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From Data to Decision: Determining Evidence Sufficiency in Test and Evaluation

When is enough evidence enough?

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The Problem

How do we know when enough evidence exists?

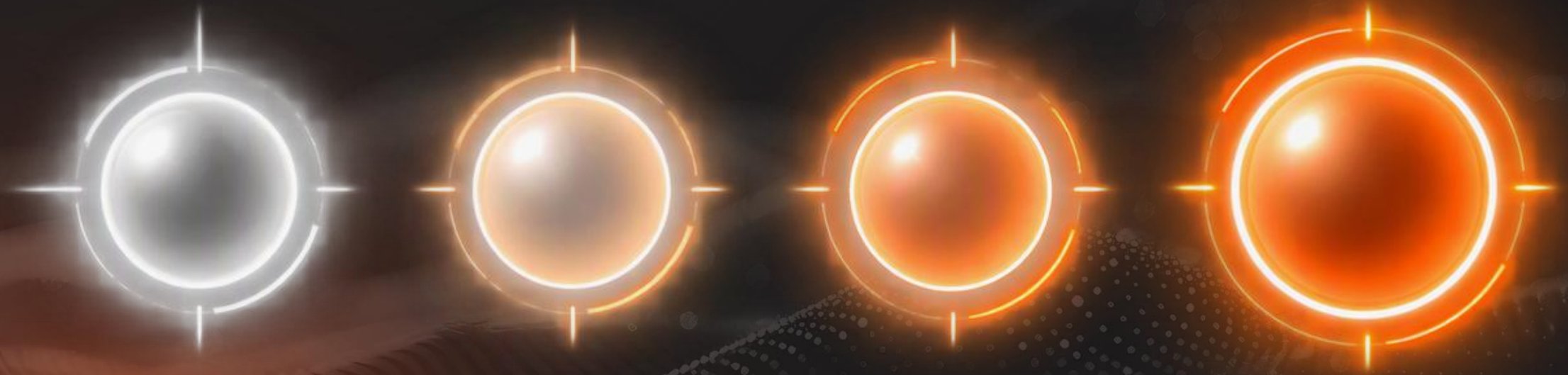


Is the evidence sufficient?

Is confidence justified?

What residual risk remains?

