Integrated approach to level-up your Process Safety performance

Bilfinger Engineering & Consultancy BeNe

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Agenda

01. Introduction: Issue at hand

- **Process Safety incident reports** investigated by the Dutch RIVM in recent years state:

  "most incidents could have been prevented"

- **Observation:** Causes are mentioned
- **Missing detail:** Reports do not mention ***how*** it could have been prevented (preventive measures)

Designated cause	**Number of incidents**			
	2021	2022	2023	2024
Material degradation (corrosion, erosion etc.)	6	1	4	8
Human failure during operation	6	6	7	4
Over pressure (PSV, PRV, RD)	2	3	1	1
Failure of ESD measurements (temperature, vibration, level, impact)	2	2	3	2
Unknown	1	1	1	-

* Analyse van incidenten met gevaarlijke stoffen bij Seveso-inrichtingen 202x

01. Introduction: Issue at hand

- RIVM report mentions 3 main causes of incidents :
  - *** Material degradation;**
  - *** Human failure (within APM framework not specifically mentioned);**
  - *** Failure of existing IPL (Independent Protection Layers)**
- Focus for this presentation: material degradation and IPL/ instrumentation failure.

Designated cause	Number of incidents			
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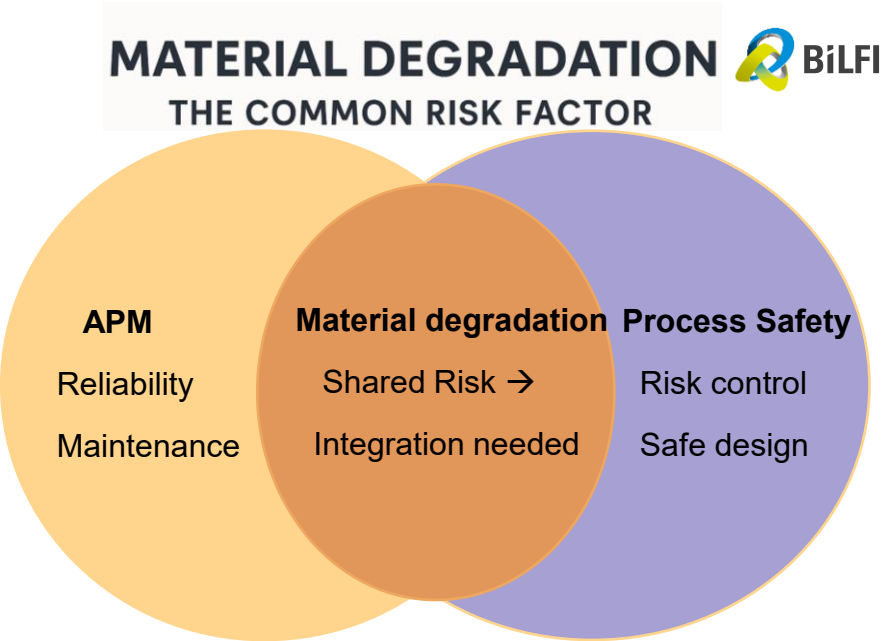
* Analyse van incidenten met gevaarlijke stoffen bij Seveso-inrichtingen 202x

01. Introduction: Issue at hand

Material degradation – Why it matters

- When materials degrade, design integrity is lost
- Design integrity is the basis for Process Hazard Analyses (PHA)
- If design is compromised → Higher risk of incidents
- Examples: Corrosion, (hydrogen) embrittlement
- Requires regular inspection and defined tasks
- Asset Performance Management (APM) detects and manages degradation proactively



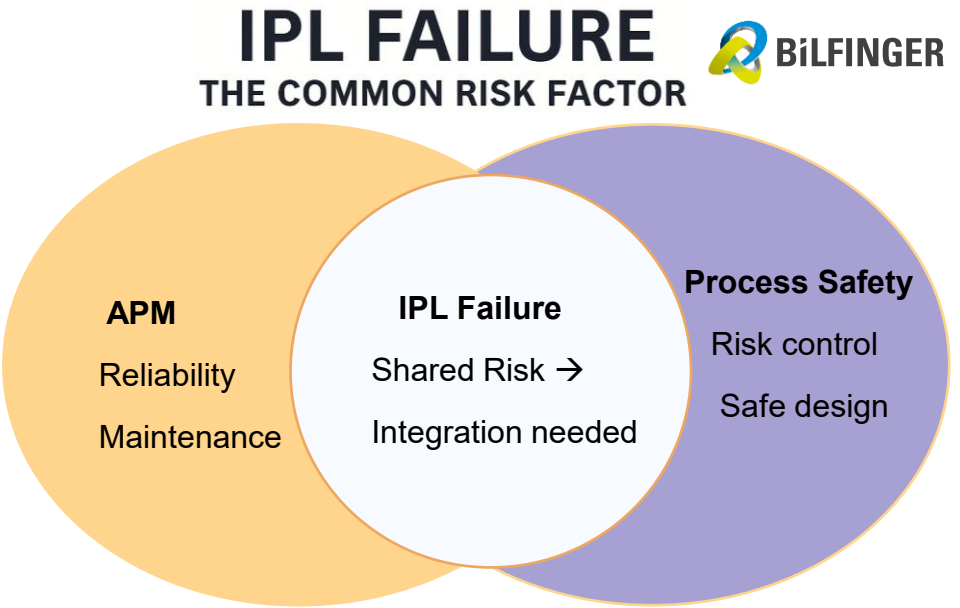
Material degradation is the common risk factor

- Impacts Asset Performance Management (APM) – Unplanned downtime, costly repairs
- Impacts Process safety – Hazardous incidents

01. Introduction: Issue at hand

IPL failure – Why it matters

- Failure of your safeguard (IPL)
- Spurious trips (false alarms)
- If IPL is compromised → Higher risk of incidents
- Common types: Fouling, neglected maintenance, calibration
- Requires regular inspection and defined tasks
- Asset Performance Management (APM) detects and manages IPL failure proactively



