RISK BASED INSPECTION
PROJECTS & TURNAROUNDS

Gary Knight · NEPIC Best Practice in Projects & Turnarounds Conference · Middlesbrough Football Stadium · 22nd May 2019

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AGENDA

1. The asset lifecycle
2. Asset performance management
3. Risk based inspection
4. Roles & responsibilities
5. Adding value
6. Summary

THE ASSET LIFECYCLE
ASSUMED BEHAVIOUR

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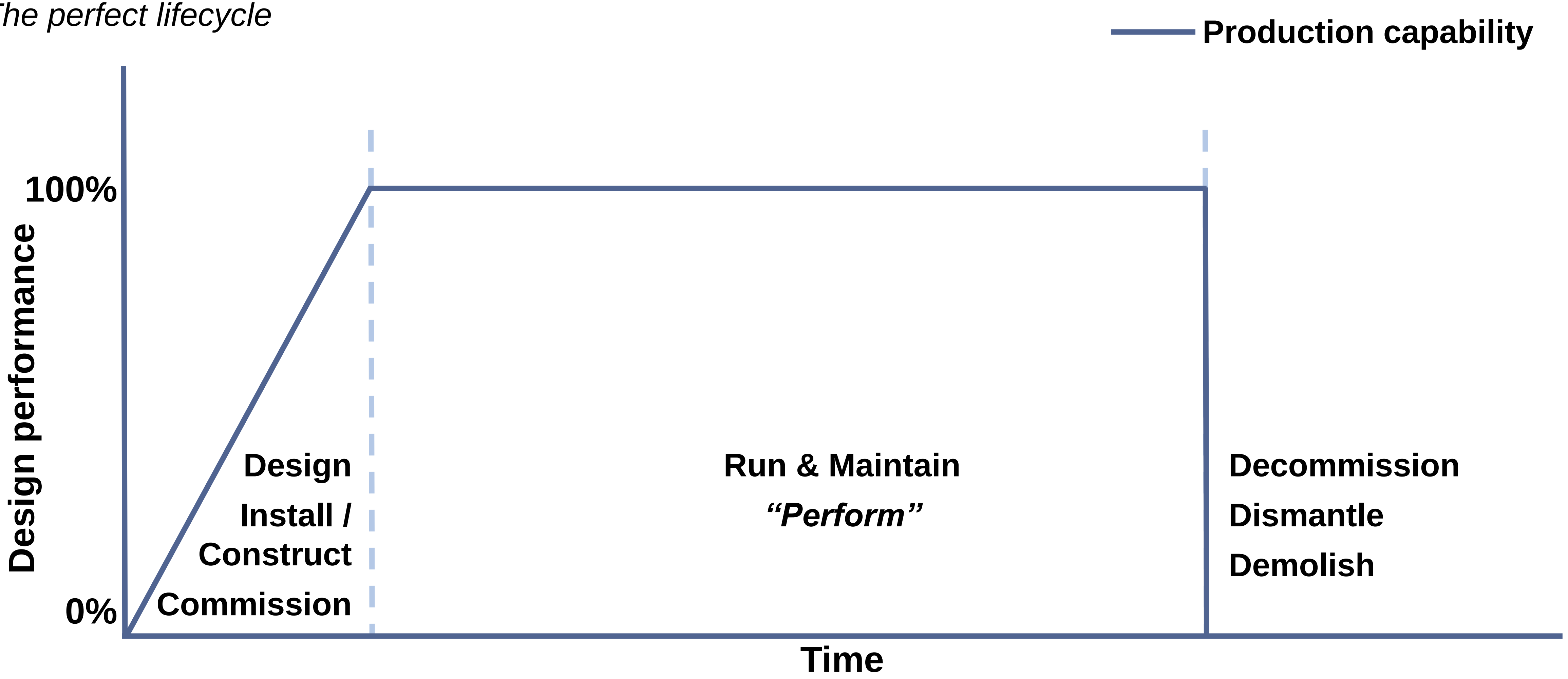
The perfect lifecycle



