



INDORAMA
VENTURES

ALBEMARLE®

ShirEtsu

OCI
NITROGEN



STORK

VINCI
A Fluor Company

sitech
services

3P
QUALITY
SERVICES

BRAND SAFWAY

ooi | Opleidings- en Ontwikkelingsfonds
voor de isolatiebranche

DEKRA

KINT

ION
Nederlands
Instituut voor
Onderzoek en
Opleiding in de
Isolatiebranche

Rijksdienst voor Ondernemend
Nederland

INDUSTRIAL 10,11,12 OKTOBER 2023
BRABANTHALLEN
HEAT+POWER

STATUS OVERVIEW.

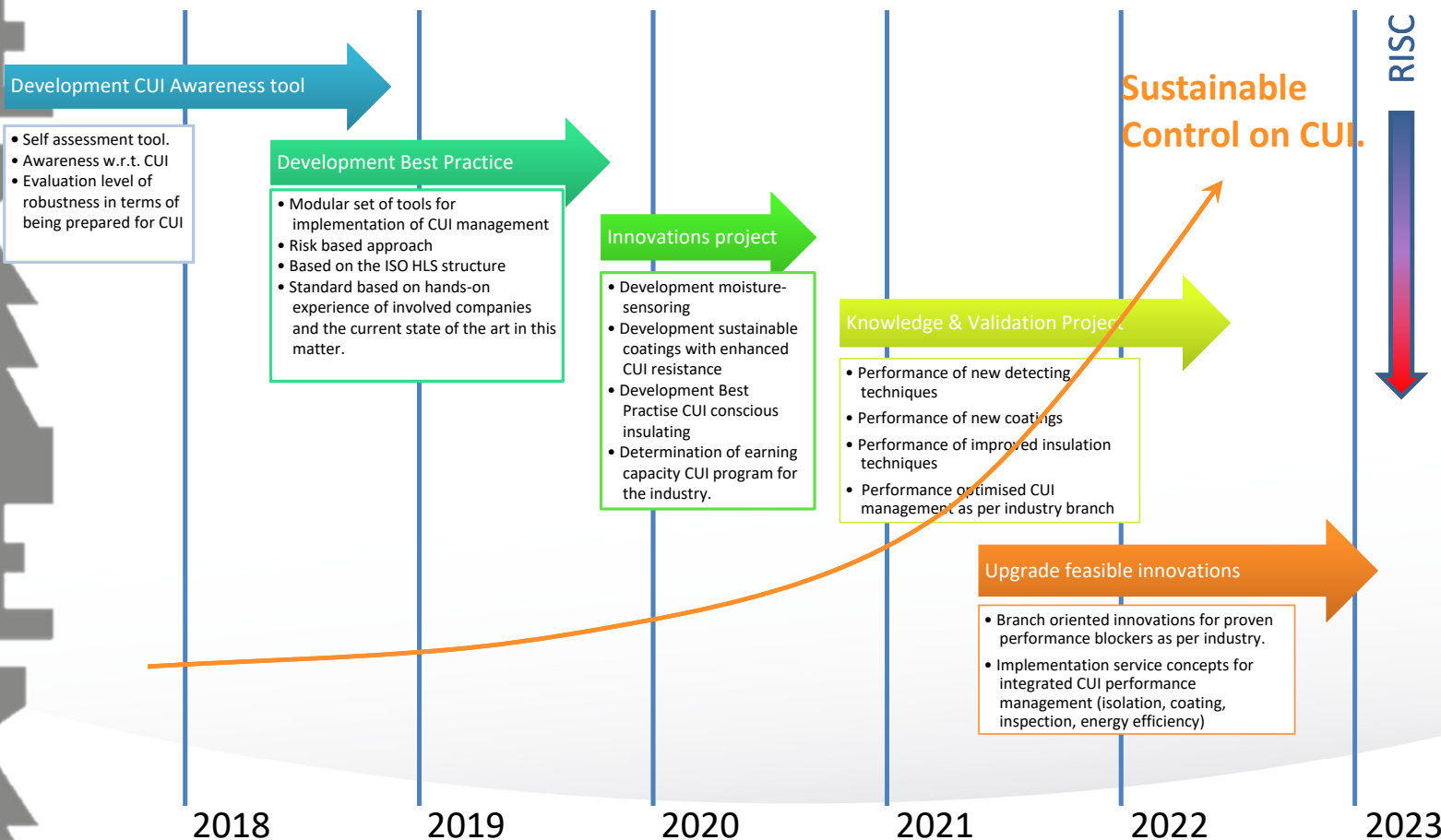
Corrosion
under
Insulation

WORLD CLASS
MAINTENANCE

Questions that were puzzling us from the start...

- How can a CUI management program help an individual company?
- Where is knowledge with respect to CUI management concentrated on behalf of the industry?
- What is the driving force in order to join forces towards the implementation of an independent CUI platform?
- Avoid a trial & error approach by having a best practise
- Within NL & BE; nowhere. So creating a point of concern is helpful.
- Avoid the hard “failure based lesson” which ultimately leads to costly measures and loss of confidence in industry.