IPL failure is the common risk factor

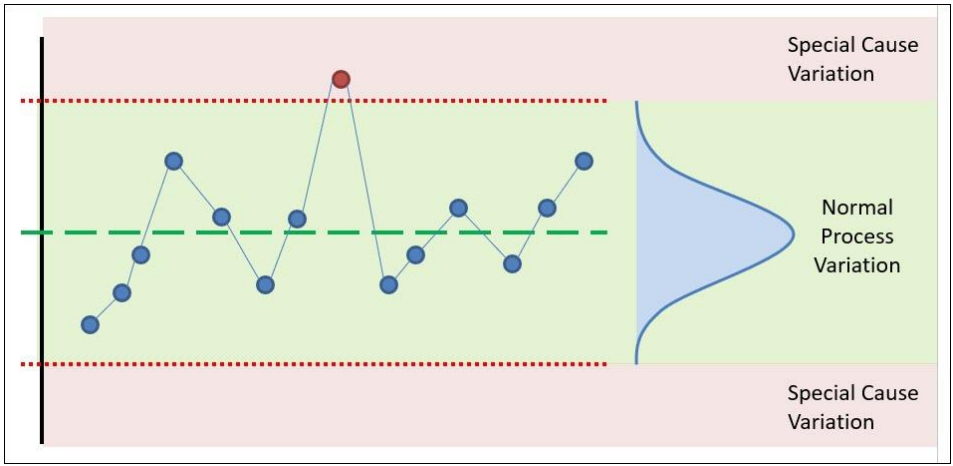
- Impacts Asset Performance Management (APM) – Unplanned downtime, costly repairs
- Impacts Process safety – Hazardous incidents

01. Introduction: Issue at hand

Integrated approach

Under normal operational circumstances:

- Material degradation and IPL failure can be proactively managed by APM
  - Chemical or Stress induced
  - Also: COI, (H2) Embrittlement
  - Define maintenance approach for each degradation mechanism
- Predefined maintenance for high critical equipment



Process conditions outside normal operating window:

- Process Safety lifecycle (IEC 61511)
- **Optimize prevention of incidents by Asset Performance Management**

So, what is APM ?

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01 Introduction

02 **The Asset Performance Management framework**

03 APM Workflow: Reliability Centered Maintenance

04 APM Workflow: Mechanical Integrity

05 APM Workflow: Process Safety

06 Results and take-aways

02. The Asset Performance Management (APM) framework

APM (Asset Performance Management)

- Creates value for the asset owner by reducing costs and improving safety
- Focuses on asset health, reliability and lifecycle performance
- Uses data-driven strategies to optimize maintenance and reduce downtime

Process Safety

- Ensures safe operations under design conditions
- Relies on equipment integrity (IPL's) to prevent hazardous incidents

02. The Asset Performance Management (APM) framework

Risk Based maintenance

Mechanical integrity (Risk Based Inspection)

Maintenance is organized on predicted failures under normal process conditions.

Reliability Centered Maintenance

Equipment criticality defines predefined maintenance schedule.

Process safety

Risk reduction for “out of control” situations.

Plan-Do-Check-Act

Plan

Combined planning optimizing effort

Do

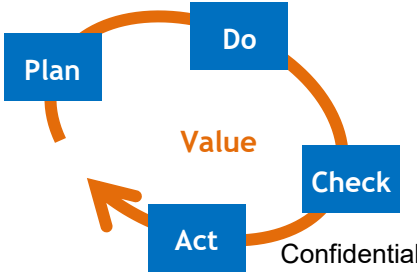
Executing planning as good as possible.

Check

Measure execution against the planning

Act

Optimize planning if needed



On several levels

Maintenance execution

Needs to be defined as crisp as possible

→ **Efficiency**

→ Doing the things right

Middle management

Needs to compile a planning

→ Planning contains the necessary tasks

→ **Effectiveness**

→ Doing the right things

Management

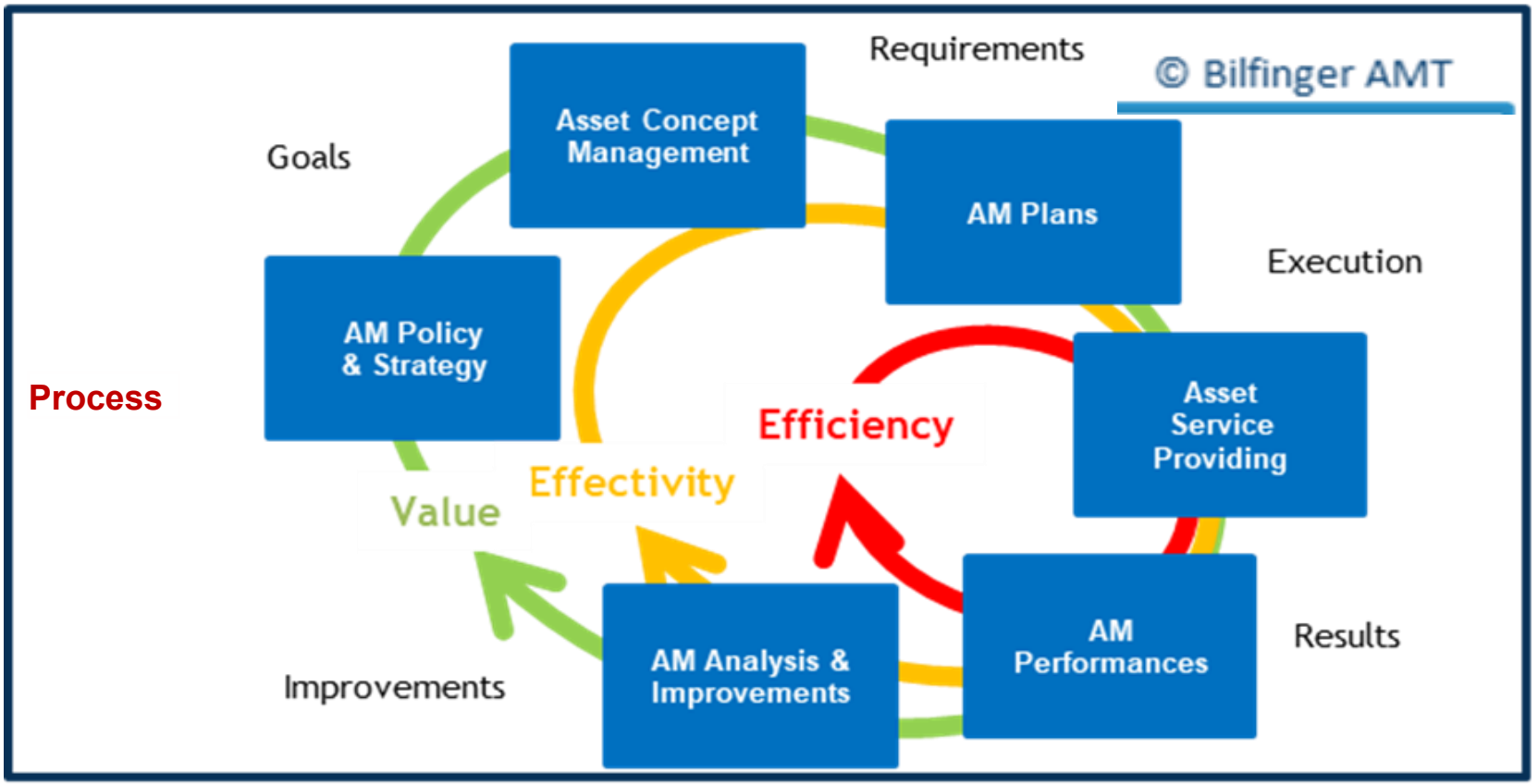
Dictates strategy to be followed

→ **Value** (acc. To actual business purpose)

