Workshop: Verification and Regulatory Issues for Remote Robotic Inspection

work smarter, more safely and more efficiently

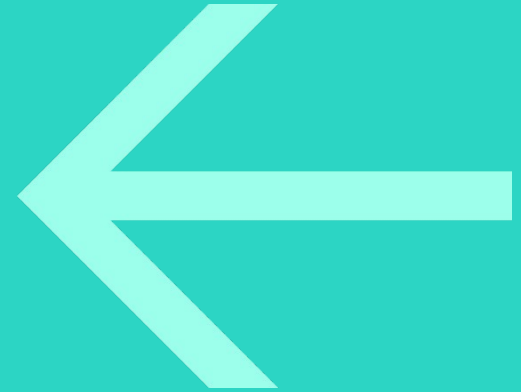**Frank van Bockel**

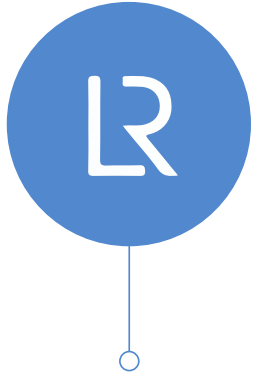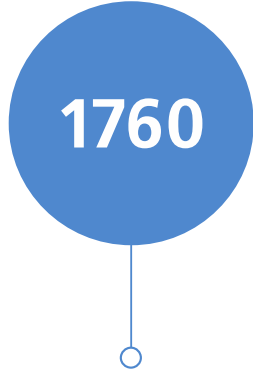Lloyd's Register

About Lloyd's Register

Who are we?

About LR – at a glance

Who we are
A global organisation with specific areas of focus around marine, energy, management systems and inspection services.

History
Founded in 1760 as a marine classification society.

Independent
Wholly owned by the Lloyd's Register Foundation, a UK charity dedicated to research and education in science and engineering.

Lloyd's Register Foundation
Registered charity – 100% shareholder of Lloyd's Register Group Ltd