We started with these questions by discussing this with a number of interested companies in order to define the common interests.



Call for Action / Business Driver

- Prevention is better than correction.
- Save on failure costs.
- Investing in a cost-effective approach from TCO.
- Recognisability from management structure
- Preventing “trial and error” approach

CUI solution:

- Modular approach based on maintaining what is good, improving what can be improved.
- Using generally proven concepts with regard to predicting corrosion, assessing damage, determining risk, estimating lifespan, controlling costs.
- Transparency through independent approach from WCM; a supplier-independent concept.
- With the involvement of KINT, ION, VNCI, RVO, SDN

Business model:

- Risk-oriented, so investment in those areas where it yields best profits.
- Taking into account the continuation of those concepts which are already doing well.
- Improve together by using each others individual experiences for the better good.

(Potential) partners:

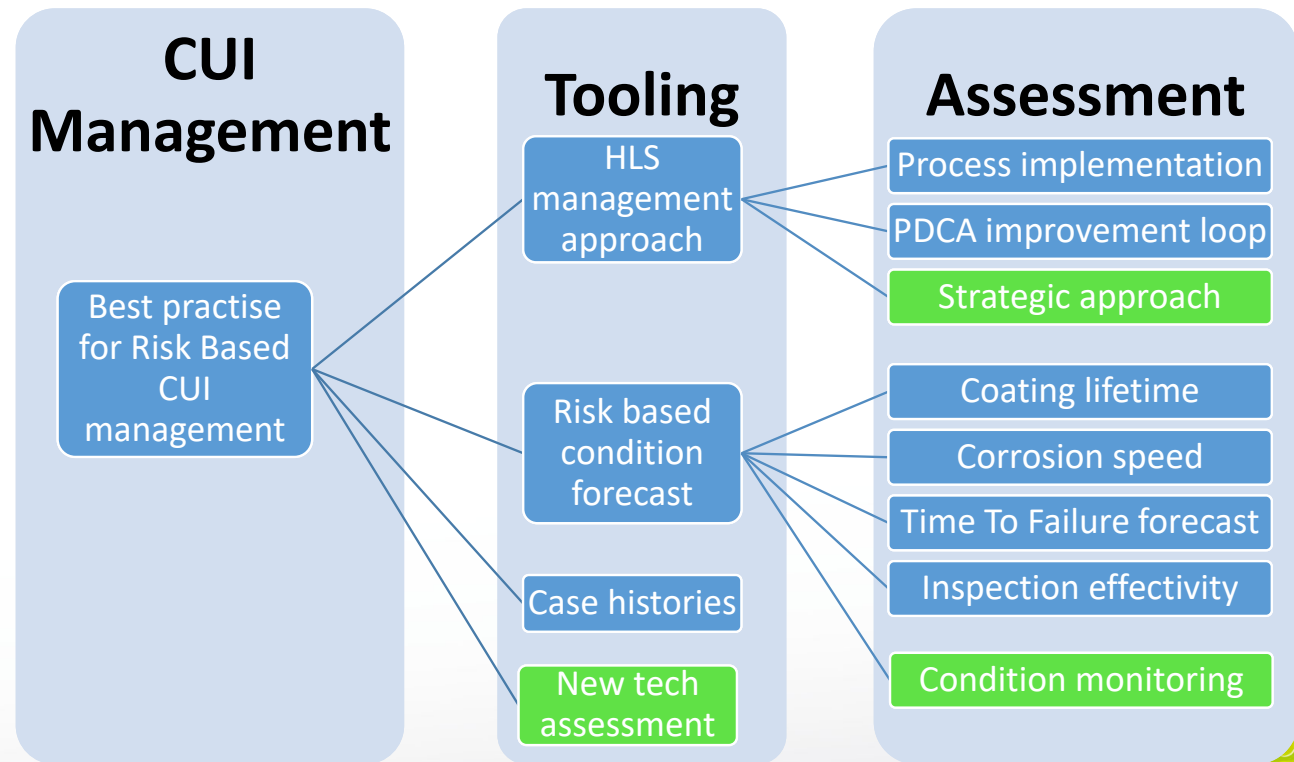
- Asset-owners from “BRZO” sector
- Isolation and coating industry
- Inspection- and service suppliers



Developments within WCM CUI-approach:


Related activities:

- Positioning EFC BP



Rational monitoring

- Application note.
- Instruction.
- Aspect checklist (completeness)
- References.

 **Rational Monitoring as part of CUI management.**

Note: A rational monitoring setup.
Date: 6 April 2023
Author: Geert Henk Wijnants
To: Whom it may concern
Project: Duurzame Grip op Corrosie Onder Isolatie (Sustainable Control on CUI).