→ Change in economical change → strategy to be adapted

02. The Asset Performance Management (APM) framework

Asset management: Value – Effectivity - Efficiency



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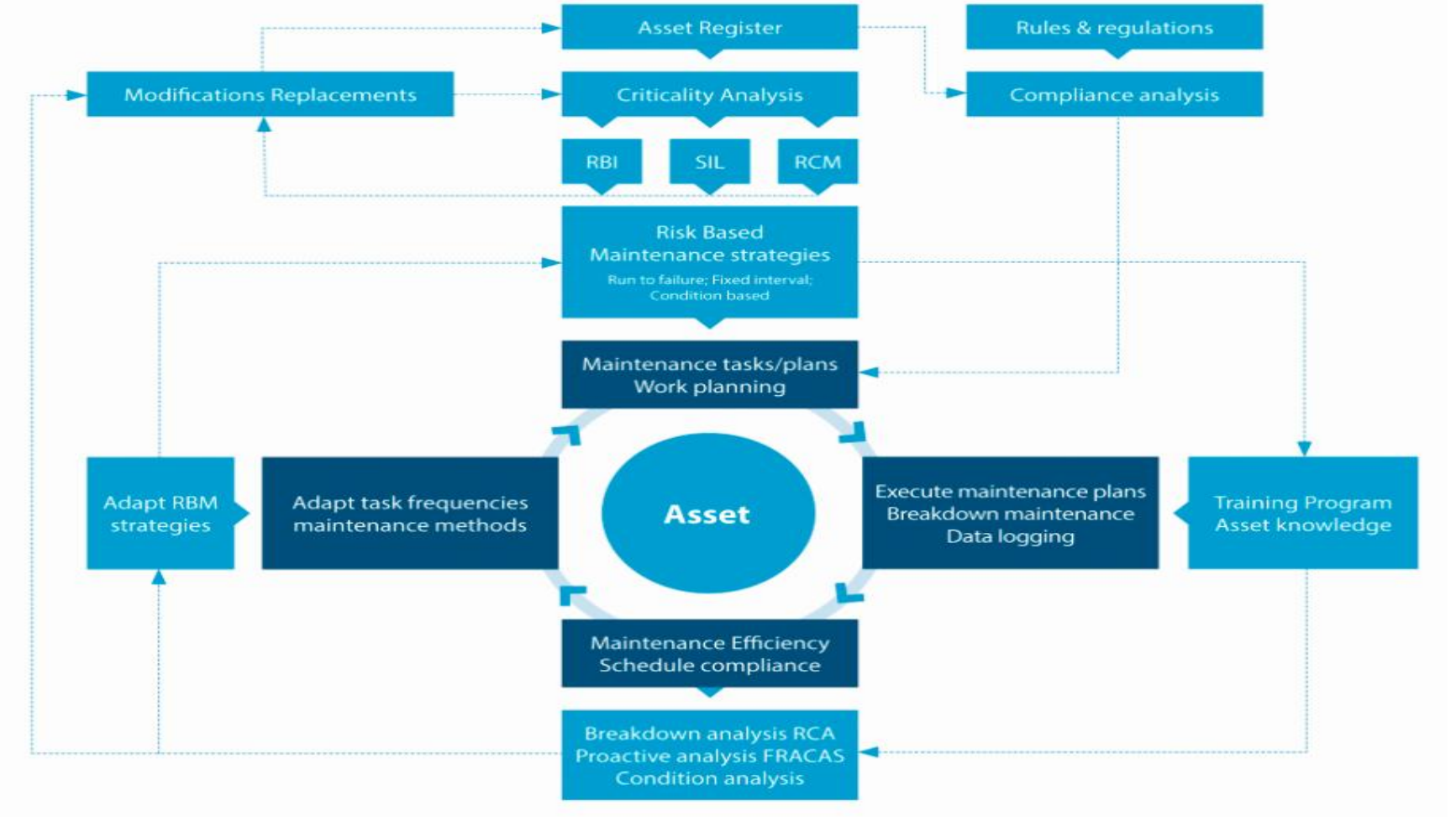
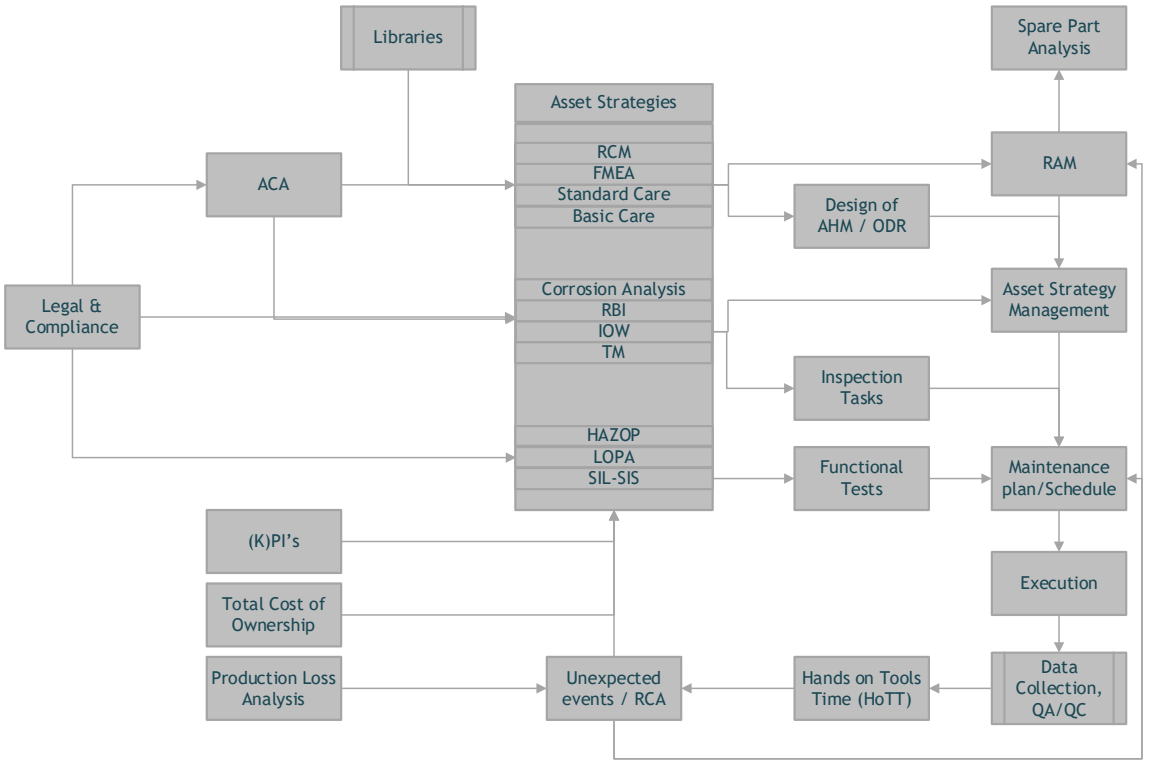


