Prepared for:

C-Cube International BV

2022

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C-Cube

YES! DELFT

Tanks
Innovation by Collectivity

Horizon 2020
European Union Funding
for Research & Innovation

Interreg
North-West Europe
OPIN
European Regional Development Fund

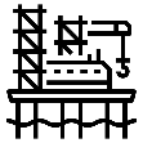
Rijksdienst voor Ondernemend Nederland

eit Climate-KIC
Climate-KIC is supported by the EIT, a body of the European Union

RIMA
ROBOTICS FOR INSPECTION AND MAINTENANCE

Markets

Offshore
Dredging
Storage
Wind



Infra
Bridges
Waterlocks
Rail infra

Industry
Shipbuilding
OEM
Process

Institutions
Research firms
Universities

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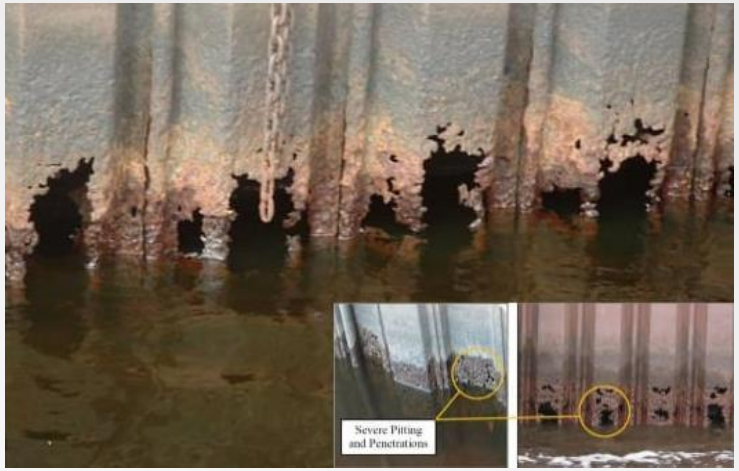
Corrosion

- Financial risk
- Limits lifetime
- Safety problems
- High Costs
- Environmental impact
- Discovery during projects

NACE INTERNATIONAL IMPACT

The global cost of corrosion is estimated to be US$2.5 trillion, which is equivalent to 3.4% of the global GDP (2013).



