

3 October 2019

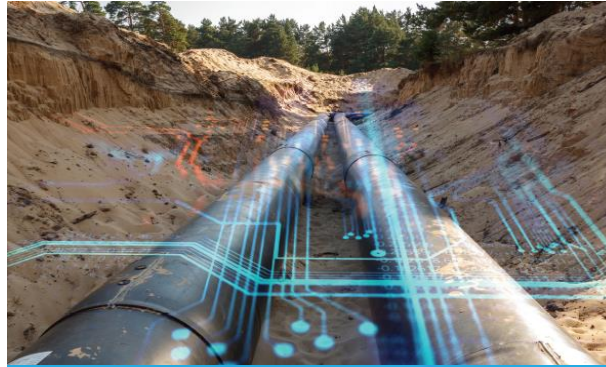
INDPENDENT
RISK
MANAGEMENT



IRM Systems Markets and typical clients



Offshore pipeline and platforms



Onshore pipelines



Onshore piping on plants & terminals



Water pipelines (all materials)

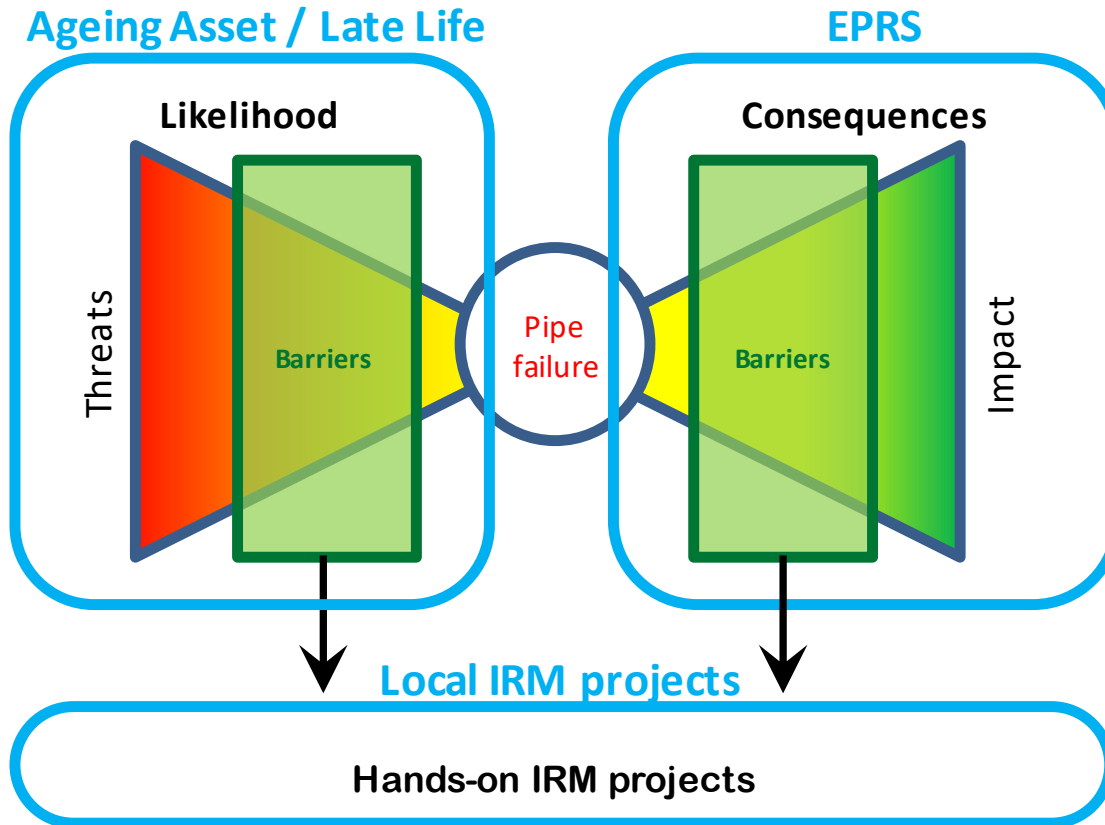


Maasvlakte Olie Terminal



Ministerie van Defensie





Increase Safety.

Knowing more implies less unexpected incidents



Improve Reliability.

Better performance, less disruptions

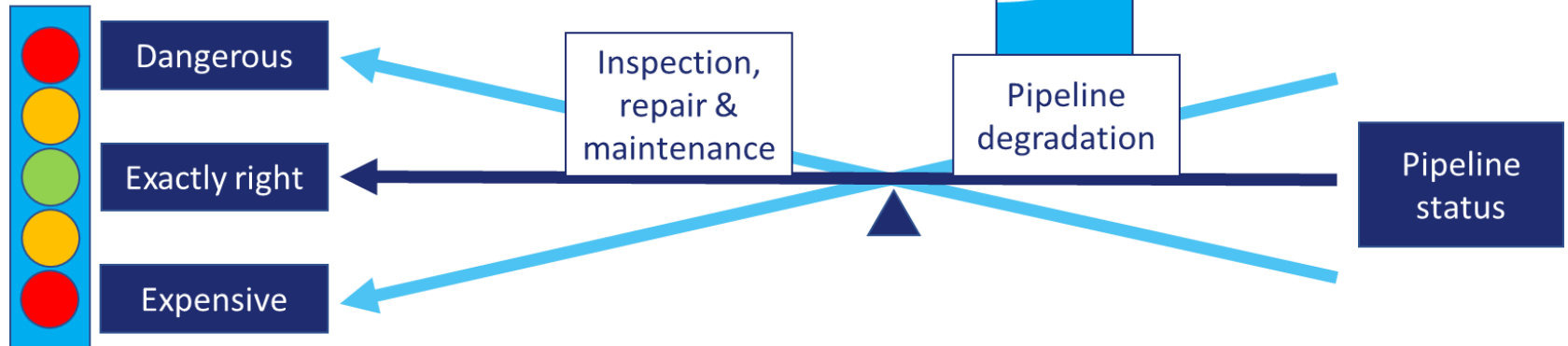


Decrease Costs.

