



Mentoring the Next Generation Towards Corrosion Prevention

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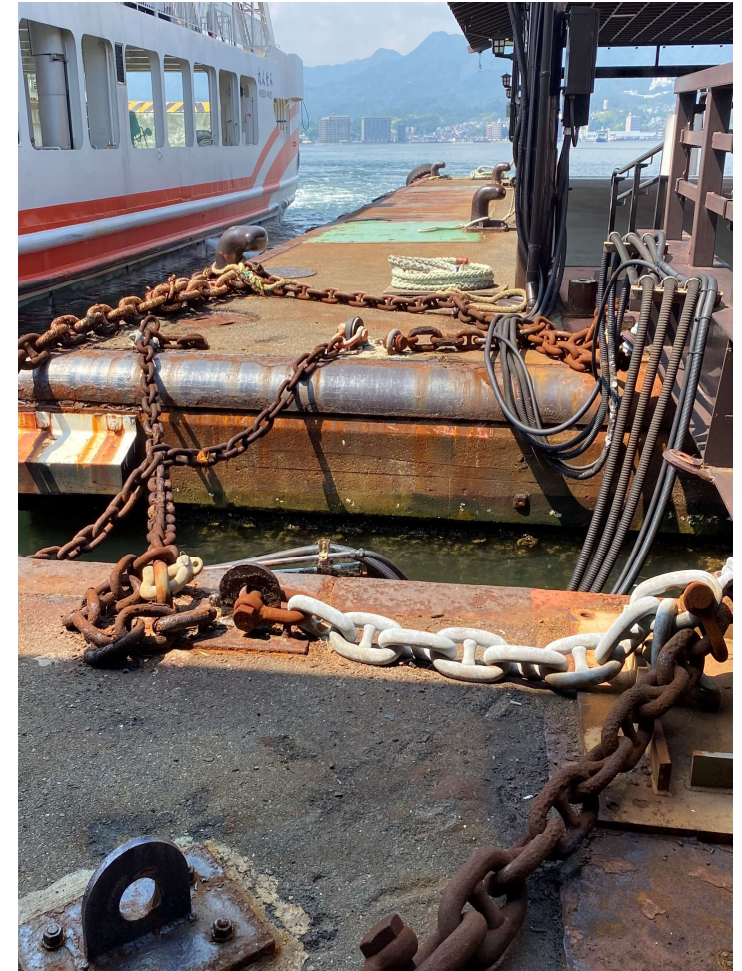
Tuesday 15th October 2024

Agenda

Parliamentary & Scientific Committee APPG

- **What is Corrosion?**
- **Safety Impact of Corrosion**
- **Financial Impact of Corrosion on Society**
- **Environmental Impact of Corrosion**
- **Solutions to Corrosion Problems**
- **Role of Corrosion Professionals**
- **Role of Education & Mentoring**
- **Summary**

Shiny and rusted metal chains (source: personal collection)

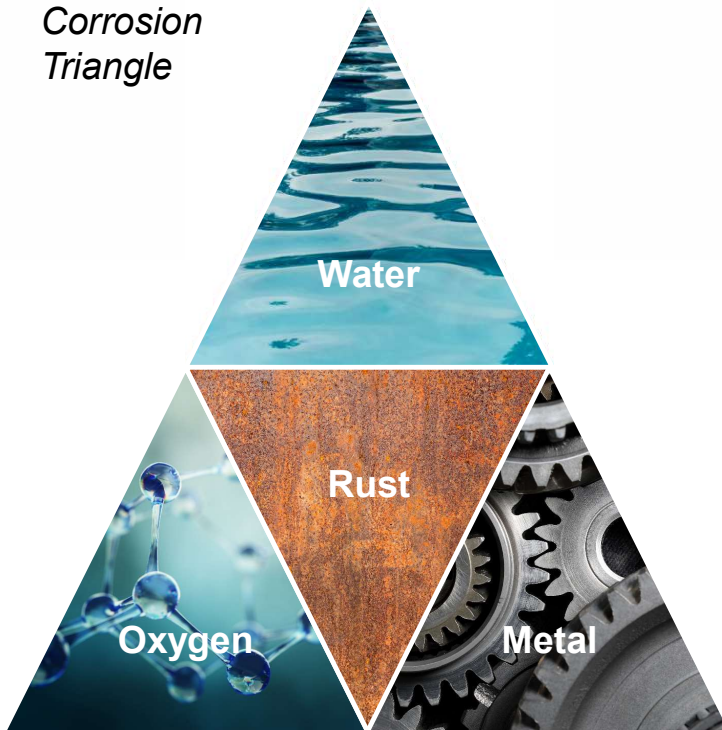


What is Corrosion?