02. The Asset Performance Management (APM) framework

Asset performance management workflow
DETAILS FOR IMPLEMENTATION

3 core APM workflows:

- Reliability Centered Maintenance
- Mechanical Integrity
- Process Safety



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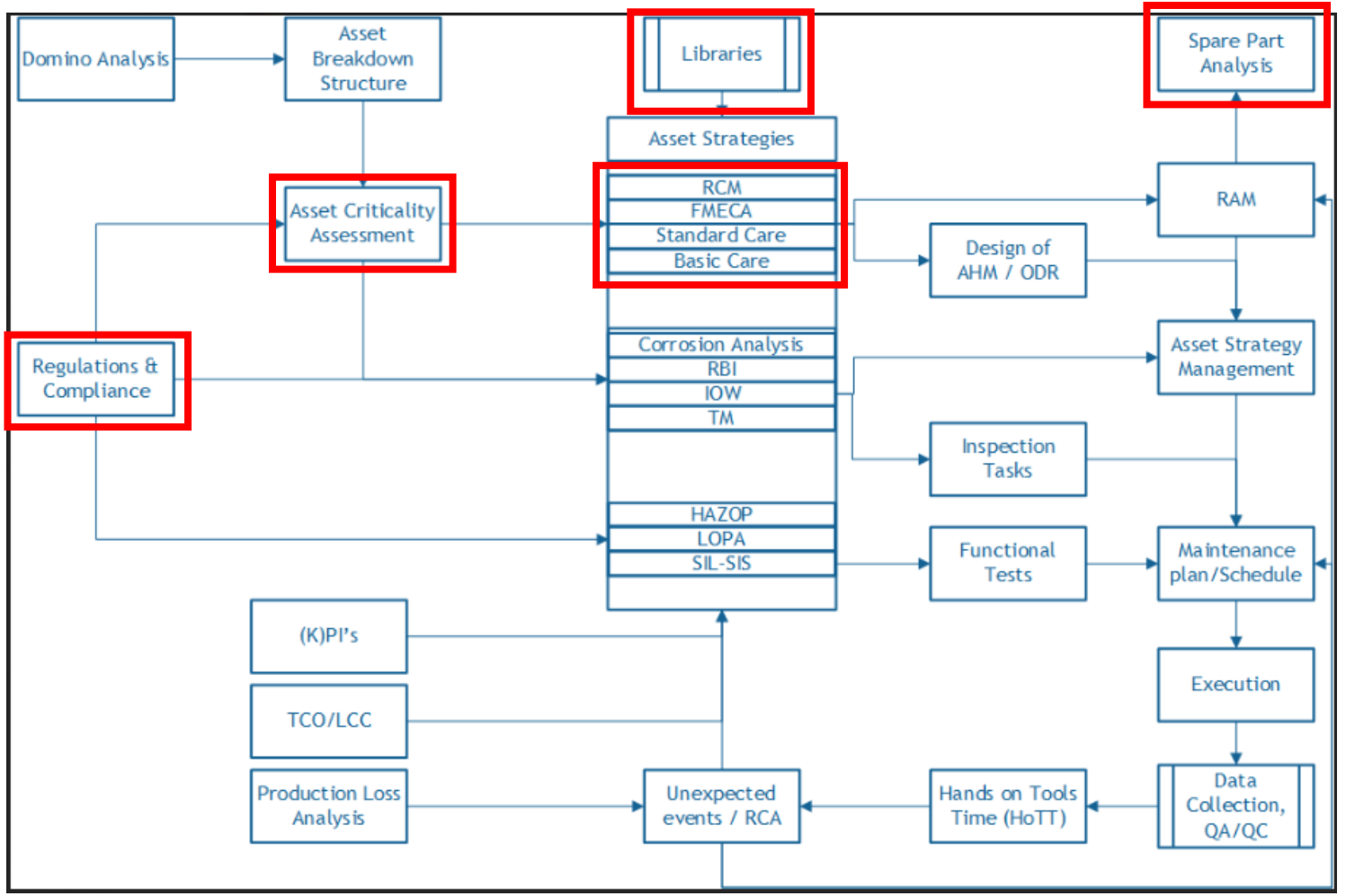
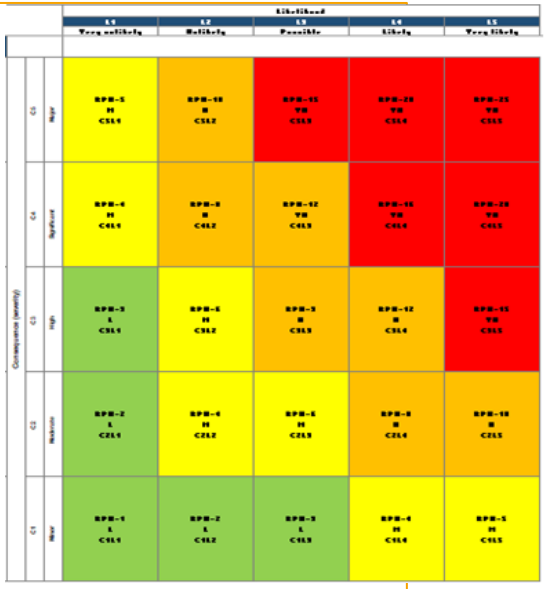
03. APM workflow: Reliability Centered Maintenance (RCM)