More efficient budget allocation



Pipeline Integrity Management:
Understand where, when and how to
act.





Add value
to suboptimal data
for better pipeline integrity management



Actual **PIM** varies enormously:

- Bare minimum to
- Implementing extensive monitoring, repair and replacements programs plus management controls.

What is **right**? US vs. EU

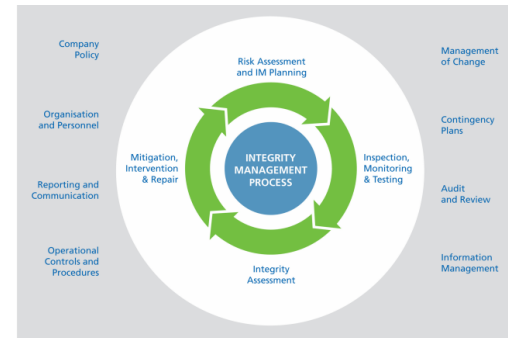
Historically: was seen as a set of physical activities, i.e. inspection, testing, maintenance, repair etc., applied to operating assets in order to **avoid structural failures**.

Today: continuous assessment process, with the overall objective set at ensuring that assets are indeed **managed and operated safely**.

Text Source: NACE - GAS PIPELINE INTEGRITY AND CORROSION
CONDITION ASSESSMENT DURING COMMISSIONING: A CASE STUDY –
Jozef Zoltis, Pedro Guillén, Oscar Martinez, Maritza Lopez, Rogelio
Gutierrez & Jesus Córdoba



VS.

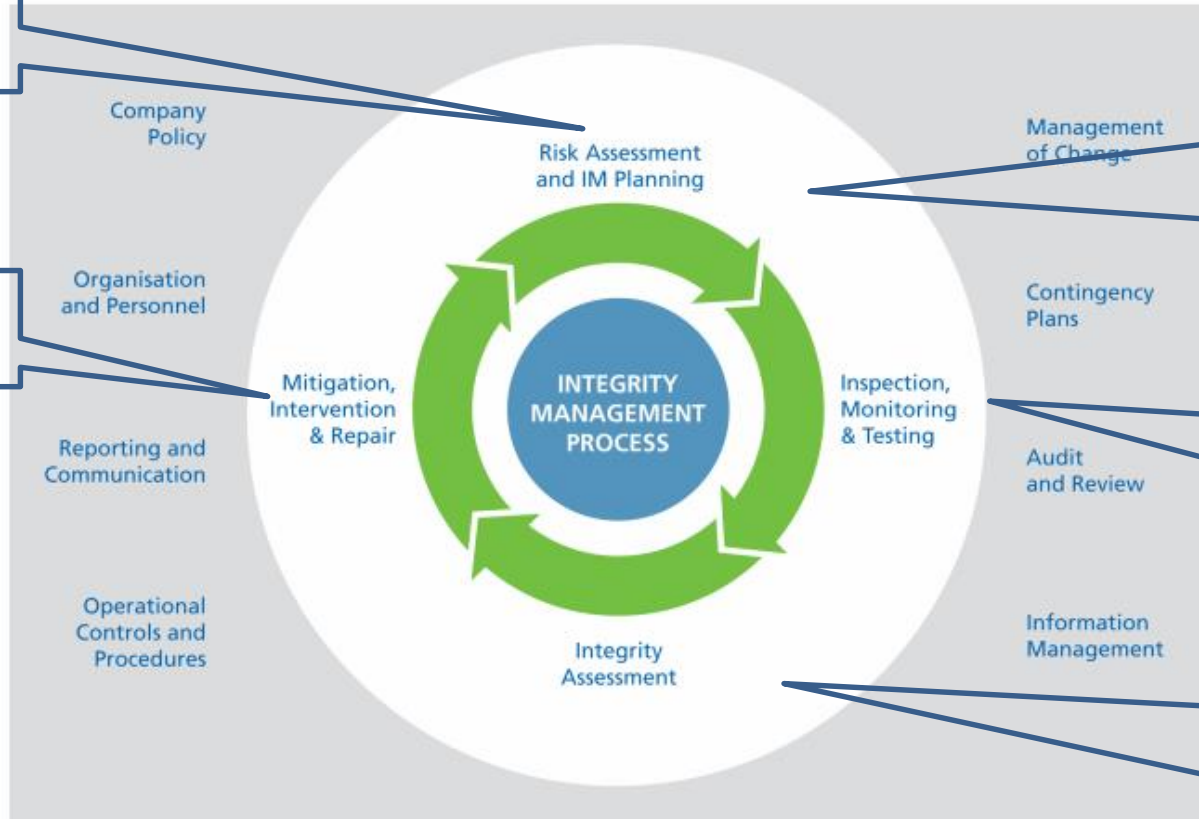




INTEGRITY MANAGEMENT SYSTEM

- Update Threats and Risks

- Repair
- mitigate



- Identification of Credible Threats
- Risk calculation
- Plan Inspection and Monitoring based on results

- In-line Inspection
- In-field investigation
- CIPS, DCVG, Patrolling, etc.

