Financial and Safety case for Risk Based Inspection embedded in IBM Maximo

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Equipment failures cost global oil and gas operators and other asset-intensive industries billions of dollars every year, in addition to jeopardising the safety of equipment, plants, people and the environment.

This paper offers an introduction into how embedding Risk Based Inspection (RBI) functionality in IBM Maximo creates value to oil and gas operators and other asset-intensive industries, by providing better visibility on risk-based monitoring to improve safety, equipment integrity and operational reliability, which can result in uptime equipment gains of at least 20%.

Why RBI?

Lloyd's Register Energy believes RBI encompasses more than just optimal inspection regimes; it also provides the optimal maintenance tasks and frequency based on the identified failure mechanisms.

A good RBI program identifies the equipment items that contribute to high risk due to a high likelihood of failure from poorly understood damage mechanisms.

The RBI analysis provides the right insights, to make the right decisions, to keep assets "under control" – operating within set boundaries for business performance, safety, and compliance at all times:

- Reduces unplanned downtime
- Reduces failures, specifically HSE and catastrophic ones
- Can be easily applied to aging plants with unknowns
- Balances long range improvements with quick wins

Challenges with existing risk approaches:

- Existing risk approaches typically have a narrow view and look backwards at failures vs. predicting and mitigating.
- There is often a lack of engineering expertise in-house which results in organisations starting from scratch with reliability models every time.
- They lack the ability to close the loop between recommended actions and actual performance.

Asset Intensive Industry Goals

To Improve:
- Uptime
- Asset longevity
- Safety and Risk Management
- Improve yield
- Cost control

To achieve:
- Safe operations
- Profit and ROI
- Balance long/short decisions
- Sustainability
- Regulatory

Lloyd's Register Energy

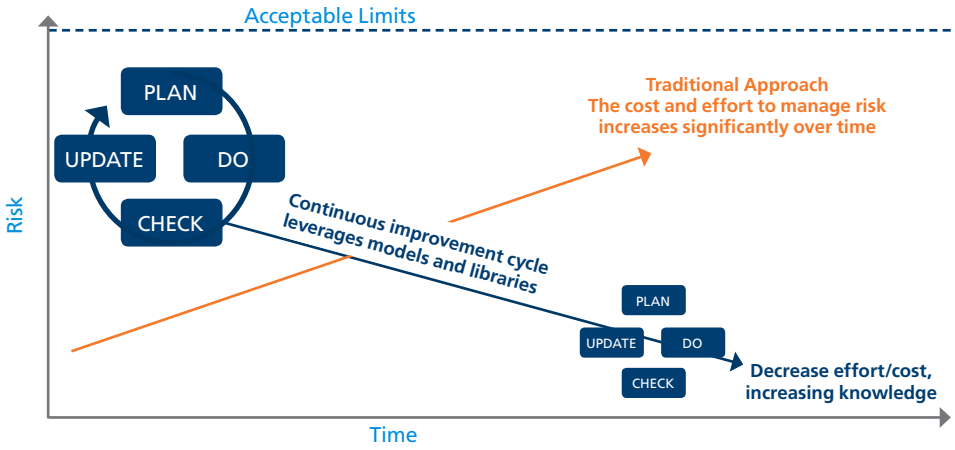
Working together for a safer world

Moving from a time based to risk based approach:

A good RBI system should allow the management of the historical inspection and RBI analysis information – typically this data can be transferred and preserved. If managing from a strict time-based approach, it is more than likely the owner/operator will probably only have basic equipment tag, design, and construction information on file.

Depending on the level of risk approach the owner/operator chooses to go with (qualitative, semi-quantitative, or quantitative), there may be a requirement to collect additional process data and perform analysis.

