Integrity Monitoring? New thinking in the approach to Subsea IMMR

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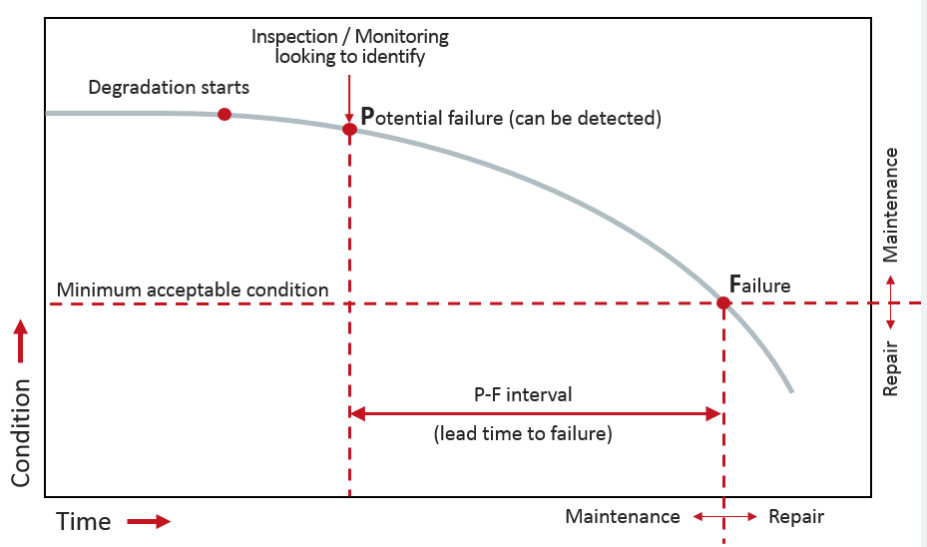
Outcomes

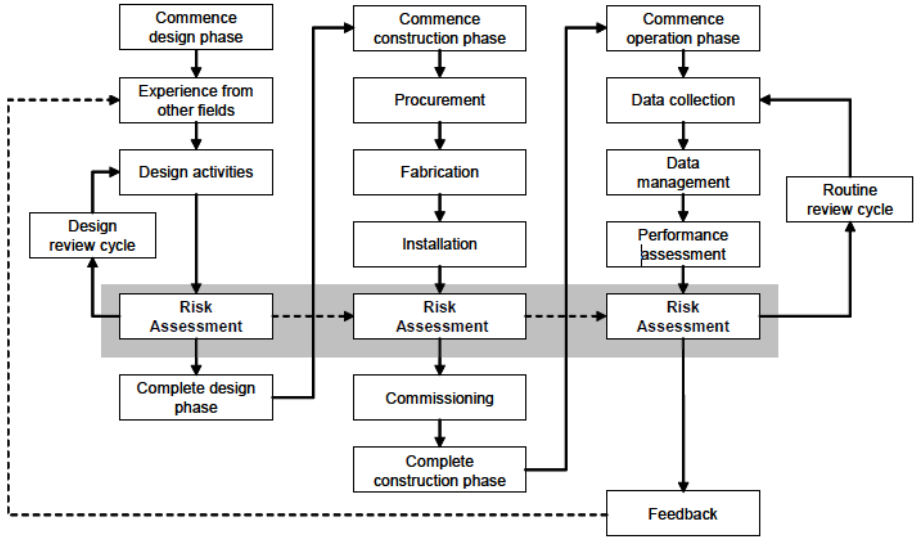
A full lifecycle consideration of inspection, monitoring, maintenance and repair (IMMR)

Aligned IMMR activities to characteristics of failure scenarios to better inform decision making

Innovative, value driven decision making to set inspection intervals:

- Maintained our best in class subsea availability performance
- Reduce inspection hours by greater than 10%





