RISK ENGINEERING

Mechanical Integrity Deep Dive

Empowering Safer Operations and Smarter Insurance Decisions

Gallagher

What is the Mechanical Integrity Deep Dive?

Our Mechanical Integrity (MI) Deep Dive is a specialised technical solution designed to:

1

Identify

hidden vulnerabilities in high-risk industrial assets.

2

Analyse

degradation mechanisms, including corrosion and wear.

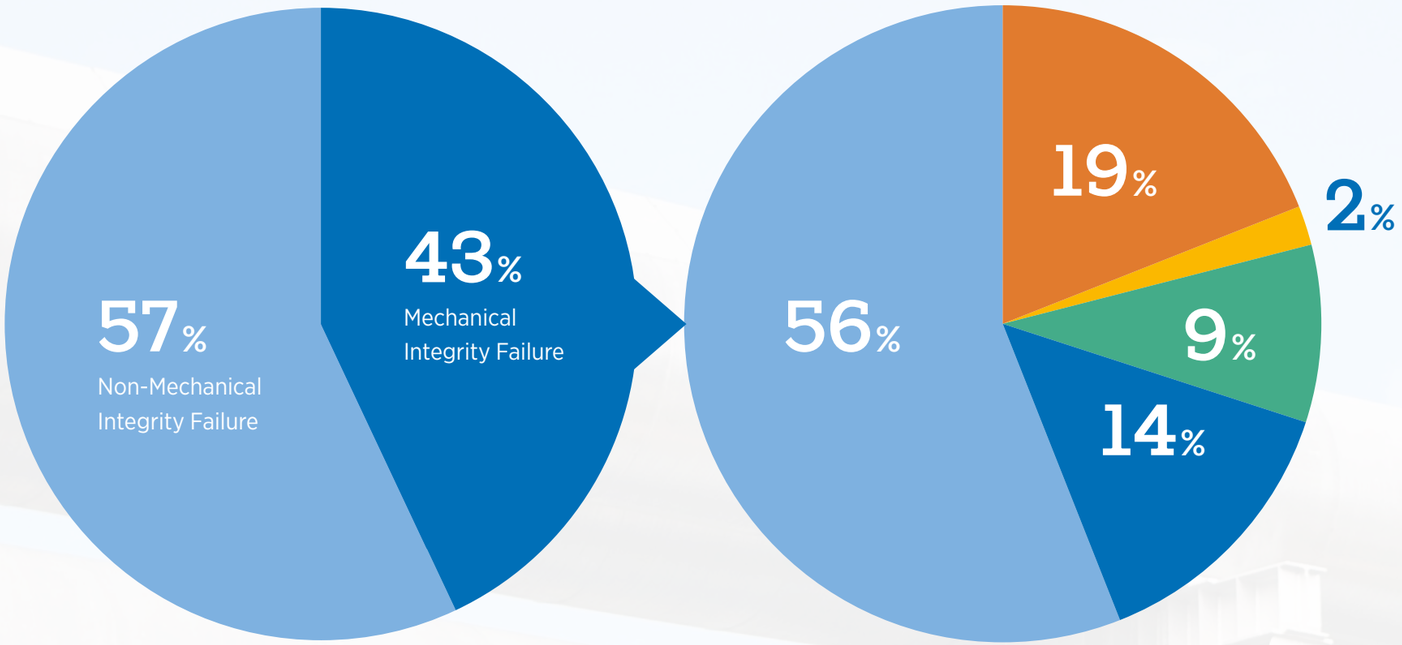
3

Evaluate

the effectiveness of inspection, corrosion and risk-based strategies.

Tailored for insurance underwriters and plant operators, this comprehensive integrity health check goes beyond surface-level audits. Developed in collaboration with insurance markets, it provides decision-makers with precise technical insights to enhance safety, reliability and insurability.

Why is the Mechanical Integrity Deep Dive important?



Data Set: 100 Losses

Data Set: 43 'Mechanical Integrity Failure Losses

- Piping internal corrosion
- Piping external corrosion
- Equipment external corrosion
- Equipment internal corrosion
- Bolted joint/seal failure

Reference: "Common causes of major losses in Onshore oil, gas and petrochemical industries", LMA — September 2016 edition.

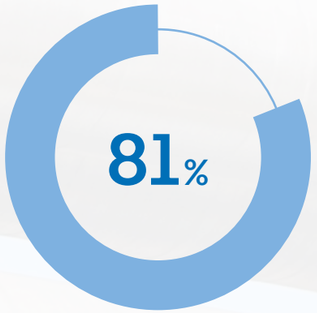
Key insights from industry data

Analysis of **100**

onshore oil, gas and petrochemical losses (1996–2015).

