

Global Cost of Corrosion, Safety Considerations and Failure Impacts

Stephen Tate – Immediate Past President, 28/08/26

Global Cost of Corrosion and Failure Impacts - Bio's

An Introductory Presentation with contributions by:

- **Stephen Tate – ICorr Immediate Past (National) President**, PG.Dip Eng, MBA, MICorr, Past Aberdeen Branch Chair and Past Vice Chair.
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Global Cost of Corrosion and Failure Impacts

- 1. Safety Impact of Corrosion**
- 2. Financial Impact of Corrosion on Society**
- 3. Environmental Impact of Corrosion**
- 4. Solutions to Corrosion Problems**
- 5. Role of Corrosion Professionals**
- 6. Role of Education, Mentoring, Knowledge Transfer**
- 7. CP as Prevention, Cost Considerations**
- 8. Summary**

Figure 1: Close up of shiny and rusted metal chains (source: www.alamy.com)



Global Cost of Corrosion and Failure Impacts.... What Can Happen?



1985 – Swimming Pool Roof Collapse in Switzerland
12 people died,
cause – Chloride Stress Corrosion Cracking of stainless-steel rods
(source: HSE)

Global Cost of Corrosion and Failure Impacts.... What Can Happen?



- 2023 – **HSE Alert**
- **Peterhead Firm fined £350,000 by HSE after corroded chemical tank burst left worker injured**

(source: BBC).

On June 21, 2023, a severely corroded 700-tonne chemical storage tank burst at the [Tetra Technologies UK Limited](#) offshore supply base in Peterhead, releasing nearly 481,000 litres of calcium chloride brine. The catastrophic rupture critically injured a contractor, leaving him with life-changing spinal fractures and chemical burns.

Victim is still dealing with the effects of multiple broken bones and chemical burns three years later.

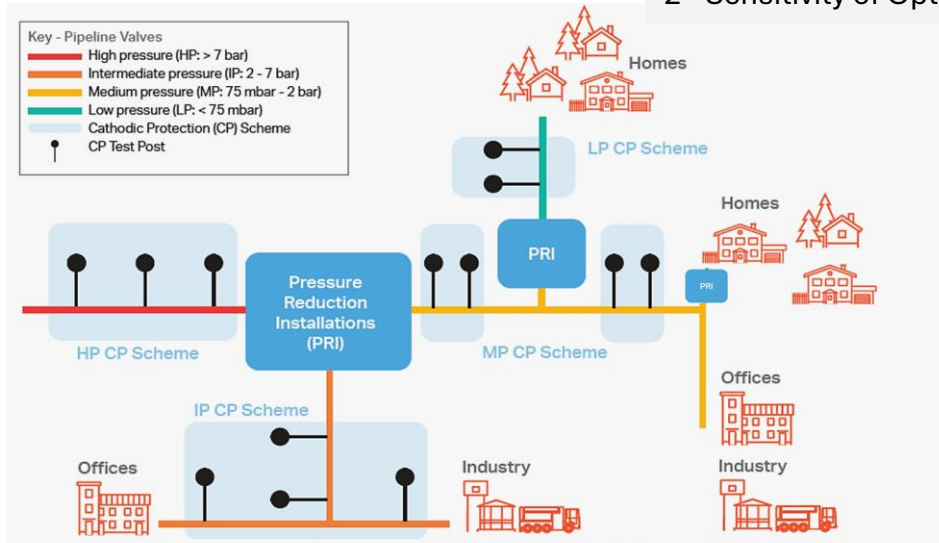
Corrosion Related – Explosion Risks

Prevention Options

0 - Reactively replace pipeline failures (i.e. the baseline position)

1 - Targeted proactive repair (preferred option)

2 - Sensitivity of Option 1 to interruptions to supply valuation



UK Gas System – CP
and Pressure
Breakdown (courtesy of
CADENT)

Corrosion Related – Explosion Risks



Explosion **completely destroyed** one home and damaged dozens more!