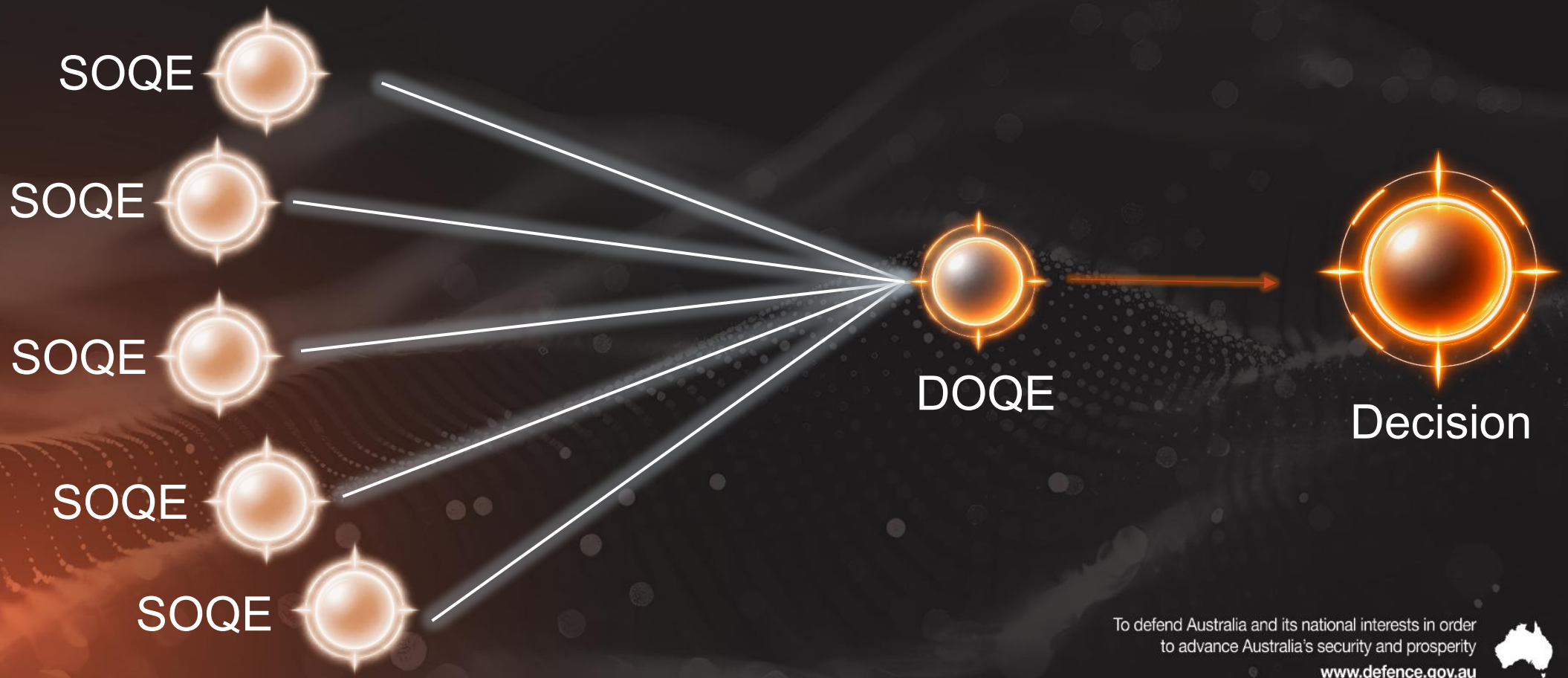
From Activity to Decision



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Decision OQE and Supporting OQE