This note has been defined in order to give an overview of the key elements of the monitoring concept which has been identified by World Class Maintenance.

In the period 2011-2013 a variety of monitoring concepts have been reviewed which has resulted in revitalized attention for the rational monitoring concept which has been developed in 1998 by a variety of institutions and companies, united in the Delft Cluster program.

This concept discerns two main drives in order to apply a monitoring concept:

- a scientific drive and
- a management drive.

For the **scientific drive** the objective is to learn from the results of measurements in general. In this case the main criterion that applies is that the system should be able to discern the observables that one is interested in.

For the **management drive**, the objective is to control based on the results obtained. This means that specific alert and alarm criteria need to be defined with the related measures in order to ensure that the management concept can be expected to be effective.

The latter approach has been applied successfully onto monitoring processes which were applied during construction phases and can typically also apply to maintenance processes, as the application of monitoring of hydraulic oil for harbor cranes (Bosch Rexroth; "Nijlpaard"; 2011) has shown.

Key features of a rational monitoring concept for management purposes, can be summarized as follows:

- Consider the monitoring approach a process that needs to be functional during a specified period.
- Ensure that acceptance, alert and alarm criteria are defined upfront, so before implementing the monitoring approach.
- Verify that the identified acceptance, alert and alarm criteria (a) can be achieved with the proposed monitoring setup and (b) can be verified by tests during use (calibration) and (c) that the setup can be repaired in case the measurement setup has been compromised.
- Ensure related mitigating measures can be executed in time, meaning that the reaction time between alert/ alarm and the related measure is sufficient to avoid the risk that should be prevented.
- Assesses that risk by means of a standardized approach (EN 16991 / IEC 61508)

The above is a summary of aspects that are considered relevant. A checklist with instruction has been developed which has been identified by the acronym "HERMES", the name of the messenger of the gods, which stands for "**H**ET **R**ationele **M**onitoring **E**valuatie **S**ysteem", meaning "The Rational Monitoring Assessment System".

This checklist and the related set of instructions are included in the next section for application on any monitoring approach that requires a structured rational analysis.

In case of any comments or queries, feel free to send a message to geerthenk.wijnants@stork.com

You are encouraged to share results obtained when applying this approach to your particular case.

Strategic approach

- Generic setup, using ISO HLS.
- Template available for “kick-start”.
- Adapted to company vision.
- Based on PDCA improvement.
- Aligns with compliance req.'s.

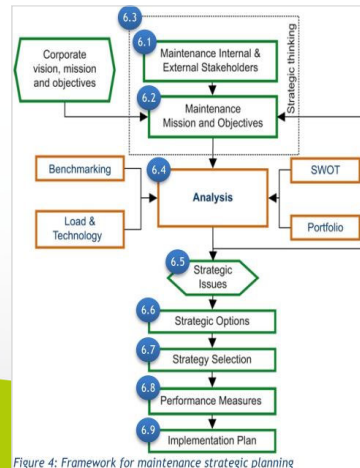


Figure 4: Framework for maintenance strategic planning

Company	Date of introduction: ##-MMM-2023
Strategy for Risk Based CUI management	Date: 27-Mar-23 Concept: World Cl

1 Scope - Introduction

This strategic document defines the processes, related measures, plans and planning that are required in order to manage the risk related to corrosion under insulation effectively. This document applies to those industrial installations which have been identified as being critical from risk perspective, as assessed by Company's business values as identified by the applicable risk assessment methodology.

The framework for this document has been developed by the World Class Maintenance organization in order to provide interested companies with a conceptual approach that comprises the key elements that are required in order to ensure a consistent, traceable and sustainable approach. The purpose of this approach is to describe the framework that is used for a strategic maintenance plan that links the maintenance function with the corporate strategy and integrates it with other functional areas. Within this framework, a systematic process for maintenance strategic planning is described and key success factors that need special attention are identified.

Design/methodology/approach - An analytical methodology is adopted in order to base the framework on a systematic approach.

Generics - Involvement of major stakeholders as well as top management commitment is essential for the successful development of any maintenance strategic plan. The strategic plan in maintenance differs from other areas because of its intangible benefits to the organization and special type of stakeholders. Therefore the related handling of senior management and other partners within the organization is highlighted in this framework.

Practical implications - Senior maintenance managers and strategy developers are expected to benefit from this framework when developing their related plans. The systematics when developing a plan are therefore highlighted in this strategic document.

Originality/value - This approach is mainly based on the results of an excellent extensive survey on maintenance approaches as described in ref. (1) in which the key elements of a strategic planning are put together in an integrated framework. This baseline has been adapted by means of an expert review by WCM partners, which has resulted in the approach which has been adopted by Company.