- 2021 – **HSE Alert**
- 3 Gorse Park - Ayrshire, A **corroded gas service' pipe led to a house explosion in South Ayrshire which left a family of hospital**

(source: BBC/HSE)

[BBC News 19 October 2021](#)

[HSE Report 14 September 2022](#)

Corrosion Related – Explosion Risks



- 2022 – **HSE**



Corrosion Related – Explosion Risks



Explosion severely damaged the Hotel which was later demolished.

- 1983 – **Aberdeen,**
- The Royal Darroch Hotel, **A failed gas service' pipe led to 6 Deaths and Multiple Injuries.** Scottish Gas were ordered to pay ~£3M in compensation to the victims.

(source: Historic Aberdeen)

[THE ROYAL DARROCH... - Historic Aberdeen & Shire - Scotland | Facebook](#)

- Only 1 week later, the adjacent Cults Hotel, suffered a leak traced to a medium pressure (MP) main in the road.

Corrosion Related – Structural Risks



Homes Demolition - More than 500 homes have been affected by RAAC.

- 2026 – **£150M Aberdeen, Demolition / Rebuild of Homes affected by RAAC** (corroded steel of - reinforced autoclaved aerated concrete). Widely used 1960's to 1990's (source: BBC/HSE)

[BBC RAAC Issues](#)

[BBC HSE](#)

- The Health and Safety Executive (HSE) says RAAC is now beyond its lifespan and may "collapse with little or no notice". Many Schools and Hospitals also affected.

Environmental Impacts of Corrosion



Corrosion can cause leaks and spills, leading to environmental pollution. Global CO₂ emissions from steelmaking for replacement of corroded steel are forecasted to be ~4–9% of total CO₂ emissions by 2030 if no appropriate mitigation actions are taken.

(source: Iannuzzi M. and Frankel G. S., 2022)

Financial Impacts – Why Corrosion needs more Advocates

Economic Impact of Corrosion

Corrosion costs the UK around £100 billion annually, between 3-4% of GDP, affecting public infrastructure of all types and individuals.

Preventable Corrosion Costs

15-35% of corrosion-related costs can be avoided through better design, material choice, and timely maintenance.

Policy and Sustainability

Corrosion control supports infrastructure resilience, net-zero goals, public safety, and reduces carbon emissions.

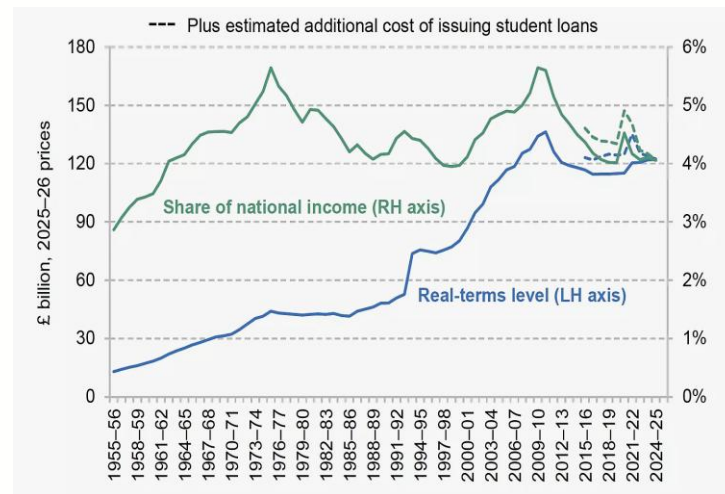
Public Trust and Safety

Corrosion failures can cause amenity and school closures, bridge restrictions, and utility failures, eroding public trust.