03. APM workflow: Reliability Centered Maintenance (RCM)

Asset criticality and maintenance approach

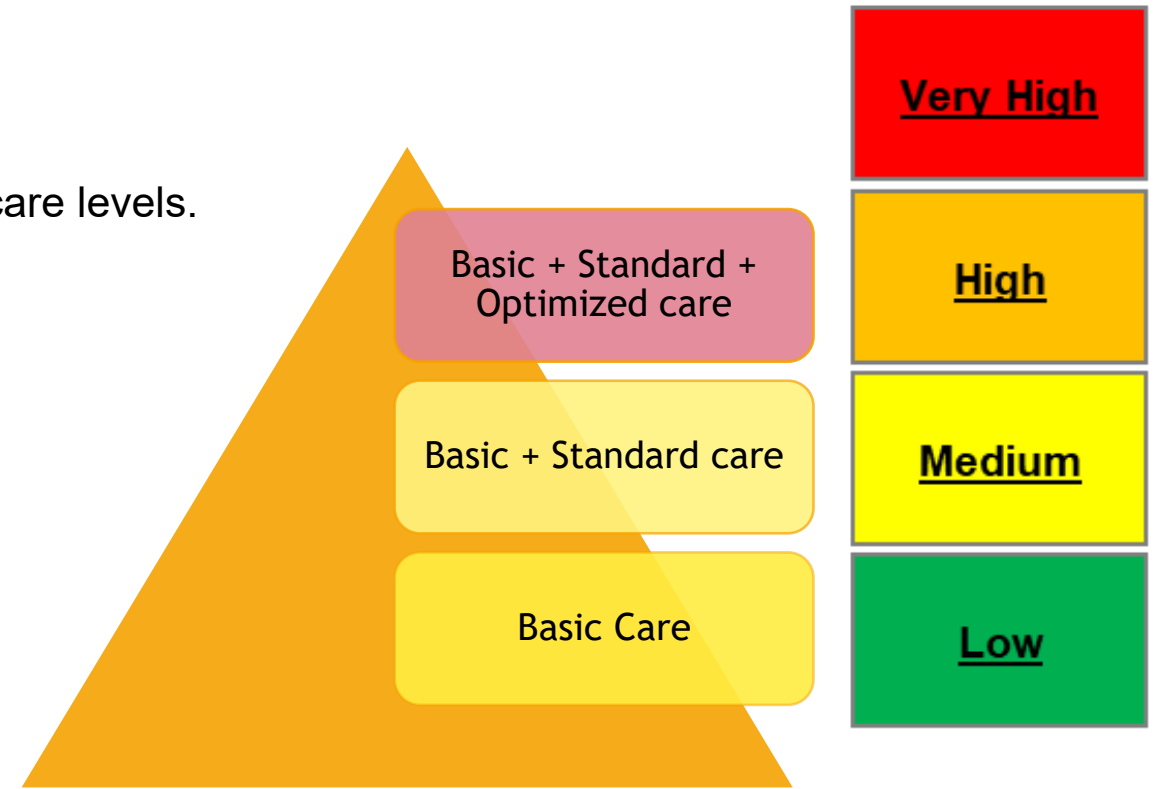


- Asset criticality is assessed by a multidisciplinary team
- Equipment ranking determines the maintenance approach:
  - Low criticality → Basic care
  - Medium criticality → Basic + Standard care
  - High / Very high criticality → Extended care with optimized tasks
- A maintenance task library exists:
  - Predefined maintenance tasks
  - Per equipment type and failure modes
- All departments are invited to add when criticality is assessed.
- Example: Functional Process Safety includes SIL loops: extensive care
  - During the HAZOP the tracing was point of discussion.
  - The tracing itself was not deemed a SIL-loop but the tracing was assigned the same Extensive maintenance regime as for the SIL loop itself.

03. APM workflow: Reliability Centered Maintenance (RCM)

How To Approach?

- Align the Care levels with the Risk levels
- All assets, deserve at least Basic Care.
- Look for Effectiveness and Efficiency in all care levels.
- Be lean by combining & linking activities in Basic and Standard levels
- Decide about the Optimized Care by holding an HAZOP/RCM/FMEA study.