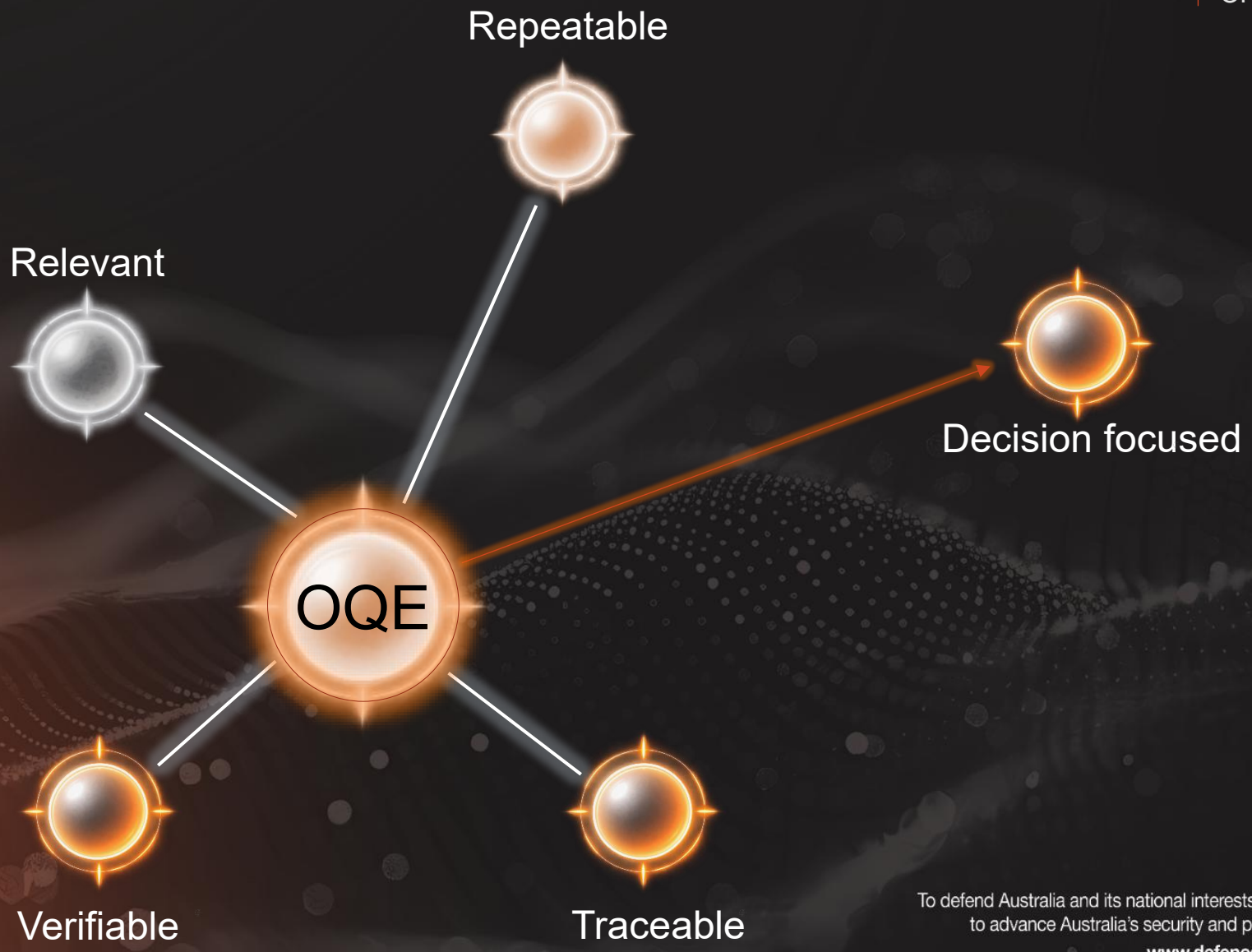


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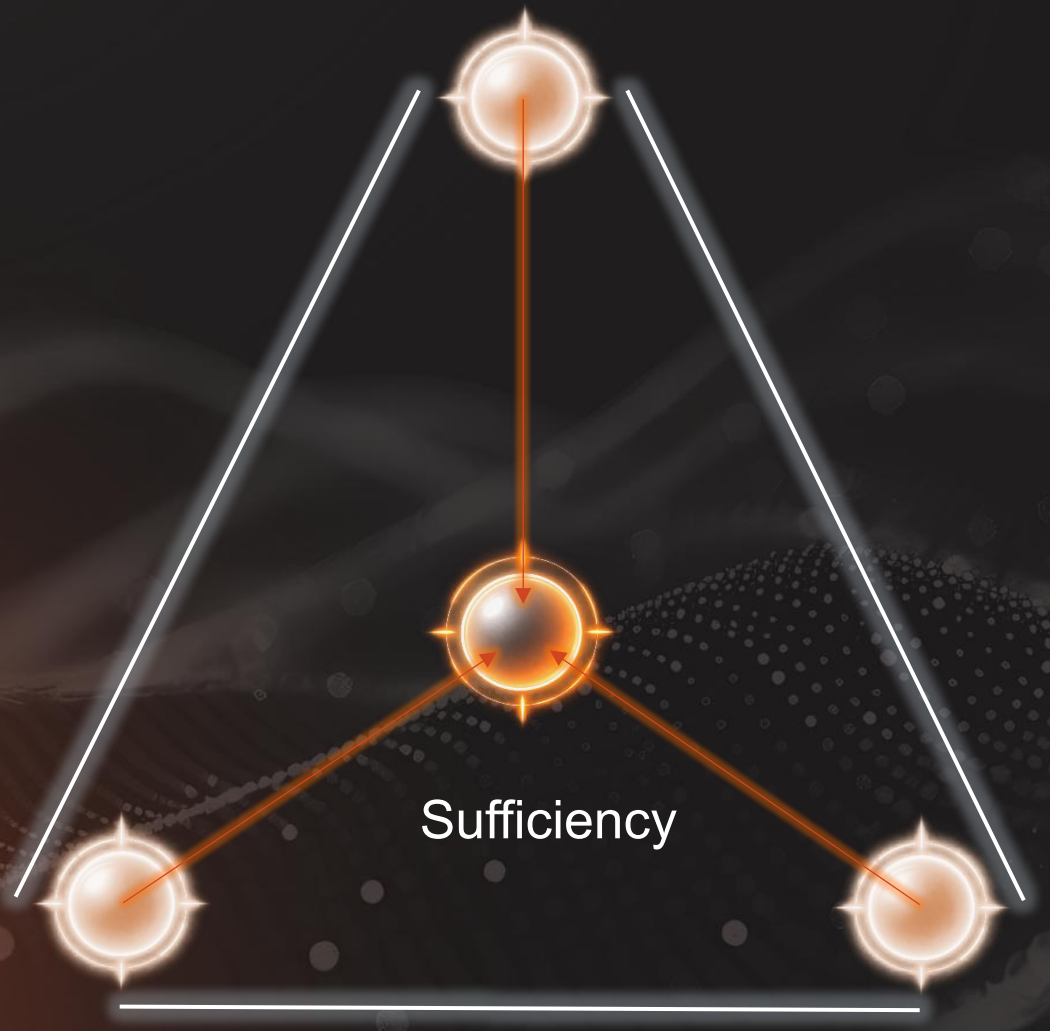
What is OQE