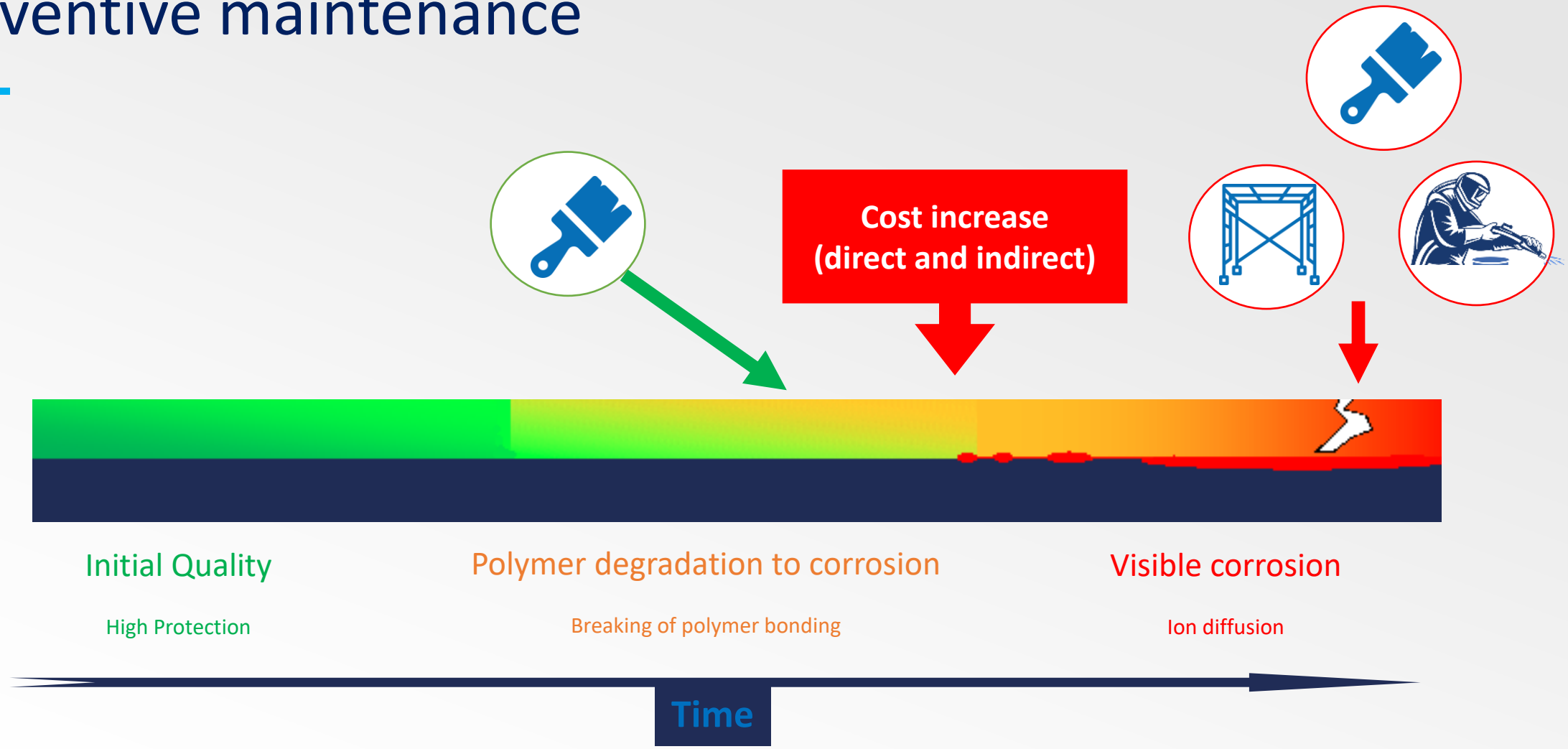
Coating Degradation

Cost increase (direct and indirect)

Initial Quality	Polymer degradation to corrosion	Visible corrosion
High Protection	Breaking of polymer bonding	Ion diffusion

Tijd

Monitoring & Preventive maintenance



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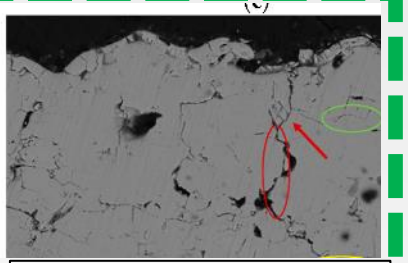
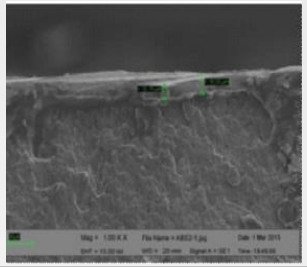
Inspection methods