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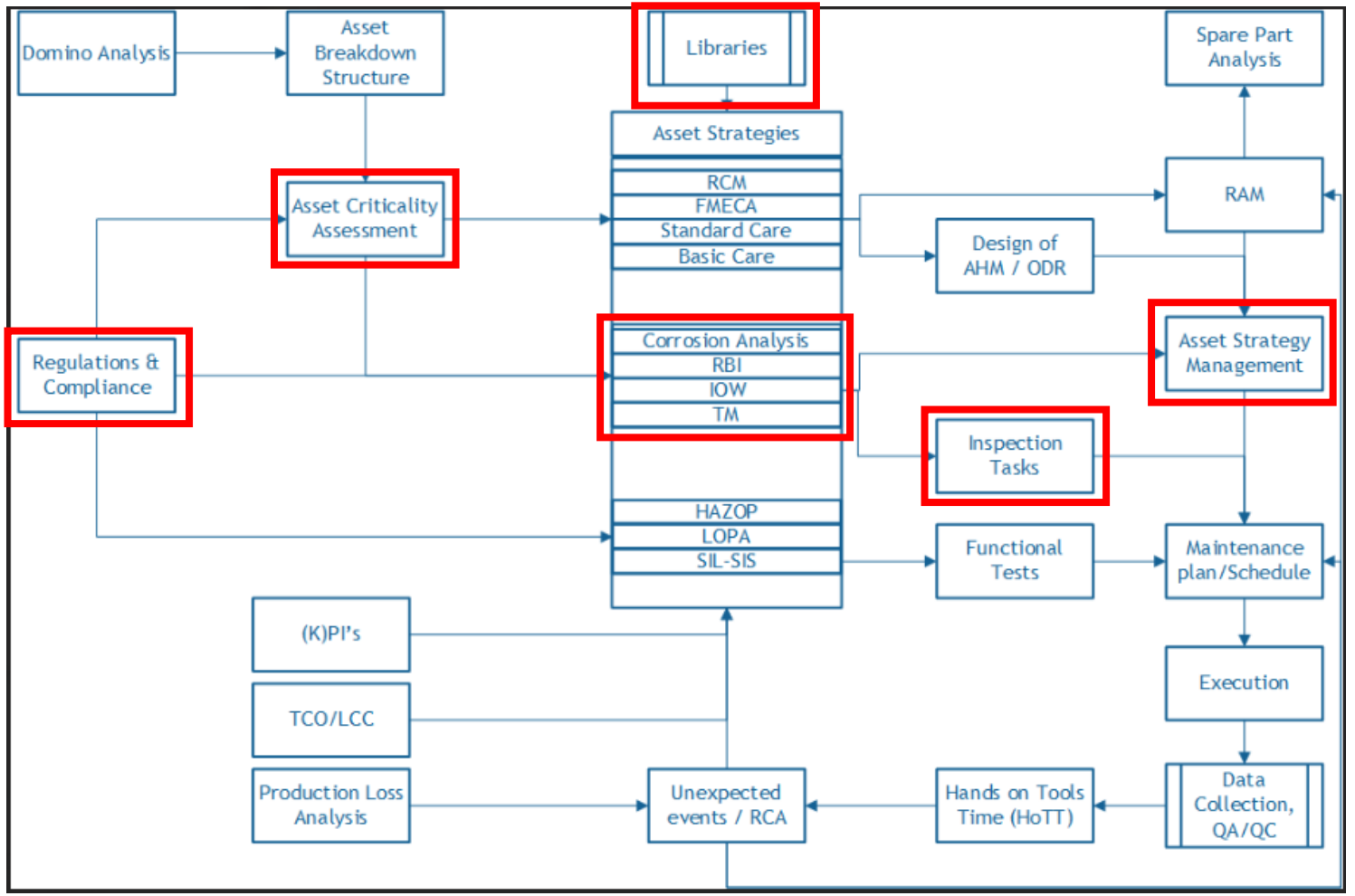
04. APM workflow: Mechanical Integrity (MI)



04. APM workflow: Mechanical Integrity (MI)

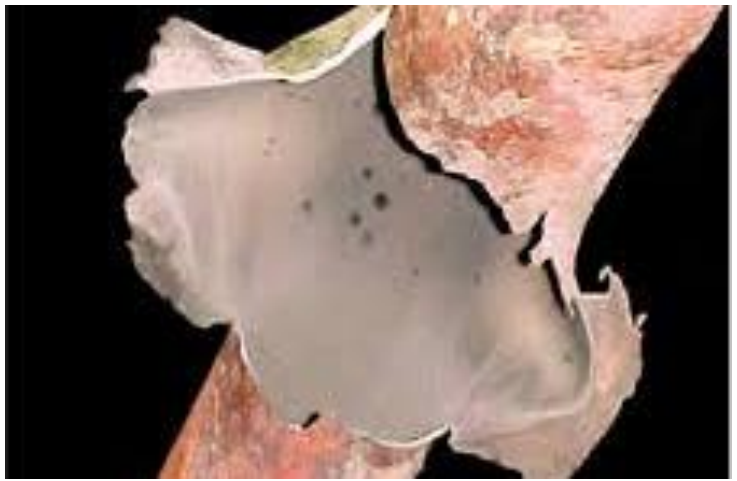
- Mechanical Integrity department reviews degradation mechanisms during normal operations.
- If left unchecked, degradation can lead to Loss of Containment (LOC).
- LOC can occur even when process parameters remain within the operational window.

Example of corrosion loops

- Corrosion loops: group equipment with similar degradation conditions.
  - Enables focused inspections and targeted maintenance.
  - Helps define corrective actions when needed.
- Goal: To prevent failures and loss of containment

04. APM workflow: Mechanical Integrity (MI)

In some cases, these degradation mechanisms are activated by process parameters getting out of their normal operating window.



For these cases:

- Integrity Operating Windows (IOWs) are defined
- IOW parameters do not trip operations, but alarms trigger immediate investigation.
- Inspection to show the effects may be required if process parameters exceed normal limits.
- IOWs set safe limits on process parameters to avoid accelerated equipment degradation and ensure safe operations.

