit, will remain in force and perhaps be supplemented by newer ECAs in future but the significance of the global limit is that it will affect all ships regardless of their trading area.

Compliance with the 2020 SOx regulation is challenging and particularly because there is no single answer on the best way to comply. Various factors need to be considered and different solutions will suit some ships better than others but the choice will require balancing the technical restrictions with financial forecasts over the timescale of the ship's planned life. We offer a balanced commercial and technical view to support our customers in developing a strategic plan in response to these regulations. For example, in May we launched the 'Sulphur 2020 – Options Evaluator' online tool to help the industry identify the best strategy for compliance. The 'Options Evaluator' aims to bring some much-needed clarity to what the potential cost and investment implications could be for the various compliance strategies such as transition from fuel oil to MGO, use of scrubbers and HSFO or use of other compliant fuels such as LNG or methanol. It has been well received by the industry.

Whichever compliance strategy is selected, planning is critical. It's the one thing that will help mitigate risk of non-compliance and cost, while maintaining safety. There are numerous issues to be considered but the biggest issue is probably crew awareness and training. Dialogue with all stakeholders involved should also start at the earliest opportunity. We're here to support our customers' business, every step of the way and our advisory, class, statutory and type approval services are complemented by the fact we are the only class society with a fuel testing business. We see this as especially important given fuel formulations will be changing and the fuel oil ranges on offer will be wide and varied.

May 2018

We launched the 'Sulphur 2020 – Options Evaluator' online tool

It's not enough to focus on the short-term compliance requirements. It's important to balance this with the longer-term.

Our focus

Our world is experiencing significant change and we aim to maintain its relevance in this shifting world but also go beyond the traditional areas of class to have the vision and the tools to assist our customers in adapting and succeeding.

For 258 years we have been trusted as an independent regulator and custodian of global safety and environmental standards. We have always supported the sector through new developments and have a history of firsts. Consequently, we have long and deep relationships with many of our customers as evidenced by our leading market share, for example, in the Cruise, LNG and FLNG sectors.

However, we cannot afford to be complacent and are continually innovating to ensure that we remain as relevant for our customers in the future as in the past. Additionally, as the adoption of technology, connectivity and society's sustainability expectations of our sector accelerate, we are welcoming the opportunity to collaborate with an increasingly diverse set of companies and advisers. This includes digital start-ups, flags, policy makers, global OEMs and established industry players. Our reputation is becoming one of a trusted advisor and innovation partner.

Investments

We have accelerated our pace of change in the past two years, especially in the way that we co-create and work with partners to prove value in innovative solutions and at the same time invest in our own tools and systems to ensure that we deliver a great customer experience.

Continued investment in technology and people remains a priority for our business and this year we have launched LR Class Direct, a new platform that enables our customers to stay fully informed of the classification status of their assets in real time, through online access to the latest details. The new platform features better navigation, a refreshed user interface, cloud technology that has strong safeguards are in place to protect privacy, improved search, mobile/tablet accessibility and optional weekly email summaries.

We've also made a significant investment in the strengthening of our existing portfolio of cyber security services by acquiring Nettitude. Together with Nettitude we now offer an unparalleled capability for cyber security in the maritime industry, supporting our customers with a complete suite of assurance and technical services to identify, protect, detect, respond and recover from cyber threats and incidents. The maritime industry is now able to access the same pragmatic cyber security services that industries such as Finance & Banking, IT, Technology and Engineering have been benefitting from since 2003.

Successes

Without doubt the 2020 deadline represents a real challenge. However, this is only the beginning of the journey and, while the industry needs to be making decisions now, it should also be future-proofing for what's next. It's not enough to focus on the short-term compliance requirements. It's important to balance this with the longer term, for example, the transition to low–zero carbon fuels.

We have worked with several academic partners to produce research reports looking at fuel and technology trends for the marine industry, including the launch this year of the Zero-Emission Vessels (ZEV) 2030 study in conjunction with the University Maritime Advisory Services, a partnership between the University College London Energy Institute and MATRANS. This study, the follow up to last year's Low Carbon Pathways Report, demonstrates that the industry needs to advance thinking beyond marginal gains in energy efficiency and alternative fossil fuels, and zero-emission vessels will need to be entering the fleet in 2030 and form a significant proportion of new builds from then on if the sector is to meet the ambition set out by the IMO.

This is probably the biggest single challenge facing the industry and we have committed a significant proportion of our research and development, spending and efforts to looking at how viable zero-carbon fuels are as a scalable alternative. We're already piloting a range of innovative technologies and supporting customers as they deploy them, and we expect to be doing a lot more over the next reporting period. By looking at different decarbonisation options for different ship types we can identify drivers that are needed to make them a competitive solution as well as showing the opportunity for a successful, low-cost decarbonisation pathway for shipping.