THE ASSET LIFECYCLE
THE TRUTH

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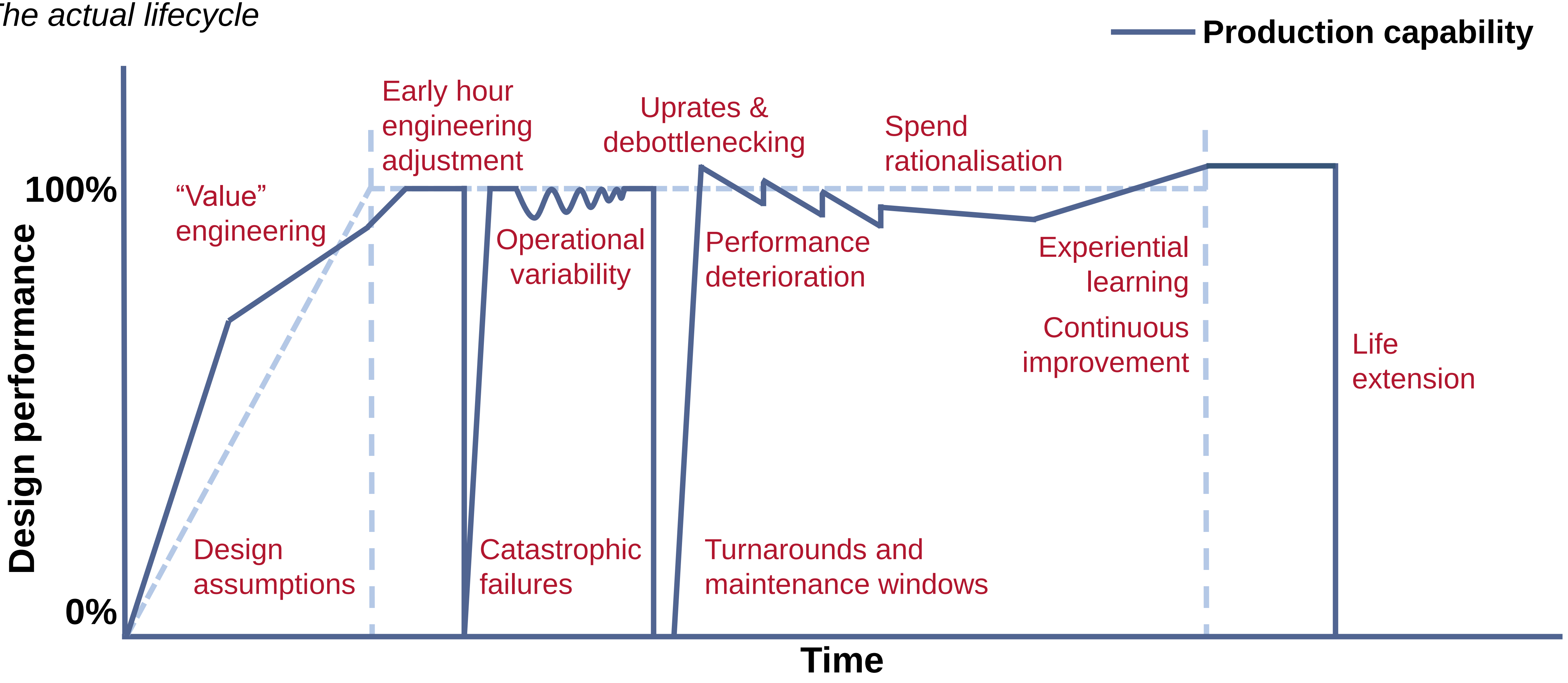
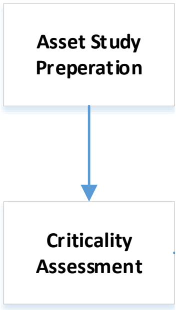
The actual lifecycle



ASSET PERFORMANCE MANAGEMENT
OVERVIEW



PREPERATION

- Asset list
- Legislation and codes of practice
- Operating context
- Equipment history
- Current inspection & maintenance practices