- Immediate & Future (FFP) Assessment of all anomalies:
 - Corrosion
 - Manufacturing & Const.
 - Geometry
 - Linear



Life Extension

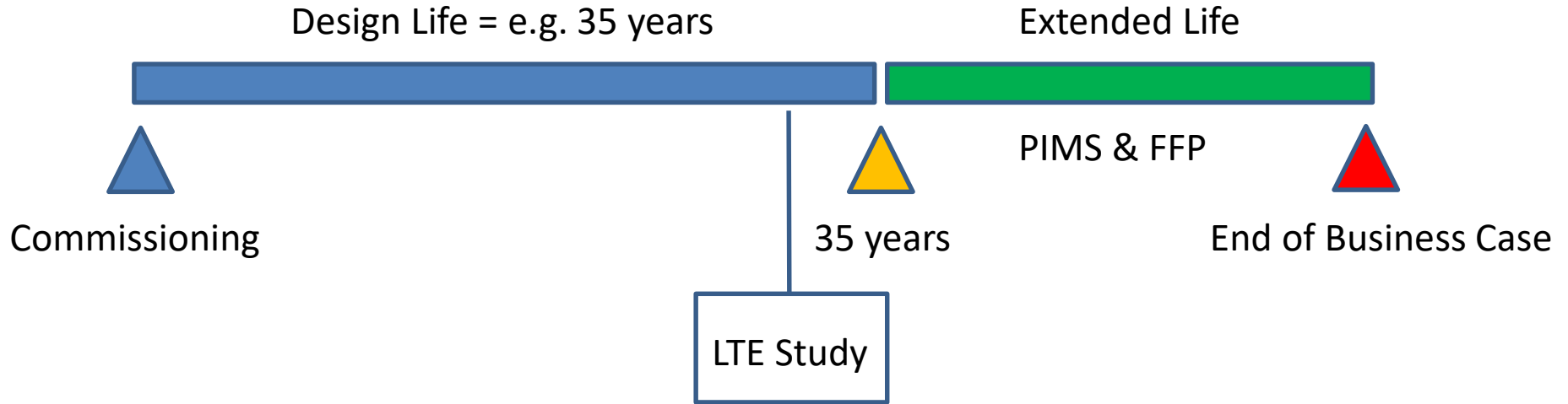
- Acceptability for operation beyond specified design life assuring not exposing society to unacceptable risk (ISO/TS 12747).

Fitness for Purpose (FFP)

- FFP assessment helps identifying the needed verifications/repairs and actions during a reinspection interval.
- The Fitness for Purpose should assess all identified threats through Inspection both
 - time-dependent (Corrosion & Crack Growth + Fatigue) and
 - time independent (e.g. 3rd Party, manufacturing).

Key inspection (ILI, ECDA, ICDA, SSCDA etc) – type and interval

- Inspection should be planned according to the risks at which the pipeline is exposed.



- LTE study is developed before the end of the design life
- It is intended to ensure all actions and foundations needed to continue safe operation are identified
- Managed in a PIMS



Objective FFP: identify actions to ensure safe and cost effective operation during a determined operating period by e.g.:

- Diagnose cause of identified anomalies
- Determine the impact of those anomalies
 - Acceptable today?
 - Until when?
- Repair Plan based on current and predicted acceptability of the reported features
- Assess mitigation measures and propose actions to control threats
- Recommend a Reinspection Interval based on the above
- Serve as a meaningful input for the re-evaluation of the Pipeline Risk Assessment



Questions:

- When do we Inspect and what it triggers the inspection?
- Do we assess all (time-dependent and non-dependent) anomalies?
- How do we assess the anomalies?
- Do we calculate corrosion growth rates and fatigue lives to predict failure of features?



Some typical facts

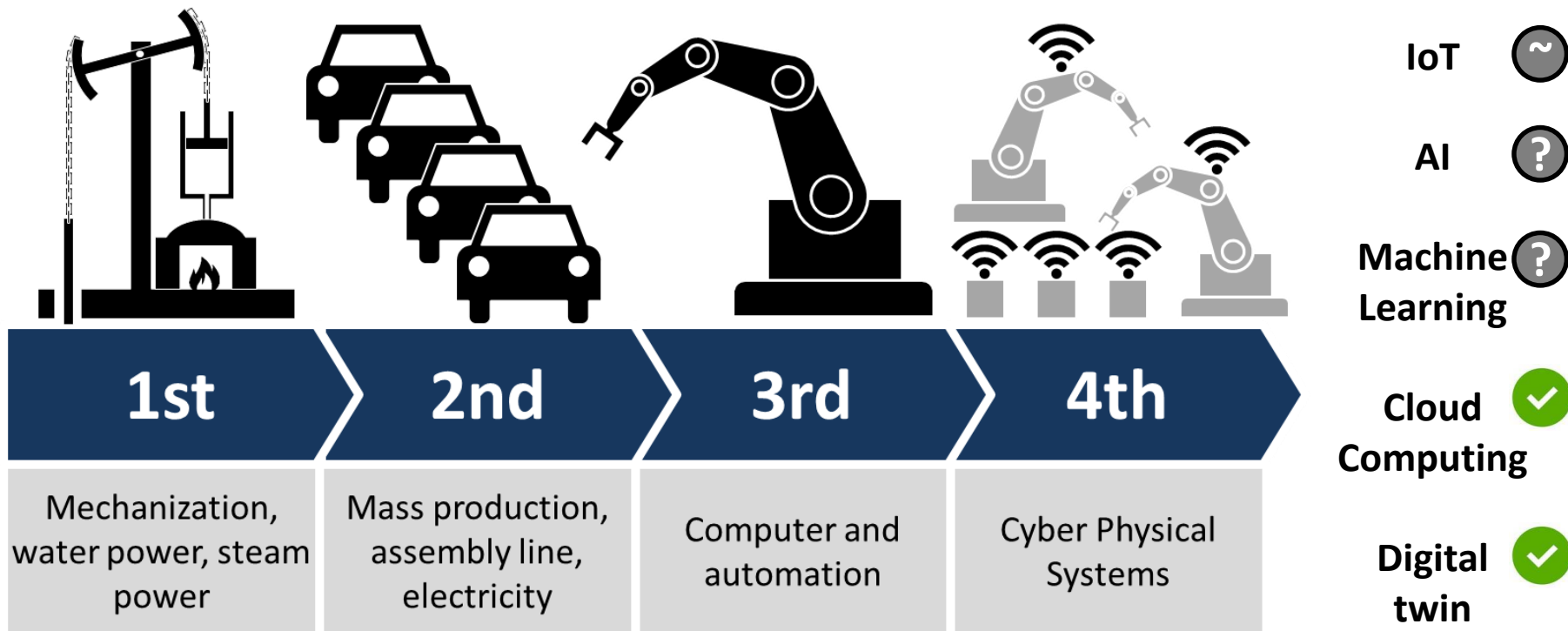
- Data and information scattered, not available or not in right format
- Traceability and updating of data is challenging
- Deriving required actions from data still difficult
- Sharing data between parties: still limited
(note: in addition to already sharing of information on risks, incidents and degradation mechanisms)