Intact coating



Coating degradation



DFT changes

Coating failure

corrosion and pitting

Inspection Method

DFT

CQM

Visual

CQM

DFT

Can be misleading

Visual

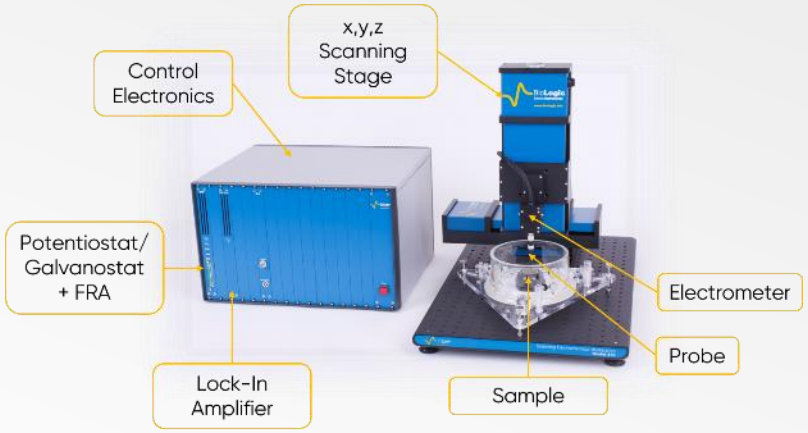
Steel thickness

Overview of technologies

Sensors/ Dashboard

- Coatings
  - Handheld
  - IoT
  - Crawler
- Corrosion
  - IoT

CQM vs Traditional Equipment



Potentiostat plus FRA

Use-case: Laboratory

- **Measurement time: ~ 30 minutes**
- Bulky and heavy (5 kg)
- Too vulnerable to use in the field
- Difficult to use

CQM

Use-case: On-site measurements

- **Measurement time: ~1 minute**
- Compact and lightweight (300 grams)
- Robust IP68 and drop resistant
- One-button system, easy to use

Coating Quality Measurement

Coating Quality Measurement (CQM) provides insight:

- How well protects visually intact coating: barrier property
- Coating degradation
- Presence of corrosion under the coating
- Forecast when corrosion starts
- Prognosis of % visible corrosion

CQM complies with ISO 16773

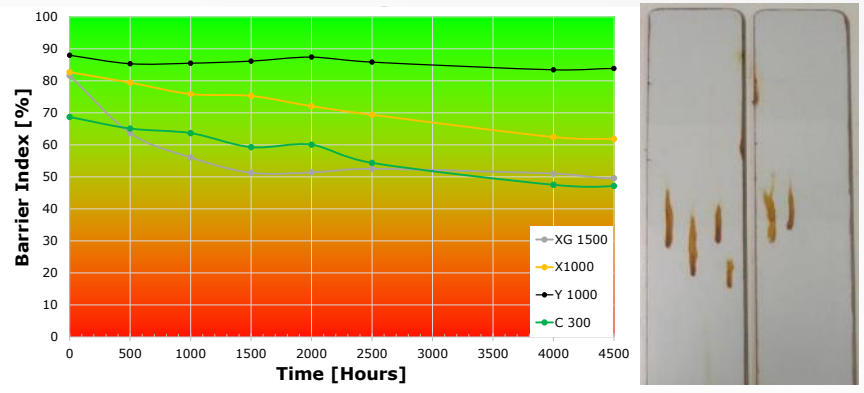
Port of Rotterdam purchase condition/ specifications