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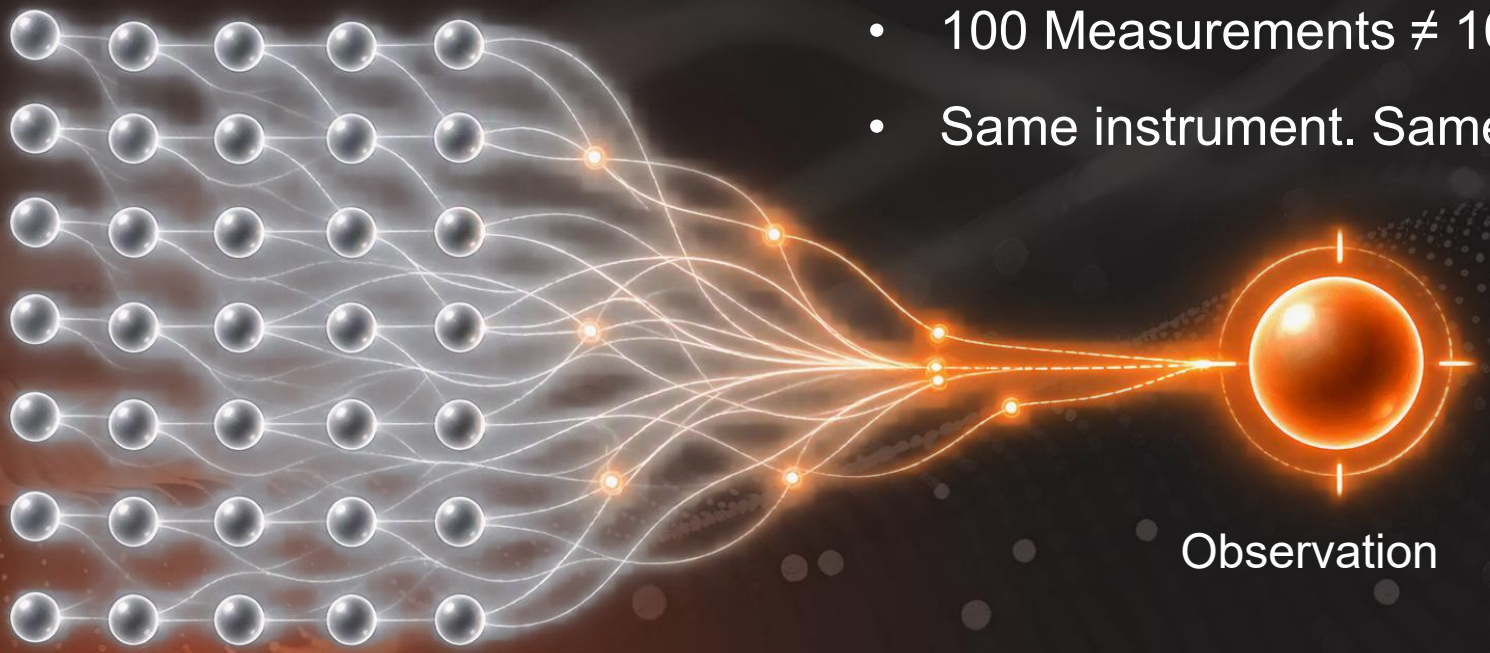
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What makes Evidence Sufficiency



Why Quantity Alone Fails

- Evidence Volume ≠ Independent Information
- 100 Measurements ≠ 100 Independent Observations
- Same instrument. Same operator. Same method.