Objectives

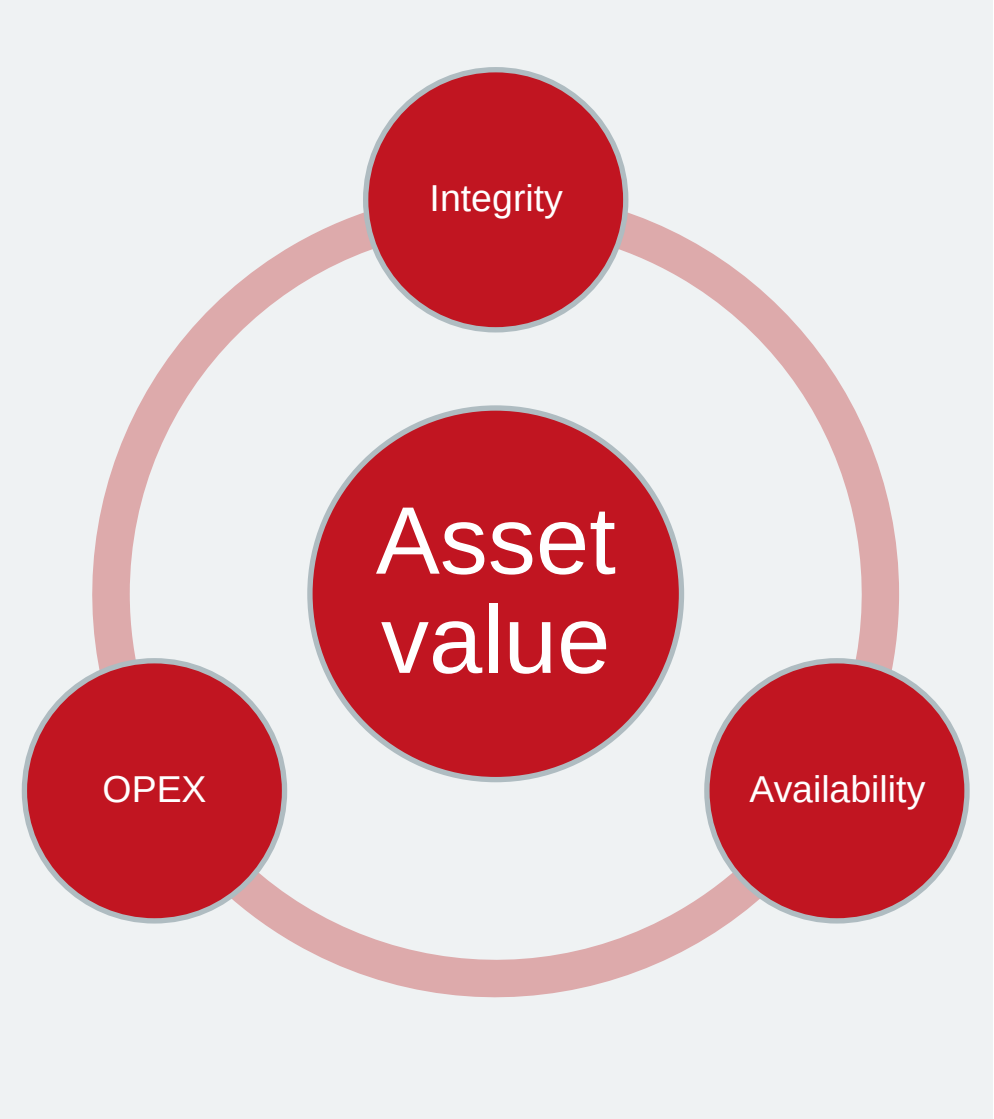
Protect and improve the value of operating assets

Best in class integrity management

Consistently high availability with reducing operating expenditure (OPEX)

Deliver subsea systems that are:

- more reliable,
- simpler to operate,
- lower cost to maintain, and
- easier to manage.



Historic approach improvement opportunities

LIFE CYCLE	ASSESS	SELECT		DEVELOP	EXECUTE		OPERATE
Value chain activities	Assess	Concept select	Concept definition	FEED	Execute	Commission and start-up	Operate
			Basis of design IMMR philosophy Sparing philosophy		Inherit design RBI Integrity envelope CMMS		RBI revision

Current approach can and does deliver high availability, however improvement opportunities exist:

- Accelerate value creation through early consideration of designed in OPEX performance
- Promote collaboration between subsea and pipeline disciplines and inspection capability
- Better clarity of justification for IMMR activities and risk based inspection (RBI) intervals