Annual cost of
corrosion in UK

≈

Annual budget
for UK education



UK education costs over the years (source: HM Treasury)

ICorr's Parliamentary Engagement (P&SC)



Photo acknowledgements: www.icorr.org

- ***Reuse, Renew or Replace?*** | 15th October 2024 | Portcullis House, Westminster
- **Who Was in the Room?**
 - Parliamentary and Scientific Committee (P&SC)
 - Chaired by George Freeman MP
 - 11 ICorr delegates attended
 - MPs, scientists & policy stakeholders
 - House of Commons & House of Lords
- **Four expert presentations:**
 - *Raising Awareness of Corrosion*
 - *Value Retention Processes*
 - *Mentoring the Next Generation*
 - *Advanced Corrosion Management*

Delivering Our Message to Parliament (P&SC)

The Economic Case

- ~£100 billion / year – comparable to UK education budget
- 35% savings £32 billion / year already within reach
- Comparable to the Chancellor's' *black hole* in public finances

The Safety & Environment Case

- Continuing RAAC failures in public buildings (huge extent).
- M6 and M8 motorways weakened bridge replacements (2021–2026)
- Wytch Farm oil spill (MIC, 2023)
- Forth Road Bridge – £1.4 billion to replace
- Berkshire railway signal collapse (2014)

The Skills & Education Case

- Ageing workforce, retiring experts
- Corrosion not a stand-alone university discipline
- ICorr have initiated YEP & mentoring programme's
- Need for school outreach & STEM
- New ICorr - Corrosion at Home education initiative.

Solutions to Corrosion Problems

Cost-effective materials selection to match asset life cycle and improve safety & reliability

Effective corrosion risk management

Enabling effective contact between Materials and Corrosion Specialists and Government bodies and communities to facilitate the provision of corrosion control expertise

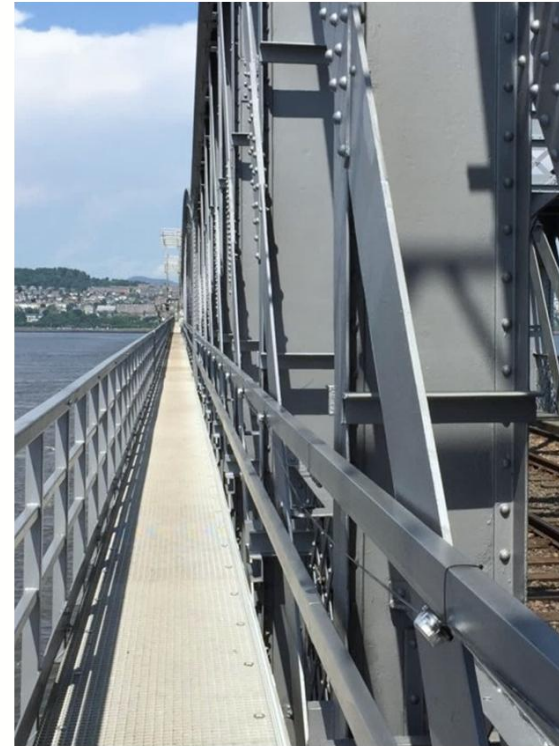
Appropriate education, training and mentoring to increase competency and corrosion awareness



Active Prevention

- Corrosion and associated costs **cannot be eliminated completely**
- **~£10 to £30 billion / year could be saved in the UK**
- **Optimised** corrosion prevention practices can:
 - Improve safety
 - Protect the environment
 - Save a lot of money
 - Reduce inconvenience to the Public, i.e.:
 - **Prevent or reduce water and gas leaks**
 - **Enable more reliable journeys** by preventing corrosion of roadside and trackside infrastructure
 - **Extend life of public infrastructure**
 - e.g., Forth Road Bridge (FRB) cable corrosion led to wires failure. Partial mitigation by dehumidification. FRB replacement could have cost even ~£2.4 billion. A new bridge was built due to weight limits on the damaged FRB."

Refurbished Tay Bridge (Dundee, Scotland), UK's longest rail structure – restoration cost: £75 million (source: www.networkrail.co.uk)



Active Failure Prevention (Total Replacement)



£60M Replacement of RC Clifton Rail Bridge, Nr. Penrith on M6 Motorway in 2025.