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- **Corrosion – material deterioration**, usually a metal, due to a chemical reaction with its environment
- It can occur in a variety of environments: marine, industrial, atmospheric:

Corrosion Triangle



Offshore Wind Farms



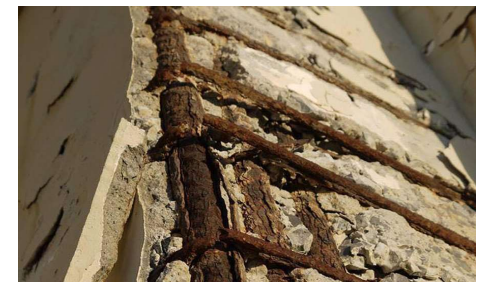
Process Plants



Bridges



Buildings



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



Photo acknowledgement:
www.reddit.com

Financial Impact of Corrosion on Society

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- Global cost of corrosion is **~\$2.5 trillion annually** (source: NACE 2016 Study)
- ~3.4% of the global Gross Domestic Product
- 2023 – UK GDP was £2,690 billion (source: House of Commons Library on-line)
 - Assuming 3.4% of GDP is the UK's cost of corrosion, **corrosion costs UK Plc ~£90 billion / year**
- **~15 to 35% of annual corrosion costs could be saved** (source: NACE 2016 Study)
- 2022 – average disposable income in UK was ~£39,328 (source: Office for National Statistics)
 - Annual cost of corrosion per average UK household ~£1,300
 - **Potential 35% savings would reduce this cost to ~£850**

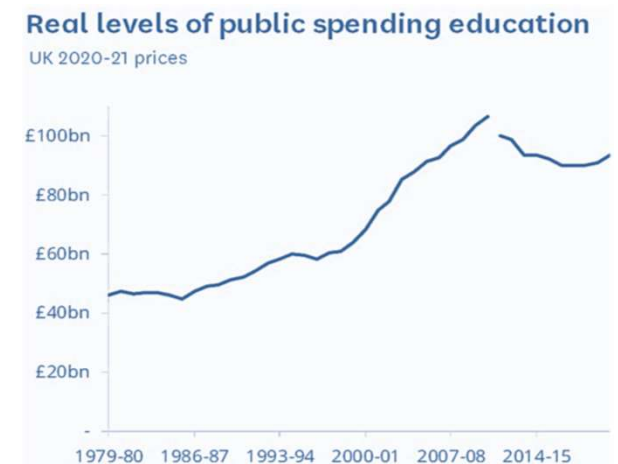


Annual cost of corrosion in UK

≈

Annual budget for UK education

UK education costs over the years (source: House of Commons Library on-line)



**Corrosion can cause leaks and spills,
leading to environmental pollution**

**Steel replacement due to corrosion could
contribute 4–9% of global CO₂ emissions by 2030
if appropriate mitigation actions are not taken
(Source: Iannuzzi M. and Frankel G. S., 2022)**

Corrosion Management

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- **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:**
 - Prevent or reduce water and gas leaks
 - Enable more reliable journeys
 - Extend life of public infrastructure

Forth Road Bridge (South Queensferry, Scotland), cable corrosion caused wires to fail – bridge replacement cost: **£1.4 billion** (source: personal collection)



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

Solutions to Corrosion Problems

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

Effective corrosion risk management

Communication between Materials and Corrosion Specialists, Government bodies and communities