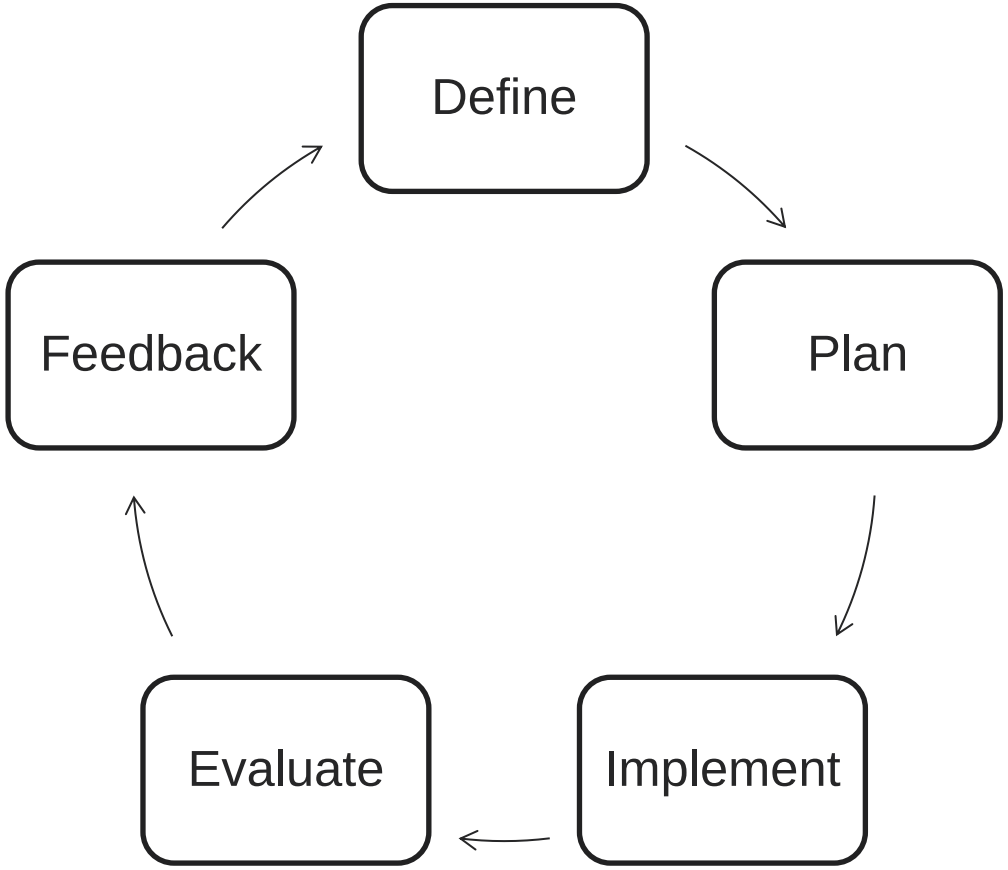
Growing acknowledgement of these opportunities throughout industry:

- Energy Institute and American Petroleum Institute producing/updating guidelines
- Agreement from consultants but no ‘go by’ deliverable

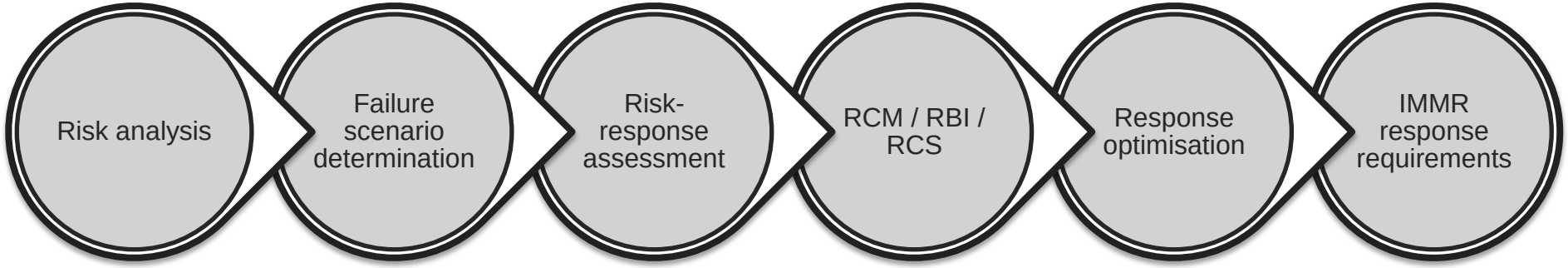
IMMR process

A repeatable process applied at each life cycle phase, based on the framework principles anticipated in the changes to API RP 17N:

- Define
  - Credible failure scenarios
  - Valid responses to manage those scenarios
- Plan
  - Create a plan to communicate the IMMR responses to the failure scenario
- Implement
  - Data collection to support revision of the plan
- Evaluate
  - Assess the validity of the responses
  - Identify required changes to the plan
- Feedback
  - Provide input to iteration and optimisation of the plan



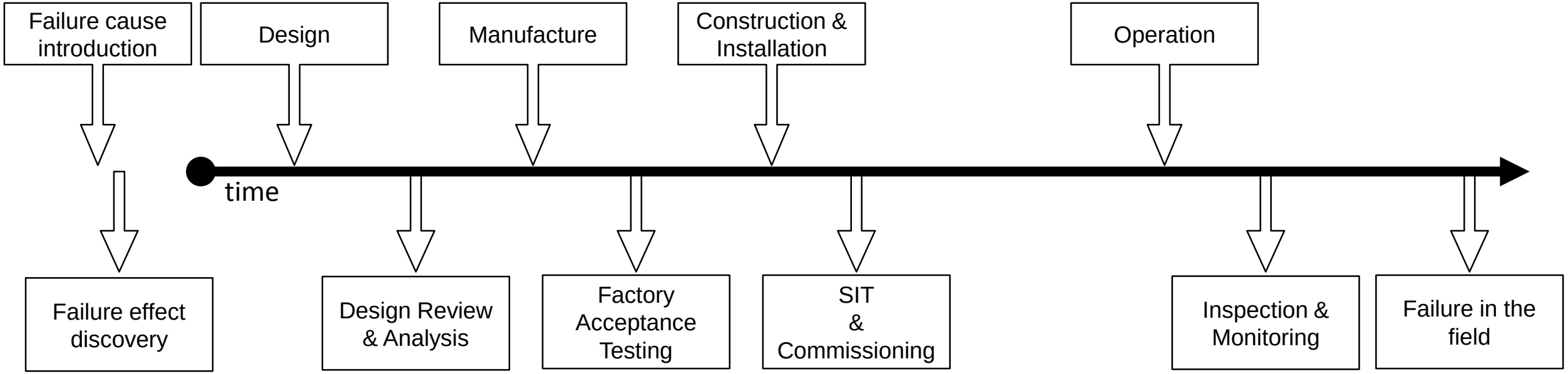
Risk Response assessment



Central to the IMMR process:

- Collate all risks already identified in project (from e.g. HAZOP, FSA)
- Translate to a failure scenario
- Use the characteristics of the failure scenario to determine valid risk responses
- Utilise reliability/risk centred decision support tools to set task frequencies
- Select the IMMR responses that best satisfy the objective to optimise around integrity, availability and OPEX
- Output IMMR requirements to a single plan