Challenge

- Comprehensive systems/ quantitative assessment methods to manage integrity of the pipelines need a lot of data
 - digitalisation plays a key role in enhanced data use
 - data connection + centralising needed for improved statistics + benchmarking
 - future legal requirement?

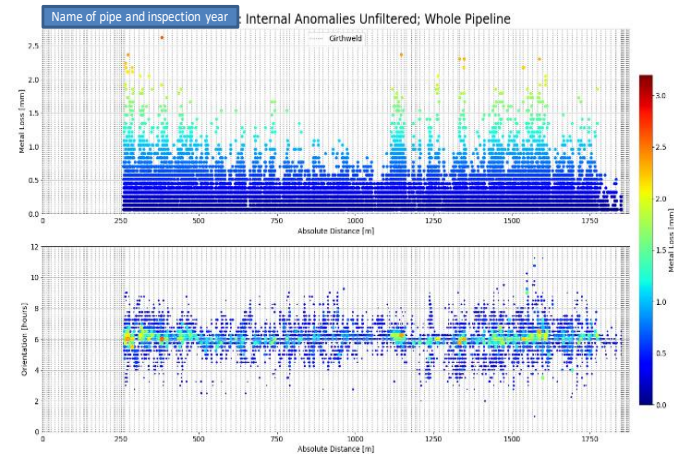
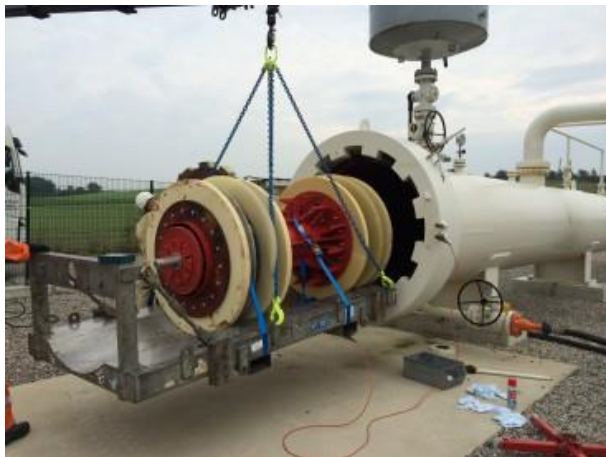


- Step by step
- Conservative market – education and time needed
- Rules and regulations allow for operator specific analysis methods
- Real Artificial Intelligence (AI) is still far away
- Domain knowledge required
- Data structuring and cleaning is key
- Automation of assessments and reporting (visualisation)
- Fully automated Integrity Assessment needs application of standardisation (e.g. PODS)
- Focus on cost benefits to enable application