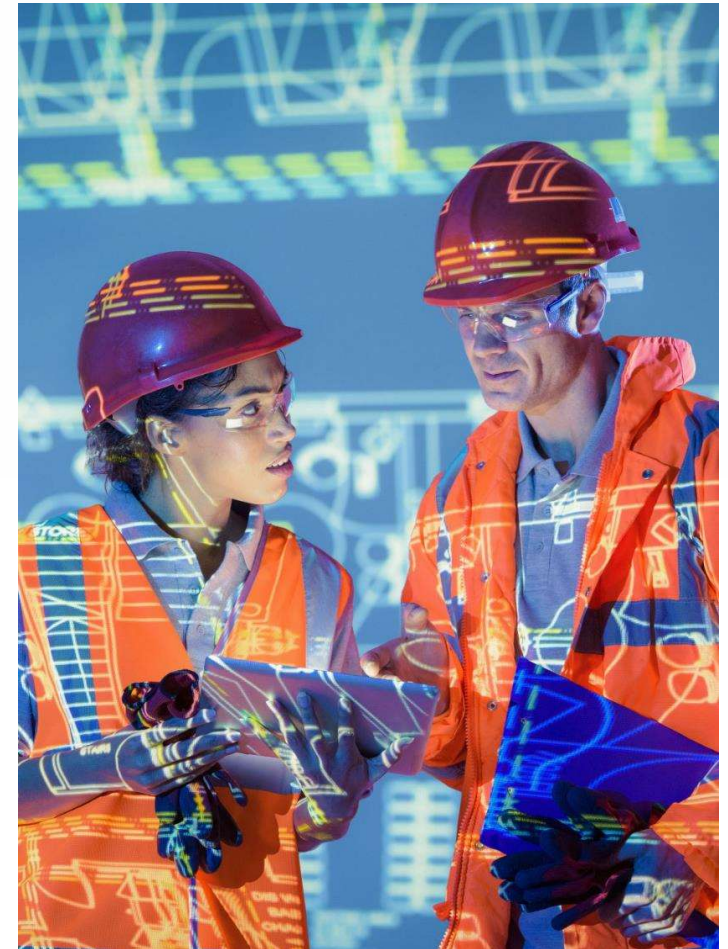
Appropriate education, training and mentoring to increase competency and corrosion awareness



Role of Corrosion Professionals

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- 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

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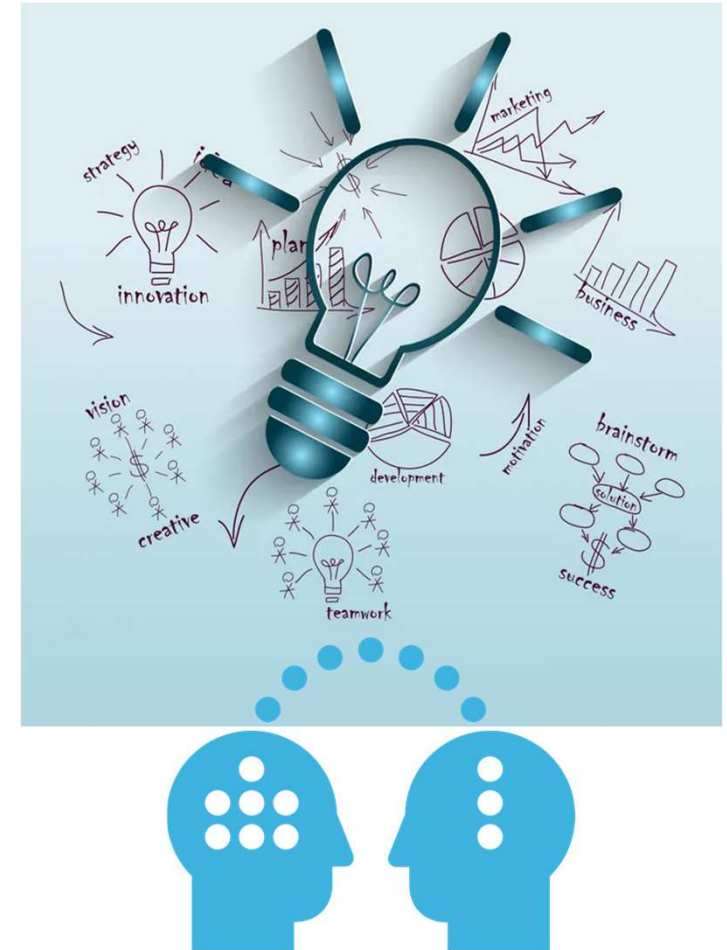
Knowledge – one of the most powerful competitive advantages in today's markets

