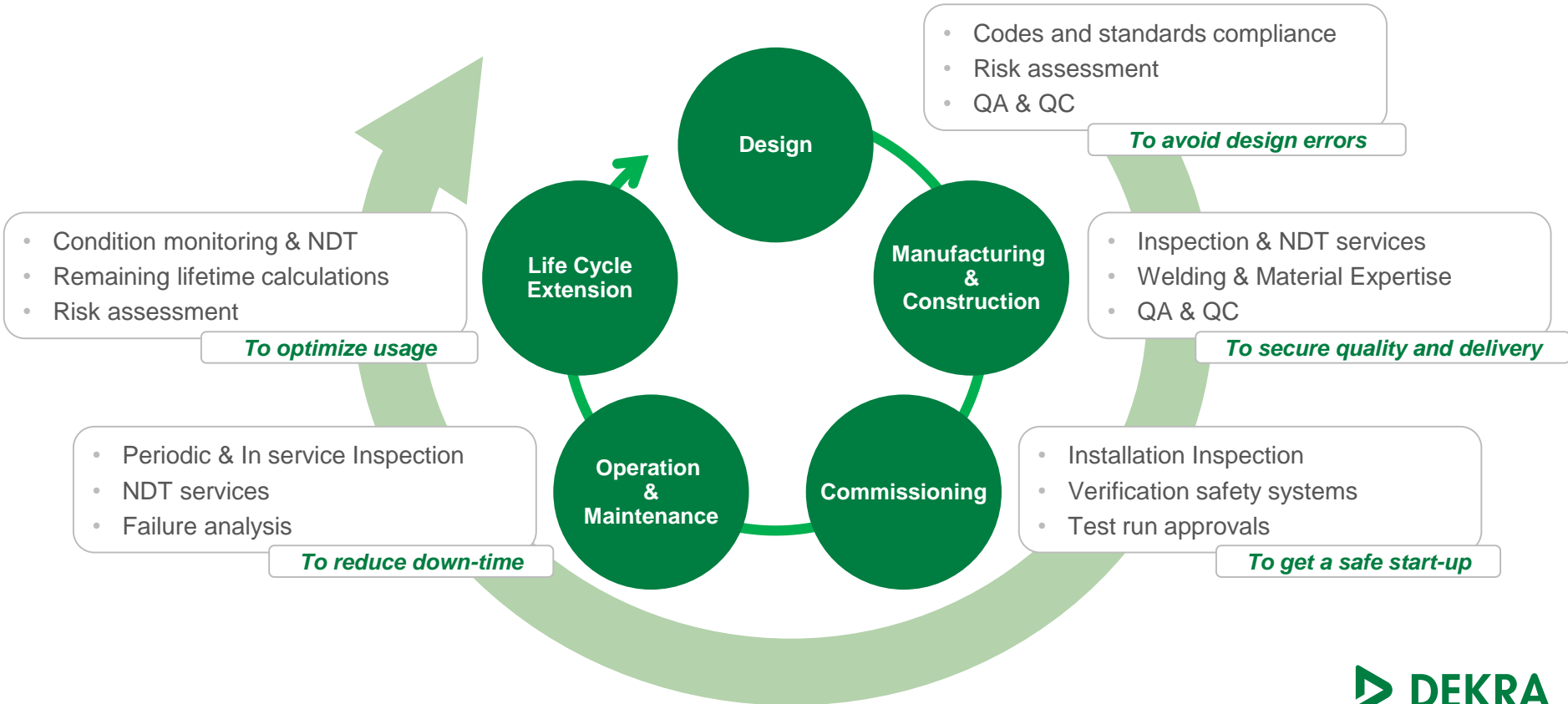




Global partner for a safe world

**Sensors and analytics for
static equipment at
power plants, refineries and chemical plants**
Maarten.Robers@DEKRA.com

Services during full lifetime



The world is evolving

Analogs exist

- Condition Monitoring – Rotating equipment
- Structural Health Monitoring – Infrastructure, Aerospace