2 References - Relevant documents

The next documents have appeared to be very useful and have as such been used successively in order to develop this strategic document:

- (1) A framework for strategic planning in maintenance; Umar Al-Turki (2011); Journal of Quality in Maintenance Engineering, Vol. 17 Iss: 2 pp. 150 - 162.
- (2) Harmonized structure for MSS (Management System Standard) with guidance for use. ISO Annex SL Appendix 2 (2021).
- (3) Best Practise for Risk-Based CUI Management; World Class Maintenance. Feb. 2022.
- (4) EFC 55, Corrosion Under Insulation (CUI) guidelines; 3rd rev. Aug. 2020.
- (5) NACE SP0198, Control of Corrosion Under Thermal Insulation and Fireproofing Materials – A Systems Approach.

3 Terms and Definitions

Management system: a set of interrelated or interacting elements of an organization (3.1) to establish policies (3.5) and objectives (3.6), as well as processes (3.8) to achieve those objectives

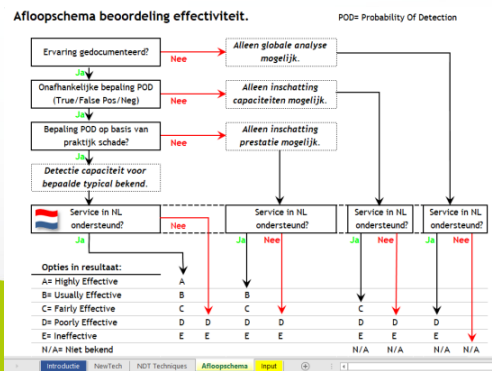
Note 1 to entry: A management system can address a single discipline or several disciplines. responsibilities, planning and operation.

Strategic planning: Strategic planning is by definition a vision based long term plan that can be done at the functional, business or corporate level. In general, regardless of the type and purpose of planning, strategic planning includes the determination of actions or tasks as well as resources needed for their implementation.

Tactical planning: Long term and short term tactical planning is concerned with selecting ways within a preset strategy for achieving long, medium and short term goals and targets. Tactical planning is on a secondary level with respect to strategic planning.

New tech assessment.

- Overviews various innovations.
- Preselected matured tech.
- Based on proof from practise.
- Based on expert reviews.
- Effectivity using API 581 eff.score.
- Guidance by decision scheme



Corrosie
onder
Isolatie

10,11,12 OKTOBER 2023
BRABANTHALLEN
POWER

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RAPPORT

Effectieve innovatieve technieken voor COI beheer.

Opsteller: Deelnemers regiegroep "Duurzame Grip Op COI"
Aan: Asset owners
Belanghebbenden

CONCEPT.

Contact persoon: Geert Henk Wijnants
E-mail: geerthek.wijnants@stork.com
Uw referentie: COI beheer.
Onze referentie: WerkgroepNewTech/2023/R1
Datum: Sept. 6, 2023
Onderwerp: Effectiviteit nieuwe technologie voor COI beheer.

Expert groep: Maarten Robers (Dekra), Henri van der Ploeg (Delamine), Michel Huibregtse (Shell), Peter Janssen (Sitech), Geert Henk Wijnants (STORK; Secretaris), Ikesh Patel (Shell).

1 Inleiding.

Dit rapport is een initiatief van de expertgroep beoordeling nieuwe technologie ten behoeve van duurzame grip op COI. Deze groep is ontstaan in vervolg op de ontwikkeling van de "best practise voor Risk-Based CUI management" die een belangrijke rol vervult in het verbeteren van de veiligheid van industriële installaties (Ref. 1). Deze best practise is in 2020 ontwikkeld op basis van ervaringen met bestaande technieken en bewezen effectieve toepassingen voor de inspectie van en (3) beoordeling van de conditie van bedrijfsapparatuur (beoordeling van de aanwezigheid van schade). De eerste twee toepassingen worden [screening technieken] genoemd. Dat betreft technieken om te bepalen of er ongunstige omstandigheden aanwezig zijn die tot een probleem kunnen leiden. De derde toepassing betreft technieken om, als er een afwijking is aangetroffen, de ernst van die afwijking te kunnen beoordelen. Dit betreft [technieken voor conditie beoordeling].

Om de aansluiting te blijven vinden met recente ontwikkelingen qua technieken, is het nuttig om de in een bredere groep aanwezige ervaring te bundelen. Daartoe is de expertgroep opgezet, die voortgekomen is uit de regiegroep "Duurzame grip op COI".