Insufficient competent * Engineers in the UK

* Competency = Qualifications + Training + Experience

Knowledge transfer (KT) is especially important when experienced UK personnel near retirement

- 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 at the University of Manchester



Summary

- Corrosion degradation:
 - 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 training programmes available
- **Effective corrosion management requires competent Corrosion Engineers and Scientists**
 - Mentoring the future generation of corrosion professionals & fundamental academic R&D – key to combating corrosion, thereby **improving safety, reducing costs, and promoting sustainability**

Swiss Swimming Pool Roof Collapse in 1985 (source: www.reddit.com)



Final Comment

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



Photo acknowledgements:
www.autoweek.com/car-life/classic-cars/a2143171/junkyard-treasure-1976-lancia-beta-coupe



Thank You for Your Attention



intertek
capcis

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Appendix

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Approaches to Knowledge Transfer

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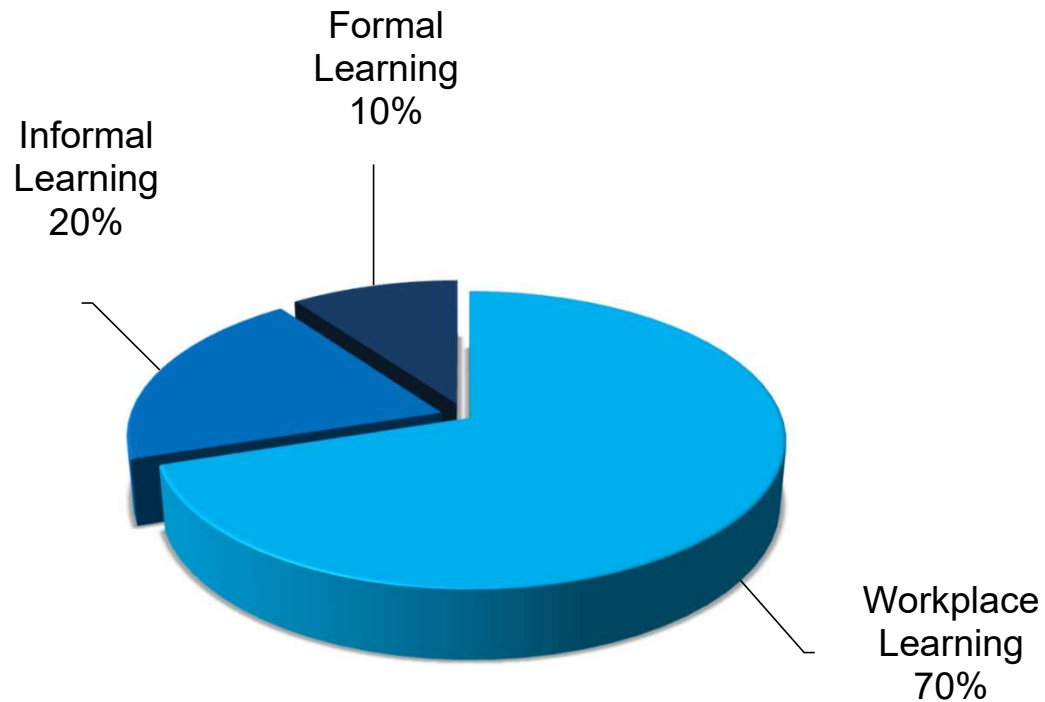


Figure 5: 70:20:10 Model for Learning and Development (Eichinger, R. and Lombardo, M., 1990s)

Work experience



- Projects
- Work meetings
- Taking notes
- Site visits

Informal Learning



- Mentoring
- Appraisals
- Feedback

Formal Learning



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

- **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

*Customised subject-based curriculum
(source: personal collection)*

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