Marine & Offshore

Running parallel with the environmental challenges facing the industry is its digital transformation. We believe the industry will welcome the increased adoption of greater levels of autonomy in shipping, thus allowing technology to do what it can do best and allow the crew on board to spend more time on tasks where their skills and experience can add the greatest value. To support the industry in understanding the future of autonomous maritime systems we launched Global Marine Technology Trends 2030 Autonomous Systems, produced with QinetiQ and the University of Southampton.

We have consistently led the development of marine regulations and compliance frameworks in digital technologies including autonomy. Over the past year we have made further advancements in this area and in the support of customers, initiating the digitalisation of their assets, for example, the first China smart ship achieving LR Digital Ship descriptive notes. There has been much 'smart talk' in the industry but we have been concentrating our efforts on developing 'smart solutions'. We have launched notations that address these new areas into the market ahead of our competitors and they have been created following extensive collaboration with key industry stakeholders. We have been very fortunate to engage with a varied number and type of stakeholders spanning several geographies who have enabled us to set a standard that addresses the unique risks of such novel technologies when implemented in maritime. This makes our notations sound for the industry, being based not only on leading technical capabilities but also leading experience.

Long-term outlook

We think collaboration is the most important ingredient for success. We need to work together effectively with our customers and our partners in industry and academia, to make the most of opportunities and meet the challenges of a changing world, with the knowledge that our future performance depends on today's decisions.

We particularly need to encourage collaboration between all industry partners working ahead of regulation as this is the key to getting regulations right and fit for purpose. The biggest challenges will always come when regulations are used as the last resort to move the industry forward. We are seeing this now with the sulphur 2020 limit. To achieve the IMO GHG ambitions for 2050 we need to be working much more collaboratively across industry now on Batteries, Hydrogen, Methanol, Hybrid, Power Management Systems, solar and wind. We need to be learning, adapting and implementing so we get this right for the crew, for the safety and environment around our vessels and for improved performance benefits for the whole marine supply chain.

It's also more important than ever to support and invest in the people our industry relies upon. For this transition to be successful we must find a way to balance and integrate the right level of technology and the necessary level of human activity. Finding the 'sweet spot' will be the critical issue for the post-2020 maritime industry and will likely drive higher levels of safety for people, business and the environment. We need to balance the investment in technology with our investment in people.

Women in Maritime

Maritime UK established a Taskforce in early 2018 to address fairness, equality and inclusion within the maritime sector.

The Taskforce brings together leaders from across the maritime sector to identify practical steps to increase the number of women in maritime and crucially, within senior roles across its shipping, ports, services, engineering and leisure marine industries.

Achieving a balanced workforce at all levels in the maritime sector will undoubtedly improve culture, behaviour, outcomes, profitability and productivity.

The Taskforce has launched a 'Women in Maritime Pledge' as a precursor to the development of the 'Women in Maritime Charter'. The pledge is aimed at supporting gender diversity and inclusion across the industry.

We are represented on the Taskforce and we are a signatory of the pledge.

Energy

The RTAMO tool looks promising and we have good expectations from the test project as it is aligned with our lean way of working which we are incorporating in our organisation with a focus on simplification and efficiency.

Saurabh Kumar

Project focal point from AkerBP

The market and business challenges

It's been another highly challenging year for the Energy business with fluctuating market conditions, price sensitivities and geopolitical issues across the sector. But confidence in the market is starting to return. Oil prices have been trading above $70 a barrel since April 2018 and the market has been successful in bringing down production costs driven by technological innovation in software systems and improved process controls. Oil exploration is beginning again and pressure is cautiously building to get production up and running with increasing stability across the energy supply chain.

Like the rest of our business around the globe South East Asia and Australia have been particularly exposed to increased competition in this challenging market environment. But, with increased regional investment and rapid growth in the renewables energy sector, there are positive signs for the future. We've made good progress over the past year and we plan to continue developing our presence in the low carbon space across offshore wind, grid system and nuclear markets.

The challenges faced by the market have given us a real opportunity to step back, review what we're doing and look at the role for technology in our business. In the early part of the year we were able to successfully remodel for the anticipated market climate and chart a course for the future post 2018. Not only will this improve how we operate internally; more importantly, it will enhance the services we deliver to customers.

Customer insights

To help shape our customer's strategic thinking as well as our own, we've been gathering insights from our annual Technology Radar research. We've been looking at how policy, consumer behaviour and advances in technology could affect the pace of energy transition from fossil to low carbon and how it will affect the way we produce and use energy in the coming decades. These issues are on our customers' minds too. We've seen a positive market uptake in new technology products and innovative tools such as virtual reality training and 'Super Surveyor' to help protect, regain and grow market share.