OWNERSHIP & DIRECTION   FUNDING & SUPPORT

Lloyd's Register Group Limited

MARINE   ENERGY   MANAGEMENT SYSTEMS

- Mission to enhance safety of life & property, and advance public education

- Based in the UK but awards grants globally

- Impact and excellence are the major

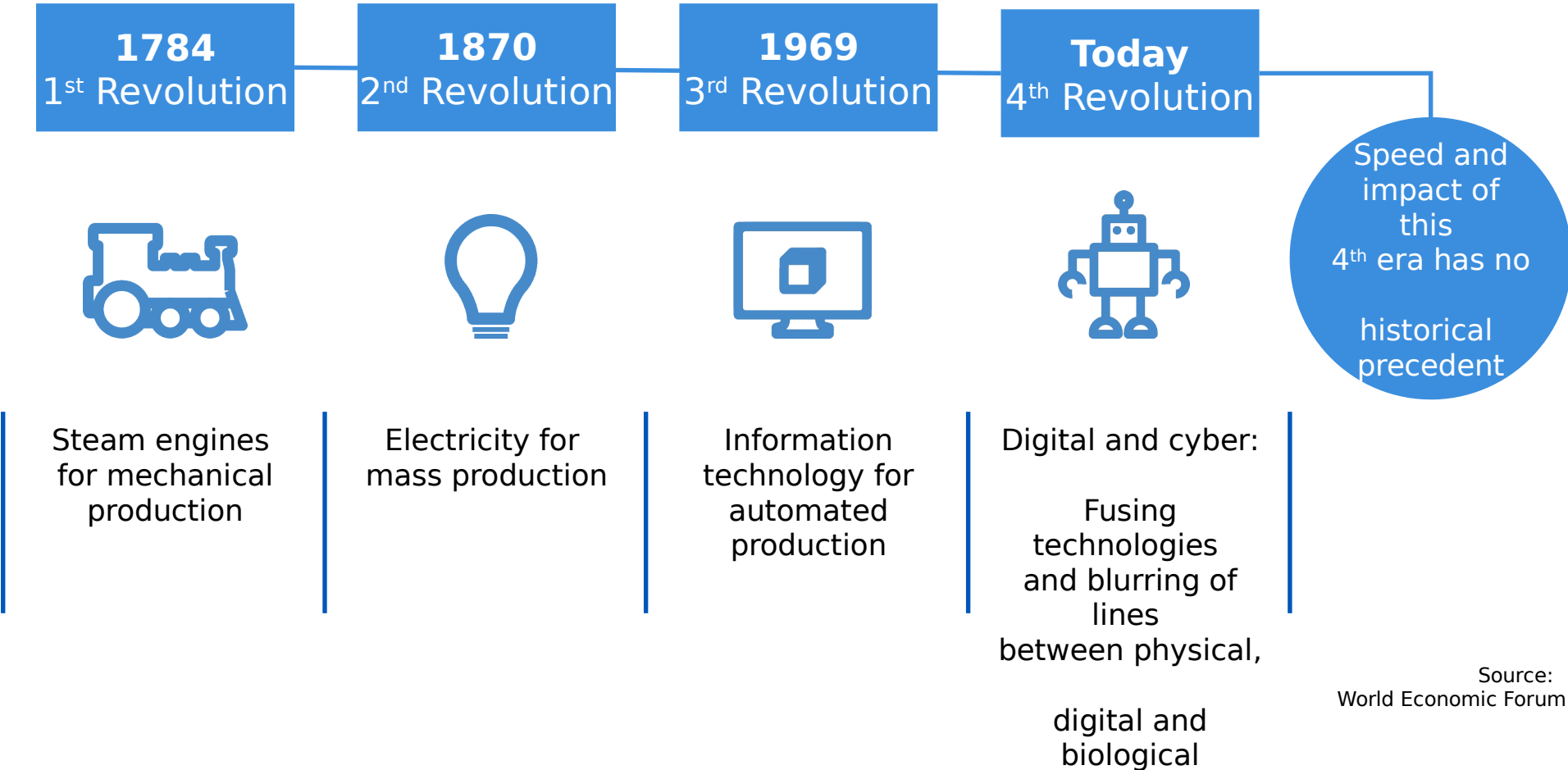# LR Foundation

LRF - Foresight reviews

http://www.lrfoundation.org.uk/programmes

Inspection Innovation

The changing world around us

| 1784 1st Revolution	1870 2nd Revolution	1969 3rd Revolution	Today 4th Revolution

Speed and impact of this 4th era has no historical precedent

Steam engines for mechanical production

Electricity for mass production

Information technology for automated production

Digital and cyber:

Fusing technologies and blurring of lines between physical,

digital and biological

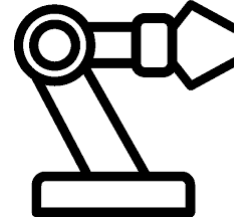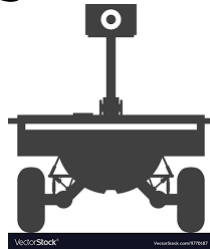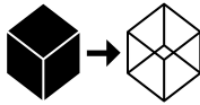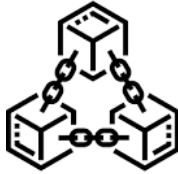Source: World Economic Forum

Industry 4.0 technology

Smart solutions shaped with human intellig

- Additive Manufacturing
- Blockchain
- IoT – sensor technology
- VR/AR
- AI – Machine Learning
- Digitalization / data analytics
- Robotics
- Digital Twins
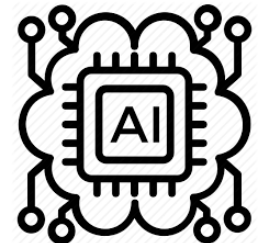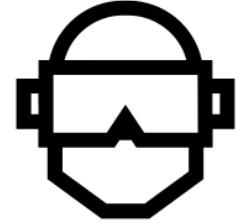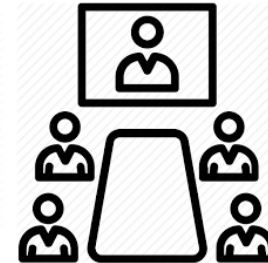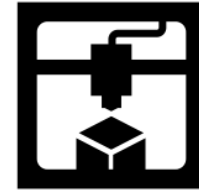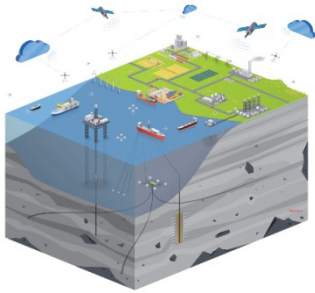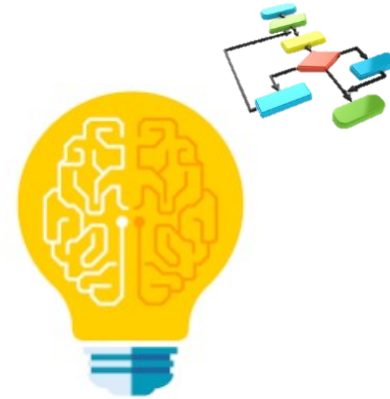
Remote Presence Technology

Collect

Image data capture. Cameras, Lidar, drones, mobile devices. Capturing data from any asset
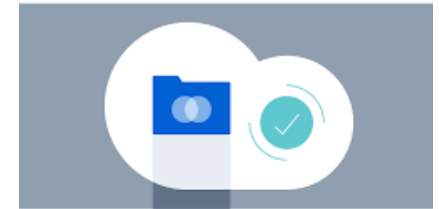
Store