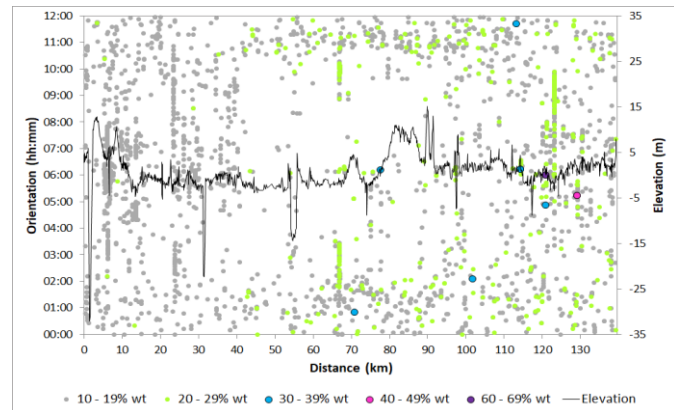




Key data source: Intelligent pigging Metal Loss, Geometry, & Planar Defects

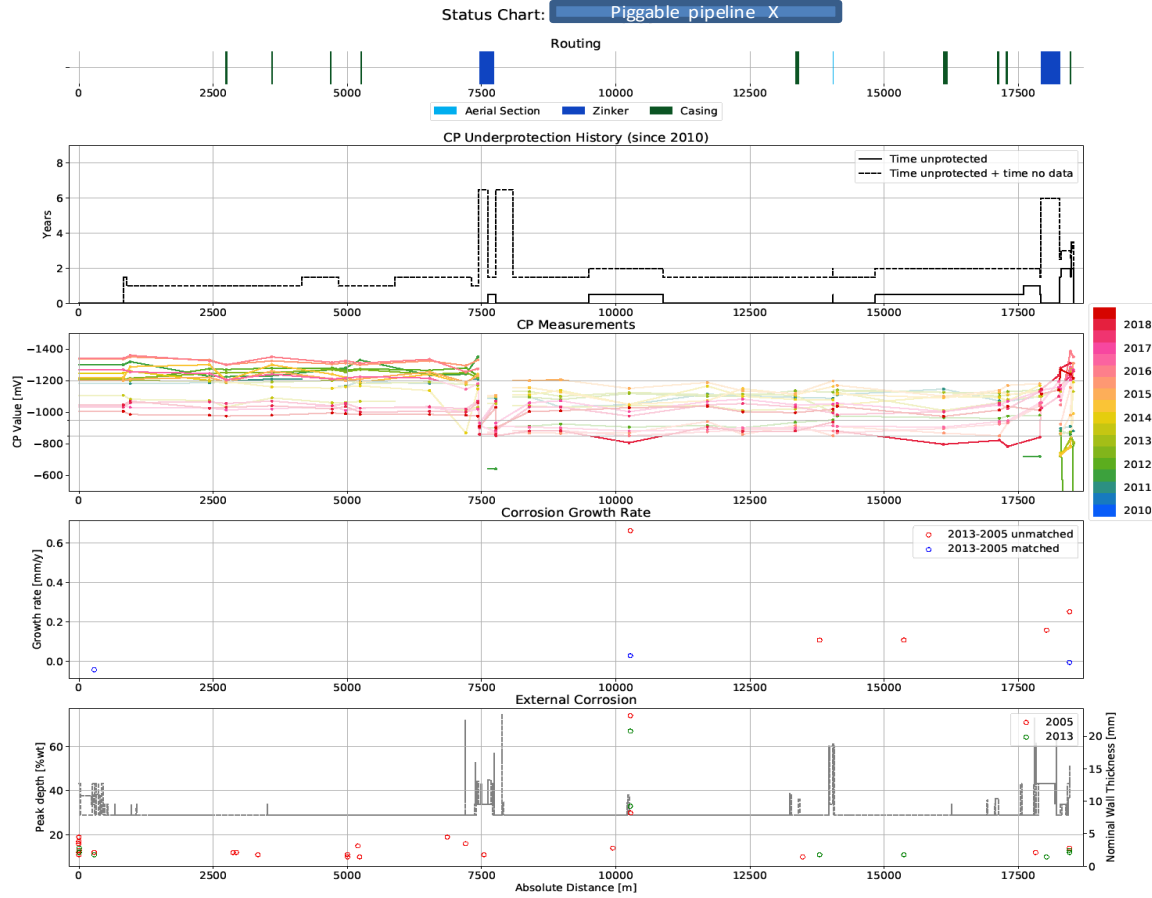


Example of a pig receiver on a natural gas transmission pipeline.