Technology advances

- Industrial Internet of Things
- Artificial Intelligence

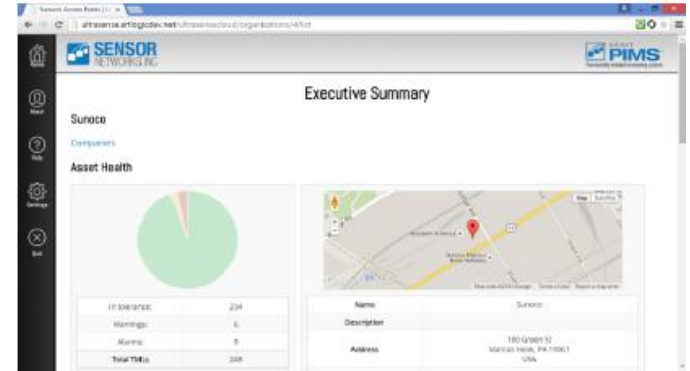
NDT co-operating closer with Engineering and Maintenance

- Reliability Centered Maintenance
- Risk Based Inspection
- Predictive Maintenance

Basic example: Wall Thickness / Corrosion Monitoring

UT sensors can be installed permanently at critical locations.

Dashboards present the resulting data and an interpretation of it.



Permanently installed sensor - Advantages

Safety

- Less staff in the plant, less need to go into hazardous areas

Cost

- Less need for access and preparation

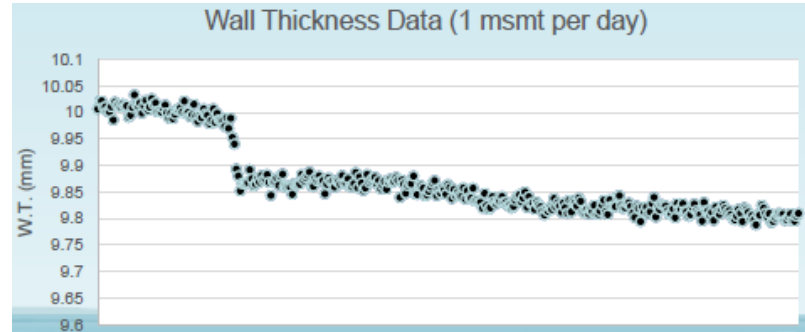
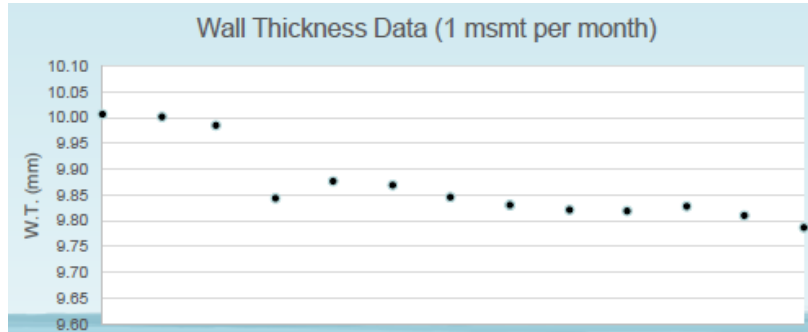
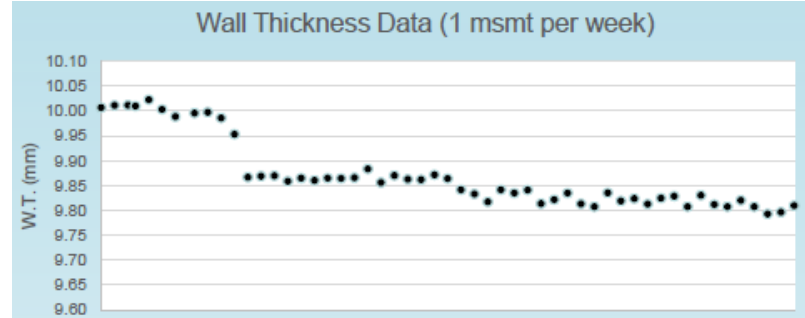
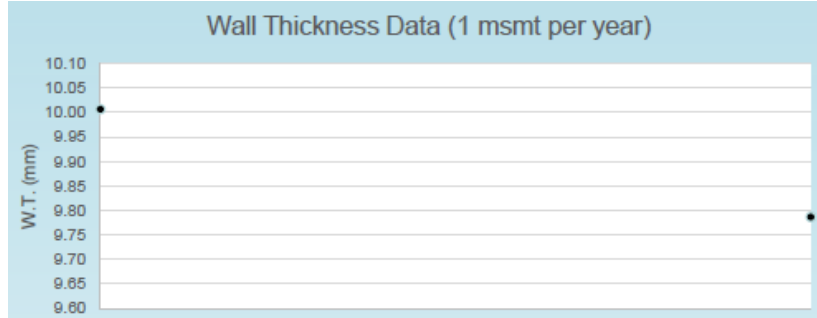
Accuracy