Our focus

The challenges faced by the industry in the past year were a litmus test for us in terms of how we remodel and reshape our services and capabilities. Adapting to these challenges has driven the technology and innovations process, resulting in a huge number of technology acquisitions. We've consolidated our business in ship decommissioning and recycling and put our focus on energy applications in those areas. We're also looking at all kinds of remote inspection innovations, from smart camera surveyors right through to drones. We're ahead of the curve with many of our developments – and technology and innovation are helping us on the path towards recovery from a difficult year.

To meet future customer expectations we're focusing heavily on Asset Integrity and Maintenance Optimisation services as well as our capabilities in Risk Management Consulting. We're building on the momentum of launching AllAssets software and are now integrating RTAMO™ (Real-Time Adaptive Maintenance Optimisation) to help customers get the most out of their new technology. This solution gives reassurance to operators of critical power generation facilities that they are working efficiently and effectively. Test projects with some of our customers, including AkerBP in Norway, showed that the software can deliver up to 40% reduction in operational maintenance expenditure. Another example of our work in this area is in the US, where we're connecting our AI sensor and SmartSleeve technology, so pipeline manufacturers can monitor the 'health' of their pipeline 24/7. Our strategy in this area is allowing us to capture efficiencies, apply technologies and create valuable insights for customers.

As well as advances in technology, the energy sector will also be paying attention to the global spend on decommissioning oil and gas infrastructure which is expected to reach £41bn by 2040. It's clear this is a real growth area for us and a key area of focus for many of our customers.

Energy

The award to LR and IGI to develop geochemical and geological databases demonstrates the OGA's commitment to providing access to trusted and high-quality data to stimulate exploration activity and production in the UKCS.

Jo Bagguley

Principal Regional Geologist at the OGA

Investments

Our Wells business is growing as we build on operations in new geographic areas including North Africa and Mexico. And we're developing new service offerings in well integrity and assurance, offshore and onshore decommissioning and in the geothermal sector.

We are also investing in more IRIS data service developments and new geoscience products. Our precise facility modelling capabilities use High Density Scanning (HDS) technology with Geographic Information Systems (GIS) to assemble and visualise large geographic data sets. Having these capabilities has helped us win a number of key projects. As we start to expand deeper into digital technologies they will become more and more important in enabling us to offer a holistic approach to customers.

This year we also integrated our SGC business, originally acquired by the legacy Senergy company. Aligning SGC's established portfolio with our own will allow us to offer an even more compelling suite of expert services. In particular, the evolution of our GIS and data management services will deliver industry-leading solutions to customers in the oil and gas pipeline, renewable energy, utilities and transmission sectors.

Successes

One of the most exciting things we've been working on is the development of a virtual reality simulator to support safety training. The development is the result of a truly collaborative approach. We could identify the right suppliers with the right industry knowledge to help us develop the idea, build the prototype and then validate it in the market.

We launched the prototype at many locations across the world, including the Offshore Technology Conference in Houston and at Offshore Europe in Aberdeen, and got an overwhelmingly positive response. This feedback has helped us to develop the prototype even further during the past year and a major oil and gas operator has already done a pilot phase using the technology.

Turning from the virtual world to the real world, we've grown our reactivation and compliance-based services within Drilling Integrity. We've also increased our market presence within US land projects, in Central and South America and China. And we've combined our expertise within Development Solutions, Reservoir Services, Rock Properties and Technical Training into a single entity to offer customers an improved service delivery.

We were also pleased to use our expertise in seismic imaging to help the Oil & Gas Authority's (OGA) four-year initiative to evaluate petroleum systems across the UKCS. The high-quality databases generated by our advanced reservoir modelling were made publicly available and were used by oil and gas professionals and academia to determine the extent of E&P opportunities in the UK.

Long-term

We're seeing a real transition happening in the energy industry. There's a wider geopolitical discussion going on that's bringing together different areas of the sector which, until now, operated as silos. As oil and gas companies extend their product portfolio into renewables, the barriers between those silos are disappearing.

As renewable energy becomes cheaper and more scalable, the oil majors are recognising the long- term value of renewable technology to lower greenhouse gas emissions and have taken the first steps to move beyond their core oil and gas business in to wind and solar power as well as energy storage. We're starting to see more collaborative approaches on that front in the shape of joint industry projects and joint ventures. So it's likely that the volume of capital transactions will increase across the industry. We have the opportunity to advise on both sides of these types of transactions, for example, mergers, acquisitions and asset transfers.

Although the recent downturn has been harsh it's been the catalyst for positive change in the industry. It should come out a lot healthier, more streamlined and more cost-effective.

Looking ahead there are exciting changes in the markets we work in. The world is paying greater attention to issues around sustainable energy. And growing economies need to think about the sort of energy their industries and infrastructures will be using in the future.