2 Uitgangspunten (TOR).

De werkgroep heeft de volgende uitgangspunten genomen:

- Toekennen effectiviteitsklasse:** De beoordeling van de technieken dient uiteindelijk te leiden tot het aan kunnen vullen van het ontwikkelde spreadsheet wat de geschiktheid van een techniek afbeeldt op een bepaald probleem aan te kunnen pakken. Er dient uiteindelijk dus een relatie te ontstaan tussen techniek, technisch probleem (soort constructie, soort constructie, diameter) en de effectiviteitsklasse (A t/m E conform API 581).
- Bewijs van prestatie:** Bepalend voor de beoordeling is of er geloofwaardige referenties aanwezig zijn waar gebruik van kan worden gemaakt. Dat betreft dan hetzij referenties van één of meerdere experts of referenties zoals uit andere onafhankelijke bronnen is verkregen.
- Ontwikkelde methode:** De toegepaste techniek voldoende ontwikkeld te zijn dat zeker gesteld is dat bij herhaalde toepassing er een reproduceerbaar resultaat uit komt. Dat veronderstelt een ontwikkelde techniek en ook een ontwikkeld eenduidig proces bij de toepassing.
- Traceerbare beoordeling:** De uiteindelijke beoordeling dient dusdanig onderbouwd te zijn, dat dit bij herbeoordeling na enige tijd nog te volgen, te herleiden en daardoor na verloop van tijd ook is











WORLD CLASS
MAINTENANCE

Status of affairs:



Development English version for the Best Practise

- Best Practise handbook Finalized
- Tool prioritization Finalized
 - Tool risk assessment Finalized
 - Tool corrosion model Finalized
- Gap-analysis tool Finalized
- Inspection- selection tool Finalized
- Presentation for rollout approach on a site Finalized
- Life Cycle Costing tool Finalized
- Strategy for CUI management Finalized
- CUI Condition monitoring reference model Finalized

-  ISO_High_Level_Structure_CUI(EN).pdf
-  ToolBP_CuiManagementPrioritization(EN).xlsx
-  ToolBP_CuiManagement(EN)(Jan22).xlsx
-  BPSectionCorrosionModel.xlsx
-  GAP_Analysis_TOR_BP_CUIManagement(EN).xlsx
-  Tool Suitable NDT techniques(EN).xlsx
-  WCM RB CUI Management(20Nov19)(EN).pptx
-  Lifecycle costing CUI management(V2.4)(EN).xlsx
-  DeStrategischeAanpakVoorEffectiefCOI_Management.pdf
-  WorldClassMaintenance BestPractiseCUI_MonitoringStrategie(NL).pdf

Tooling made available through WCM website

via WCM Vector; <https://www.wcmvector.com/>

Development Eco-system

- Separate website (EN) with gap-analysis developed Finalized. <https://www.wcm-cuiassessment.com>
- Q&A / ask the expert still to develop. Being developed
- Development expert-group for new technologies Active; ongoing

CUI-projects

- Cooperation with KicMPI on behalf of validation process for CUI-protection-lifetime Ongoing
- Best practise isolation condition assessment – commissioning & as-used. Finalized
- – incl. EED (Energy Efficiency Directive) assessment. Finalized

Q2 2023
Q2 2023

Status with respect to the application of tooling:

GAP-Analysis tooling: 4 companies; 5 audits; all “Chemicals”.

Benchmark score: 4+; exception Leadership and planning. => First profits to be obtained.

Level 1 assessment: Tooling



Level 2 assessment: HLS Conformity



Background

Best Practice available since the end of 2019.

- Set-up in accordance with ISO HLS structure.
- Audit points included in the design.
- Assessment along two lines:
 - Management line (HLS)
 - Contents line (Critical elements)
- ➔ Probability of failure; average / max. / min.
- Consequences from std. risk model EN16991.
 - ➔ Risk assessment and earning capacity.



The development and some results.

- Choice for limited detail:
“Stoplight” : Good/Average/Bad.
It’s about the insight, not about discussing whether it’s a 4 or a 7.
- Large differences in one company depending on role/position
- Characteristic: “no policy implemented”
- Communication is essential.



The screenshot shows an Excel spreadsheet with the following content:

	A	B
1		1: Gap analysis against the BP Risk Base
2	Assessment framework:	Risk assessment as incorporated
3		During the assessment, it is verified to
4		Management framework: (focused on
5		Has a structure with ownership
6		Has a systematic approach with
7		Contains a budget structure bas
8		Evaluates deviations where the
9		Risk assessment:
10		Quantitative risk assessment wi
11		Risk assessment includes legal pe
12		Determining the risk based on th
13		Corrosion speed:
14		Distinction between steel / stain
15		Based on temperature:
16		Based on number of temperature
17		Dependence on type of environm
18		Dependence on type of insulatio
19		Depending on condition (state)
20		Service life of coating:
21		Distinguish coating / TSA:
22		Judged based on proven experie
23		Input generation of the coating:
24		Input of preservability from des
25		Contribution of work process an
26		Method of management of the in
27		NDT Effectiveness:
28		Input type of the research obje
29		Uses an overview of the effectiv
30		Process requires level of covera
31		Processes required level of risk
32		Distinction screening & conditio
33		Distinction according to diamet
34		Distinction according to wall thi
35		NDT Efficiency:
36		Uses consideration of the most
37		Knows options blasting / paintin
38		
39		Findings: (generally observed aspects
40		
41		
42		
43		
44		

At the bottom of the spreadsheet, there are two tabs: "Explanation" and "Gap-analysis".

Next steps in development.

Based on the overview obtained from the internet application.