CRITICALITY ASSESSMENT

- Regulatory requirements
- Consequence of failure
- Likelihood of failure

ASSET PERFORMANCE MANAGEMENT
OVERVIEW

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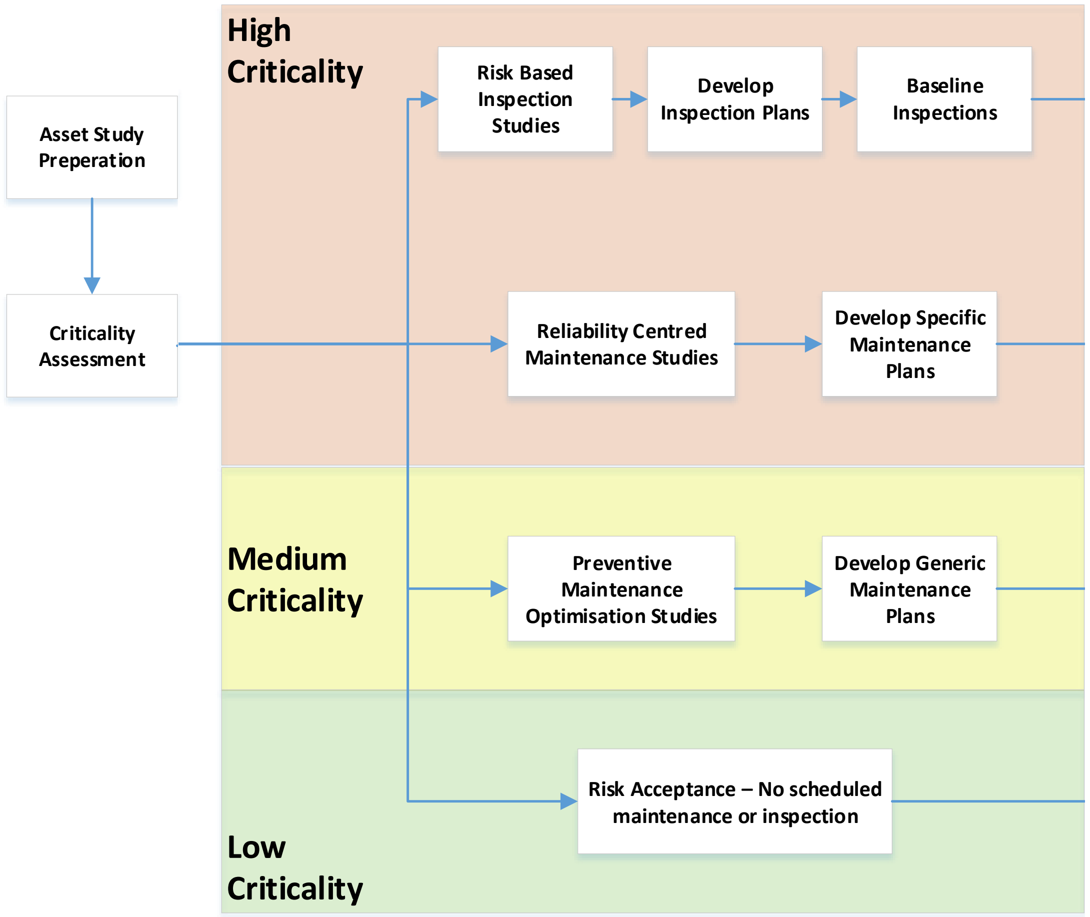
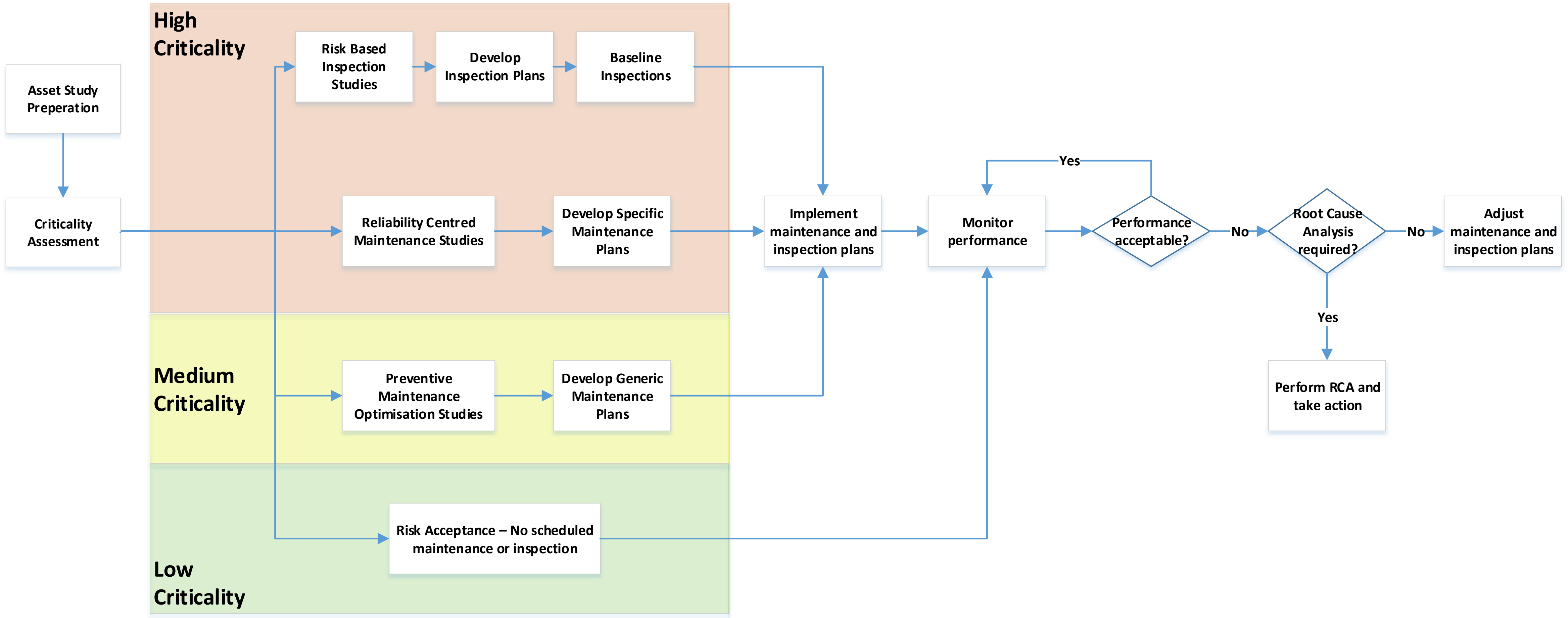