We are working to understand how tomorrow's smart energy will effectively integrate electricity, heat and mobility. Our technology-centric approach will focus entirely on this increasingly converging energy market as we make an important contribution to the success of the energy transition in Europe, America and in Asia. Our technology investments are building a foundation for the future and will create long-term value for society and energy sustainability. By developing exciting, world-class opportunities we're meeting the challenges of changing market conditions head-on.

KEY HIGHLIGHTS:

1. The world's biggest lithium ion battery was launched in Jamestown, north of Adelaide, Australia. The 100MW/129MWh battery was installed at the Hornsdale Power Reserve project, located on Neoen's Hornsdale Wind Farm. As a long-standing and trusted partner, our experts worked with Neoen to help deploy this ground-breaking technology by developing the technical parts of the grid connection and ensuring compliance with the requirements of the Australian energy network.
2. The International Electrotechnical Commission (IEC) accepted the Technical Specification for the development of an all-new global wind farm. The new Technical Specification will be designated IEC TS 61400-28. It introduces the concept of independent verification of equipment maintenance throughout the entire life-cycle of a wind farm.
3. LR and the University of Bristol developed and improved wind speed analysis and data for trend comparisons through a 'windiness dashboard'. Investors, developers, owners and operators of current wind farms can now use this product to assess and predict energy production at all project stages, from planning and development through to operation.
4. Our experts helped SIEMENS-GAMESA become the first wind turbine manufacturer in China to be a certified provider of Global Wind Organisation (GWO) Basic Safety Training (BST) training. Safety is the number one priority for companies operating in the global wind industry.
5. The launch of a unique 'end-to-end' oil and gas decommissioning consortium involving LR, WorleyParsons and Ardent is aligning efforts on decommissioning activities for oil and gas operators. The aim of the collaborative industry consortium is to help companies across the supply chain increase productivity in their core business areas without incurring costly time constraints and delays in decommissioning; reducing the decommissioning burden, risk and costs.
6. We worked with the UK's Oil & Gas Authority (OGA) on a 10-month project combining subsurface and geoscience expertise with digital technology. We created geological and geochemical databases to stimulate exploration and production (E&P) in the UK. With our experts' help the OGA was also able to produce the first set of regional geological maps and data sets ahead of the 30th UKCS Licensing Round.
7. As part of a three-year contract with LR, the Oil & Gas Authority (OGA) has released its first set of Regional Geological maps and data sets which cover the UK Central North Sea and Moray Firth.
8. Our Risk Management Consulting team in Norway signed three exclusive frame agreements to help companies find sustainable approaches to cut greenhouse gas emissions across the transportation sector.
9. BP Trinidad and Tobago LLC. (BPTT), one of the leading upstream operators in Trinidad and Tobago's Energy sector, worked with us to deliver efficiencies and improve asset integrity across onshore and offshore facilities including BPTT's network of pipelines.
10. Hyundai Heavy Industries Co. Ltd. and Royal New Zealand Navy valued the support of our safety and environment expertise in their safety case preparation for the new MSC project in Korea.
11. We won the B2B Marketing Awards' Best Digital Customer Experience for our Virtual Reality and gaming training simulator. The award recognises the 'ground-breaking' virtual experiences that deliver excellence in interactive training and knowledge share. The simulator is helping to deliver reputational and commercial training benefits across the energy industry.

Thanks to LR we are using their technical expertise to help us undergo the most rigorous of sustainability challenges we have ever undertaken. We are confident that their risk analysis approach and their local knowledge and understanding of environmental challenges will help us achieve cleaner transport.

Jørn A. Endresen

ASKO MIDT – NORGE AS

Business Assurance & Inspection Services

This year has seen us integrating Acoura – a provider of risk services for the food and drink supply chain – into LR. Acoura's food and beverage expertise strengthens our offering further with new technical capabilities, for example, around seafood assurance.

The market and business challenges

Businesses across all sectors are thinking about how new technology can improve their systems and data management. As new solutions and ways of working emerge they bring with them issues around safety and compliance such as long working hours in the gig economy or traceability within the food industry. To remain relevant and add value to businesses and customers, management systems' certification requirements need to keep pace and remain in line with market developments.

Organisations all over the world have been making the transition to revised key standards including ISO 9001:2015 (quality management) and ISO 14001:2015 (environmental management). Throughout the three-year transition period we have been helping businesses transition to these new standards and to harness the benefits of a process-based approach, improve risk management and align corporate strategy with management systems.

Companies are facing increasingly complex brand protection challenges which our Customised Assurance (CA) can help solve. CA involves the creation of a tailor-made programme which addresses a customer's risk management and compliance issues in a 'full service' assurance offering.