With that:

- Benchmark as steering tool to optimize from overall perspective.
- Create awareness to tackle the largest management gaps.
- Being able to follow one's own development (trend!) to monitor the effectiveness of the path followed.

Application of the tooling developed:

Application often takes place on a modular basis as originally intended:

1. Use whatever complements the existing approach
 - a) Application condition classification (Huntsman)
 - b) Overall Application (Delamine)
 - c) Fitting parts as a supplement (Shell Catalysts -BE)
2. Applying takes time and is not yet a priori time (among other tasks)
3. From international framework pos. response to open concept (Kaefer)
4. Introduced as best practice for the EFC55 update.

Status wrt the expert group New Technologies:

Currently 5 experts from div. background involved; NDT; Asset owner(2); Corrosion; Asset management
List with new technologies prepared. Pre selection TRL_BRL / Classification / Review / Final.

New CUI screening detection technology.



SELECTIE:	Technologie:	Leverancier:	Meet methode:	Data beschikbaar:	Website:	Atlas profiel:	Proeftijdsduur:	Screening / Detectie Evaluatie:	True positiviteit:	False positiviteit:	False negativiteit:	Toepassingsgebied:	Order- of opzetlocatie:	Data verwerking:	Eigen gebruik / data in a sensor (Type):	Handmatig / automatisch:	Gevoeligheid:	Cost/Time ratio:	Risico (Indicatie):	Conclusie:	Klas	
J	Signal abnormality & corrosion-dread	CorrosionKader	Fiber wire Electromagnetic waves through wire Aandringen draad onder de isolatie.	MW/Cellular/Wireless Infrasound/RTU/RTU	https://www.corrosionkader.nl	A; Zone 1 (E 3 GD cert.)	NB	Screening met reflectie van radar reflectie in combinatie met corrosie van de...	NB	NB	NB											
J	Optische draad die per sensor verschil gas uitstating meet.	Fluvis	Optical fibre moisture measurement Aandringen draad OP de isolatie		www.fluvis.nl	?	maximaal 10 minuten maximale draad lengte 100m maximale draad diameter 100µm	Screening middels vergelijking en KI.	NB	NB	NB									Suggestie: klasse E; nogal gevoelig te zijn voor div. Imbedded factors.		
J	Combinatie meting vochtgehalte (RH) en voedseltemperatuur (DPA), Fluks 316 sensor.	Transter	4G/5G netwerk Batterij gevoed met draad isolatie na portafable in de		https://www.transter.nl	A; Zone B	TRL 7 qualifikaie test door Equator verkregen.	Screening	NB	NB	NB										Patent in klasse B; betreft zowel de techniek (sensor) als de combinatie de data op false data voork beperkt.	
	3-Sci Bertec Berixus C-Cube Clarech Cor Instruments LLC CORASCO COSAATOR Eduyl E-Galvanje Easme Easus Emcept HDD Obvious Indusent Imagely Diagnostics Gentpro IFC Insect Korber 84 Metal Samples Company Oceaneering/Arcon Oceaneering/Spent Haver Ltd Percepsens (Emerson) Percepsens PERCO CORROTEX Reosens Rubinack Covesso Seergetekis Sensuron Sensurion LLC Structural Monitoring Systems PK Sudraa PI NDT Wardgan WI Cor proximity Wiseas 3Dpacer Yokosawa	Water accumulation sensor DR LPR Fiber wire Fiber wire PEC Guided wave/UT Thermocouple Water accumulation sensor Air humidity sensor Capacitive moisture measurement X-Ray backscatter Hexcon X-ray Focused Stress Concentration Percolation sensor Pop-out fiber wire Optical fibre moisture measurement EMAT Guided wave Sub-Terrestrial sensing technology Radio wave antennas; Air humidity sensor Array of low cost magnetic sensors																				

Rating based upon:

- ✓ True positives
- ✓ False positives
- ✓ False negatives

➔ Add-on to BP RB CUI management.

The framework for the developments:

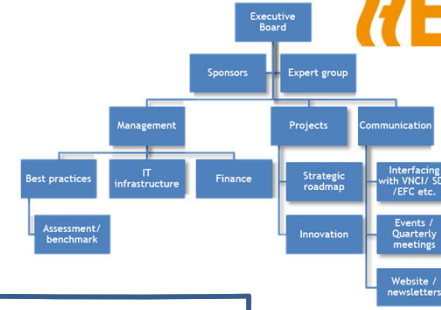
Development along 5 main parts. These are:

1. Design and organization of the COI ecosystem
2. Development and management of the digital COI platform (website)
3. Internationalization of the COI platform
4. Encouraging the use of the developed tooling; optimization
5. Further development of existing and start-up of new practices

