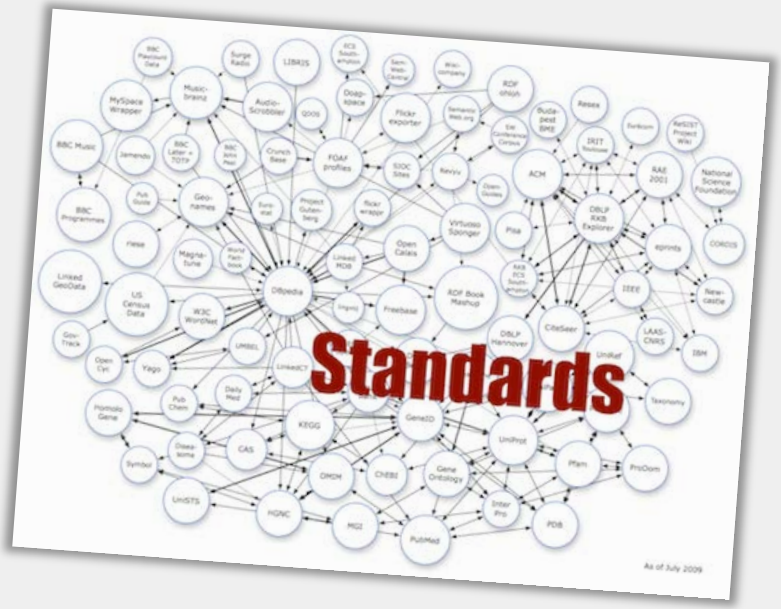
Gør tanke til handling
VIA University College

Current and Future Standards for MIC Management

Dr. Torben Lund Skovhus
VIA University College, Denmark

Industry Workshop on MIC
Calgary, November 1st 2017



Agenda

- Why standards?
- Current standards on MIC
  - Some challenges…
- Future standards on MIC
  - Our current plan…
- Opening up for comments, suggestions and discussion

Why standards?

Standards are published documents that establish specifications and procedures designed to ensure the reliability of the materials, products, methods, and/or services people use every day. Standards address a range of issues, including but not limited to various protocols that help ensure product functionality and compatibility, facilitate interoperability and support consumer safety and public health.

IEEE
Advancing Technology for Humanity

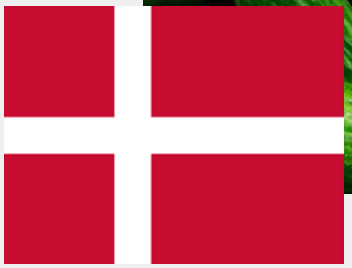
Why standards?

Standards are published documents that establish specifications and procedures designed to ensure the reliability of the materials, products, methods, and/or services people use every day. Standards address a range of issues, including but not limited to various protocols that help ensure product functionality and compatibility, facilitate interoperability and support consumer safety and public health.

IEEE
Advancing Technology for Humanity

Why standards?

– Pros and cons

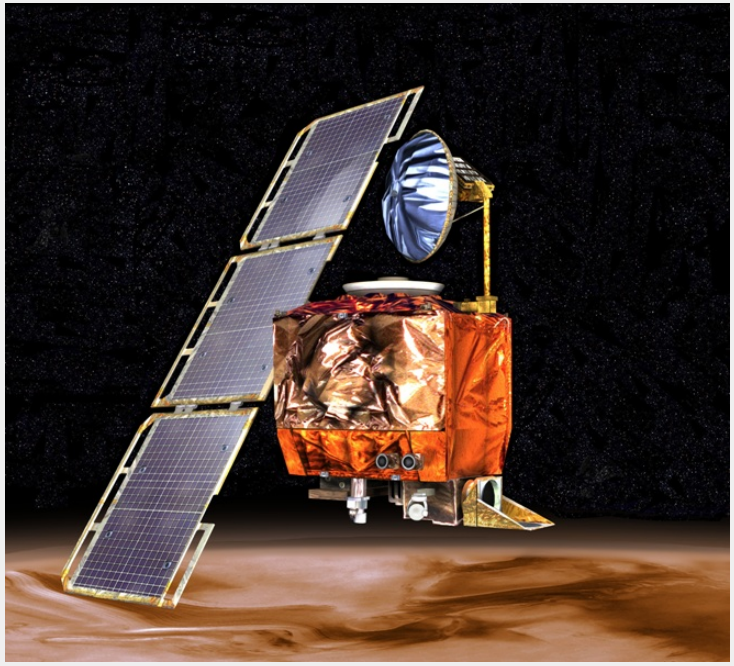


Why standards?