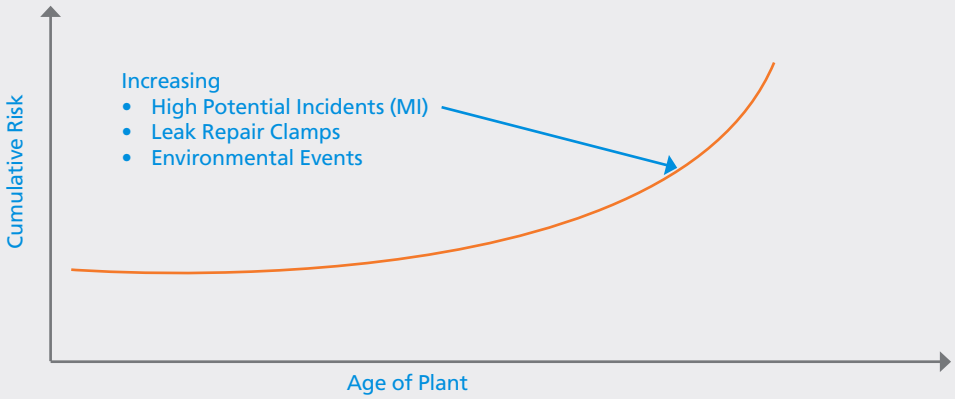
Sustainable solution over time:



"Prioritise and optimise inspection and maintenance regimes, improve safety and reduce repair costs with RBI."

Equipped with the right RBI technology and methodology, owner/operators can gain the knowledge to make safe and cost effective business decisions as the age of the facility increases.

The approach focuses on good business practice, not just compliance. Value can be created by reducing the costs associated with the inspection and maintenance of the assets, but also increased uptime by avoiding failures.

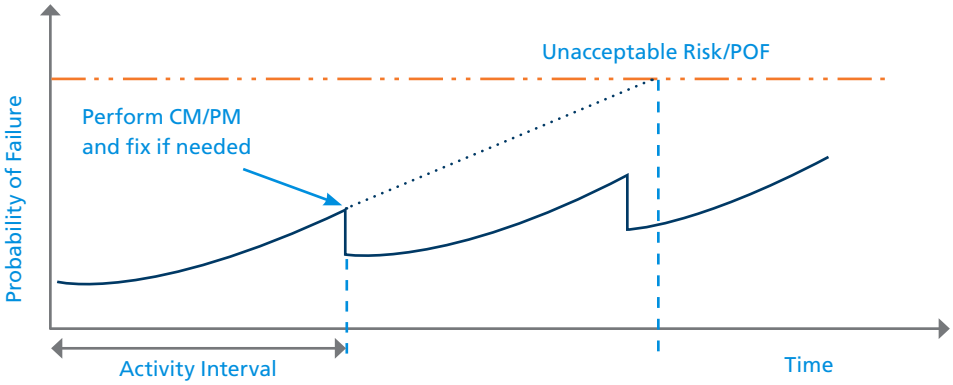


The intent of the LR Asset Integrity approach is to focus resources on critical equipment in ways which will prevent failures, particularly catastrophic ones.

For example, inspections on higher risk items may have to be added or increased while at the same time, inspections on low risk items are candidates to reduce or eliminate.

Additionally, inspections that do not increase the confidence in the condition of the equipment are candidates to be eliminated, while the correct inspection method and interval can be adjusted to maintain an acceptable level of risk. In many cases, intervals can be extended while keeping risk at an acceptable level. In every case, the inspection planning will account for all regulatory requirements.

"Identity and focus resources on critical equipment."



The Financial Case

Customers have large investments within their Enterprise Asset Management (EAM) systems primarily to improve uptime, extend asset longevity, provide visibility to maintenance, manage safety and risk, and improve inventory. However, the EAM systems lack the engineering models to realise the full potential.

