

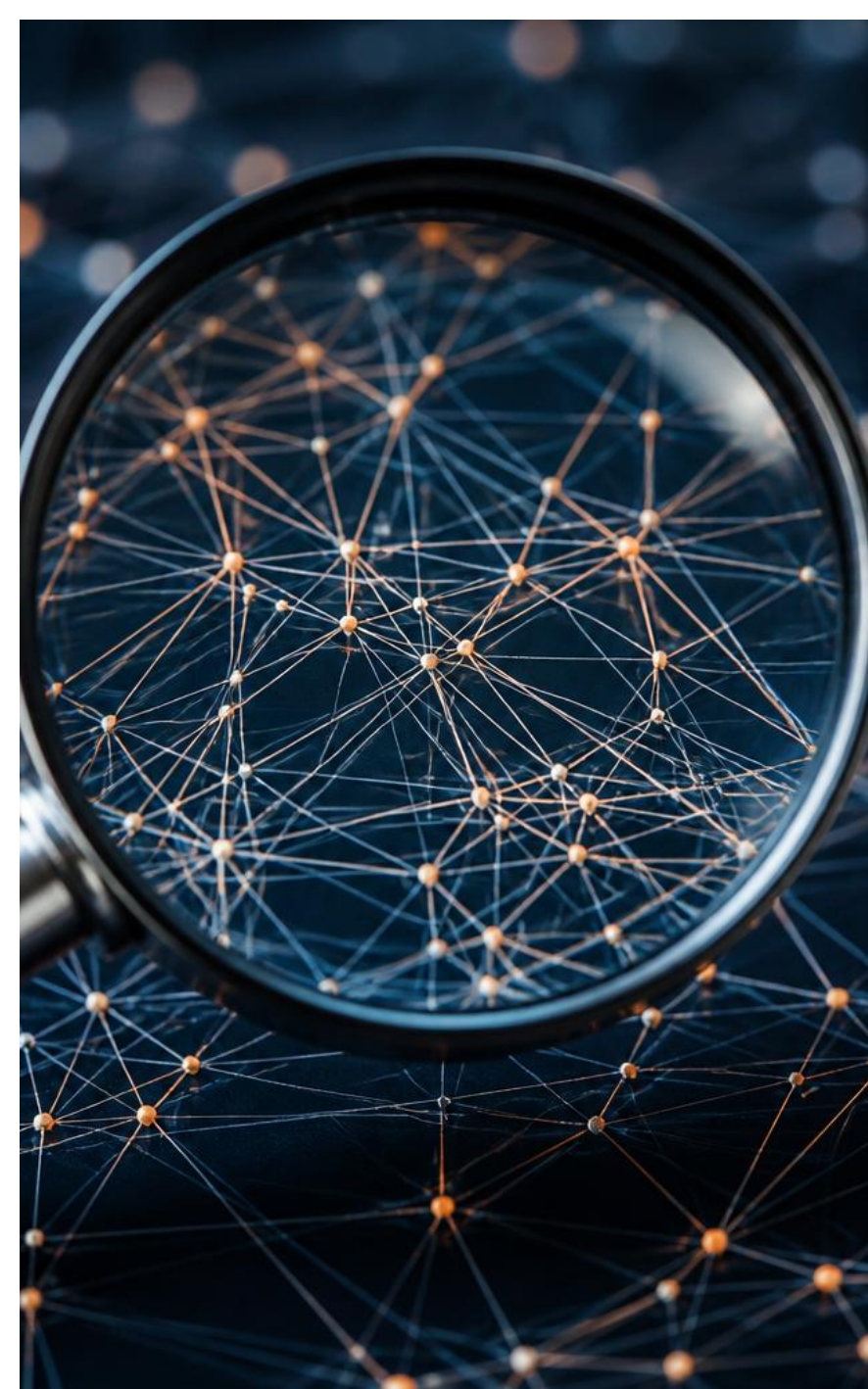


From a Search for Intrinsic Value to Persistent Systems

The deductive development of TEQR

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Introduction

This presentation is not about proposing another systems methodology. It began with a question in economics whose exploration unexpectedly led to systems engineering.

That exploration resulted in a structured framework for interrogating planned change in persistent systems.