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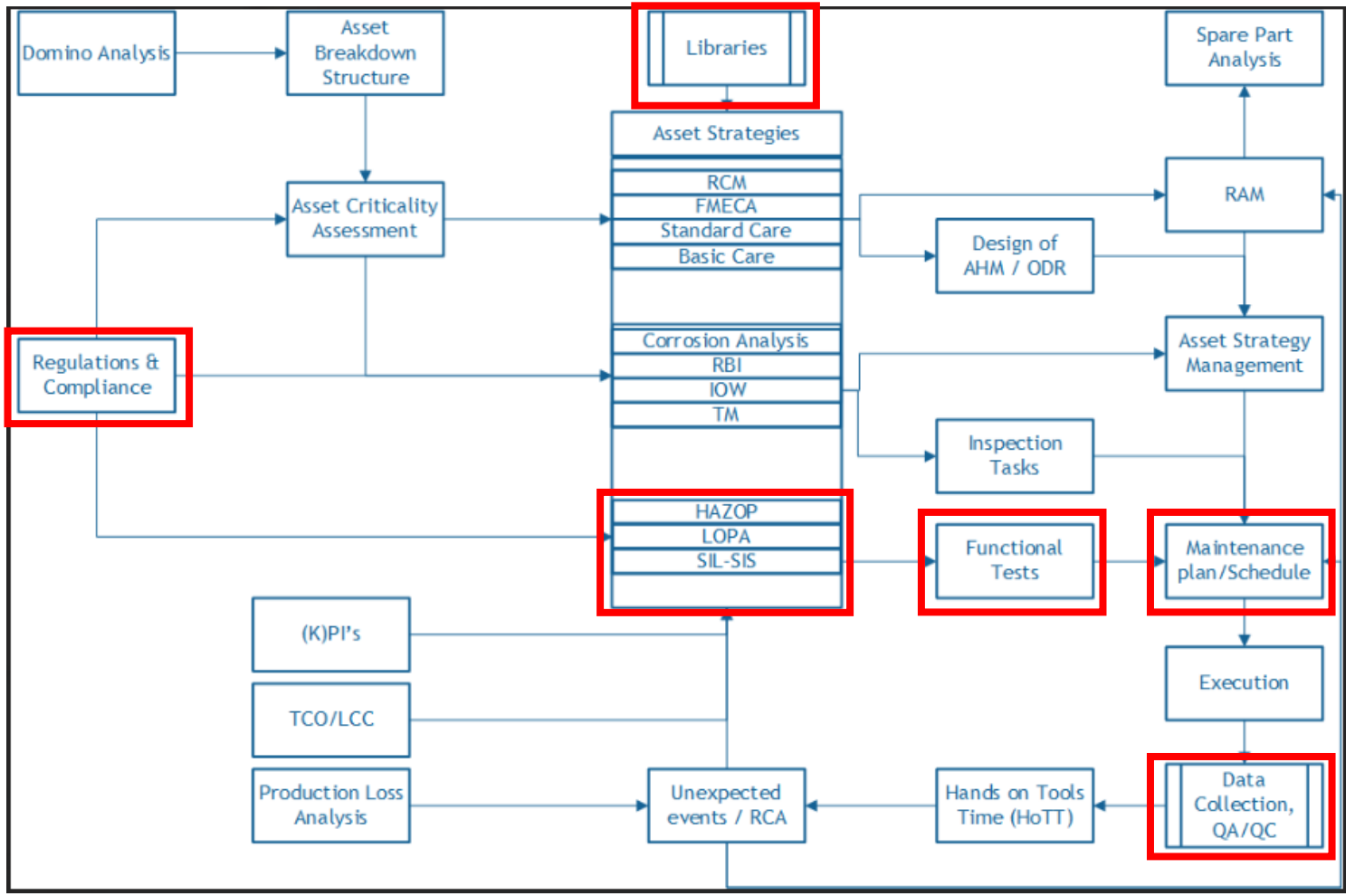
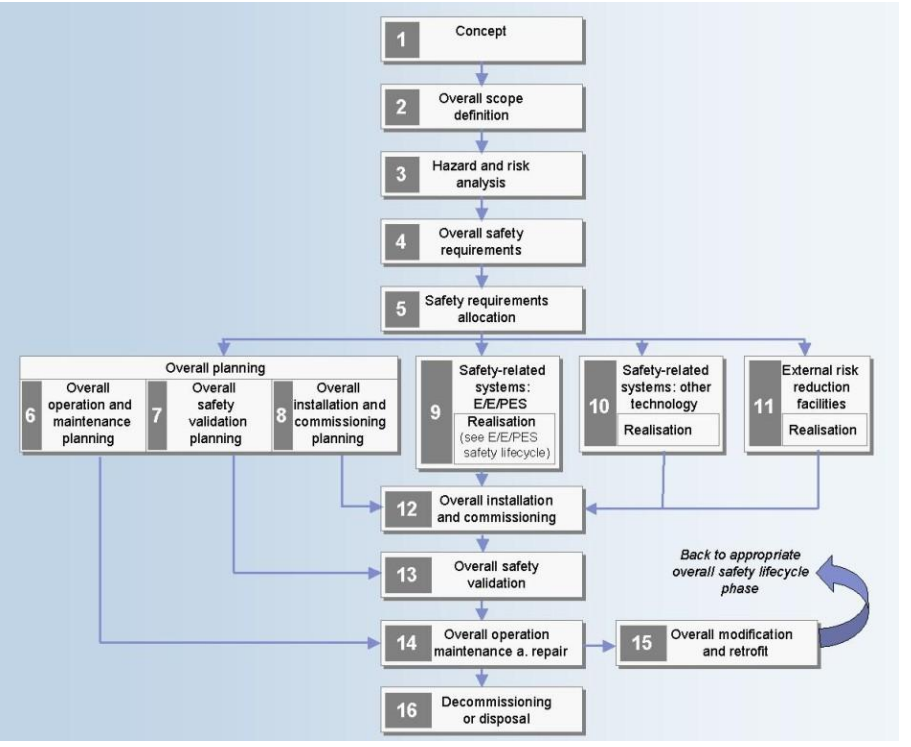
05. APM workflow: Process Safety



05. APM workflow: Process Safety

- Process Safety Lifecycle is followed
- Integrated Team executes the HAZOP/LOPA

- Failure frequency enriched by own data
- Risk Reduction data for IPL improved by own test results
  - ➢ <u>Example:</u> Passive protection



- Functional test and maintenance on SIL loops is clearly defined
- Any deviation in the system is flagged as recommendation.

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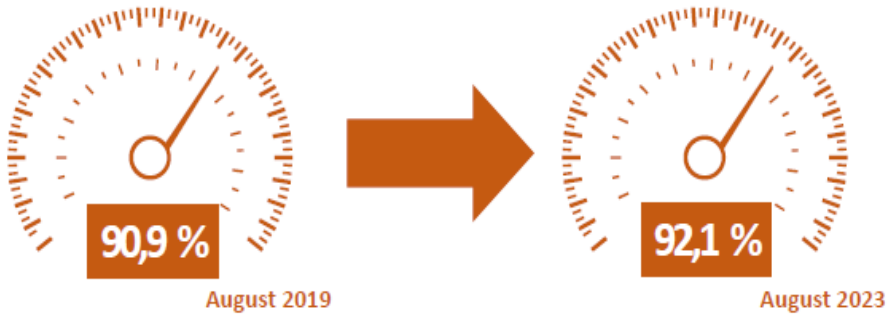
06 **Results and take-aways**