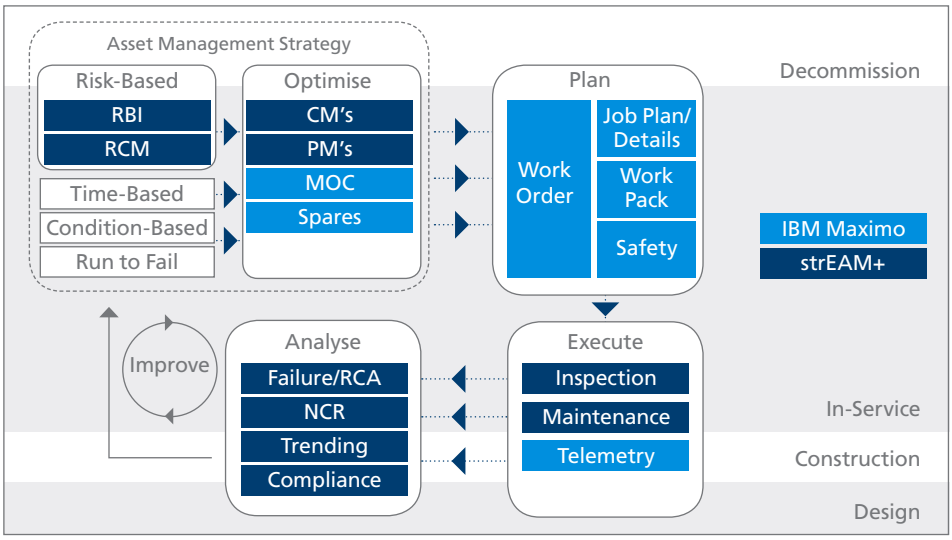
LR Energy provides an industry leading solution that is embedded within the client's EAM system with a first release in IBM Maximo.

"Leverage existing EAM Investments"

By embedding the solution within the EAM system, the approach allows for two primary benefits to the customer:

- Allows operators to realise existing EAM investments in modules such as Change Management, Compliance, Qualifications, etc. by combining the Asset Integrity tools with existing EAM modules to provide a holistic view of assets for tactical decision making.

Framework for the full asset life cycle stored and performed in the EAM system



- Provides valuable Asset Integrity tools such as RBI and Reliability Centred Maintenance (RCM) without the cost of expensive integration and data transfer. Other functionality includes standardised Failure Mode and Effects Analysis (FMEA) to understand the failure modes that may impact equipment operation and a Root Cause Analysis (RCA) function to provide understanding in the event of failure occurring so that actions may be put in place to prevent further failures, including those on similar equipment.

Within a single data source, the overall process drives continuous improvement to ensure key equipment performance data, ranging from condition monitoring, inspection data, predictive engineering models, and maintenance feedback, is recorded and analysed in IBM Maximo to improve equipment integrity through appropriate knowledge management.

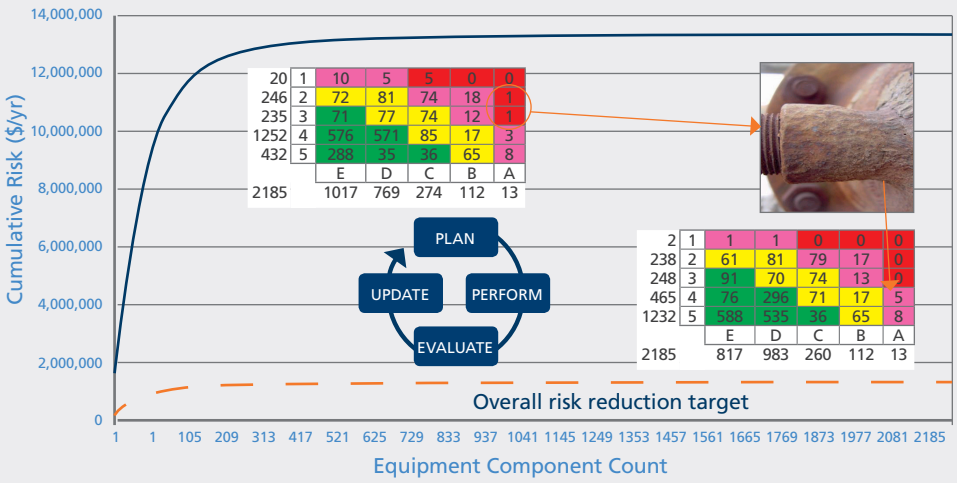
The Safety Case

Implementation of a RBI solution that embeds in EAM systems, helps to quantify your health, safety & environmental (HSE) risk, allows for the prediction of failures, focuses resources and fosters continuous improvement.

Post initial analysis – In an example, the graph opposite shows that less than 10% of 2000 components carries the bulk of the risk. Predicting the failures per mechanism, quantifying the HSE risks (in this case dollars per year), allows the operator to easily focus resources on areas that carry the bulk of the risk.

Post mitigation steps - The risk of failures can be dramatically reduced.