After a difficult couple of years Inspection Services (IS) has made progress. While revenues are marginally lower than last year they have stabilised with the last quarter returning to modest growth and are more positive than those reported in the market by other operators. We introduced several initiatives during 2017 to reduce costs and make sure IS was the right size for the business and these have delivered an improvement.

Customer insights

We have recently started a customer journey mapping project in the UK&I certification business looking at how our customers experience our end-to-end service. The aim is to find the things that delight our customers and do these more often while identifying the areas where we can improve.

Navigating the global supply chain for safety-critical industrial projects is high on the agenda of many of our Inspection Services customers. For high-profile thermal power, oil and gas, petrochemical and renewable projects – as well as the day-to-day maintenance of existing facilities – sourcing good, reliable vendors is a challenge. To that end we have launched the Vendor Passport™, co-developed with online vendor management ecosystem SupplHi.com. The Vendor Passport™ complements both our existing supply chain vendor assessment service and SupplHi's vendor registration platform; providing a globally-accessible, online ecosystem where we approve vendors according to a best-in-industry assessment scheme. The Vendor Passport™ is delivering revenue and continues to grow.

Our focus

Business Assurance & Inspection Services (BA&IS) has also been focusing strategically on innovation – looking at where we can use technology and innovation to help our customers' systems and processes and better manage risks in their supply chain. The innovation team has been working on many exciting 'proof of concept' projects including the use of blockchain to help bring transparency and improve communications between supply chains.

Investments

We have ambitious plans to grow our cyber security business across the whole LR Group. To support this in March we acquired award-winning cyber security specialists, Nettitude. We are now able to offer a 360-degree suite of assurance products that address the needs of our customers while also providing access to new markets and opportunities for growth. We understand that our customers' businesses are changing and we understand their pain points. This acquisition puts us in the best possible position to address those requirements.

As we look to the future with a leaner operating structure we are investing more in technology and operating systems to improve our customer experience.

As safety has been at the core of Lloyd's Register for 258 years, our goal is to be the service provider of choice for ISO 45001.

Across all our markets we are investing in solutions for supply chain assurance. This is a particular priority in the food sector but is relevant across our customer base. In IS, for example, we believe we can drive a return to growth by addressing these challenges for key Engineering Procurement Construction customers.

Successes

This year has seen us integrating Acoura – a provider of risk services for the food and drink supply chain – into LR. Acoura's food and beverage expertise strengthens our offering further with new technical capabilities, for example, around seafood assurance. It also opens up opportunities to develop new relationships with global retailers and the major food brands. Our customised approach, enabled by leading technology, allows us to go to market with a suite of solutions from off-the-shelf products to a bespoke 'full service' offering.

The revision of key standards has also been a big opportunity for us. We've continued to grow revenue as customers make the transition to the revised ISO standards for quality and environmental, among others, to meet the September 2018 deadline. Helping our customers transition to new standards has also been a significant source of revenue in automotive (ISO/TS 16949:2015) and aerospace (AS 9100:2015 series). Elsewhere in certification March saw the publication of ISO 45001 – the first international management system standard for occupational health and safety (OH&S).

Our business operating system (BOS) is now deployed globally. With a new customer interface, which is being progressively rolled out, it enables us to deliver a more positive customer experience.

Long-term

Both the BA&IS businesses will continue to build out from their core certification and inspection markets. They'll do this by expanding into specialist certification schemes and sectors such as food and cyber, and inspection markets in energy and industrial manufacturing.

At the same time we will aim to enhance our position in second-party services for both assurance and inspection. In the longer term we'll be looking to develop cyber opportunities across our core customer base, leveraging our Nettitude capability. In addition we will continue to push for growth in the food, beverage and hospitality markets. We recognise that organisations need different skills and capabilities around compliance and risk management. While certification will remain at our core we see significant opportunities in CA services and we are expecting growth in this part of our business over the coming year.

As safety has been at the core of Lloyd's Register for 258 years our goal is to be the service provider of choice for ISO 45001 and we believe we'll see a significant increase in the number of organisations that include an Occupational Health & Safety management system in their portfolio. We also plan to roll out our online risk management platform, LR Assist, which has up until now been for our food customers only. It is our intention that customers in other sectors will be able to access the same customisable dashboards complete with non-compliance resolution and reporting. We will continue to drive forward innovation projects and develop technology to enable us to better service our customers and add value to their businesses.

Creating a sustainable future.

7,997
Ethics training completions

2.2m
Litres of water predicted to be saved at HQ

1,141
Trained in CPR

Sustainable solutions for the future

Changing weather patterns, a rapidly expanding global population and polluted oceans act as pressing reminders that we must find sustainable, efficient and clean industry solutions. Maintaining and protecting ocean resources, developing low-carbon fuel sources and encouraging resource efficiency are all significant opportunities for industry to lead the change.