– Pros and cons

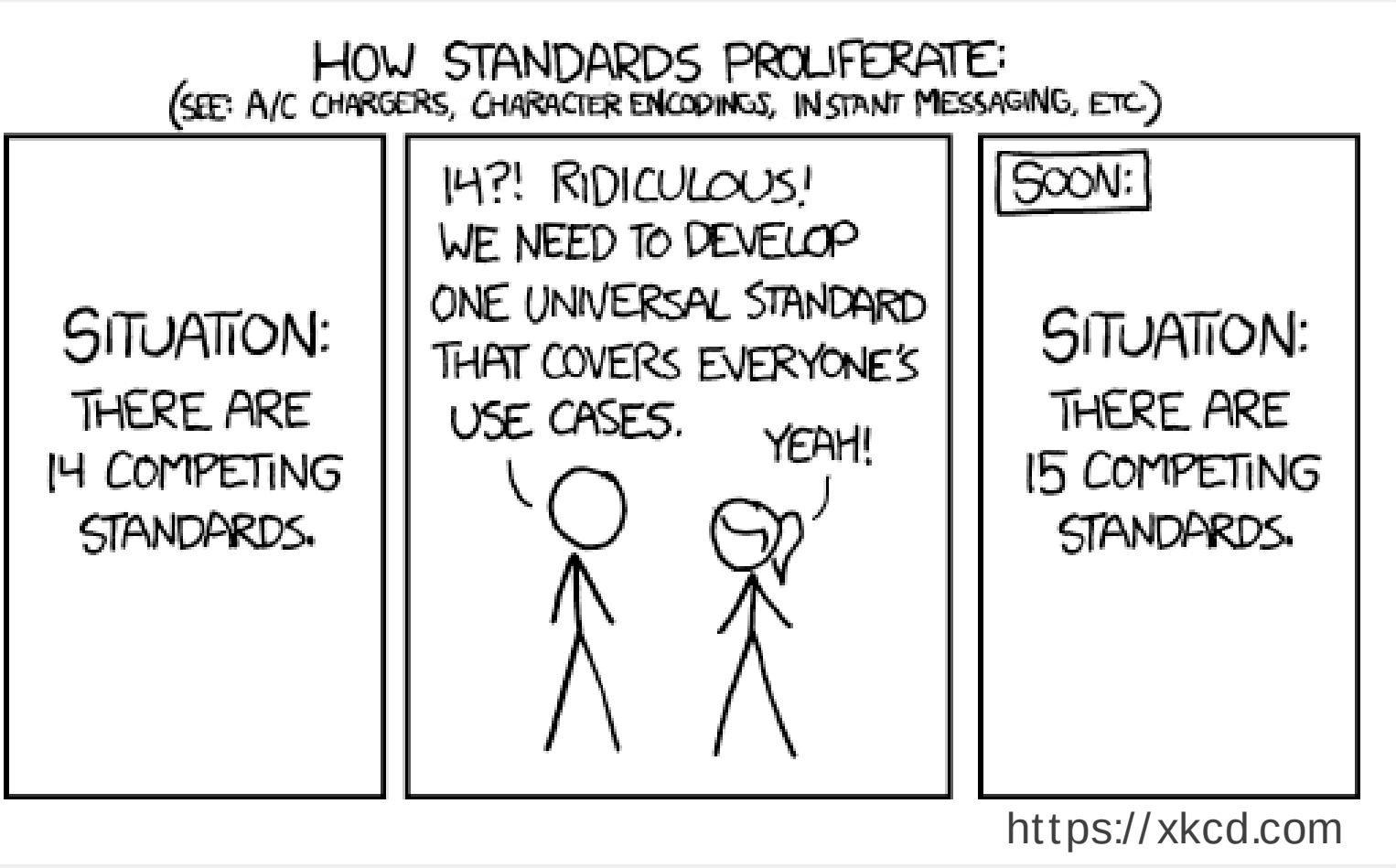
Why standards?

Nov. 10, 1999: Metric Math Mistake Muffed Mars Meteorology Mission



1999: A disaster investigation board reports that NASA's Mars Climate Orbiter burned up in the Martian atmosphere because engineers failed to convert units from English to metric.

Where we don't want to end up…



https://xkcd.com

Why standards?

Activity 1

Knowledge
(for action!)