As-Found Risk determined in 3.5 months



Summary

RBI embedded in IBM Maximo allows operators to prioritise and optimise inspection and maintenance regimes, achieving cost savings of up to 50% whilst reducing operational risk. In addition it can help increase uptime equipment availability by at least 20%, avoiding failures by creating a strong understanding of predictable and non-predictable failure modes.

Time to Value	• Proven approach with preconfigured models, though customers can develop their own
Focus limited resources on most important items	• Predictive models • Optimal life performance of the asset
Integrated processes that generate maximum ROI	• Leverage existing EAM investments • Reduce cost of ownership

Case Study 1

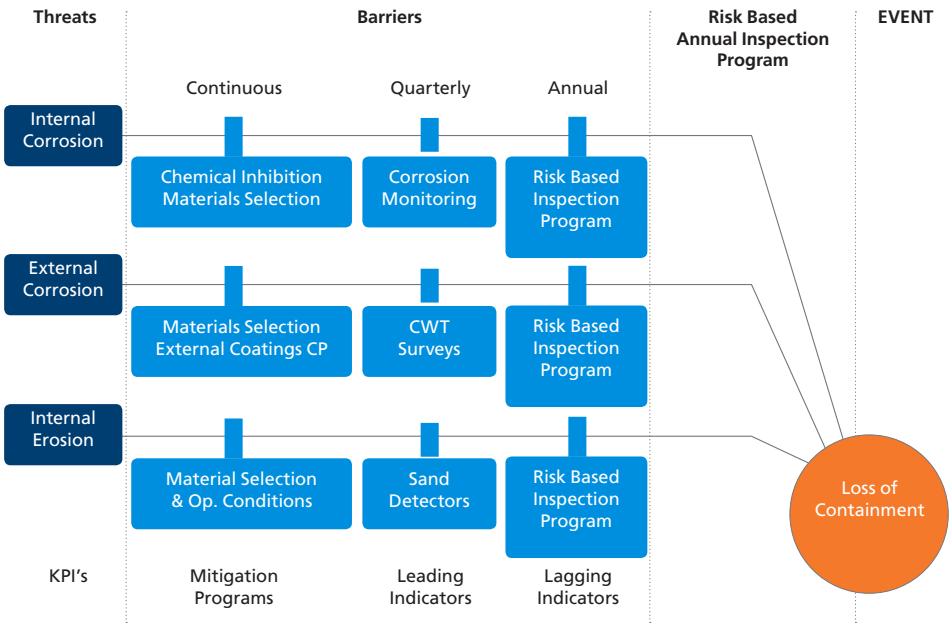
Top side pressure systems on Floating Offshore Installation

Objective

- Customer annual maintenance budgets were asked to be reduced safely without jeopardising production and having a loss of containment event.

Solution delivered

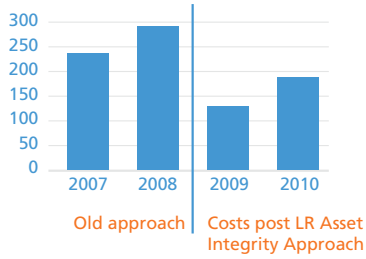
- Implement an RBI methodology with the aim of understanding the damage mechanisms and consequences of a loss of containment.