We feel these are the areas where we can make our greatest contribution. With that in mind we've built our sustainability programme around those three key themes in alignment with the UN's Sustainable Development Goals for 2030. By deploying all our professional expertise to help address these challenges we are developing solutions for moving towards a more sustainable world.

Sustainable oceans

Our long connection with the marine sector meant that this year we became a founding -member of the UN Global Compact's Sustainable Oceans Platform. This multi-stakeholder group aims to mobilise the private sector to take tangible action, make investments and form partnerships to leverage the ocean as a resource to deliver the Global Goals. We also helped the IMO produce its landmark agreement to reduce greenhouse gas emissions from shipping - a historic moment in the decarbonisation of the shipping industry.

Low carbon

We are playing a leading role in the transition to renewables and this year our work resulted in a combined total of 34GW of low-carbon power generation. We also advised on an innovative energy storage facility in Australia.

Resource efficiency

Our work in the food sector is helping to establish transparency, trust and responsibility in supply chains. In particular, our work on sustainable fisheries is helping to promote safe, responsible and traceable sources of seafood.

The progress we've made towards creating a sustainable future is shaped by our unique 21st century model as a social business. Our profits fund the Lloyd's Register Foundation, a charity which supports engineering-related research, education and public engagement for understanding risk. We are proud of this approach and of the contribution we're making. Our aim is to help our own business, and those of our customers, transition to a cleaner, safer and more sustainable world.

FIVE THEMES OF SUSTAINABILITY AT LR

Our framework

We deliver our sustainability aspirations through five pillars that are central to our purpose of providing benefits to customers and communities, and operating a responsible business that is supported by a productive, diverse and healthy workforce.

People

We value our people and are committed to help everyone achieve their potential. We understand, respect and value personal and cultural differences and promote diversity.

Governance

We are committed to observing both the spirit and the letter of the laws of all jurisdictions in which we operate, extending our standards to the supply-chain.

Environment

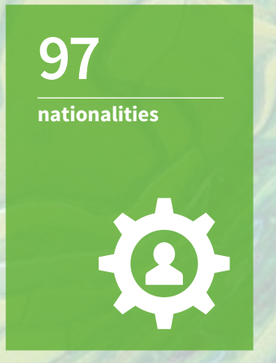
We will run efficient and low impact operations that consume less energy, produce less waste and reduce any negative effect of our business activities on the environment.

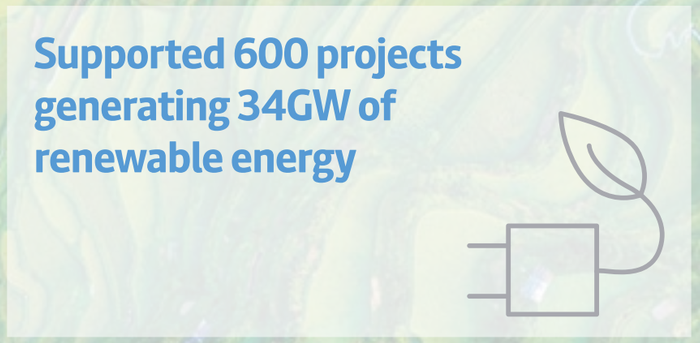
Community

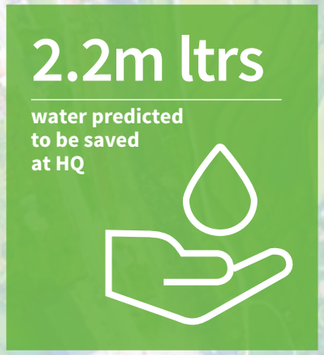
We will maximise our social impact across communities, wherever in the world we operate.

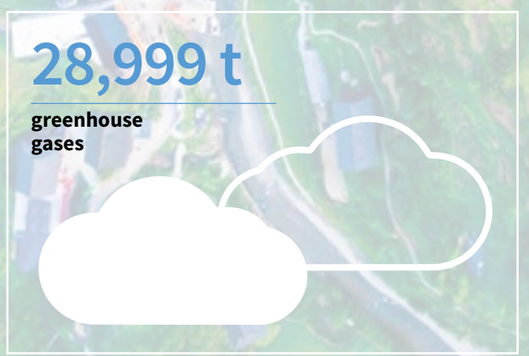
Technology & Innovation

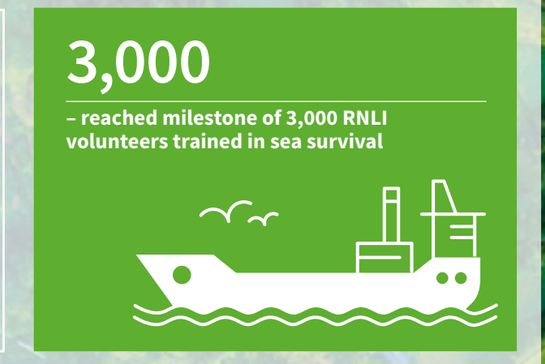
Technology is an enabler of a cleaner, more sustainable world both as a trend and a solution to other challenges.