ASSET PERFORMANCE MANAGEMENT
OVERVIEW



ASSET PERFORMANCE MANAGEMENT
FIT WITH PROJECTS AND TURNAROUNDS

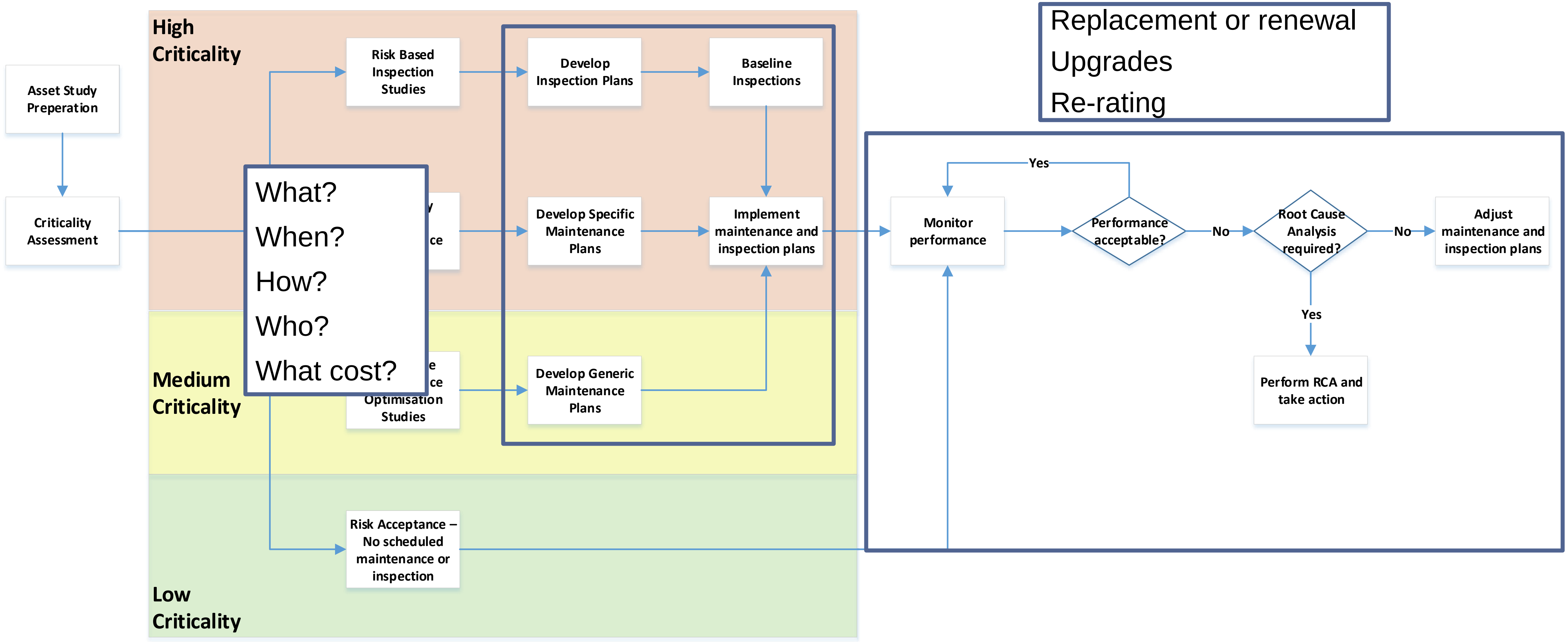
GOALS OF A TURNAROUND

“To deliver the required offline maintenance and inspection tasks which allow the equipment to perform optimally for a specified mission time”

GOALS OF A PROJECT

“To deliver a specific scope of work on time, in full”

ASSET PERFORMANCE MANAGEMENT
FIT WITH PROJECTS AND TURNAROUNDS



FOCUS ON RISK BASED INSPECTION
CONCEPT

The aim of risk based inspection is to **optimise** inspection activities

- High risk items given appropriate attention
- Lower risk items managed proportionately

Risk based inspection can be:

- **Quantitative:** Using **data** and **numerical methods** to optimise activities and frequencies
- **Qualitative:** Based upon **subject matter expertise** and **experience**
- **A combination of the above:** Generally the case

FOCUS ON RISK BASED INSPECTION
BASIC PROCESS

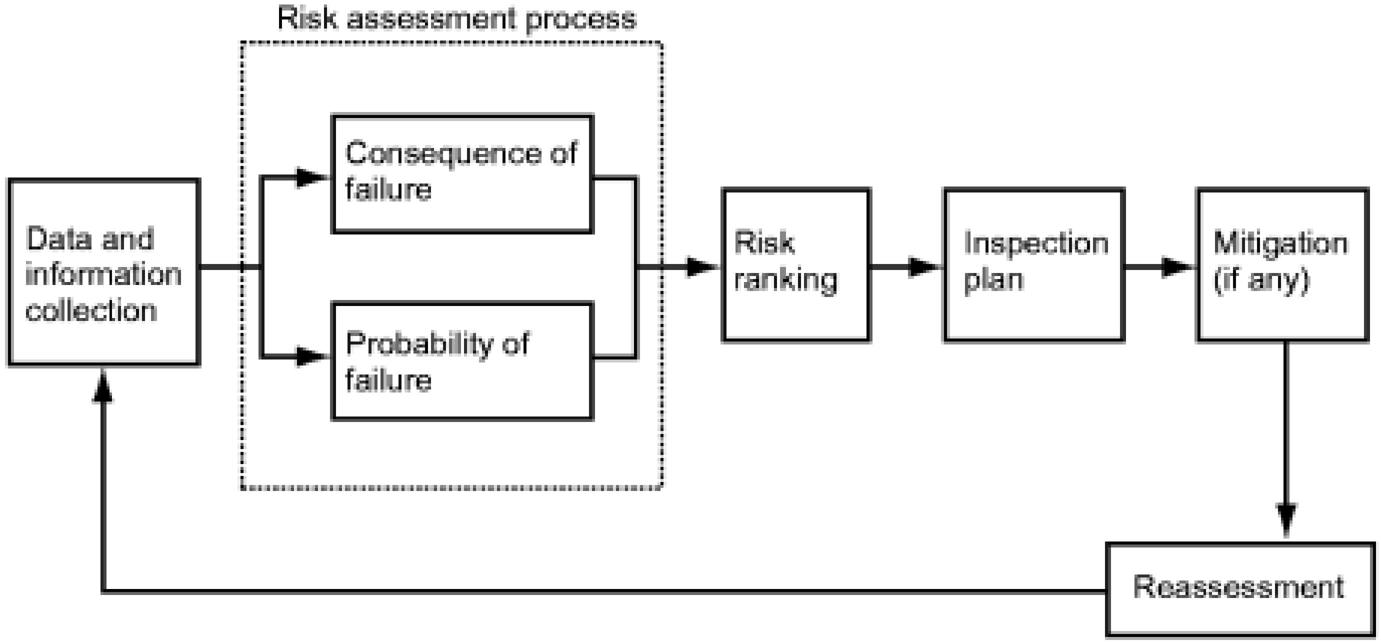


Figure 4—Risk-based Inspection Planning Process

API RP 580 – RBI Process

Regardless of method, **expertise** is key to **success**

RBI is a live process, **changes** need to be **captured**

It's a cycle that needs to be repeated to **build** effective **understanding**

FOCUS ON RISK BASED INSPECTION
CONSEQUENCE AND PROBABILITY OF FAILURE

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Consequence (CoF)