Losses ranged from USD50 million to USD1.5 billion, totalling

USD25 billion



Substantial number of losses were linked to Mechanical Integrity and 81% of Mechanical Integrity Failures were attributed to corrosion, predominantly from piping corrosion.

Damage Mechanisms

A few frequently occurring damage mechanisms are shown below.

External corrosion

Corrosion Under Insulation (CUI)

CO_2 pitting

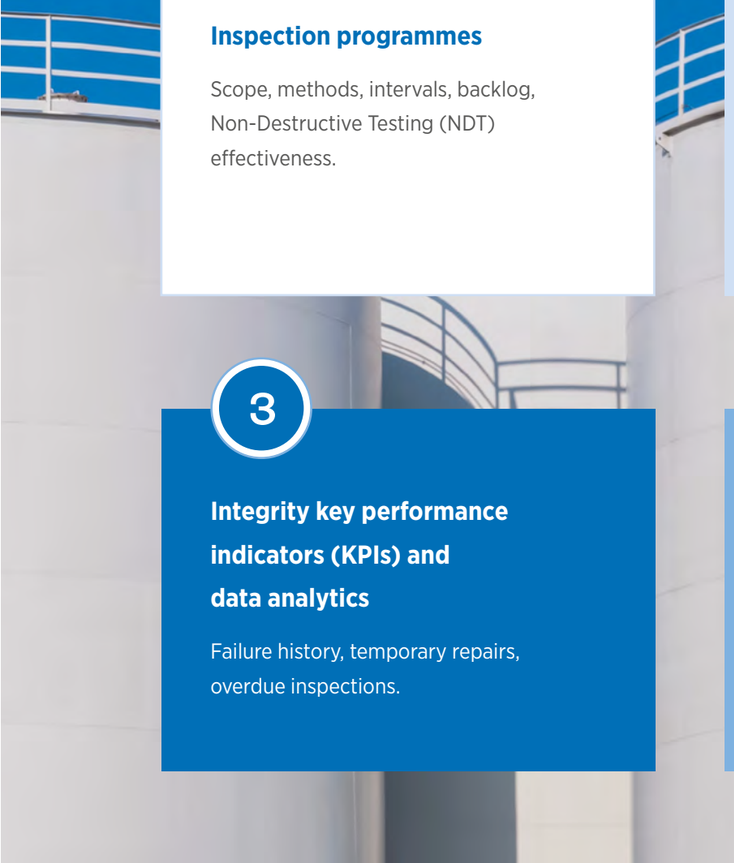
Creep damage

Examples of losses due to MI failures:

Facility	Industry	Cause	Estimated loss (USD million)
Philadelphia Energy Solutions (PES) Refining Explosion (2019), USA	Oil & Gas	A corroded pipe elbow ruptured, releasing hydrofluoric acid (HF), which ignited and exploded.	750
TPC Group Butadiene Plant Explosion (2019), USA	Petrochemical	Popcorn polymer in a dead leg expanded, rupturing the pipe and releasing flammable butadiene, causing an explosion.	380
Sayano-Shushenskaya Hydroelectric Power Station Accident (2009), Russia	Power generation	Turbine failure due to mechanical integrity issues, including fatigue cracks in bolts.	Multi-million

Key focus areas of the MI deep dive

The key focus areas outlined below are specifically tailored to address the common historical causes of MI losses.



1

Inspection programmes

Scope, methods, intervals, backlog, Non-Destructive Testing (NDT) effectiveness.

2

Corrosion mechanisms and material assessment

Chemical treatment, Integrity Operating Windows (IOWs), Condition Monitoring Locations (CMLs), corrosion loop segmentation.

3

Integrity key performance indicators (KPIs) and data analytics

Failure history, temporary repairs, overdue inspections.