People

Companies often say that their biggest asset is their people. But in our case we absolutely believe it to be true. They are the ones on the front-line, providing independent assurance and expert technical advice. As we help people in industry, governments and the communities in which we work the positive effects are all down to our exceptional people.

This year we've continued our culture-change programme, 'Be The Change'. More than half of our colleagues (55%) took part in more than 140 workshops which delivered coaching, support and recognition, to continue to build our healthy, high-performance culture. The feedback was overwhelmingly positive with many attendees saying they felt like the sessions gave them the tools and encouragement they needed to thrive both personally and professionally. We'll complete the programme during 2018/19.

While we're talking about people we must also talk about safety which is critical. Our aim is to positively influence safety standards everywhere we work, starting with our own people. Our performance in health and safety has improved for the fifth year in a row.

Our lost-time injury rate (LTIR) was 0.13 incidents per 200,000 hours, and the total recordable injury rate (TRIR) was 0.33 per 200,000 hours. Both figures are lower than previous years.

This is very positive but our long-term aim is to achieve performance levels comparable with the oil and gas operators. We believe we will achieve this by continuing to focus on the high risk-potential incidents and encouraging the actions and behaviours that lead to a strong safety culture.

Governance

We care, we share our expertise and we do the right thing. These values sit at the heart of LR and are an integral part of everything we do with our employees, customers, suppliers and stakeholders. Our Code of Ethics sets the high standard of conduct we expect from all our people, including contractors, at all levels of our business. It also declares our zero-tolerance approach to corruption, bribery and fraud and it seeks to make sure we are impartial in all that we do. Our reputation for independence, impartiality and trust is critical to the way that we work and who we work with and, as such, we place huge importance on operating responsibly, transparently and ethically.

We don't just demand those things of ourselves, we actively contribute to raising the global standard of responsible governance by challenging our supply chain partners to meet the same high standards.

In addition to our Code of Ethics, LR is also a signatory to the UN Global Compact and its ten principles on human rights, labour standards, environment and anti-corruption. Of course, any human trafficking or modern slavery exploitation is completely incompatible with our values, and eliminating all forms of forced labour is something we actively support.

We also actively encourage a culture of openness and have a dedicated whistleblowing channel to the LR Group's Ethics and Compliance Committee. We investigate all reports and will support anyone who raises genuine concerns in good faith even if they turn out to be mistaken.

Environment

As part of a programme to modernise our IT systems we are planning to replace 6,500 laptops over the next 18 months. We're making this a 'green IT project' in partnership with Dell, taking a sustainable approach that covers the way laptops are designed, replaced and re-used. We agreed with Dell to establish a closed-loop recycling project to make sure that 90% of the old equipment will either be recycled, re-sold or donated to charity and that traceability of recycled products will be assured. We have also chosen laptops that will reduce the total power consumption per charge cycle by 120kWh, saving the equivalent of seven tonnes of CO_2 a year once the project is finalised.

We continue to focus on environmental behaviours and the simple everyday actions that we can all take to reduce our impacts on the environment in our 'Green Shares' campaign. Our first focus area was waste and the actions we can take to reduce consumption of single use plastics, recycle effectively and reduce the amount of resources used in our offices. Subsequent themes will include reducing energy consumption, water conservation and low carbon travel.

Community

Many of our people are actively engaged in projects within their communities. They take the energy and the skills they've learnt at LR and apply it to issues and good causes they care about. We want to make sure all our people are given this opportunity to make a positive difference to the causes and communities they care about.

For example, in the Americas we have set up a CSR committee to formalise our efforts to give back to the community. Everybody in the LR team is allocated a paid day to volunteer for a local good cause that's close to their heart. This support strengthens our relationships within the communities in which we operate and provides our employees with the discretion to select good causes that they are passionate about. Next year we will review this programme and look at ways we could adopt it in other countries.

Technology and Innovation

Technology is a key enabler of a cleaner, more sustainable world. In particular, energy storage technologies are one of the most important growth drivers for the renewable energy industry. This technology is critically important because it will allow the power produced by renewable energy sources to be reliably stored and effectively distributed to the grid, reducing reliance on hydrocarbons.

This year we worked with Neoen, an independent producer of renewable energy, to develop and deploy ground-breaking technology, designed to accelerate the maturity of energy storage solutions.

Not only was this the first large-scale energy storage project in Australia, it was also the first use of Tesla equipment on the Australian electrical network. Our work on the project included complex model development, technical simulation and negotiation with national power network providers and operators. This project shows how our dedication to efficient, safe engineering and technology services is making a significant contribution to sustainability.