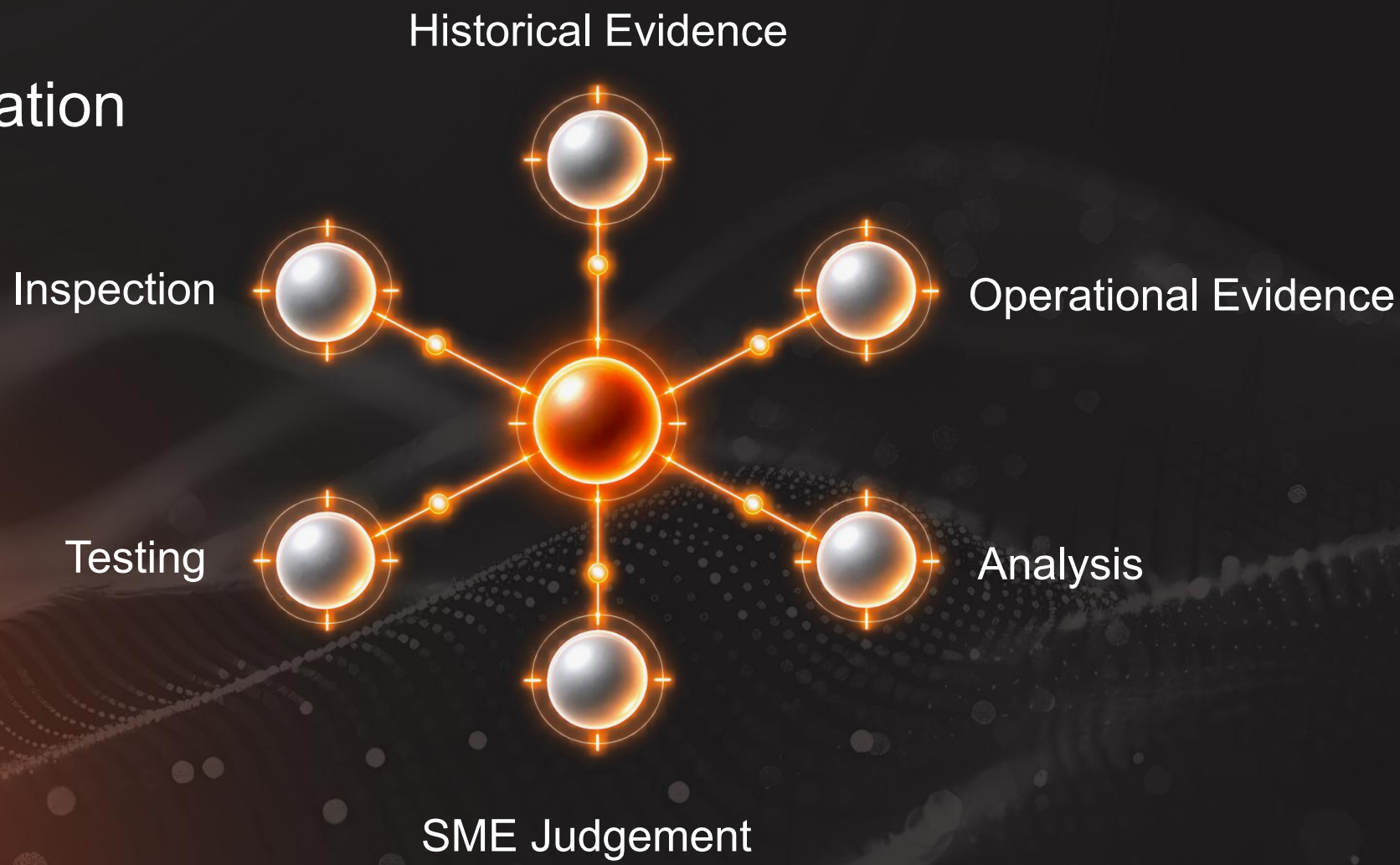
Repeated Information

Observation

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Independent Information Contribution