Three main aspects

- Safety
- Environmental
- Production

Considerations

- Fluid type
- Operation
- Location of item
- Potential size of release
- Likely failure mode – pin hole, full bore, major loss of containment

Probability (PoF)

Threats

- Credible corrosion mechanisms
- Environment
- Susceptibility based on latest industry findings / research

Mitigations

- Operational, e.g. process control, inhibitors or constraints
- Design factors, e.g. material or protective coatings

FOCUS ON RISK BASED INSPECTION
RISK RANKING OF DAMAGE MECHANISMS

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Qualitative

RISK MATRIX		CoF				
		NEGLIGIBLE	LOW	MEDIUM	HIGH	CRITICAL
PoF	CRITICAL	**Medium**	**High**	**Critical**	**Critical**	**Critical**
	HIGH	**Low**	**Medium**	**High**	**High**	**Critical**
	MEDIUM	**Low**	**Medium**	**Medium**	**High**	**Critical**
	LOW	**Negligible**	**Low**	**Medium**	**Medium**	**High**
	NEGLIGIBLE	**Negligible**	**Negligible**	**Low**	**Low**	**Medium**

Quantitative

API RP 580 – Risk plot

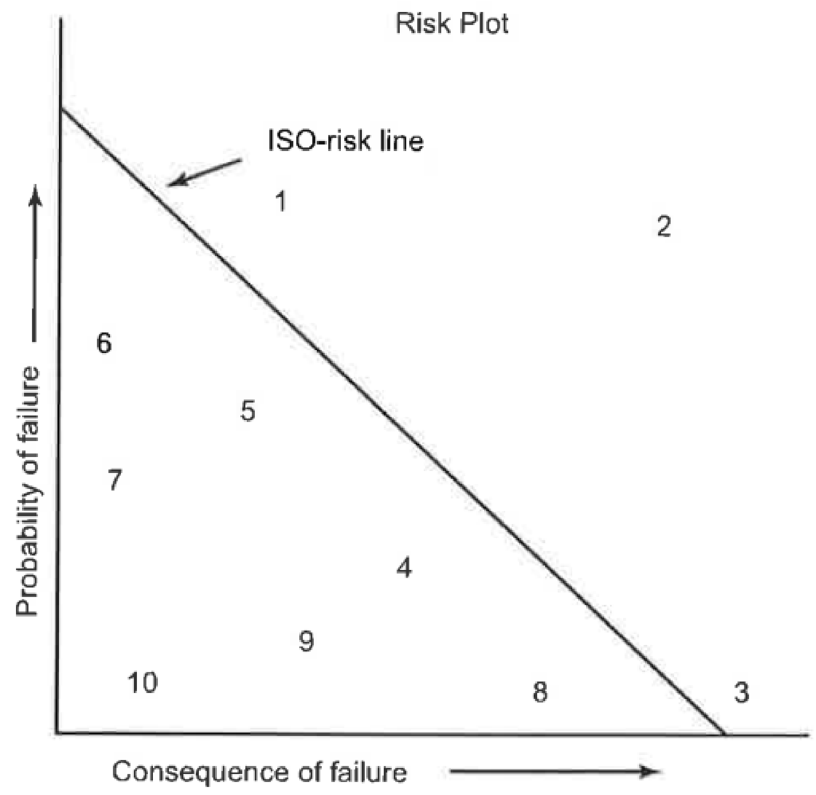


Figure 8—Risk Plot when Using Quantitative or Numeric Risk Values

FOCUS ON RISK BASED INSPECTION
INSPECTION PLANS

Content of a scheme of examination

Preparation requirements
Inspection techniques
Frequency
Coverage and locations
Training and competence

Focussed on the damage mechanisms and areas of risk

FOCUS ON RISK BASED INSPECTION
INSPECTION EFFECTIVENESS

API qualifies inspection **effectiveness** as the **coverage** and **capability** of an inspection to identify the **damage** state