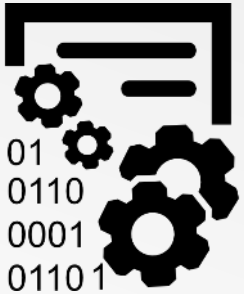
CQM Technology

Database + Sensors + Algorithm → Reporting

- ISO 12944-9
- ISO 9227
- Degradation models

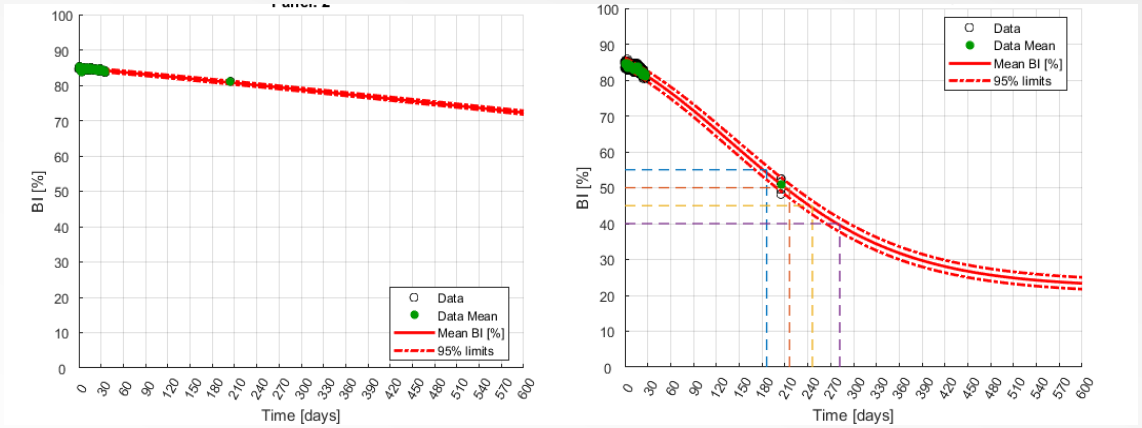
- ✓ PDF
- ✓ Dashboard
- ✓ API



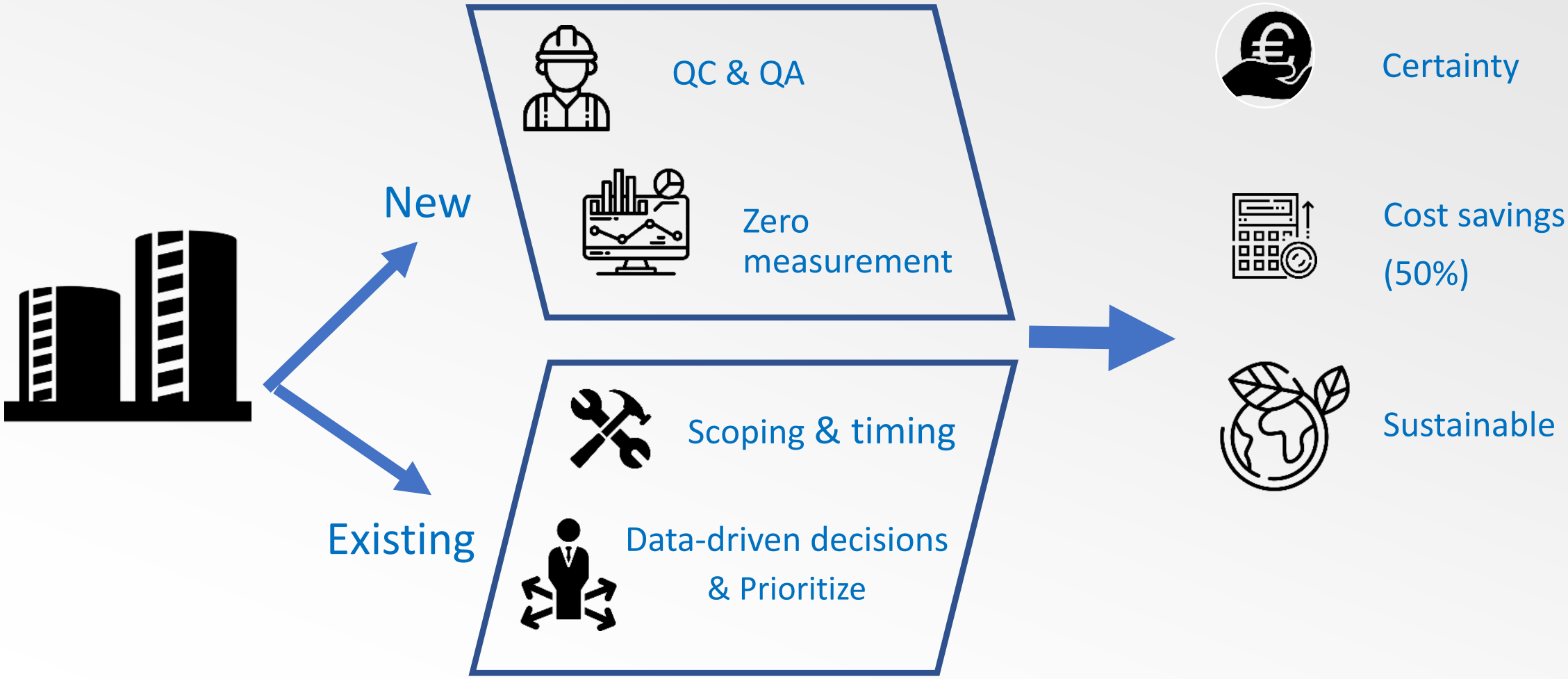


IoT Coating Sensors

Coating condition monitoring