- 2025 – **Weakened Motorway Bridge**
- Integrity lost, only 1x Train able to pass over bridge at any one time.
(source: BBC)
- [M6 Clifton Bridge Demolition](#)
- [M42 Bridge Corrosion and Demolition](#)

Role of Corrosion Professionals

- Fundamental Research
- Development of Products (alloys, coatings, inhibitors)
- Design
- Engineering
- HSE Compliance – COMAH and Safety Cases
- Asset Integrity Management
- Plant & Equipment Engineering
- Plant & Equipment Inspection
- Plant & Equipment Safety



Role of Education, Mentoring, Knowledge Transfer

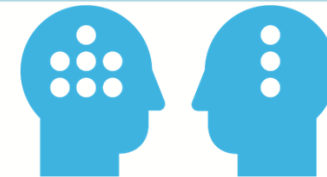
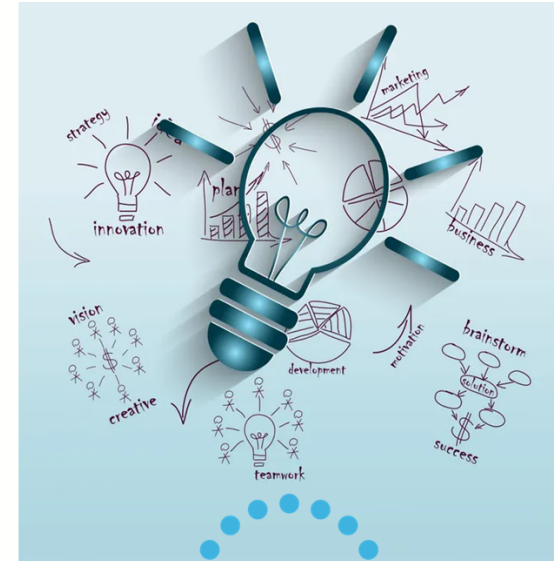
Knowledge – one of the most powerful competitive advantages in today's markets

Insufficient competent * Engineers in the UK – up to 59,000 core engineering roles unfilled annually

* Competency = Qualifications + Training + Experience

Knowledge transfer (KT) is particularly important when more senior and experienced personnel is approaching retirement

- Losing expertise due to ageing population in the UK
- Our universities are training students from around the world, many supported by their governments
- **The need to enable and encourage home-grown students into Corrosion Science & Engineering**
 - e.g., ICorr 5 Year Funding for 6 Student Scholarships annually at the University of Manchester. ICorr also now offers Internships



Approaches to Knowledge Transfer

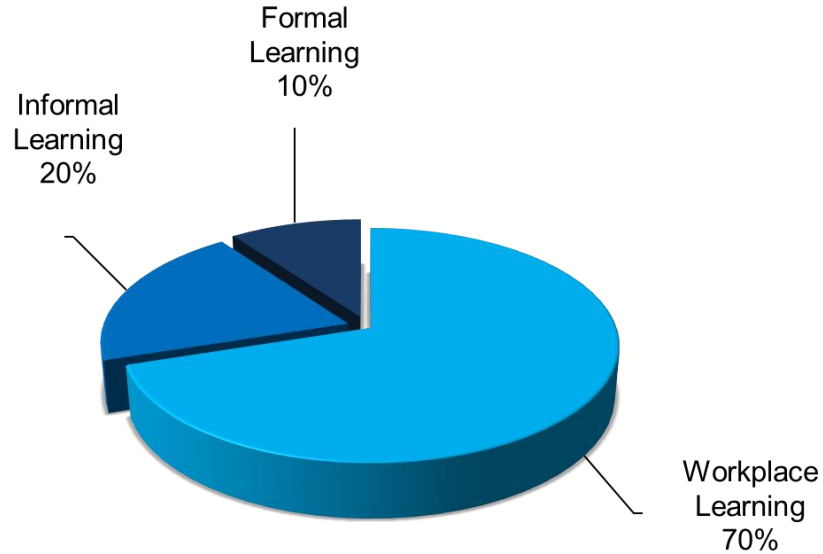


Figure 5: 70:20:10 Model for Learning and Development (Eichinger, R. and Lombardo, M., 1990s)



- Projects
- Work meetings
- Taking notes
- Site visits



- Mentoring
- Appraisals
- Feedback



- Technical books
- Codes & standards
- Training courses
- E-learning
- Conferences