Information Contribution and Confidence Growth

Effective Degrees of Freedom

Evidence
≠
Independence Assessment

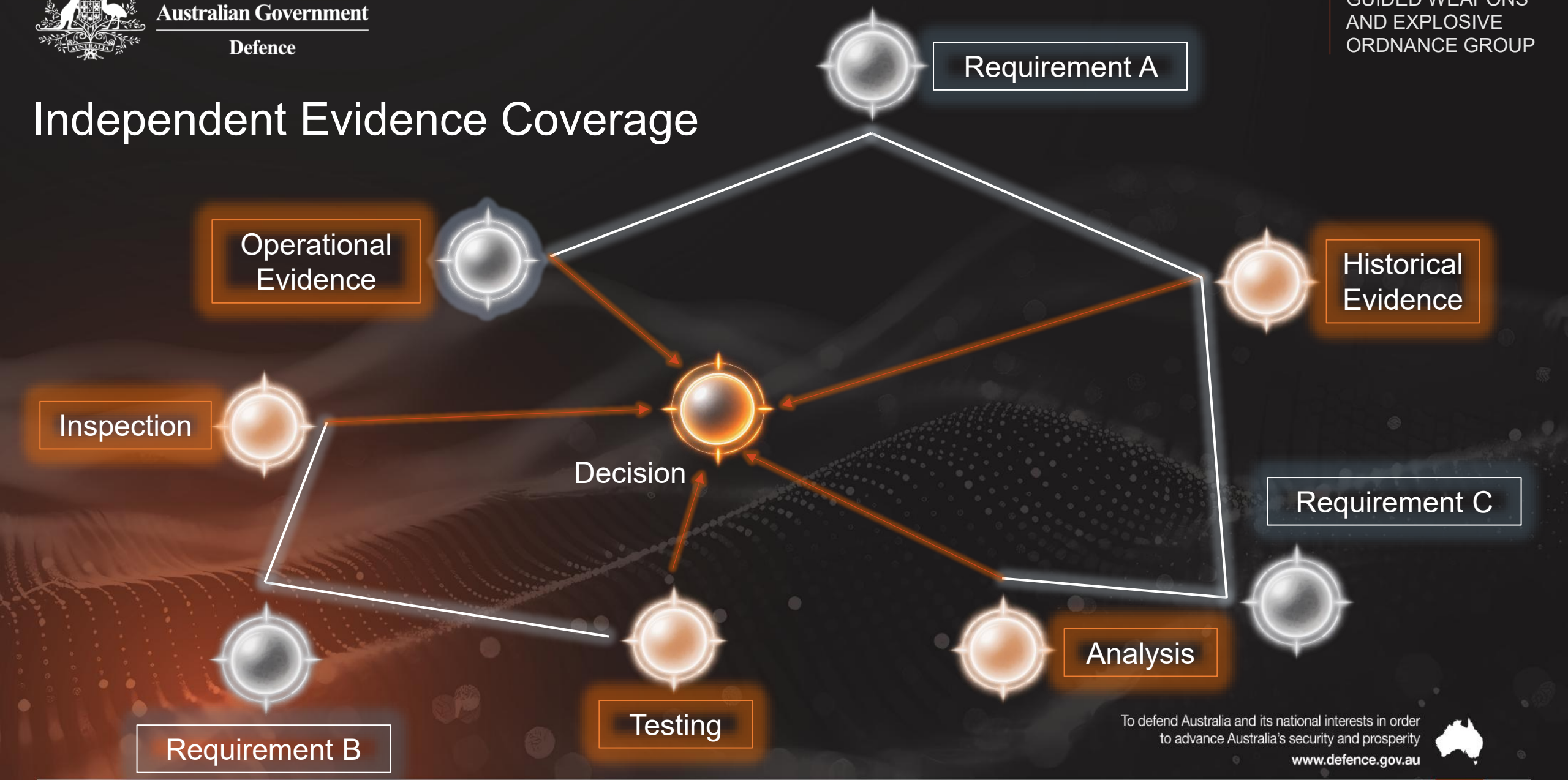
Repeated Information
↓
Limited Confidence Growth