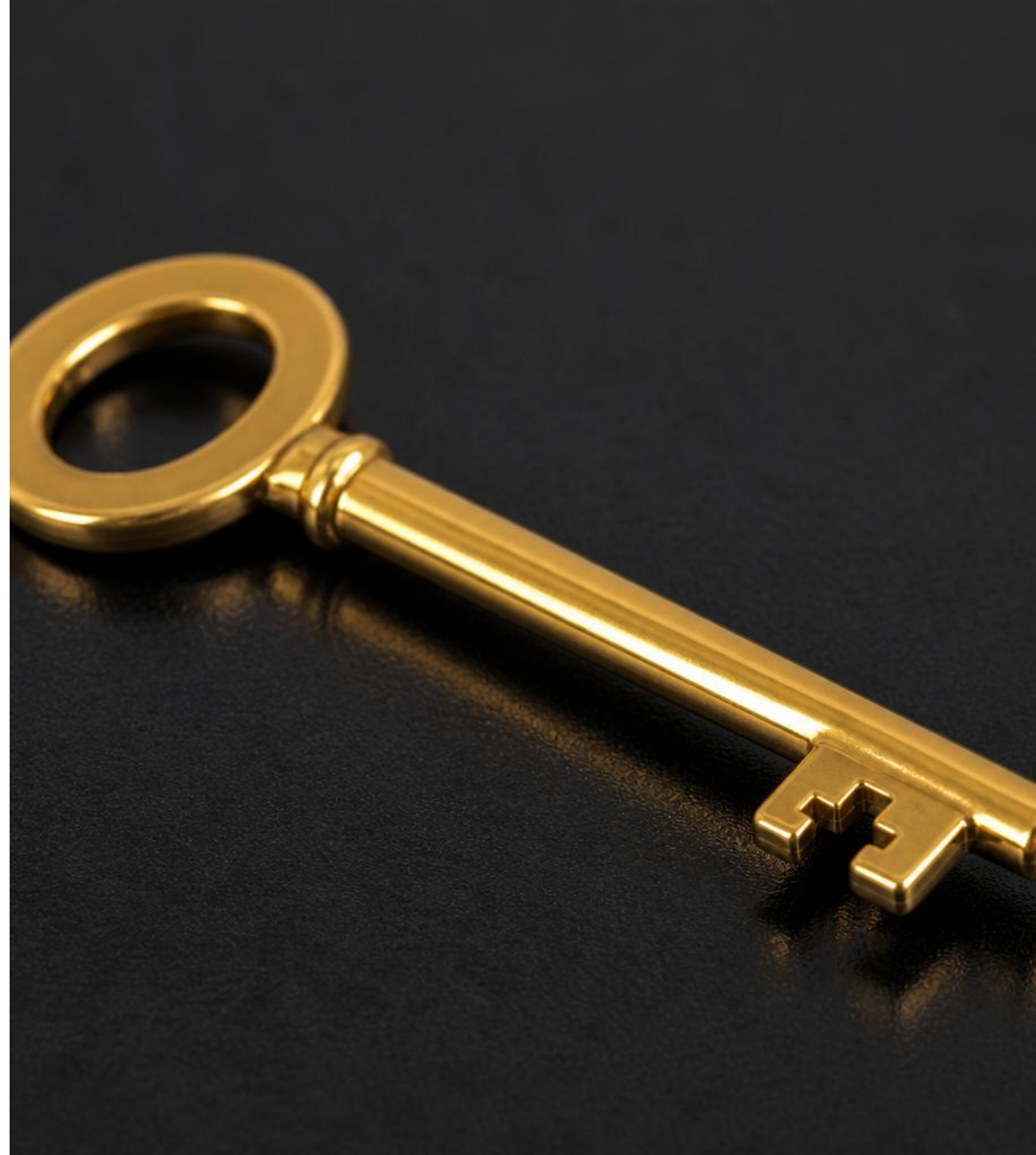
- Expose assumptions
- Identify evidence gaps
- Improve communication
- Support better-informed decisions before change is implemented

Intrinsic Value – The Motivation

Why intrinsic value?

Is there such a thing?

If there is how can it be defined?



The Four Attributes - TEQR

- Time
- Energy
- Quality
- Risk



Beyond Intrinsic Value

The initial focus was:

- Manufacturing
- Services

Throughout the whole life cycle from concept through to disposal

Improving quality was frequently observed to reduce associated risks, including business, supplier, employee and environmental risks.

Risk is dynamic, owned by different parties throughout the whole life cycle





The Realisation

The same four dimensions consistently appeared regardless of domain.

Time • Energy • Quality • Risk



TEQR

A structured framework for interrogating change.

Persistent Systems - TEQR

TEQR does not attempt to redefine what constitutes a system. Existing systems theory already provides that foundation. Instead, TEQR provides a framework for interrogating change within an identified persistent system.