Mentoring Future Generations of Corrosion Professionals

- **Mentoring – one of the solutions** to corrosion issues
 - Mentors matched with development needs of mentees
 - Clearly defined schedule, regular meetings
 - Technical presentations + talks about corrosion problems and solutions using sketches, images, videos + site-based learning
 - Customised subject-based curriculum – mentoring tool
- **Sharing experience-based knowledge is critical**
 - Mentor's support to be assured, including discussions about issues related to ongoing projects
- **Evaluation of KT**, e.g., presentations, tests, exams

Figure 6: Customised subject-based curriculum (source: personal collection)

	A	B	C	D
1	SUBJECTS			
2	Downhole & reservoirs	Oil&gas processing facilities	Soft issues: HF, MoC, Creeping, Chge, NoD	Internal Corr Mon.
3	Flow lines, gathering lines, trunk lines	Water injection systems	Subsea systems	NDT
4	Main oil lines	Legislation	Corrosion Threats Assessments	
5	Main gas lines	Corrosion mechanisms	Barriers to failure	
6				
7				
8	DOWNHOLE AND RESERVOIRS	% COMPLETION OF BASIC INTRODUCTION	TOPIC	TOPIC
9	Oil & gas reservoirs	90	sandstone / carbonaceous	lifecycle stages of production
10	Offshore production	90	types of installation:	fixed jacket
11	Onshore production	90	types of installation:	single well
12	Production types	90	primary	secondary
13	Tubing	90	purpose	Material grades
14	Well casing	90	purpose	Material grades
15	Xmas trees	90	purpose	types

Societal Impacts and Advances

- Advances by Corrosion Engineers / Scientists / Chemists mean that your **car no longer looks like this after a few years**



Cathodic Protection – A common mitigation

- Cathodic Protection is not a standalone mitigation measure. It is part of a system.
- We need to consider the intended coating system.
- For example, FBE (fusion bonded epoxy) coating vs. 3LPP (3-layer polypropylene)
- FBE coating is a cheaper product but has higher coating breakdown factors and will require more CP protection.
- Needs mechanical protection (outer layers).
- This will also increase installation costs, as pipeline anodes are installed offshore at pipelay.

FBE coated pipe



3LPP coated pipe

Cathodic Protection - Cost Considerations

- Cathodic Protection is not a standalone mitigation measure. It is part of a system.
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Cathodic Protection considerations - electrical isolation

- Consequences of failing to ensure electrical continuity.
- Accelerated corrosion of components
- Electrical continuity checks should be performed for all components not connected by welding.



Umbilical connection showing severe corrosion(source: EEMUA Publication 194)



PTFE coated subsea fastener (source: EEMUA Publication 194)

Cathodic Protection - Retrofitting

- Retro-fitting of anodes may need to be considered if:
 - Life extension is required.
 - Design did not consider all components.
 - Current drain occurs to existing infrastructure.
- Anode skids can be connected in this case. Skids are relatively inexpensive, but offshore installation of this can be costly.



(source:
forcetechnology.com)

Summary

- Corrosion degradation:
 - Is potentially significant safety and environmental threat
 - Adds significant costs to people and society
 - Indirectly adds to the tax burden
- **Chance to save ~£10-30 billion / year corrosion costs**
- **Shortage of home-grown Corrosion Professionals** in the UK – relatively few universities and colleges offer this training
- **Corrosion & degradation can only be managed by competent Corrosion Engineers & Scientists**
 - Fundamental academic R&D and knowledge transfer are key to managing corrosion, thus enhancing safety, cutting costs, and promoting sustainability.
- **Cathodic Protection (CP) is one widely-used Corrosion Prevention Option for our Infrastructure**
 - Requires Certified Designers/Installers/Inspectors

Financial Commitment to CP System Maintenance



Global Cost of Corrosion and it's Impacts

Thank you for your attention.
Any Questions?



Advancing Corrosion Science & Engineering



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Aberdeen CAD Event - 2026