Independence Information
↓
Greater Confidence Growth

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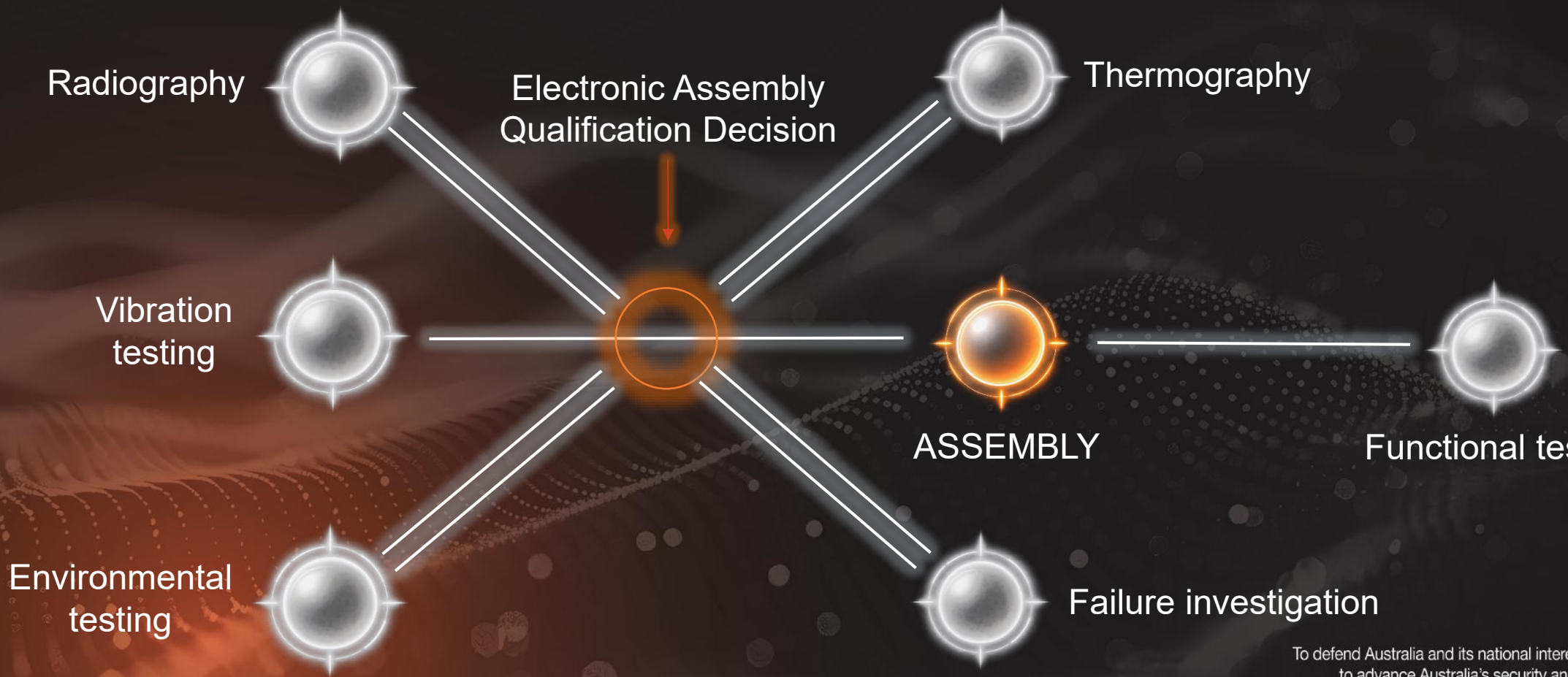
Independent Evidence Coverage



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Practical Example: Electronic Assembly Qualification Evidence