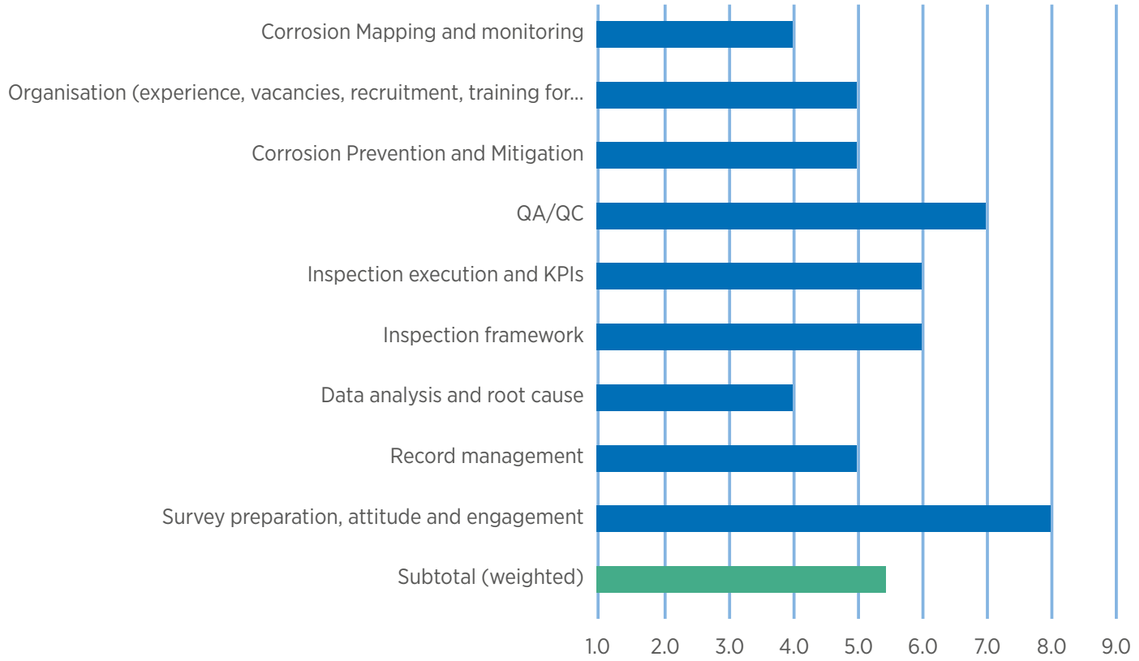
4

Fitness for service (FFS) and risk-based inspection (RBI) validation

Methodology review, assumptions review, data analytics.

Mechanical integrity scores

Our deep dive evaluates and ranks risk across nine essential metrics outlined below, providing a transparent and prioritised overview of your management programme.



Common causes of MI losses

Even mature organisations with strong safety cultures can experience MI lapses. Recognising these weak links helps close gaps before they escalate into costly incidents.

1. Incomplete or inaccurate asset registers

Outdated registers leave equipment untracked, leading to uninspected modifications and failures.

2. Inadequate inspection coverage and techniques

Limited methods and schedules create blind spots, missing critical degradation.

3. Lack of corrosion control document (CCD) and circuitisation

Generic inspections fail to address specific degradation mechanisms.

4. Failure to act on inspection findings

Deferred repairs and unaddressed anomalies lead to major losses.

5. Operating ageing assets without FFS assessment

Cumulative degradation in ageing components increases risk.

6. Weak integration with management of change (MoC)

Uncontrolled changes in process parameters or design limits lead to failures.

7. Fragmented data and lack of digital integration

Scattered data prevents effective risk analysis and decision-making.

Survey process flow

Generally, the in-depth examination takes up to two days, follows a similar format to a traditional survey and includes structured interview sessions.

Why choose Gallagher?

At Gallagher, we go beyond compliance checklists to deliver a comprehensive and actionable solution for managing Mechanical Integrity (MI) risks.

Our MI Deep Dive offers:

- A comprehensive report assessing inspection and corrosion management strategies.
- Actionable recommendations to enhance risk management and operational reliability.
- A concise summary for underwriters to support insurance discussions and demonstrate control.

Our engineers are certified by esteemed international bodies (e.g., API 510, API 570, API 653, API 571, API 580, IAM) and bring hands-on industry experience to deliver insightful and valuable input. In contrast to other brokers, our deep dives are exclusively conducted by engineers holding certifications specific to MI.

By embedding MI into daily operations, organisations can protect their people, environment, and profitability while building resilience and earning trust from stakeholders. Gallagher's capability ensures that MI becomes a strategic advantage, enabling safer operations, smarter insurance decisions, and long-term sustainability.

Naveen Kumaar Krishnan

BE MSc CEng MIMechE MEI Cert CII
Risk Engineer — Gallagher
E: naveen_krishnan@ajg.com
M: +971 (0) 56 339 9002

Jack Wishart

MA MEng CEng MIChemE MEI
Head of Risk Engineering — Gallagher
E: jack_wishart@ajg.com
M: +971 (0) 56 539 9444

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