- Time – Every system exists through time. TEQR considers the temporal characteristics of the system and proposed change.
- Energy – Every system is subject to energy interactions that influence its persistence. TEQR considers energy inputs, characteristics, interactions and pathways.
- Quality – Considers the condition and capacity of the system to accommodate variation and change while continuing to function as desired.
- Risk – Considers the likelihood, consequences and uncertainty associated with system outcomes, and how these may be altered by change.

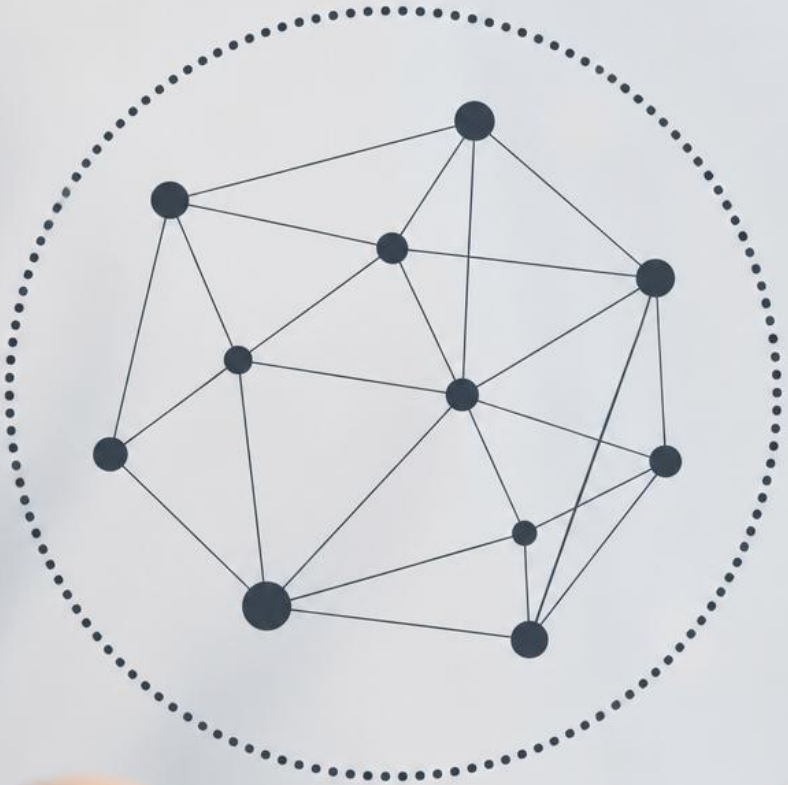


Persistent Systems

Defining the Scope Before System Interrogation

- Establish the scope:
 - Define the System boundary
 - Determine the entities and populations within the boundary.
 - Entities are discrete identifiable members within the system, each has their own quality risk point (QRP)
 - Non-self-modifying or Passive
 - Self-modifying or Adaptive
 - A group of 'like' entities forms a population, that population's combined QRPs form the Quality Risk Envelope (QRE)
 - A system may contain one or more populations
- Across the boundary – TEQR may reveal interactions, assumptions, evidence gaps or potential consequences that suggest the chosen scope should be:
 - reconsidered or
 - expanded

TEQR does not define the system boundary; it interrogates proposed change within the chosen scope whilst helping identify whether that scope remains appropriate.



Time

Time within TEQR



- **Definition**

Time concerns the temporal characteristics of a system and a proposed change, and the temporal response of the system to that change.

- **Time and System Change**

A proposed change may differ in its timing, rate, duration, frequency and concurrence with other events or changes. Its effects upon the system may be immediate or delayed, temporary or persistent, reversible over differing timescales, or cumulative.

Energy

Energy within TEQR



- **Definition**

Energy concerns the energy acting upon and within a system: its form and characteristics, the pathways through which it interacts with entities and populations, and how it is transferred, stored, transformed or dissipated.

Examples include mechanical, thermal, electrical, chemical, radiant and nuclear energy.

- **Energy and System Change**

A proposed change may alter energy inputs, characteristics, interactions or pathways even where the original energy source remains unchanged.

Where energy flows cannot readily be observed or measured directly, other system flows may provide useful indicators or proxies.

Quality and Risk

Quality and Risk within TEQR



- **Quality**

Quality concerns the condition and capacity of a system to accommodate variation in the energy with which it interacts while continuing to function as desired, and the extent to which that function is maintained when the system is subject to change.

This capacity is influenced by the system's condition, redundancy, reserves, buffering, tolerance and alternative pathways, and is relative to the energy interaction being considered.

- **Risk**

Risk concerns the likelihood, potential consequences and uncertainty associated with outcomes arising from energy interactions, the system's capacity to accommodate them, and changes to the system or its operation.