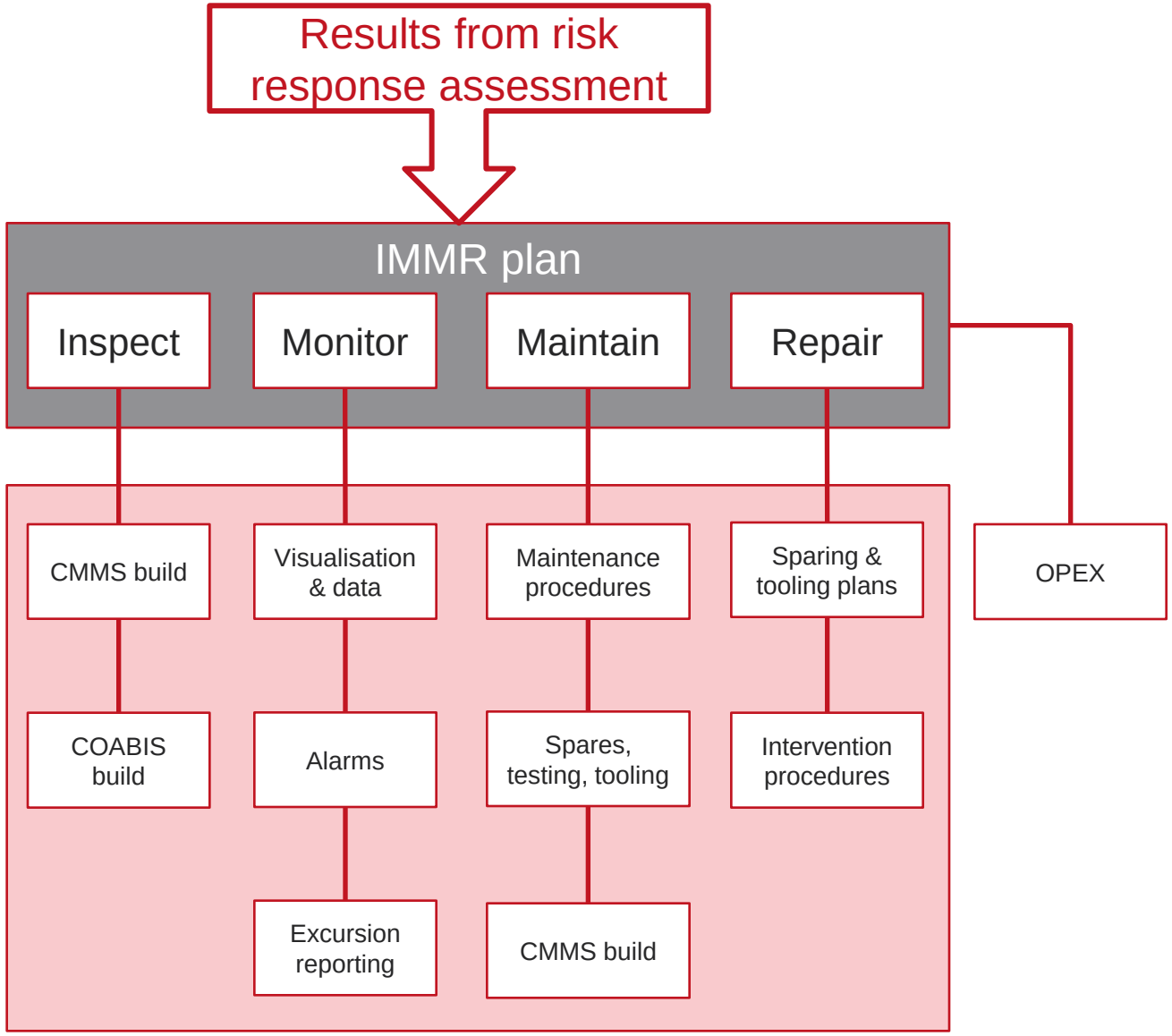
Relation between failure scenario and IMMR response



Justified, value-add IMMR activity derivation:

- Cause influences planned or triggered response
- Failure effect discovery influences applicability of data collection method
- Process leading to failure influences parameters that can be monitored/sampled

Key deliverable: IMMR plan



- The narrative that describes the actions to mitigate the risks identified. It contains the detail of the requirements and assists with the build of tools for;
  - Inspection
  - Monitoring
  - Maintenance
  - Repair
- Inspection requirements - feed into CMMS and COABIS build
- Monitoring plan – feed into the visualisation and dashboard requirements and operating procedures, alarms and reporting requirements
- Maintenance plan – feed into maintenance procedures, sparing, testing and tooling requirements, CMMS build
- Repair plan – feed into sparing & tooling plans, intervention procedures and CMMS build
- IMMR plan provides basis for OPEX estimates and budgeting

Life cycle IMMR consideration

Before

LIFE CYCLE	ASSESS	SELECT		DEVELOP	EXECUTE		OPERATE
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			Basis of design IMMR philosophy Sparing philosophy		Inherit design RBI Integrity envelope		RBI revision in light of inspection results

After

IMMR process objective	Influence selection		Influence design		Identify and develop		Validate and optimise
IMMR Plan content consideration		Compare gross IMMR implications	Identify design requirements to satisfy IMMR capability	Identify the IMMR responses to the design Detail how IMMR responses are implemented	Refine plan with project specific design concern	Update the plan with known manufacturing / installation / commissioning issues	Validate “as built” IMMR plan Update IMMR plan with known operational issues
		OPEX	OPEX	OPEX	OPEX	OPEX	Budget

Inspection intervals set based on value of information (VOI)