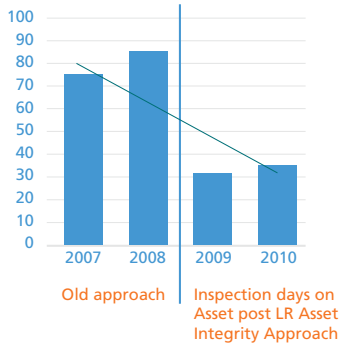


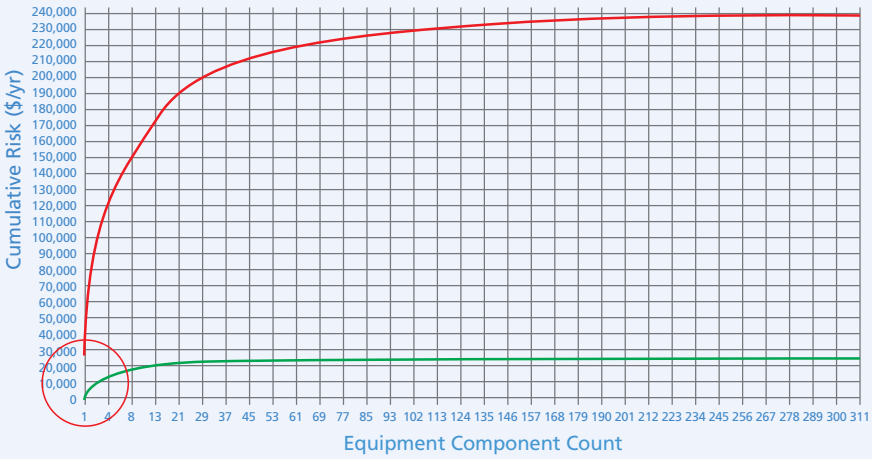
Results

- Strong understanding of where inspections can be optimised and resources to be focused. As shown in the cumulative risk curve below, less that 10% of the assets typically carry 95% of the risk.

- Based on the approach, the customer was able to show tremendous saving by safely avoiding internal inspections while simultaneously reducing the number of days on the platform.







Case Study 2

Turnaround improvement across a refining enterprise

Objective
- Migrating time-based fixed equipment inspection program to improve turnaround plans.

Solution delivered
- Study covering over 2,300 assets, to identify risk level and degradation mechanisms.
- Alignment of inspection methodologies.

Results
- Deferred internal inspections and servicing of relief valves that did not substantially change or exceed the corporate risk profile, to the second turnaround – realising over $2.5m in turnaround savings.
- Combination of risk reduction and cost savings estimated to exceed $160m.
- Ongoing savings for turnaround plans.

Case Study 3

Reduce high potential incidents at a petrochemical plant

Objective
- Over a 29 month period, there were 25 high potential incidents (HPIs) and 65 leak repair clamps installed.
- As part of the implementation project, the following goals were set:
  - Reduce high potential incidents (HPIs) by 90%.
  - Reduce leak repair clamps by 90%.
  - Reduce NDE locations on piping by at least 50%.

Solution delivered
- An analysis of the 1459 fixed equipment and piping items in the study demonstrated that 90% of the risk is associated with only 6% of the total equipment items in the study.

Results
- The plant has achieved value from the program by focusing very limited resources to accomplish the following:
  - Significant reduction in high potential and environmental incidents.
  - A reduction in process leaks to the atmosphere.
  - The prevention of numerous process leaks by focusing inspection in areas of highest risk.
  - The few leaks encountered since 2003 were predicted by the program, but inspections had not been completed prior to the leak.
  - No process leaks have required a shutdown of the ethylene plant.
  - The maintenance and inspection costs have been reduced by more than $1.5m/yr.

Lloyd's Register Energy's RBI Asset Integrity Software Solution

LR Energy's new RBI software solution, strEAM+ RBI offers an exclusive software solution that directly embeds into major Enterprise Asset Management (EAM) systems including IBM Maximo, SAP and INFOR EAM.

strEAM+ RBI provides oil and gas operators and other asset-intensive industries, with better visibility on risk-based monitoring to improve safety, equipment integrity and operational reliability.

We can help you achieve cost savings of up to 50% for inspection and maintenance of assets whilst reducing operational risk. In addition we can help increase your uptime equipment availability by at least 20%, avoiding failures by creating a strong understanding of predictable and non-predictable failure modes.

This new solution sits within the portfolio of modules being developed as part of the next generation of our highly acclaimed reliability-based mechanical integrity (RBMI) software package which will offer additional asset integrity functionality including Reliability Centered Maintenance (RCM), Root Cause Analysis (RCA), and Failure Modes and Effects Analysis (FMEA) as part of an integrated approach to optimising the performance of assets and facilities.

strEAM+ RBI has been developed in alliance with MaxGrip, a leading developer of Asset Performance Management software. MaxGrip's strEAM+ software solution is the only available solution directly integrated into IBM Maximo. To read more about our strategic alliance click here.

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'strEAM+ RBI' Factsheet
Strategic Alliance between LR and MaxGrip

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This paper has been developed in collaboration between Lloyd's Register Energy and MaxGrip