Risk may exist within the current system and may extend or be transferred between entities, populations or across system boundaries.

- **Quality, Risk and Relative Resilience**

A proposed change may alter Quality, Risk, or both. Considered together, Quality and Risk provide an indication of the system's relative resilience to the energy interactions and conditions being considered.

Time

Questions concerning Time fall in two categories

The timing of the change



When? Rate of change? Duration? Frequency? What else is occurring at the same time?

The temporal response



Immediate or delayed? Temporary or persistent? Reversible – and over what timescale? Cumulative?

Energy

Characterising energy inputs, interactions and pathways



- **Energy Inputs**

What type of energy is entering or acting upon the system? Is it continuous or variable (e.g., intermittent or pulsed)? What is its quantity, strength, power or intensity? At what rate is it transferred? How does it vary over time or across the system? Are the required energy inputs available in sufficient quantity, with the necessary characteristics, and for the required duration?

- **Energy Pathways and Interactions**

How does the energy interact within the system? Which entities or populations does it interact with? What pathways does it follow? Is the interaction direct or indirect? How does the proposed change affect existing energy pathways, and are new ones created?

- **Energy Transformation and Disposition**

Is the energy absorbed, stored, converted, transferred, transmitted, dissipated or released? Does the proposed change alter how energy is used, stored, transformed or dissipated within the system?

Quality

Evaluating system capacity and response to energy change



- **Current system condition and capacity**

What is the current condition of the system? Is it already stressed? What redundancy, reserves, buffering, tolerance or alternative pathways does it possess?

- **Response to changes in energy**

How does the system respond to changes in the energy inputs, characteristics or pathways previously identified? How does it respond when those interactions move beyond the conditions it normally experiences or is expected to encounter? What range of variation can it accommodate while continuing to function as desired?

- **Impact of change on system Quality**

How does the proposed change affect the system's capacity to accommodate energy variation? Does the addition, removal or modification of entities or populations alter its redundancy, reserves, buffering, tolerance or alternative pathways? Does it increase or decrease the range of energetic conditions within which the system can continue functioning as desired?

Risk

Evaluating exposure, uncertainty and consequences of change



- **Risk and exposure**

What adverse outcomes could arise from the energy interactions and system responses previously identified? Are there single points of failure or critical dependencies? Under what conditions could adverse outcomes occur? Which entities, populations or other systems could be affected? Could consequences extend beyond the defined system boundary?

- **Assumptions and uncertainty**

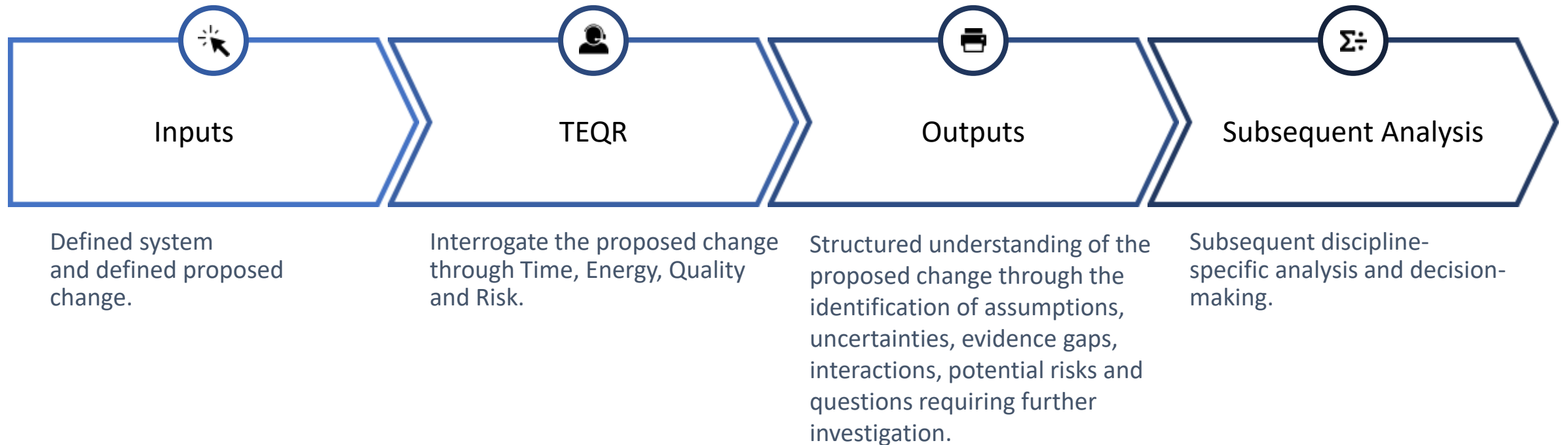
What assumptions underpin our understanding of the change and its consequences? What evidence supports them? What remains uncertain or unknown? What should be monitored, and what would indicate that the system is responding differently from expected?