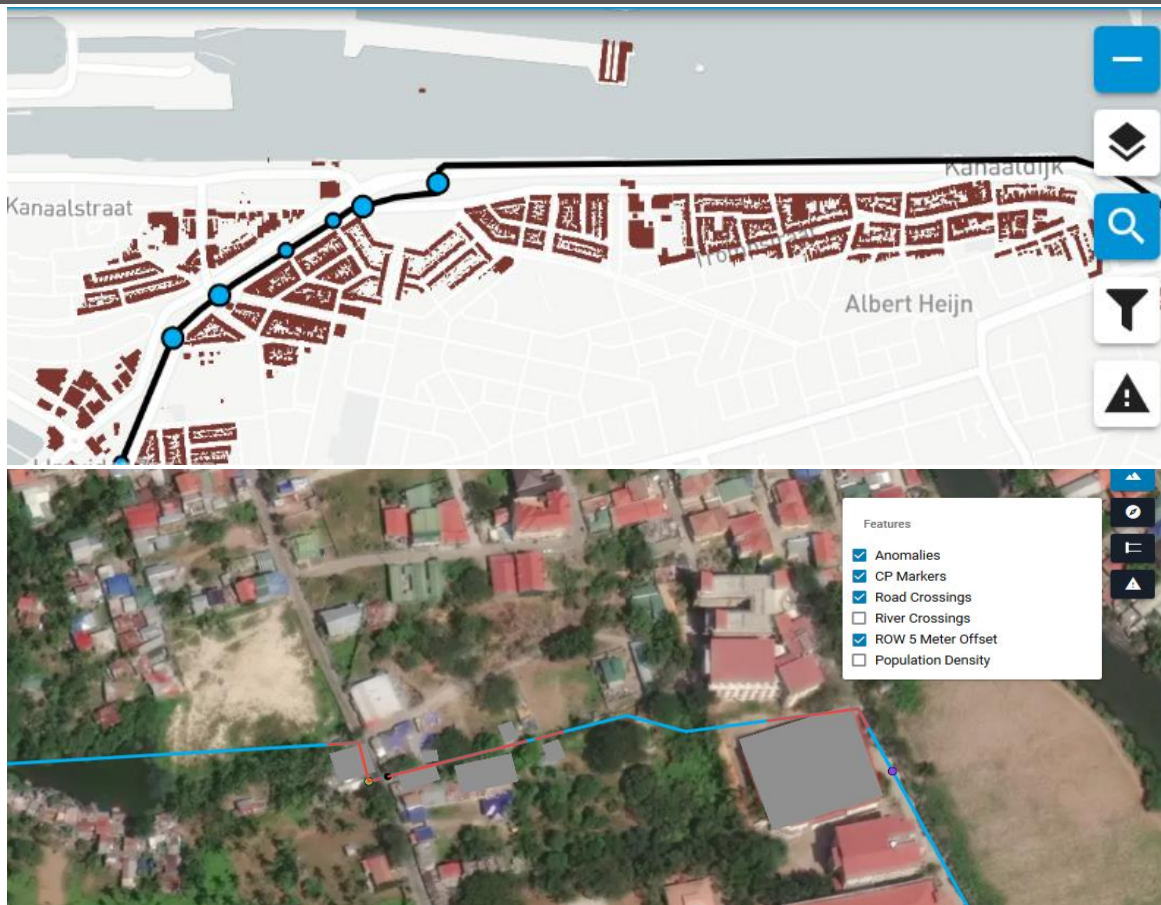


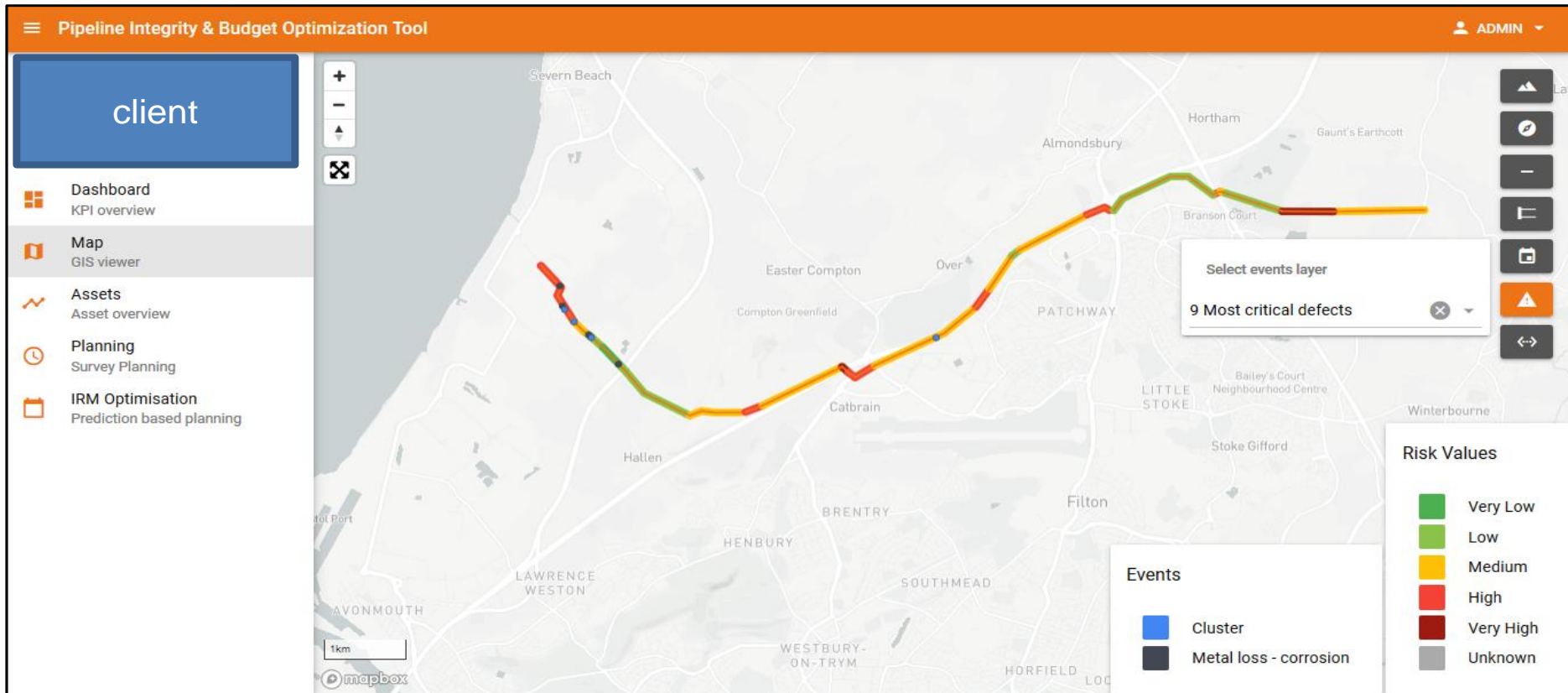
- Historic IRM
- CP/ CIPS/ DCVG...
- Inhibitor data
- Environment (soil, settlement sensors, satellite data)
- Verification dig-ups
- Benchmarking data...?
 - Risk statistics onshore pipelines
 - Concawe
 - Failure Frequency Analysis (FFA) database
 - European Gas Pipeline Incident Data Group (EGIG) database
 - Pipeline status library. Co-operation?





Visualise aligned data







What?

Automated FFP & CGRs results ILIs

Immediate ILI Findings

Immediate anomalies charts

Immediate Fitness For Purpose

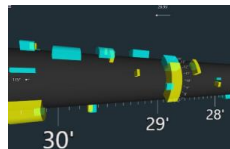
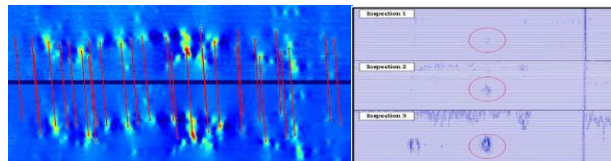
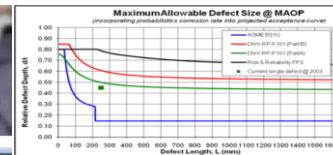
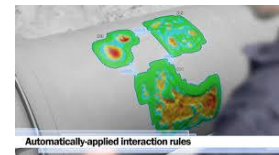
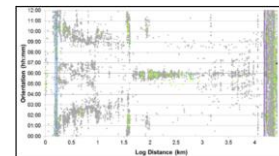
Clustering rules in 3D + Risk assessment methods