Effectiveness is a level of **confidence** that the inspection will find corrosion or defects within the areas at **risk**

Table 2.C.2.1 – Inspection Effectiveness Categories

Inspection Effectiveness Category	Inspection Effectiveness Description	Description
A	Highly Effective	The inspection methods will correctly identify the true damage state in nearly every case (or 80-100% confidence).
B	Usually Effective	The inspection methods will correctly identify the true damage state most of the time (or 60-80% confidence).
C	Fairly Effective	The inspection methods will correctly identify the true damage state about half of the time (or 40-60% confidence).
D	Poorly Effective	The inspection methods will provide little information to correctly identify the true damage state (or 20-40% confidence).
E	Ineffective	The inspection method will provide no or almost no information that will correctly identify the true damage state and are considered ineffective for detecting the specific damage mechanism (less than 20% confidence).

Note: On an inspection effectiveness category E, the terminology of ineffective may refer to one or more of the following cases:

1. No inspection was completed.
2. The inspection was completed at less than the requirements stated above.
3. An ineffective inspection technique and/or plan was utilized.
4. An unproven inspection technique was utilized.
5. Insufficient information was available to adequately assess the effectiveness of the inspection.

*API 581 3rd , Part 2, 4.7

ROLES AND RESPONSIBILITIES
THE RBI TEAM

RBI requires a team committed to ensuring implementation is maintained and updated, this should include:

- RBI Specialist
- Qualified asset inspectors
- Materials engineer
- Corrosion engineer
- Asset design engineer
- Operations and maintenance staff
- Process specialist
- Safety and Environmental personnel

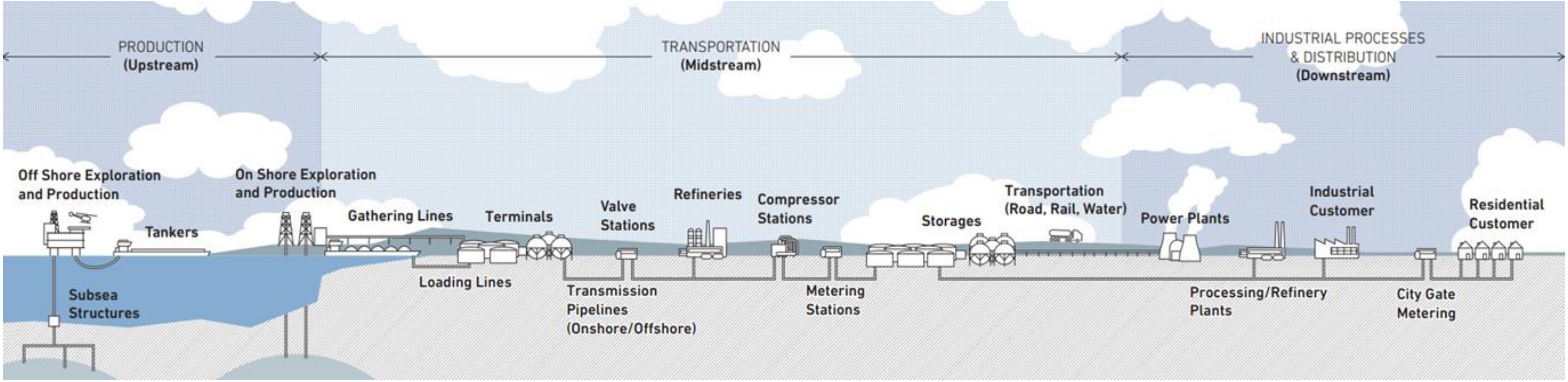
ADDING VALUE
PROJECTS

During the design phase:

- Requirements for integrity management set
- Equipment configuration and design aspects
- Materials of construction
- Team is in place who understand key aspects

Opportunities:

- Design out damage mechanisms
- Design in "inspect-ability"
- Reduce overall lifecycle costs