- **Risk modification and control**

How does the proposed change alter existing risk? Does it introduce, increase, reduce, redistribute or transfer risk between entities, populations or across system boundaries? Can the change or its effects be detected, controlled, limited, reversed or stopped if outcomes are undesirable? Are there defined thresholds for intervention or escalation, and are the means to act available when required?

Applying TEQR

A consistent framework for interrogating proposed change



The value of TEQR lies in enabling different perspectives, including those from different disciplines, to interrogate the same proposed change through a common, fundamental framework. This can provide decision-makers with a broader understanding of the impacts of change, underlying assumptions and uncertainties, potential unintended consequences, and the measures available to limit or minimise risk.

Applying TEQR: Thought Experiments

Different forms of change can be interrogated through the same four dimensions: Time, Energy, Quality and Risk.

- **Addition**

A population is added to an existing system: Competition, Increased Capability, Increased Redundancy.

- **Removal**

A population is removed from an existing system: Extinction, Local Removal, Loss of Capability.

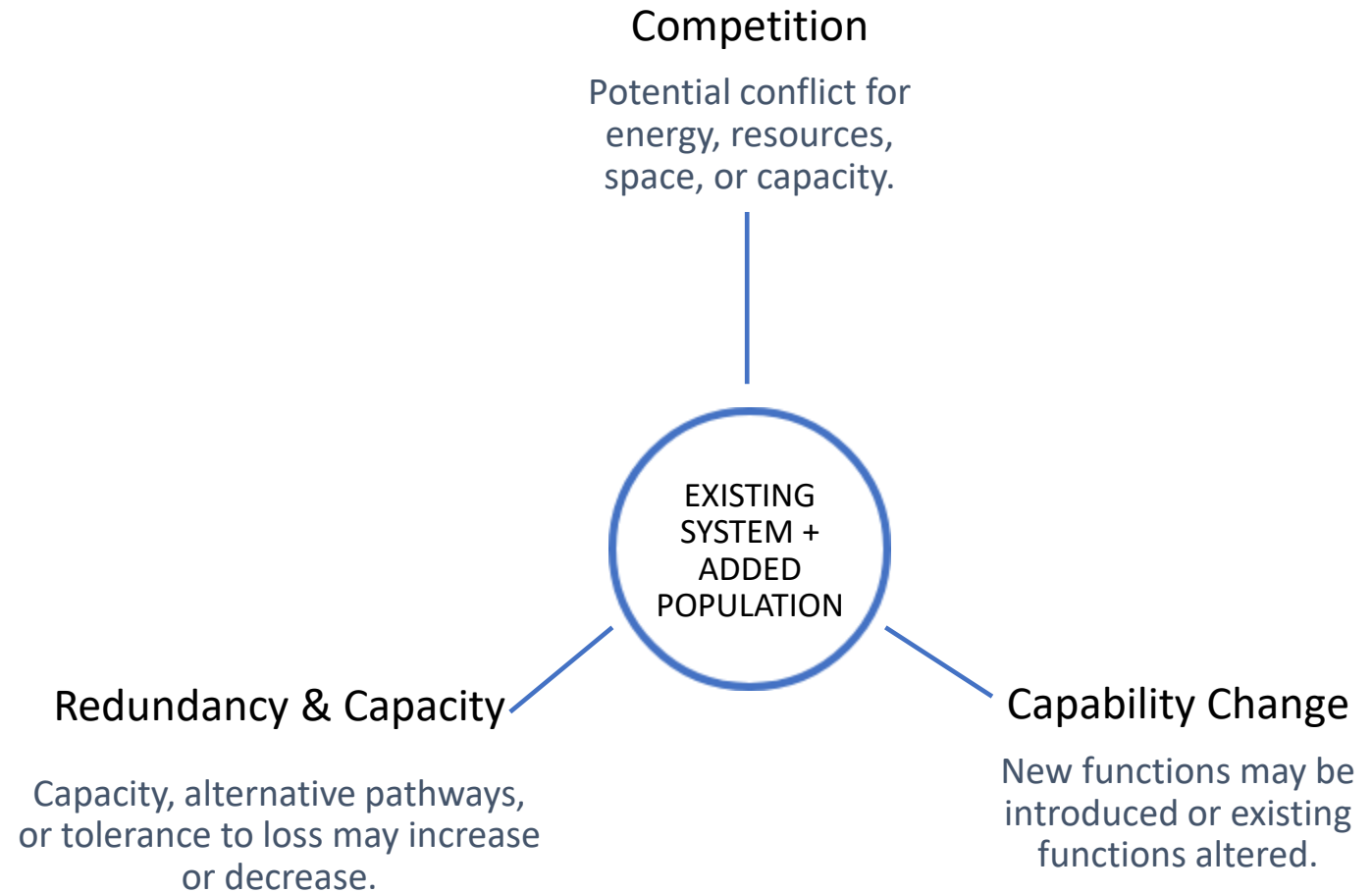
- **Introduction of a New System**

A new system is introduced into an existing system: Infrastructure, Development, Energy, Transport.

What might TEQR reveal in each scenario?

Thought Experiment: Addition

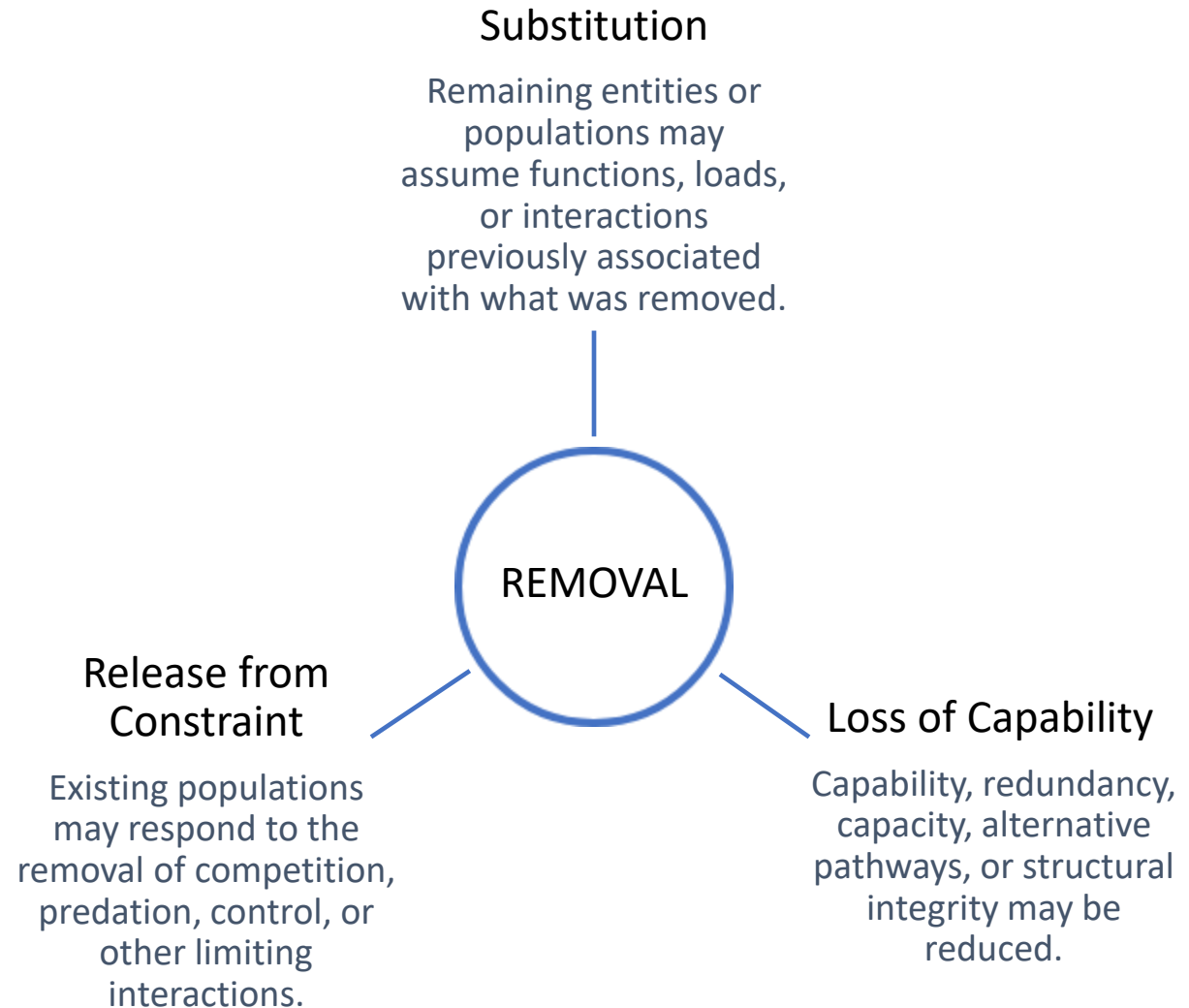
Analysing the impact of a population added to an existing system



What does the population require, what does it introduce, and how does the system respond?