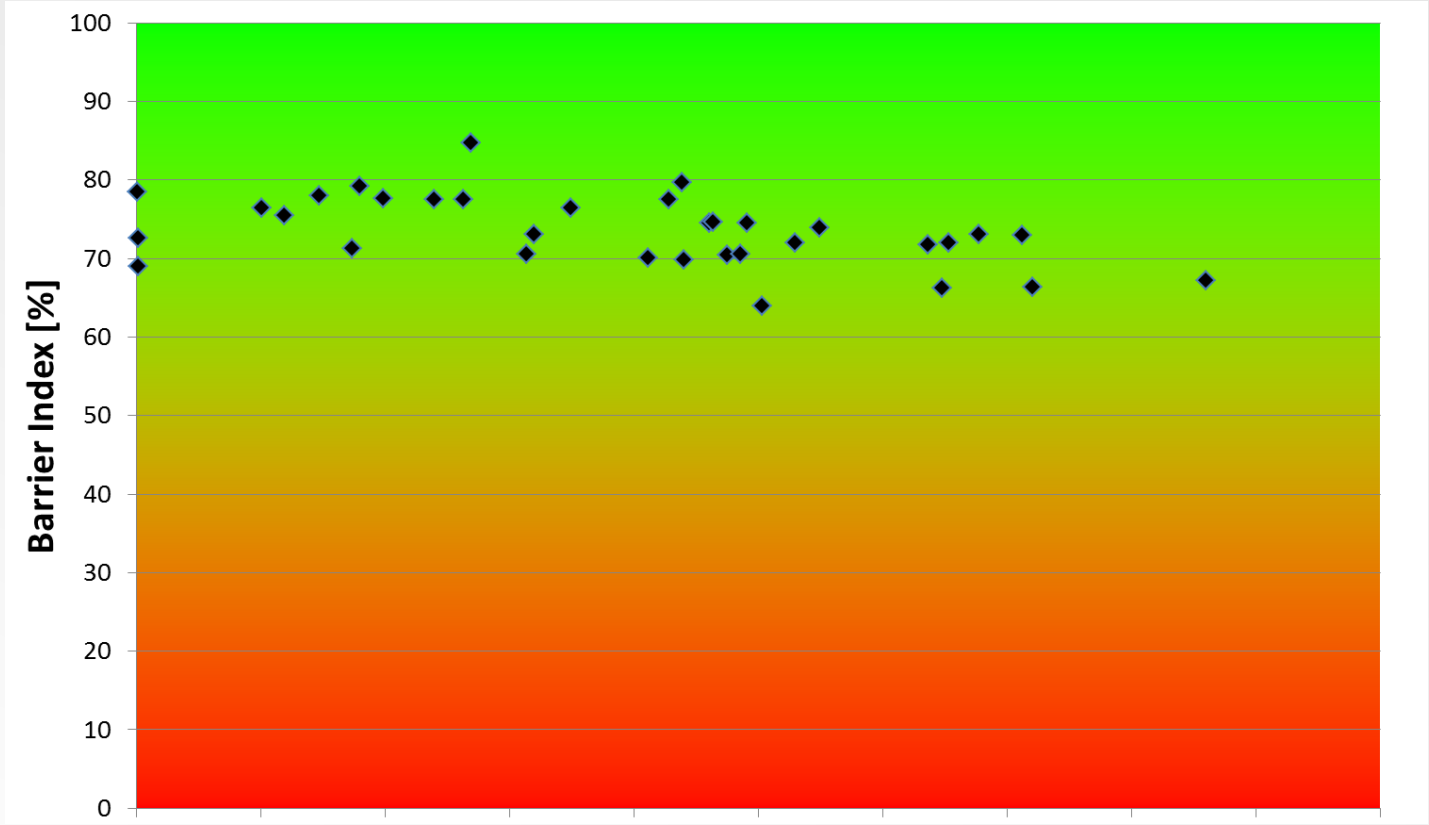
Use case & Business Case



Project: Fighter plane

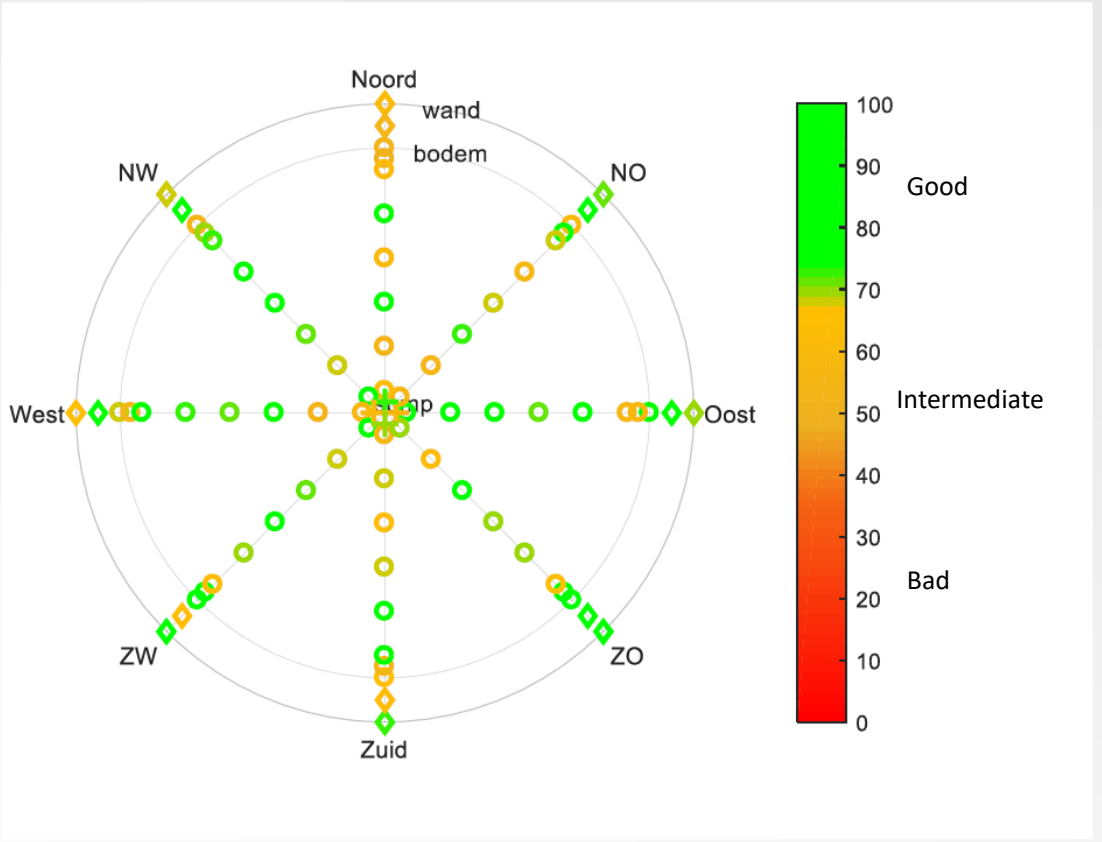
On-time replacement of strippable topcoat