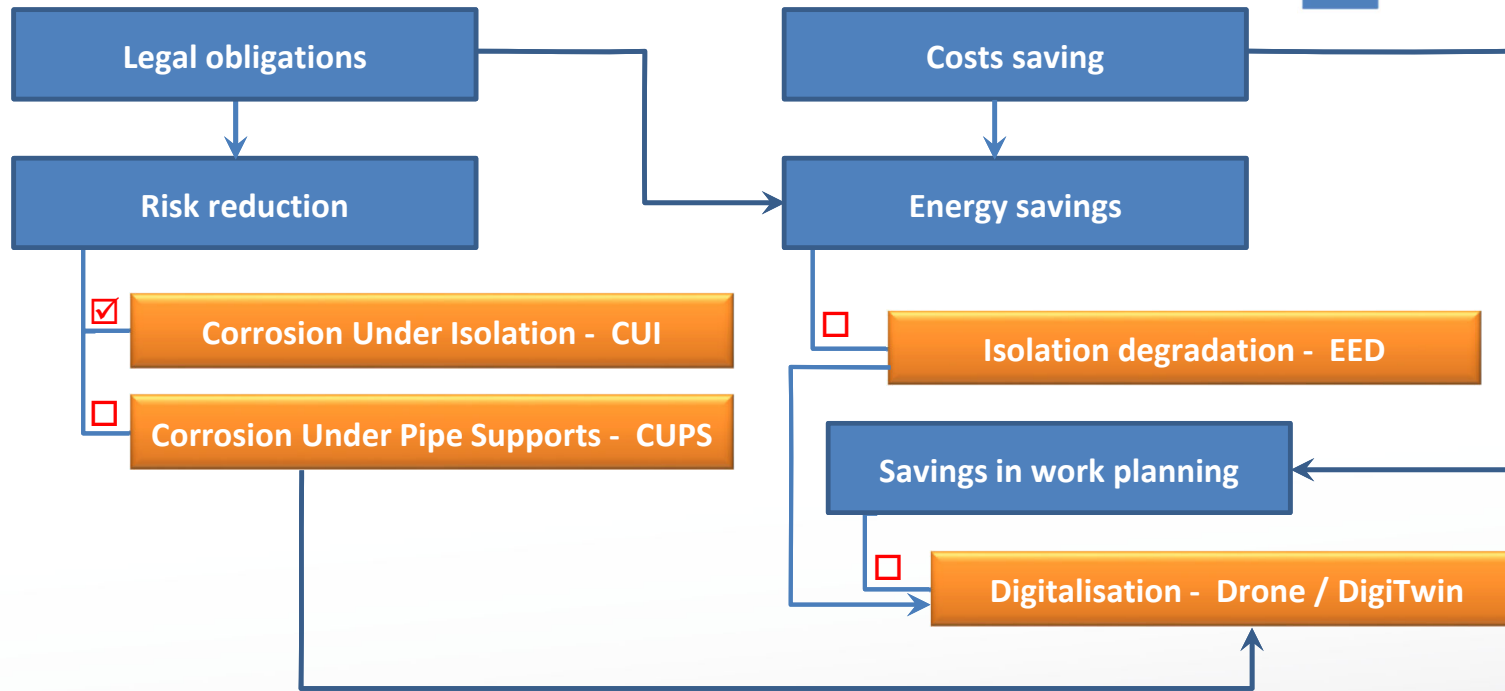
Plan for 2024+:

6. Incorporation of CUPS in the risk based CUI best practise
7. Integration of Energy Efficiency measures (EED) with CUI management
8. Validation as per proven practise of new monitoring techniques

Organization chart



The developments visualised



PEIBI
Platform for
B (dutch) **Effective**
Insulation Management in the
Industry

Figure 1: Connections between obligations, wishes, costs and benefits

The tools; as a reminder:

General access: <https://www.wcmvector.com/>
Demo Beta tool: <https://demo.wcm-cuiassessment.com/>
Live tool: <https://wcm-cuiassessment.com> (4 S's).



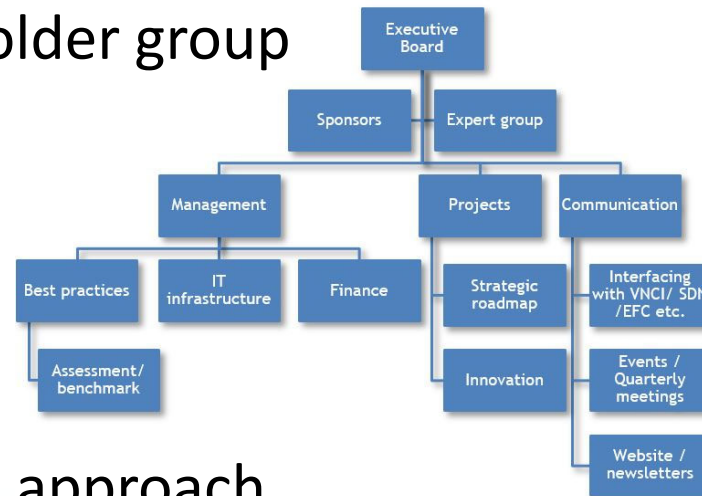
Beta tool, new role: Available for training purposes.