Platform & data lake. Data storage & management, secure, consistent format, scalable, searchable & accessibility

Analyse

Apply data science and machine learning algorithms for defect recognition and change detection

Report

Digital Visual Asset Management, to interpret asset condition, inform decision making, optimise maintenance and inspection planning

Lloyd's Register

Remote Visual Inspection Technology

Hardware

Software

Remote Inspections

4 D Criteria - Applications

- Dull,
  – Checklist, walk arounds, witnessing, night

- Dirty,
  – Sewer, chemicals,

- Distant,
  – Offshore, remote, lock downs,

- Dangerous
  – Height, subsurface, confined space,

Remote Inspections

Typical application Industry

- Manufacturing
  - Lab/test witnessing, welding
- In-Service Downstream
  - Flarestack, Pressure vessels, pipelines
- Energy
  - Turbine blades, electrical
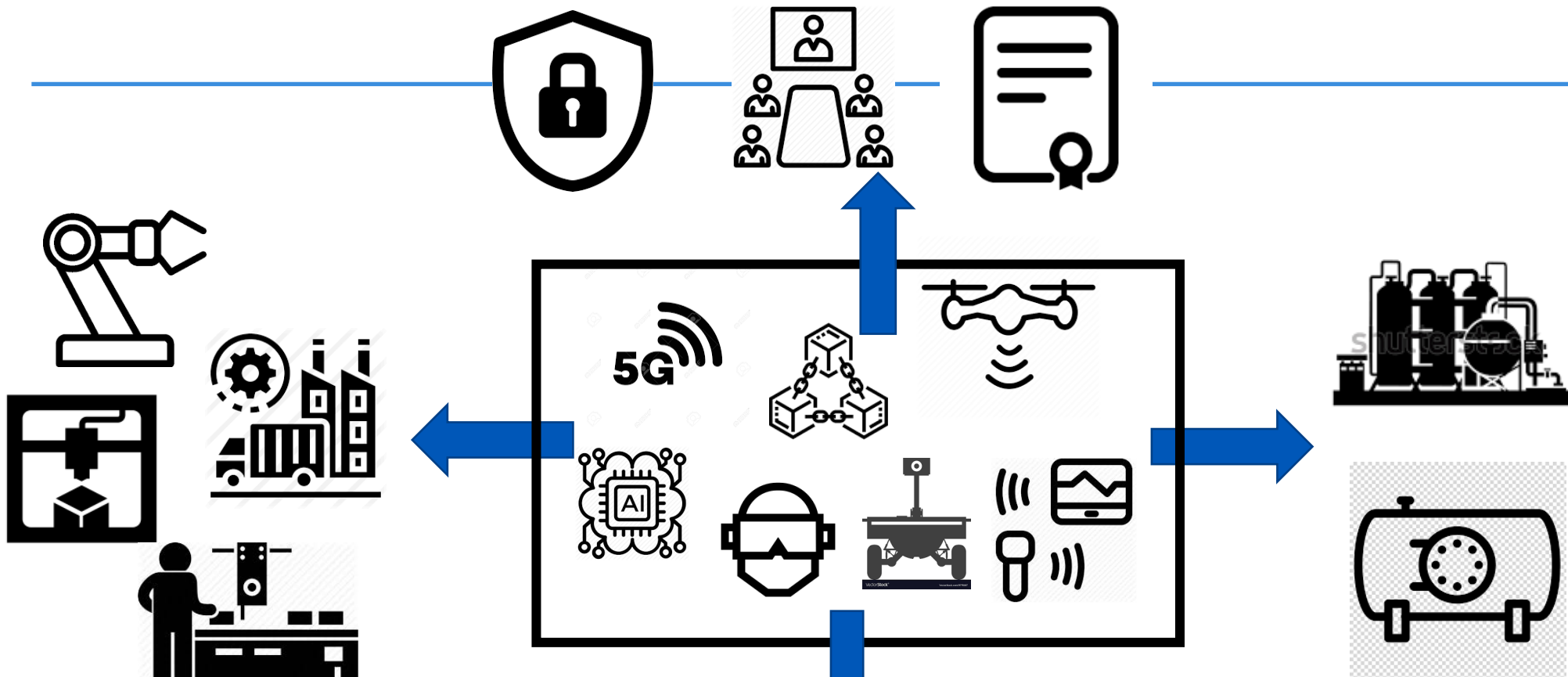- Civil / ports
  - Bridges, cranes,

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Remote (robotic) Inspections

Limitations

- Bandwidth (wifi / 4G)

- Resolutions of camera's

- Acceptance within codes/standards & Regulations (Procedures)

- Data security

- Experience

Digital and cyber:
Fusing technologies
and blurring of lines
between physical,
digital and biological

Thank you

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