- Avoid chromate emission
- Degradation mechanism
- Prognosis of degradation



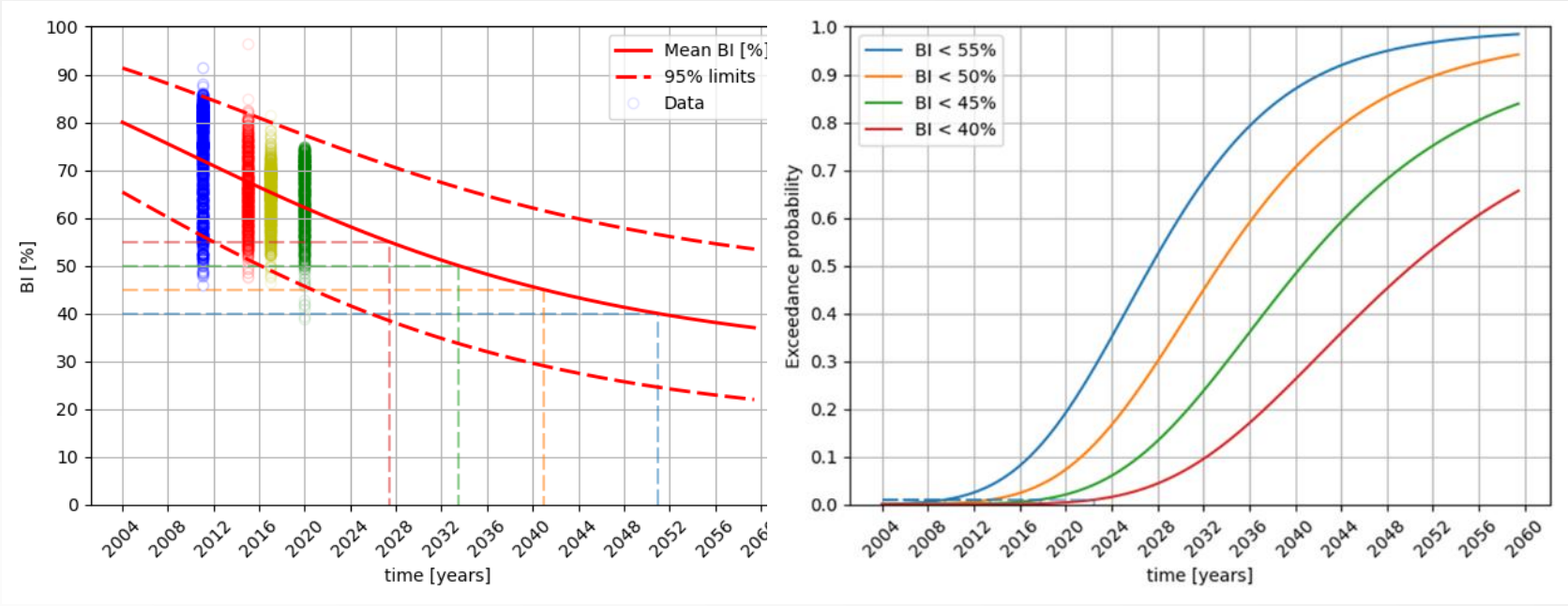
Project: Tank roof coating

- 15 years in use
- Visually intact
- Q: Coating replacement or overlaying?
- A: Local repair and overlaying



Project: Hollandsch Diep

- Data-driven decisions
- Signalling weak locations



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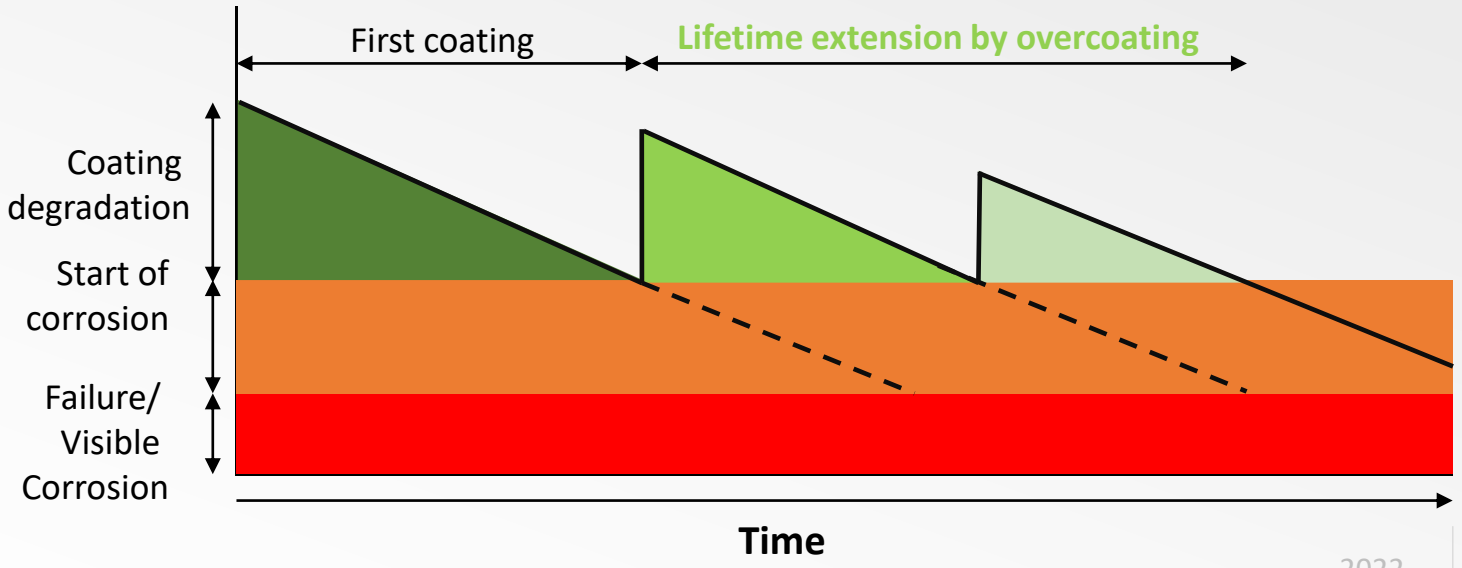
Norms