- Highly reproducible readings, better estimation of degradation rate

Responsiveness

- Faster information on crossing threshold
- Correlating to changes in operating conditions

Permanently installed sensor - Accuracy



Permanently installed sensor - Variations

Design of monitoring system is influenced by

Failure mechanism, Object material, Accessibility, Operating conditions etc.

Some examples of sensors

- UT Wall Thickness
- UT Guided Waves for pipe or plate
- Corrosion Probes (ER, ECN)
- Acoustic Emission
- Temperature, humidity (optical fiber)
- Material strain, pressure, flow turbulence
- ...



Analytics

Analysis applying statistical and artificial intelligence models

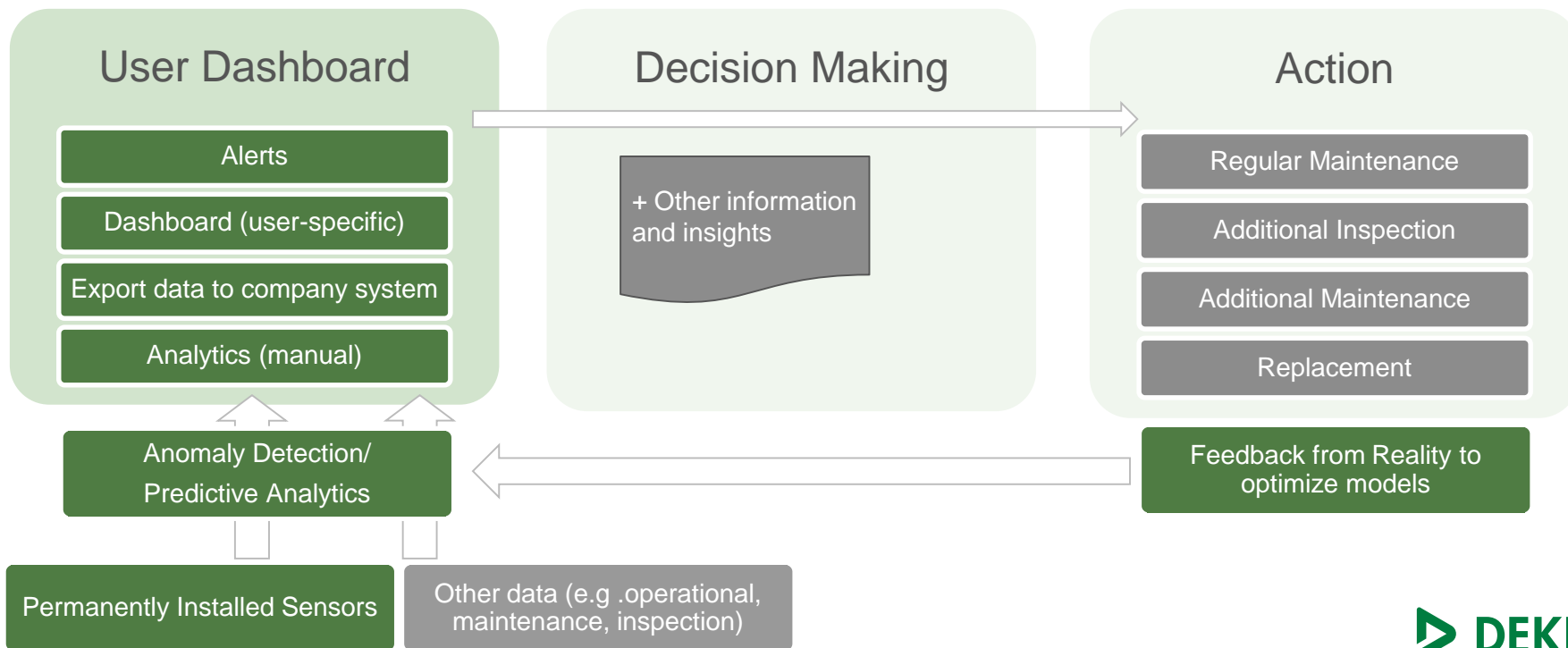
When

- Support fact-based decision making
- Large quantities of data (increasing over the years)
- Integration of multiple data sources (e.g. environmental)

What

- Drilling down through measurements
- Detect anomalies
- Estimate non-measured quantity
- Predict degradation

Analytics



Integrating it into your organization

Start small

Leverage your existing plans

Asset Management Plan / RCM / RBI

Build co-operation

IT, inspection, corrosion management, maintenance, operations, external

Capture tacit knowledge, transfer knowledge

Aligned goals:

- Improved safety, Managed uptime, Extended lifetime, Reduced overall cost



Example: Alkylation Unit Monitoring

Objective

- Monitor corrosion until outage
- Reduce cost and safety impact
- Correlate corrosion to IOW



Offering

- Monitoring low spots and pitting with connected UT probes
- While getting more accurate and timely data



Source: Sensor Networks

Example: Skin Temperature Monitoring

Objective

- Hot spot detection and location

Offering

- Grid of fiber optic cable
- Temperatures up to 650°C
- Cover large area



Source: Inventec

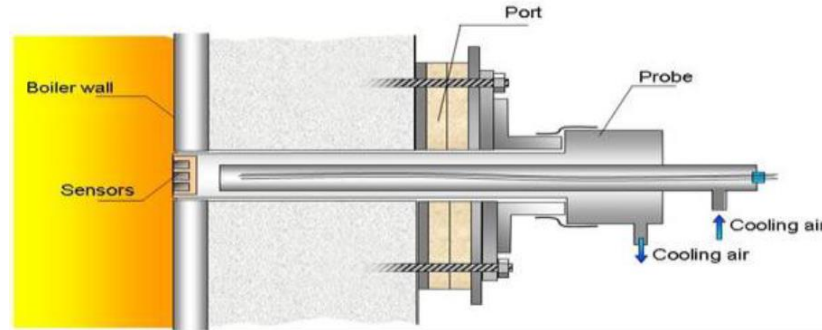
Example: Boiler Corrosion Monitoring

Objective

- Maintenance planning
- Fuel mix optimization
- Future scenario evaluation

Offering

- Electro-Chemical Noise probes
- Correlated with process (e.g. S/Cl)
- Can be extended with HT UT WTM
- Fast response time (within hour)



Source: DEKRA

Conclusion

Developments in technology offer benefits for monitoring static equipment

- Reduce safety and cost impact of NDT & Inspections
- Gain more insight into degradation and influencing factors (improved uptime and lifetime)

Implementation can start small, and grow large

- Collect data from sensors and other relevant sources
- Integrate into asset management philosophy and workflow process
- Gather feedback, optimize, review & iterate