Confidence Can Be Built Before Testing Begins

95% Reliability
95% Confidence
0 failures required ≈ 59 samples

Environmental Qualification
Vibration Testing
Thermal Cycling
Shock Testing

Result:
Large sample burden
High cost
Long schedule

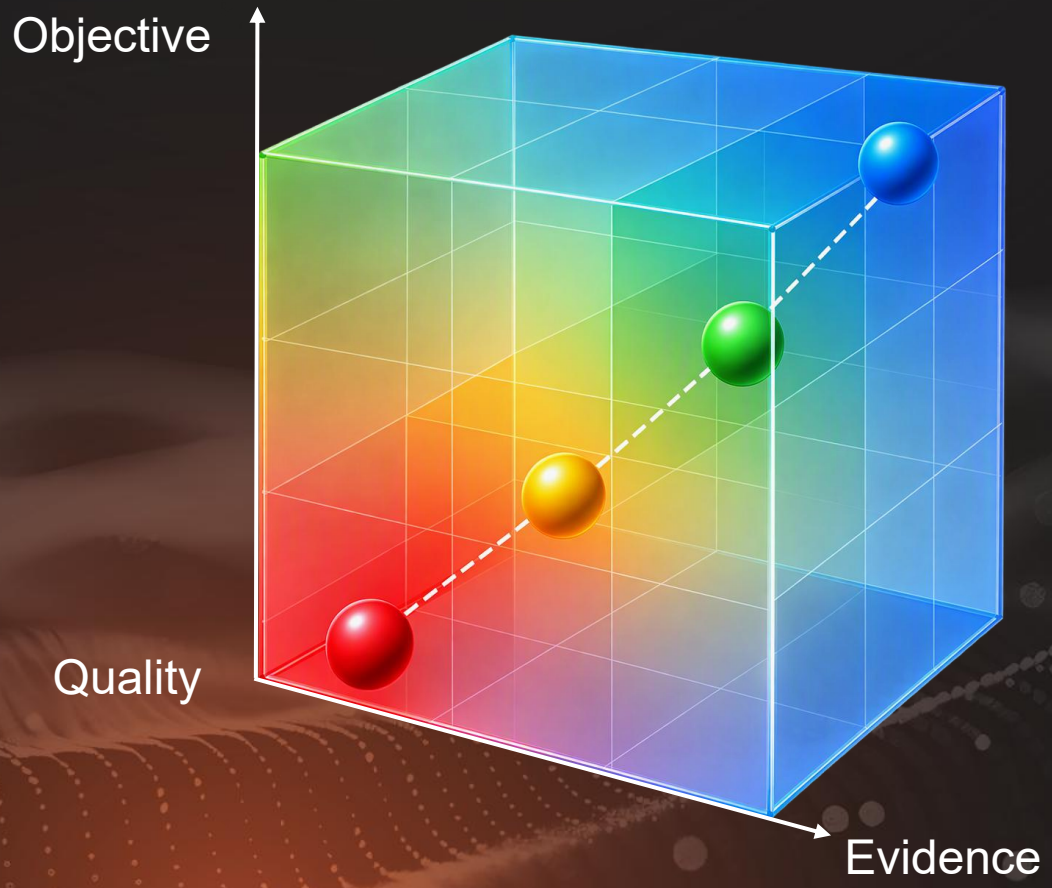
Bayesian Approach

Prior Evidence:
Historical qualification data
Fleet experience
Surveillance results
Inspection findings
Technical analysis
↓
Updated confidence
↓
Reduced new testing requirement
↓
Decision supported sooner

Existing evidence
+
New Testing
=
Decision Confidence

More independent evidence sources → Less uncertainty
More targeted testing

The Way Forward



Gap Analysis

Objective 90%

Quality 85%

Evidence 45%

Shortfall:

Independent Evidence

The objective is not to maximise testing. The objective is to achieve the confidence required to support a defensible decision.

Conclusions

- OQE supports decisions, not activities
- Sufficiency is assessed relative to a decision
- Independent evidence provides greater information gain
- Confidence grows through independent information contribution.
- Independent Evidence Coverage provides a path to evidence sufficiency.