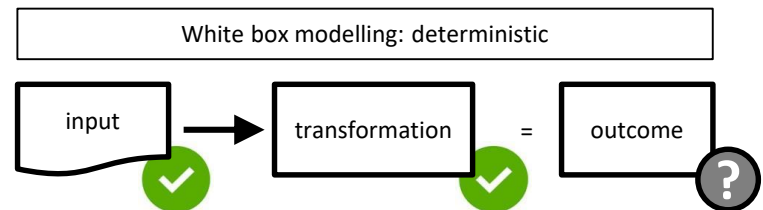
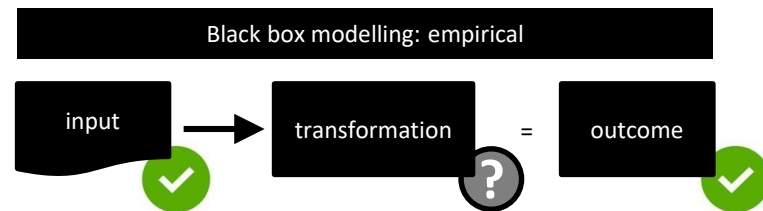
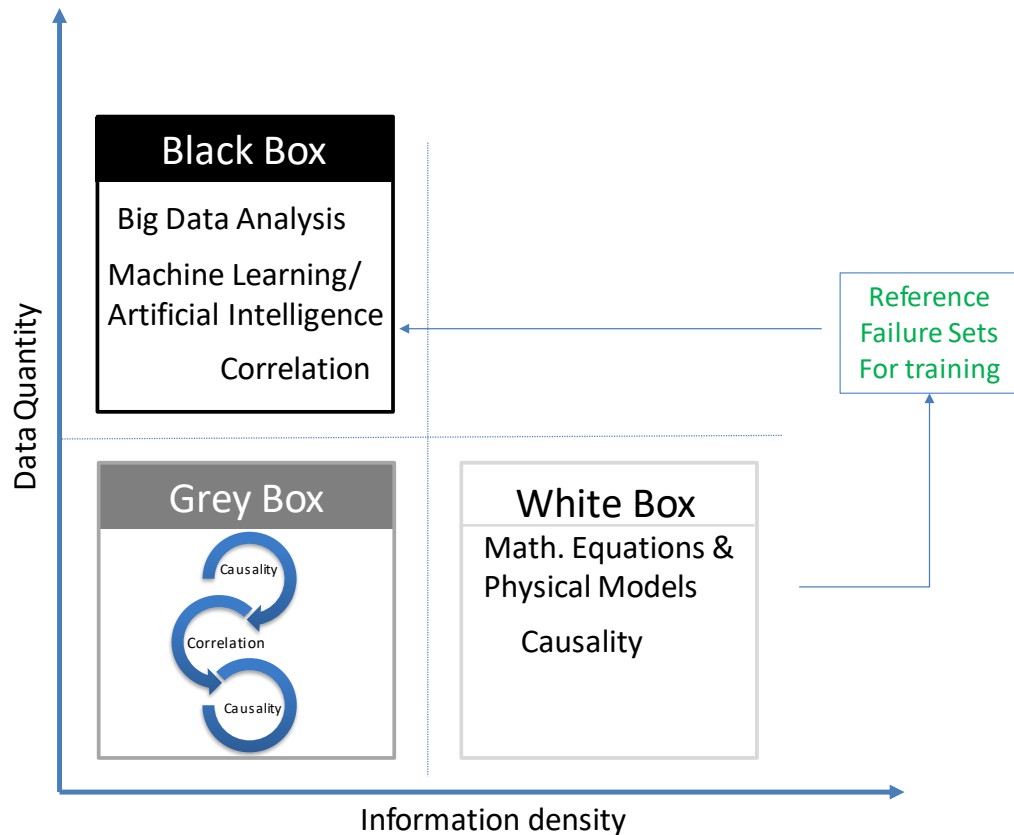
Corrosion Growth Assessment

Alignment Analyst, Run Comparison and Signal Comparison

FFP (5 yr repair plan)