- ISO 16773
- Port of Rotterdam purchase condition
- RAW
- RTD 1032
- DNV technology verification 2022

OGOS
Opdrachtgeversoverleg Staalconserveren

CQM Benefits

- Insight into how coating degrades (no surprises)
- Forecasting or overcoating period & % of corrosion over time.
- Cost reduction in combination with preventive maintenance
- Corrosion risk control



Added value CQM (just in time maintenance)
Condition based maintenance to be done

Overcoat?

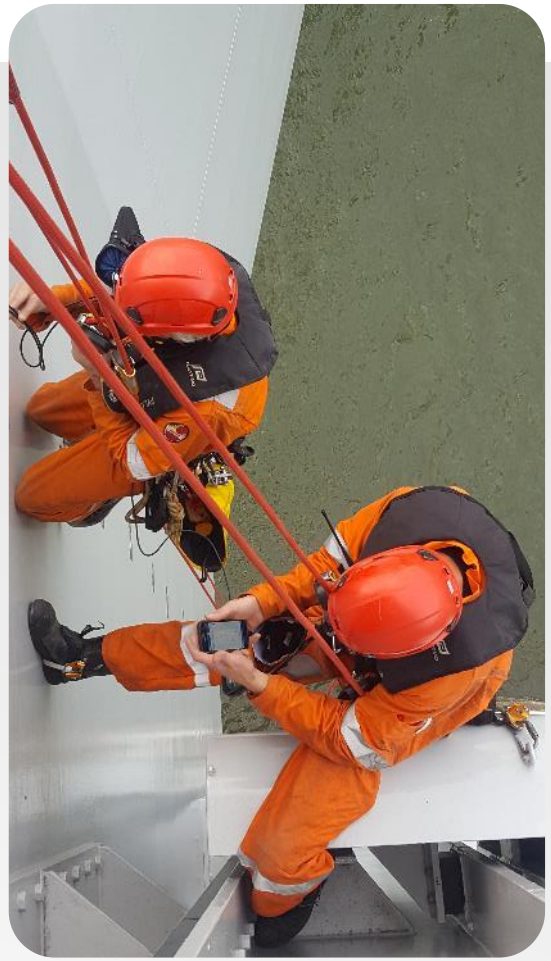
Measurement	Timing of maintenance	Consequences for overcoats
• No corrosion under the coating • Low permeability	Too early	Postpone and monitoring
• No corrosion under the coating • High permeability	On time	Optimal
• Corrosion under the coating • High permeability	Too late for overcoat	Lifetime overcoat limited (75% less)

Reconsideration

Strategy	Advice
Cost	No actions, wait till failure (local repair)
Sustainability	Blasting (per section, whole)

Secure tomorrow, today

Let’s assess together how we can get your assets ready for the future



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