Thought Experiment — Removal

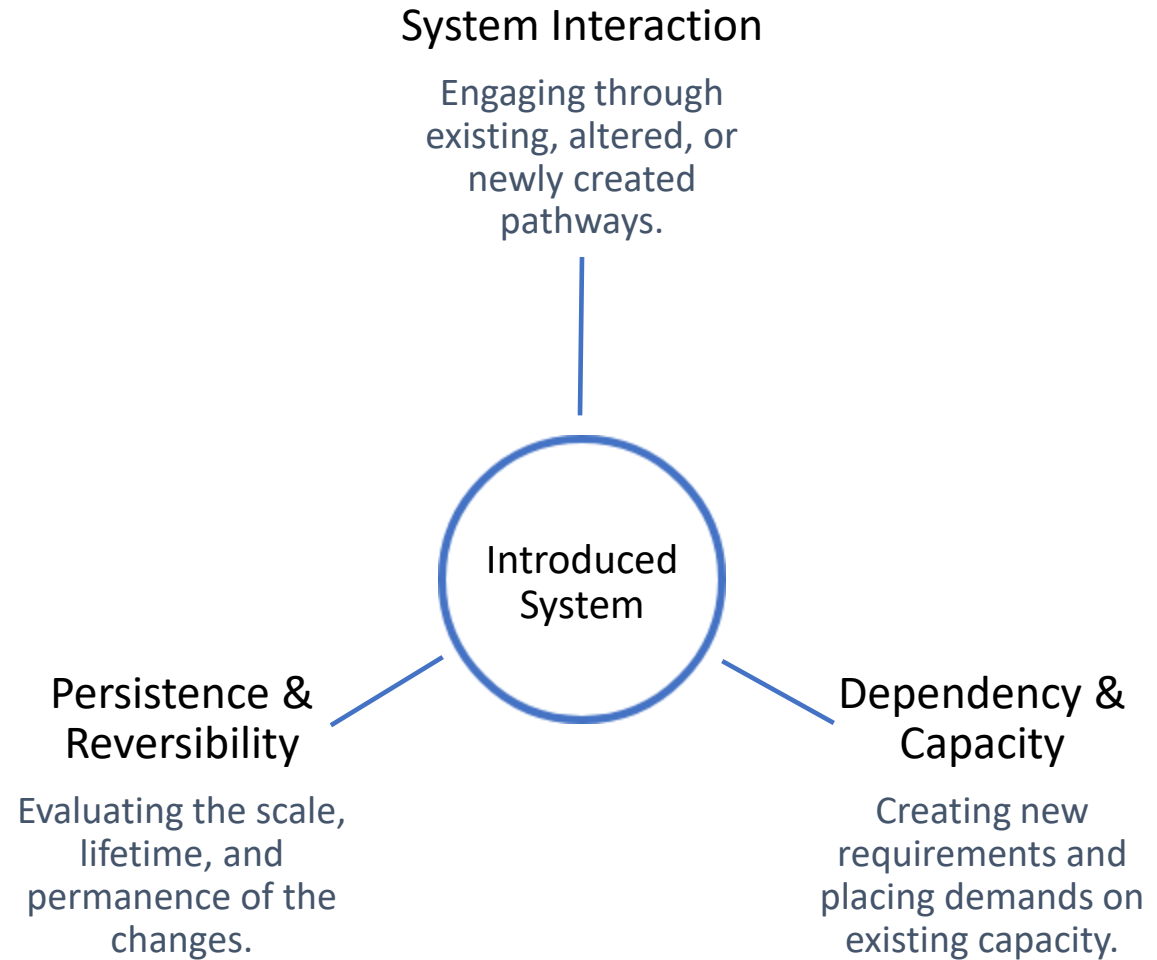
An entity or population is removed from an existing system.



What disappears with the entity or population — and what does not?