3D asset optimized digging plan PIBOT

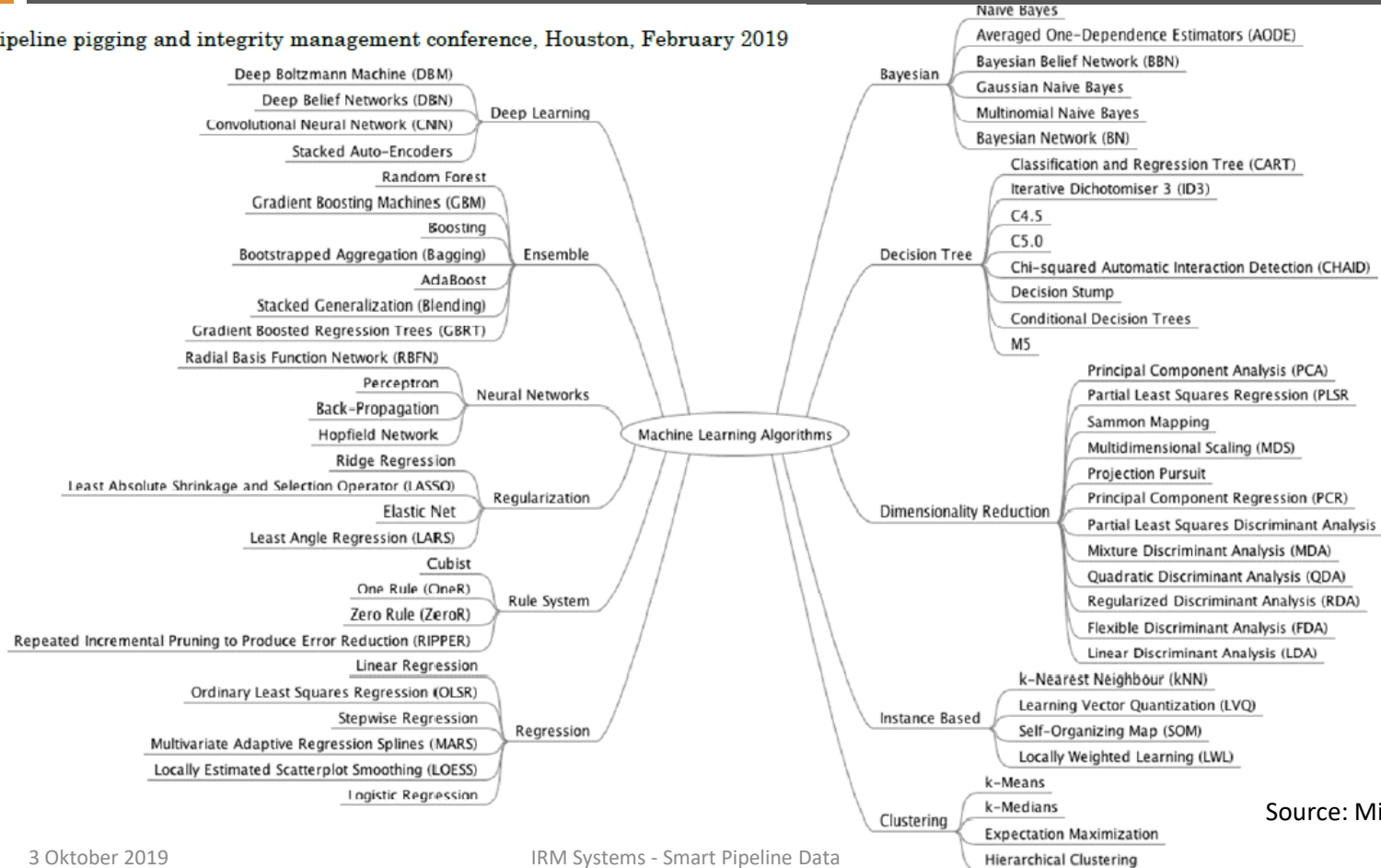






The role of Machine Learning – complex?

Pipeline pigging and integrity management conference, Houston, February 2019

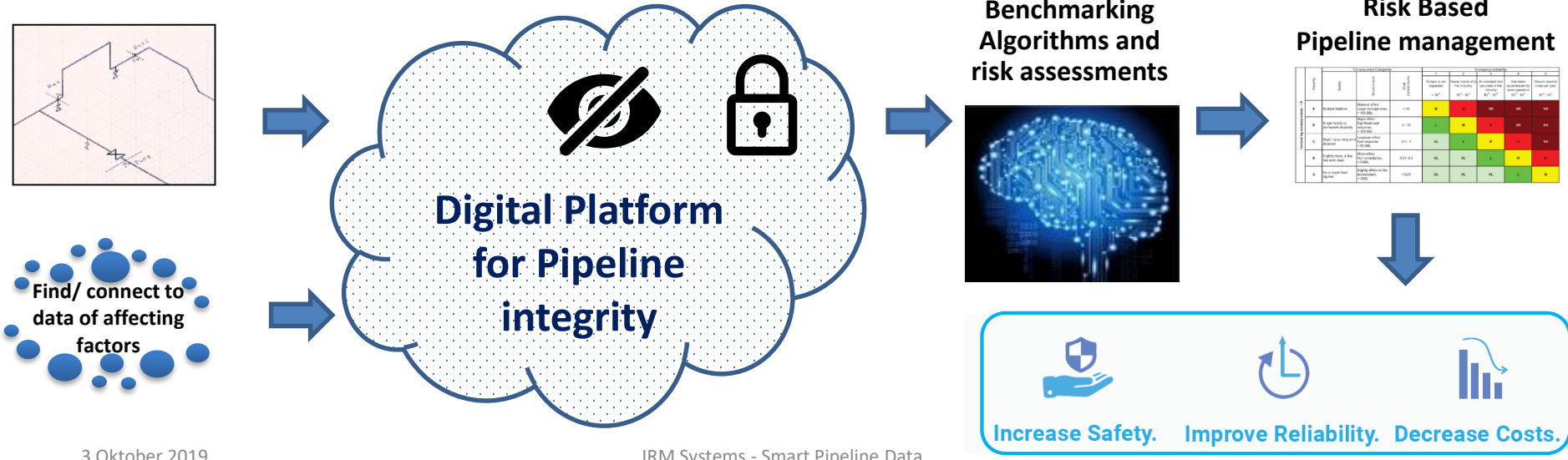


Source: Michael P. Gloven, PE, EIS



Solution: Digital Platform for managing the integrity of the pipelines

- What-Where-When-Why-How-Who
- Digital Interaction between asset and key processes (Digital Pipeline + API's)
- From Risk, to Inspection, to Assessment to Mitigation, all linked with Management Controls in one tool (possible)
- Supporting and automation of repetitive tasks





Pipeline segment
specification
+

Leakage data

Inspection
data

Operational
data

Context data

Future: other
sources



Select
Degradation
Mechanisms
& Threats

- External corrosion
- Mechanical damage
- Internal corrosion
- Wear / Erosion
- others



Benchmarking
and
Statistical
Analysis

- Degradation speed
- Trends
- Bandwidths



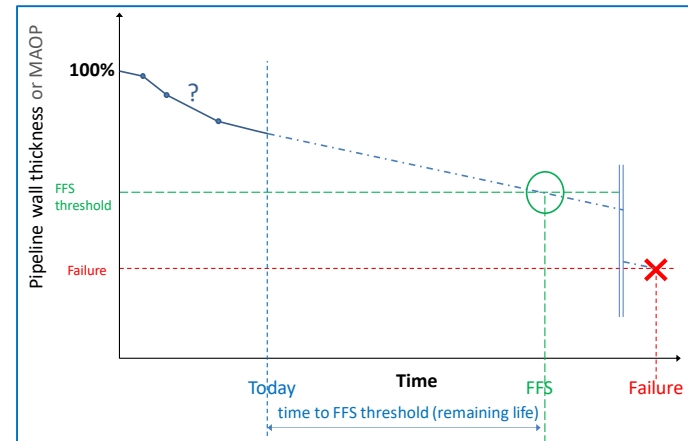
Statistically
determine:

- Time to failure
- Probability of Failure (POF)



Determine
Risk for
RBI

- Consequence of Failure (POF)
- Risk value





IRM Systems

IRM Smart Pipeline Data

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