- MIC Genes
- Indicators
- Rates
- SOPs

Activity 2

Devices/ Assays

Activity 3

Models

Activity 4

GE^{3}LS

NACE THE WORLDWIDE CORROSION AUTHORITY

ASTM INTERNATIONAL Standards Worldwide

ISO

MIC into Standards & Corrosion Management Frameworks

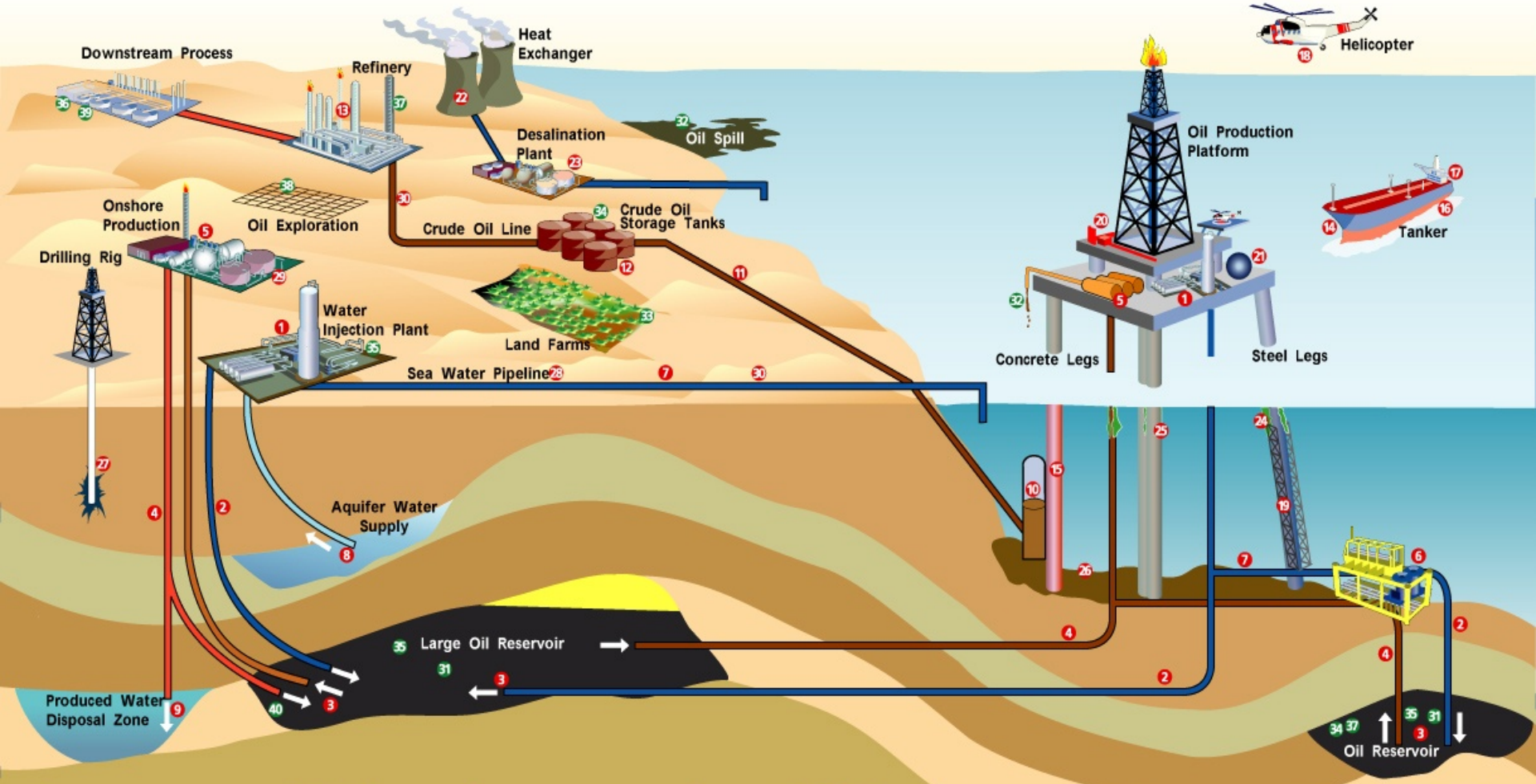
Interactions/input/feedback
between Researchers & End-users

Negative

1- Water Injection System fouling/MIC
2- Down-hole MIC (mesophiles)
3- Reservoir souring & plugging
4- Down-hole MIC (thermophiles)
5- Production system MIC, H_2S, Oil in Water
6- Sub-sea manifold MIC
7- Water flowline internal MIC & fouling
8- Aquifer supply-plugging; ESP MIC
9- Produced water injection well plugging
10- Crude oil storage H_2S, H_2SO_4
11- Oil pipline internal MIC & fouling
12- Onshore crude oil tank MIC
13- Refinery MIC
14- Crude oil cargo tank MIC
15- Diesel tank contamination/spoilage
16- Ship fuel fouling, spoilage & MIC
17- Lubricating & Hydraulic oil contamination
18- Helicopter/aircraft fuel contamination
19- Water filled steel legs & hydrotest MIC
20- Firewater system MIC & fouling
21- Potable water MIC & pathogens
22- Heat exchanger MIC & fouling
23- Desalination/RO plant fouling & MIC
24- Marine growth - steel MIC
25- Marine growth - concrete spalling
26- Discarded drill mud - MIC/environmental
27- Drilling/workover fluids contamination
28- NORM concentration by SRB
29- Production chemicals spoilage
30- Coatings biodeterioration