Thought Experiment: Introducing a New System

Assessing the impact and interaction of a new system within an existing system

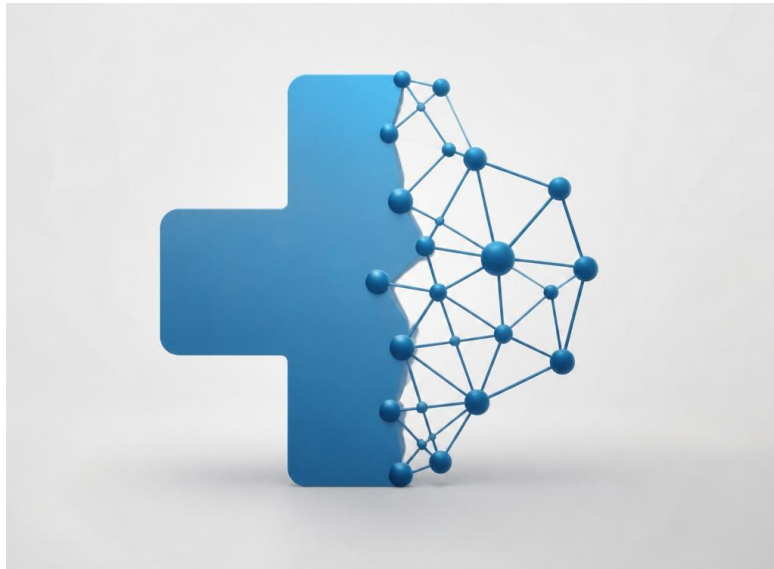


What does the new system require, change, and commit us to over time?

Synthesis: What Might TEQR Reveal?

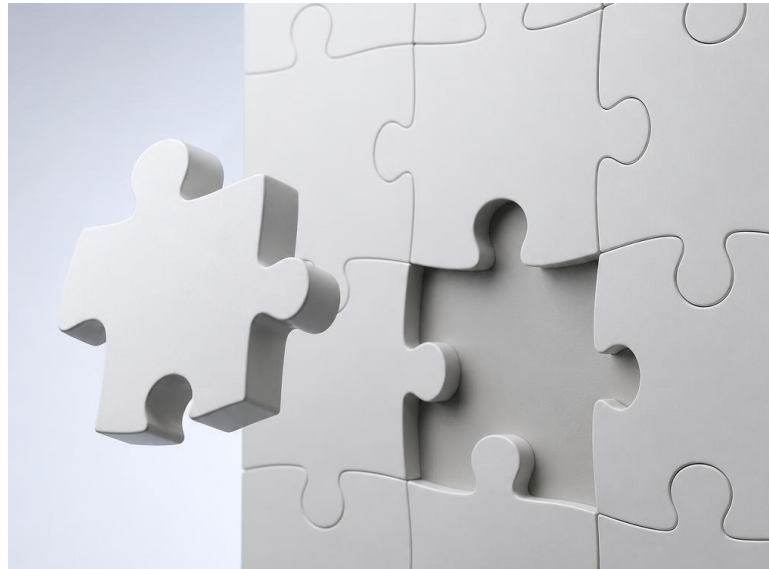
Changing what exists within or interacts with a system can alter relationships, interactions, burdens, dependencies and risks across the system.

Addition



May introduce competition, capability, redundancy and new requirements or dependencies.

Removal



May redistribute functions, interactions or burdens; reduce capability; or release existing constraints.

Introduction of a New System



May create new interactions and dependencies, alter capacity, and produce cumulative or persistent effects.

Current Development and Further Exploration

Areas emerging for further investigation



- **Nested Persistent Systems**

Explore the application of TEQR within larger, interconnected persistent systems.

- **Quality-Risk Relationships**

Further explore the relationship between Quality, Risk, and relative resilience.

- **System Persistence and Termination**

Explore how internal and external influences may sustain, constrain or ultimately terminate system persistence.

- **Burden and Interaction Redistribution**

Study how system modifications shift energy, loads, and risk.

- **Scale and Cumulative Effects**

Evaluate how repetition and aggregation transform minor changes into significant impacts.

- **Application and Refinement**

Apply TEQR across diverse domains to explore its usefulness, limitations and potential refinements.

- **Cross-Boundary Interactions**

Examine consequences extending beyond defined system boundaries.

Further development may be warranted where practical application and practitioner feedback indicate that TEQR provides useful insight.

A magnifying glass is positioned over a network diagram. The diagram consists of numerous small, colored circular nodes (red, blue, green, orange, and purple) connected by thin, light blue lines. The magnifying glass's lens is centered on a cluster of these nodes, making them appear larger and more detailed than the nodes in the background. The background is a light gray surface with a faint, repeating pattern of the same network diagram.

Conclusion

TEQR offers a consistent framework for interrogating proposed change through Time, Energy, Quality and Risk. By exposing assumptions, evidence gaps, interactions and potential risks before discipline-specific analysis begins, it may provide a broader basis for subsequent analysis and decision-making.

Its practical value, limitations and potential for further development remain to be explored through application and practitioner feedback.



Questions and Discussion

Questions, challenges and feedback welcome