Governing & directing our activities.

The Board of Directors and management leadership team work together to govern and direct our activities.

Thomas Thune Andersen

Thomas Thune Andersen is the Chairman of the Lloyd's Register Foundation and Chairman of Lloyd's Register Group Limited. He is a member of the Foundation's Nominations Committee and the Lloyd's Register Group Limited Remuneration Committee.

Thomas, a former member of the executive Board of the A.P. Moller-Maersk Group with more than 30 years tenure in its maritime and energy sectors, was appointed to the Board of the former Lloyd's Register in June 2010. Thomas is Chairman of Ørsted A/S, Vice Chairman of VKR Holding, the parent group of Velux and Non-Executive Director of IMI plc and BW Offshore Limited.

Chris Finlayson

Chris is Chairman of Siccar Point Energy, a Director of Høegh LNG and a Non-Executive Director of Swire Pacific Offshore. Formerly, he was Chief Executive of BG Group, Chairman of InterOil Corp and an Executive Vice President and Managing Director with Royal Dutch Shell. Chris is a geologist, physicist and petroleum engineer with nearly 40 years' technical and commercial experience in the oil and gas industry.

Michael F Lykiardopulo

Michael was appointed Senior Independent Director on the 26 May 2016. Michael is a Director of Lykiardopulo and Co Ltd, which is responsible for the commercial management of a fleet of modern oil tankers and bulk carriers exceeding 4m tons.

He graduated in Law from Oxford University, and is a qualified barrister. Michael was part of the Lloyd's Register Board which helped formulate the plans for the 2012 restructure and he served as a Trustee to help oversee the initial development of the Lloyd's Register Foundation. He is presently also a director of The UK Defence Club and Chairman of The Hellenic War Risks Association in Bermuda as well as serving as a Director of The Gard Insurance Mutual, also in Bermuda.

Ellis Armstrong

Ellis had an extensive career in the upstream oil and gas industry where he spent over 30 years with BP. He now has a portfolio of non-executive Board roles. In addition to Lloyd's Register, he is on the board of Frontera Energy.

He has a BSc and PhD in Civil Engineering and a Master's degree in Business Administration.

Ron Henderson

Ron is a chartered accountant and former CFO of Network Rail and Balfour Beatty. In addition to other non-executive roles, he served on the UK Auditing Practices Board. Ron also chairs the Foundation's Audit, Risk and Investment Committee.

Alastair Marsh

Alastair Marsh joined the Board in 2007 and was appointed Group Chief Executive in October 2015. He joined the Board as CFO and following a period of significant growth has now instigated Lloyd's Register's digital transformation strategy. Prior to joining Lloyd's Register he held senior finance positions at Superscape Group plc, Easynet Group plc, Laporte plc and NCR Corporation. Alastair is a chartered accountant with a B.Com degree from Edinburgh University.

Caroline Firstbrook

Caroline, a Canadian with a degree in electrical engineering and an MBA from Harvard, has worked for a number of professional services firms, and is currently COO at Clifford Chance LLP, a major law firm. She has a background in consultancy, particularly the development of corporate strategy, including managing 1,000 strategy professionals while at Accenture.

Mark Kelsey

Mark is the Chief Executive Officer for RELX Group PLC's Risk and Business Analytics division, responsible for Lexis Nexis Risk Solutions and Reed Business Information. Having begun his career with RBI in marketing, he went on to pioneer the launch of several online data services in the mid-1990s. Appointed as CEO in 2010, he was responsible for transforming RBI from a traditional magazine publisher to a leading provider of online and data services, turning-around RBI's business and profitability. Mark holds a BA in Geography from Liverpool University and a MBA from Bradford University.

Mary Waldner

Mary joined LR in March 2016, having previously been Group Finance Director at Ultra Electronics plc. Before this Mary was Director, Group Finance at QinetiQ Group plc and Group Financial Controller at 3i Group plc. From 1998 to 2008, she held a number of senior roles at British Airways plc. She is also a Non-Executive Director and Chair of the Audit Committee at Oxford Instruments plc.

Thomas Thune Andersen
Chairman

Chris Finlayson
Non-Executive Director, Chairman of Lloyd's Register Group Ltd Remuneration Committee

Michael F Lykiardopulo
Senior Independent Director

Ellis Armstrong
Non-Executive Director

Ron Henderson
Non-Executive Director, Chairman of Lloyd's Register Group Ltd Audit & Risk Committee

Alastair Marsh
Chief Executive Officer

Caroline Firstbrook
Non-Executive Director

Mark Kelsey
Non-Executive Director

Mary Waldner
Chief Financial Officer

Lloyd's Register

Get in touch

Please visit **www.lr.org**
for more information

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