Positive

31- Microbially Enhanced Oil Recovery
32- Oil spill biodegradation
33- Bioremediation - land farming
34- Biodesulfurization
35- Competitive microbes - control MIC/souring
36- Biosensors
37- Biorefining and upgrading oil
38- Microbial prospecting
39- Bacterial production of novel oilfield chemicals
40- Control by specific pathogens



Impact of Microbes on the Oil Industry

Source: Petroleum Microbiology

Current standards on MIC

TABLE 7.1
Published Standards on Oilfield Corrosion Management and Inspection

Standard/Guidance Document	Source
DNV-RP-F116, Integrity management of submarine pipeline systems (2015)	DNV GL
EFC 64, Recommended Practice for Corrosion Management of Pipelines in Oil & Gas Production and Transportation (2012)	European Federation of Corrosion
DNV-RP-G101, Risk Based Inspection of Offshore Topsides Static Mechanical Equipment (2010)	DNV GL
Guidance for Corrosion Management in Oil and Gas Processing (2008)	Energy Institute
Review of Corrosion Management for Offshore Oil and Gas Processing (2001)	Health and Safety Executive

Skovhus, Enning & Lee (2017)

Current standards on MIC

TABLE 7.2
Published Standards with the Topic of Oilfield Microbiology and MIC

Standard/Guidance Document	Source
TMO194-2014, Standard Test Method Field Monitoring of Bacterial Growth in Oil and Gas Systems (2014)	NACE International
TMO212-2012, Standard Test Method Detection, Testing, and Evaluation of Microbiologically Influenced Corrosion on Internal Surfaces of Pipelines (2012)	NACE International
A Practical Evaluation of 21st Century Microbiological Techniques for the Upstream Oil and Gas Industry (2012)	Energy Institute
SP0499-2007, Standard Practice Corrosion Control and Monitoring in Seawater Injection Systems (2007)	NACE International
TM0106-2006, Detection, Testing, and Evaluation of Microbiologically Influenced Corrosion (MIC) on External Surfaces of Buried Pipelines (2006)	NACE International
Technical Report Publication 31205, Selection, Application, and Evaluation of Biocides in the Oil and Gas Industry (2006)	NACE International

Skovhus, Enning & Lee (2017)

Future standards on MIC

- Just another standard..?
- Where should it live (organization)?
- How do we make it work in the field?
- How does it link to existing standards?
- Influence *existing* channels or building *new* standards?
- Standardization could be on several levels (sampling, handling, transportation, lab-processing, primer selection, data displaying, interpretation in models, etc.).

Future standards on MIC

Working with *existing* guidelines/standards:

Standard	Focus
NACE TMO212 (2012)	Standard Test Method: MIC on internal surfaces of pipelines
DNV RP F116 (2015)	Integrity management of submarine pipeline systems
DNV RP G101 (2010)	Risk Based Inspection (RBI) of offshore topsides static mechanical equipment

Future standards on MIC

Working on *new* guidelines/standards:

Standard	Focus	Approach
AD HOC 44 (NACE)	Title: Molecular Microbiological Methods – Sample Handling and Laboratory Processing Task: Develop a standard test method that may be used to perform DNA-based microbiological analysis of samples collected for corrosion monitoring and control	A request has been send to NACE. Ad Hoc meeting is scheduled at NACE CORROSION 2018 in Phoenix, AZ.

Future standards on MIC

Working on *new* guidelines/standards:

Standard	Focus	Approach
NEW RP XX	Pipeline failure investigation protocol including advanced MIC diagnostics	Our project will develop a new approach for combining classical failure investigation protocols with modern genomics data and MIC diagnostics

Opening up for discussion

- What MIC standards do you follow today?
- Will the approach of introducing updated and new MIC standards benefit to your operation?
- Anything you want to suggest to the onwards process – please let us know?

Contact details

Torben Lund Skovhus, MSc, PhD
Researcher and Project Manager

VIA Building, Energy & Environment
Centre for Applied Research & Development

VIA University College
Chr. M. Østergaards Vej 4
DK-8700 Horsens

T: +45 87 55 42 96
E: tols@via.dk
Twitter: @Torben_Skovhus