Concurrent effort to revise the method for setting inspection intervals

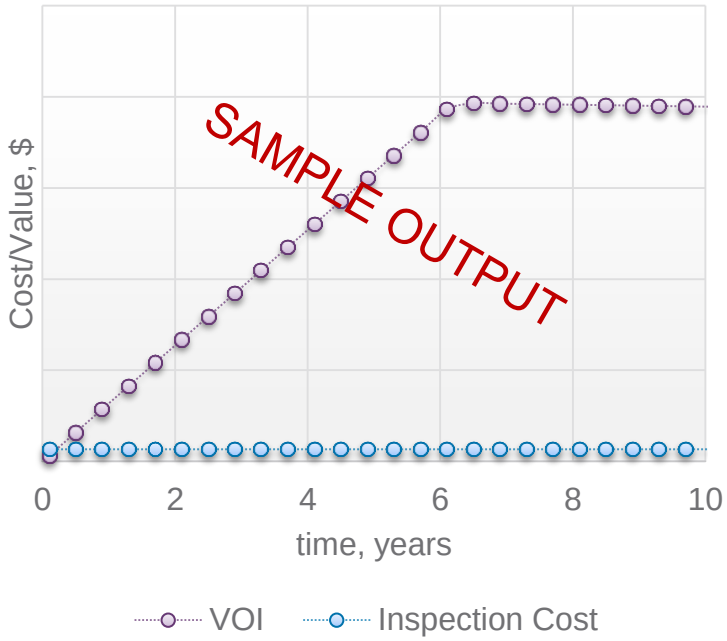
Challenges to a risk matrix based approach to setting inspection intervals:

- Risk – interval correlation is arbitrary
- Doesn't consider potentially high cost of inspection

Better justification for activities allow identification of decision the IMMR activity supports

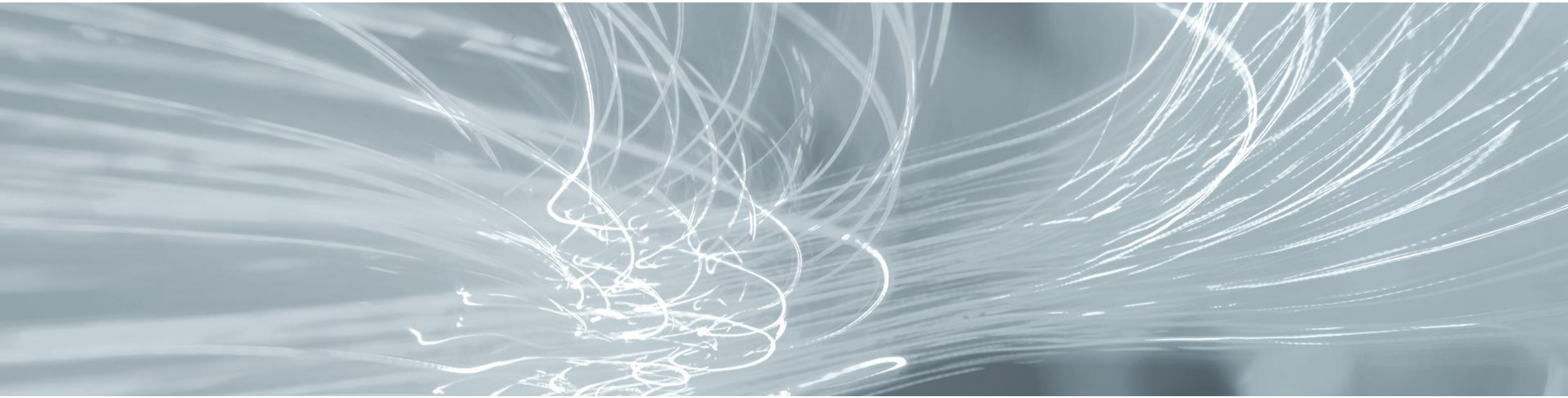
Determine upper and lower limit of inspection interval based on VOI concept of decision science

- How does the information from inspection improve decision making?



Conclusions

- Risk response assessment focusses effort on those IMMR activities that can better inform decisions with regard to failure scenarios
- Lifecycle consideration of IMMR shifts from generic to asset specific concern
- Good engagement from package engineers – supported them in highlighting design specific issues
- Promotes design discussion/decision around trade off between designed in monitoring functionality vs. inspection effort
- Initial results revealed >10% reduction in inspection hours while maintaining availability performance



Thank you

Any Questions…?