Innovation

an activity where creativity is guided through rational thinking with the objective to add value

Systematic Innovation review
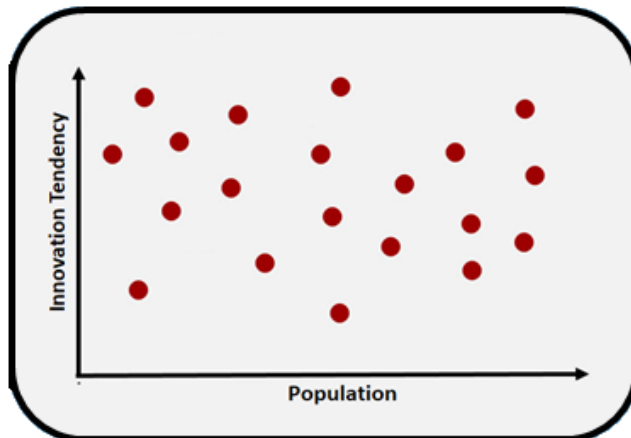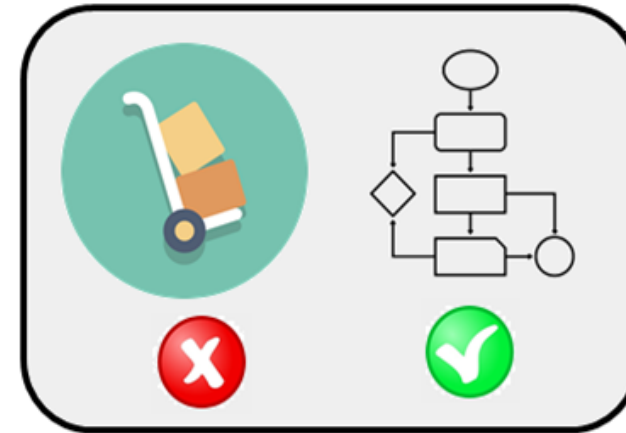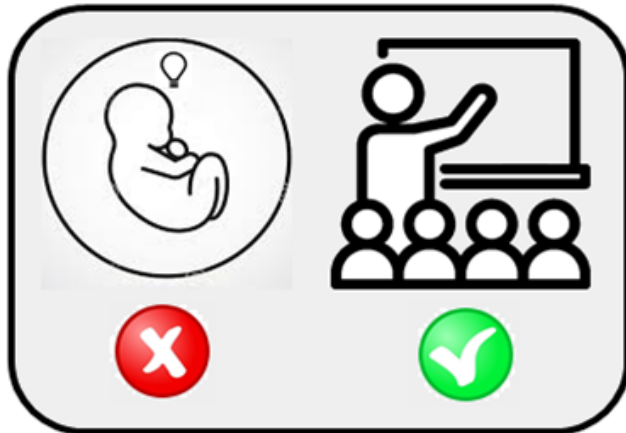
- **Phase Gate, 1940s**
- **TRIZ, 1940s**
- **Design Thinking 1950s & 1960s**
- **SCAMPER, 1950s & 1960s**
- **Systematic Inventive Thinking (SIT), 1990s**
- **Innovactive, 2010s**

Phase-Gate

- **Suitable for managing large infrastructure projects**
- **Financially biased**
- **Based on a staged development process**
- **Flexible number of stages/phases followed by assessment (gate)**
- **Multiple assessment outcome; go/abort/hold/rework…..**

Phase Examples
- Scoping,
- Business case building,
- Development,
- Validation
- Launch

Gate Examples
- Strategic Value
- Viability
- Feasibility
- Risk & Return

Idea → Phase → Gate → Phase → Gate → Phase → Gate → .... → Phase → Gate → End
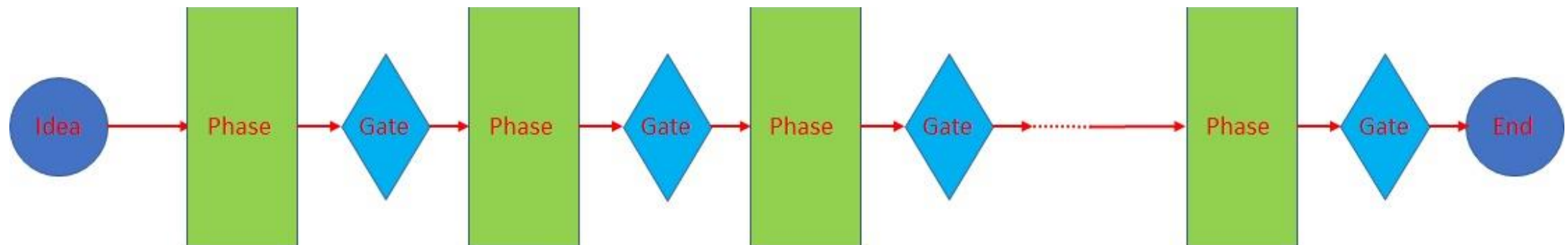
- **Ideality; (Ideal Final Result; IFR)**
  highlights the need to maintain a positive net overall value through delivering positive improvements against negative consequences and the cost of change