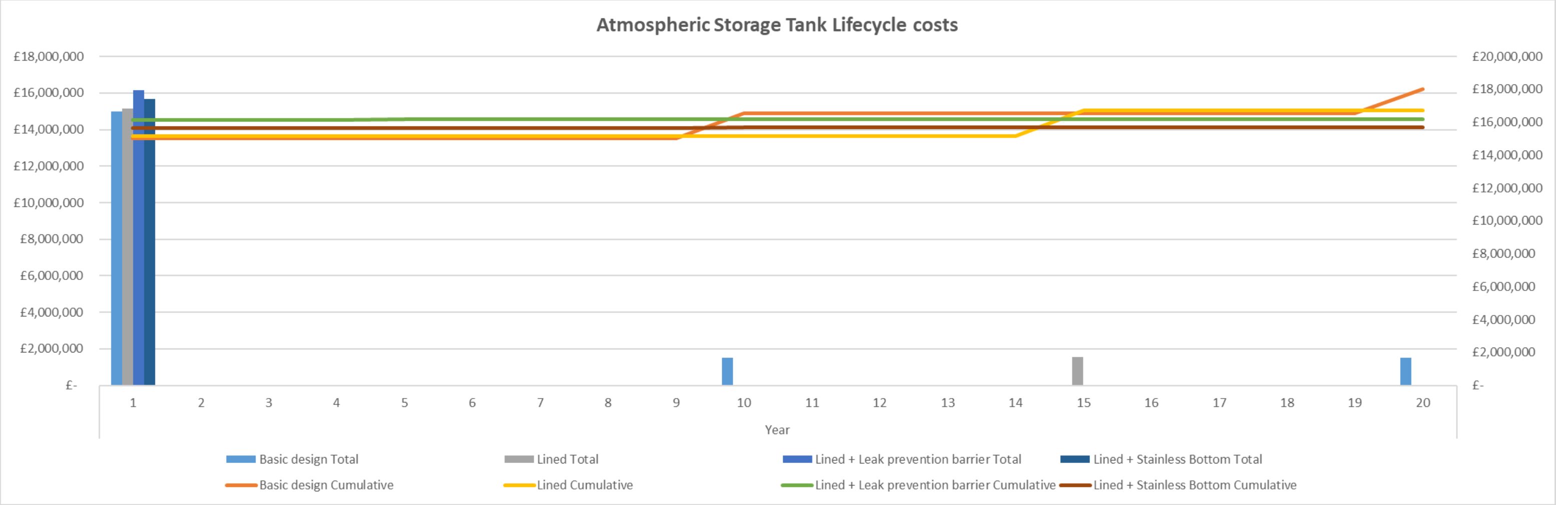


ADDING VALUE
EXAMPLE – NEW ATMOSPHERIC STORAGE TANK

Standard initial inspection interval (API) = 10 years

Table 6.1—Tank Safeguard

Tank Safeguard	Add to Initial Interval
i. Fiberglass-reinforced lining of the product-side of the tank bottom installed per API RP 652.	5 yrs
i Installation of an internal thin-film coating as installed per API RP 652.	2 yrs
iii. Cathodic protection of the soil-side of the tank bottom installed, maintained, and inspected per API RP 651.	5 yrs
iv. Release prevention barrier installed per API Std 650, Annex I.	10 yrs
v. Bottom corrosion allowance greater than 0.150 in.	(Actual corrosion allowance -150 mils)/corrosion rate*
… that meets requirements of API 650, Annex … nd external environments have been … sent very low risk of cracking or corrosion	10 yrs
… endix H, Similar Service	



ADDING VALUE
TURNAROUNDS

Opportunities:

- Developing workscopes
- Grouping of similar tasks – NDE
- Risk identification (to turnaround goals)
- Development of contingency plans
- Defining technical requirements (i.e. minimum wall thicknesses)
- Identifying technical support requirements (i.e. fitness for service)
- High quality of data collection

Thinking bigger:

- Increasing intervals
- Reducing duration

ADDING VALUE
EXAMPLE – SHELL AND TUBE NDE

Background:

- “New” NDE method for heat exchanger tubes selected used during turnaround
- Identified as a “best practice”

Results:

- Defects found!
- No contingency in place for materials, labour and technical specifications
- Contributed to turnaround over run and over spend

SUMMARY

Projects and **turnarounds** contribute to an **effective** asset performance management **system**

Asset performance management techniques offer a **framework** for a structured **conversation** to address specific asset **risks**

Static equipment and **inspection activities** present a particular challenge for project and turnaround **managers**

Adopting **RBI** as part of your **planning and preparations** process can **reduce risk** add significant overall **value**

CONTACT DETAILS

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THANK YOU FOR JOINING THIS PRESENTATION.