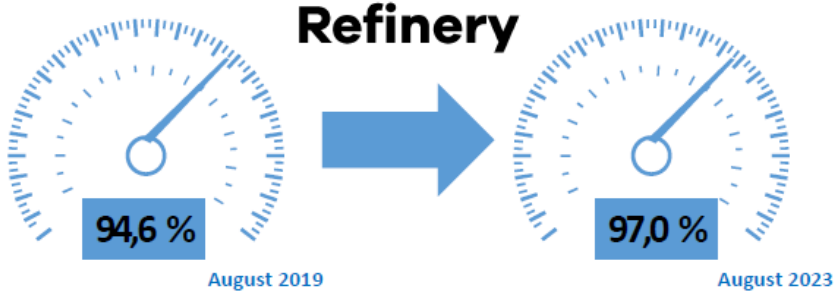
06. Results and take-aways

Proven Results – Example of Socar

Petrochemicals



Refinery



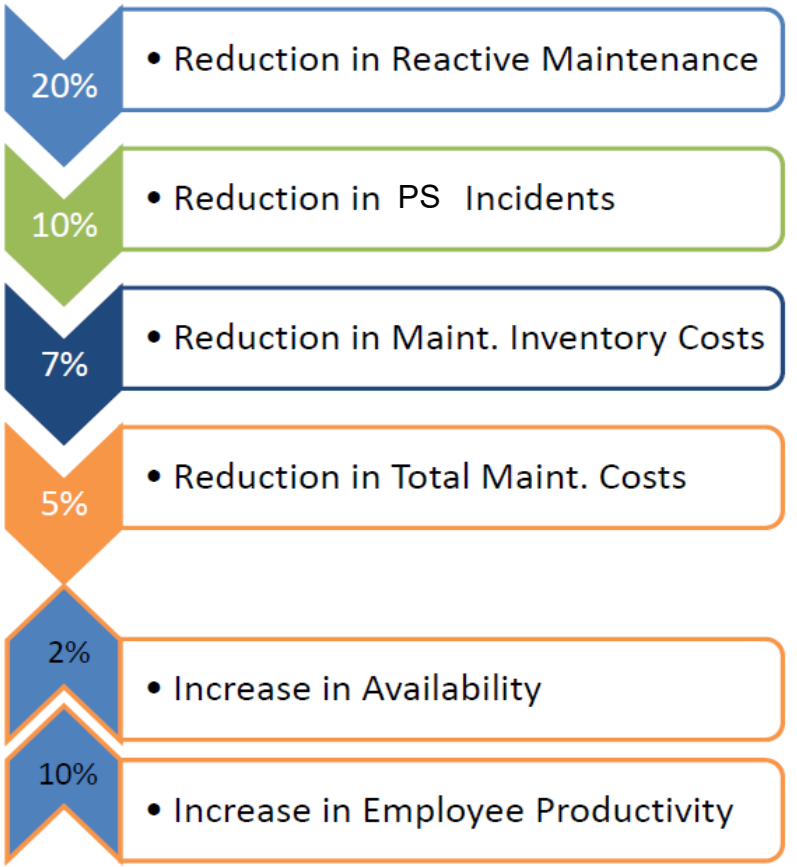
- 20% • Reduction in Reactive Maintenance
- 10% • Reduction in PS Incidents
- 7% • Reduction in Maint. Inventory Costs
- 5% • Reduction in Total Maint. Costs
- 2% • Increase in Availability
- 10% • Increase in Employee Productivity

06. Results and take-aways

Integrated APM approach

- Bilfinger: incidents can be reduced through integrated APM
- APM Integration = collaboration across departments
- for optimal maintenance
- Key participants:
    - Maintenance
    - Operations
    - Mechanical Integrity
    - Reliability
    - Process Safety
    - Working together in one approach

→ Success at multiple levels



06. Results and take-aways

1) APM Integration = Using one tool supporting the organization

- Optimized maintenance planning combined from several sources

2) Execution

- Maintenance enters feedback into system
- Operations log incidents with more detail
- Failure data enriched with end-user specifics

3) Verify the performance

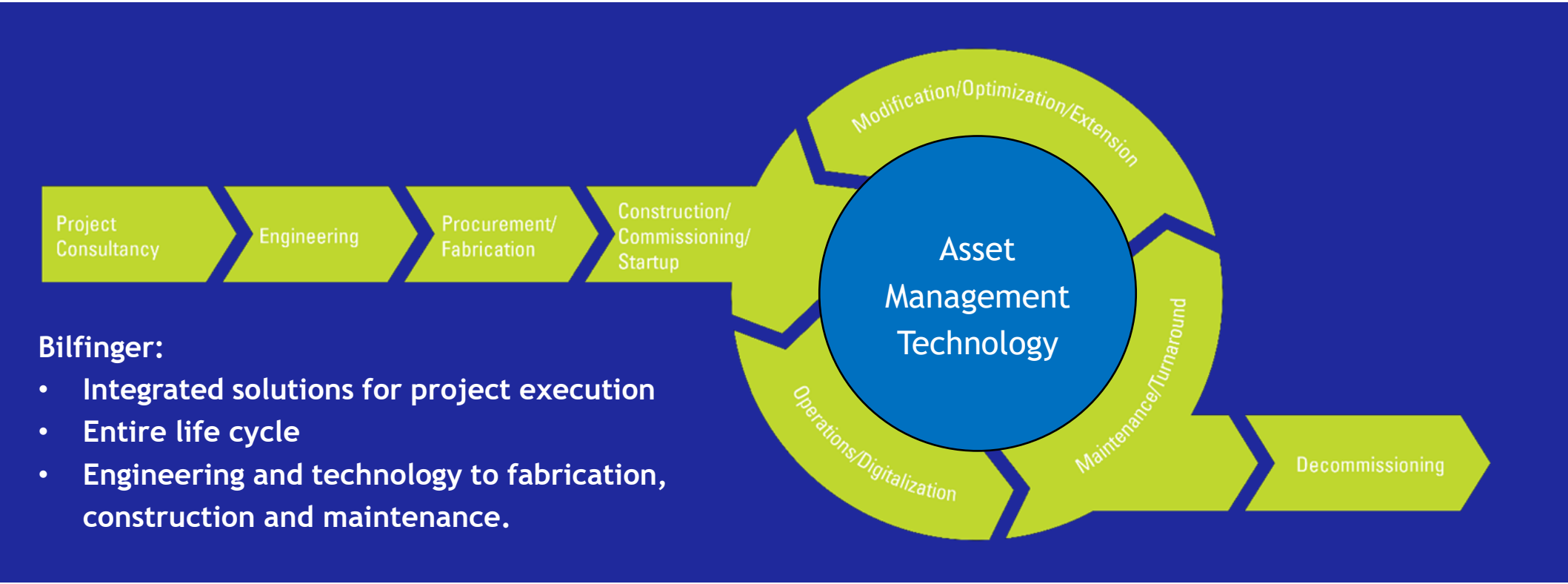
- Automated system will flag deviations

4) Continuous cycle of adjustment to the actual situation

- Process Safety quality improvement

06. Results and take-aways

Former Asset Management Technology - Now part of Bilfinger (April 1st, 2024).



Bilfinger:

- **Integrated solutions for project execution**
- **Entire life cycle**
- **Engineering and technology to fabrication, construction and maintenance.**

Thank you
for your attention.

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