Questions?



Foreseen developments WCM CUI ecosystem 2024+:

- Develop dedicated stakeholder group
 - PEIBI – initiative
- Create organization
- Maintain products
- Support innovation
- Support standardization in approach
 - Facilitate asset service concepts
- CUI support center (tools, knowledge; NDT, coating)



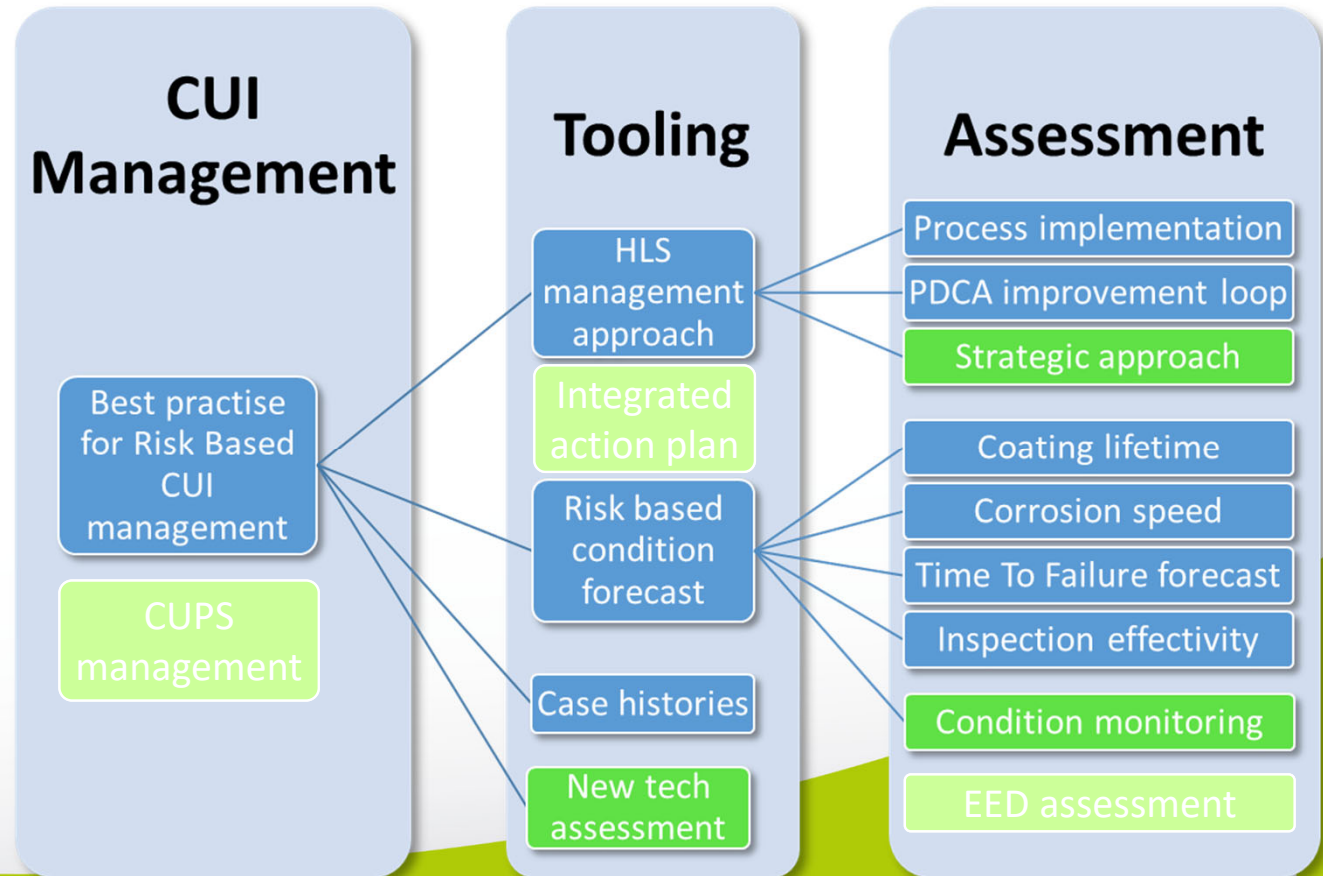
Foreseen developments WCM CUI ecosystem:

On 2024's menu:

- CUPS management
- Energy Efficiency Scan
- Integrated action plan
- New tech effectivity scan
- Standardized approach

Certified approach?

Easy-EED reporting (xml)?



Issues of interest:

- Administrative reporting load ↑
- Lack of personnel & variability of services
- Transparency in compliance
- Ensure future proof approach
 - Build upon solid concepts



Manual e-booth Information obligation energy saving.

Versie 2.1
September 2023

In opdracht van het ministerie van Economische Zaken en Klimaat

*>> Duurzaam, Agrarisch, Innovatief
en Internationaal Ondernemen*