- **Contradiction**
  deals with potential conflicts between various constraints in an optimisation process where multiple variables exist with conflicting response with change

- **Functionality**
  focuses innovators attention to the fact that solutions to problems target a single function and any supporting part of the solution that does not contribute directly to the main function is potentially unnecessary and should be identified and dealt with through an improved design

- **Use of resources**
  concerned with sustainability of all resources used as part of the solution (to a problem) and their optimum use

- **Space, Time, Interface**
  concerned with perspectives and the need to review the problems from different angles to ensure that problems are fully understood in order to respond to them with appropriate solutions

TRIZ; the process

TRIZ; Techniques

IEEE SISIG
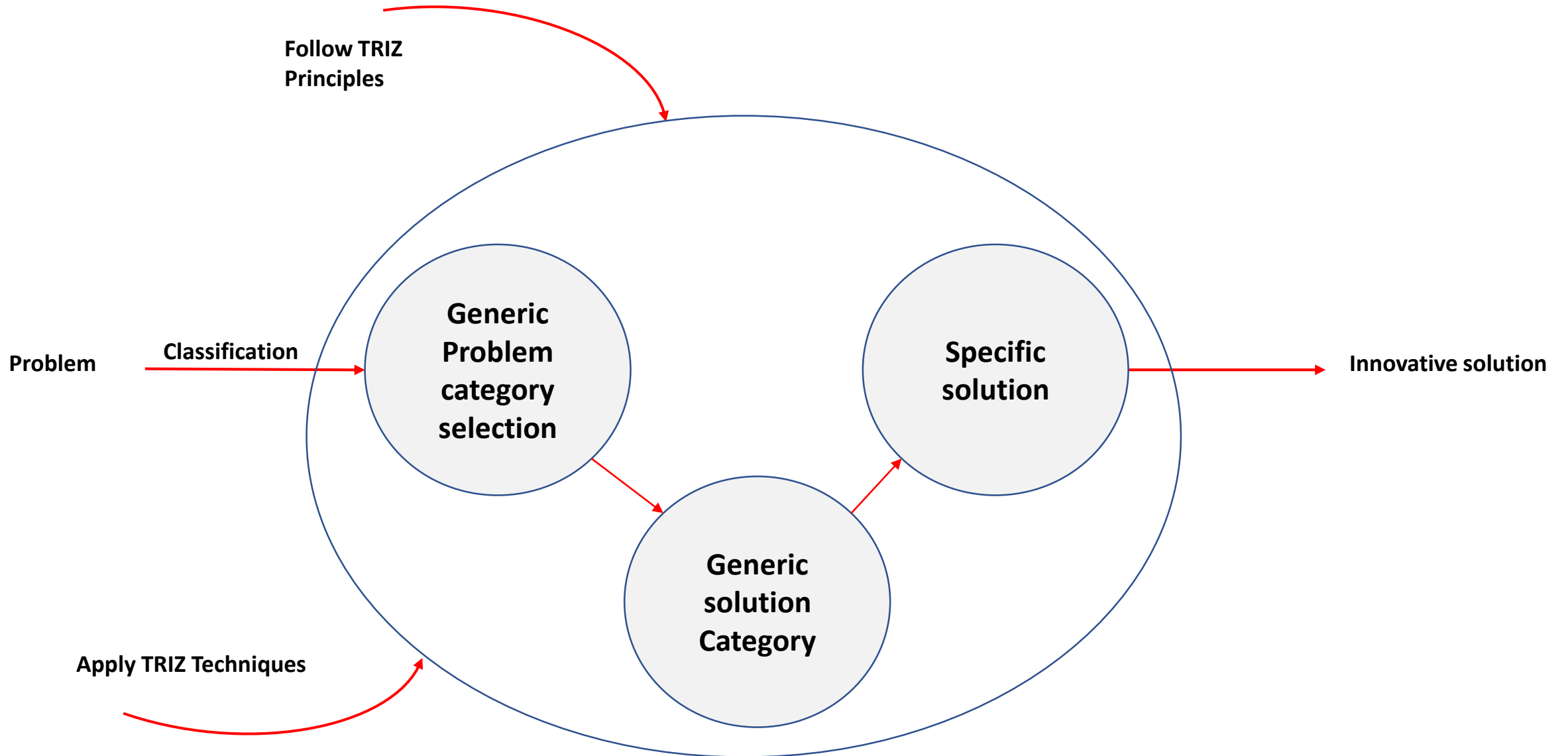
1-Segmentation

2-Extraction

3-Local Quality

4-Asymmetry

5-Consolidation

6-Universality

7-Nesting

8-Counterbalance

9-Prior Counteraction

10-Prior Action

11-Cushion in Advance

12- Equipotentiality

13-Do it in Reverse

14-Spheroidality

18-Mechanical Vibration

19-Periodic Action

20-Continuity of useful Action

21-Rushing Through

22-Convert Harm into Benefit

23-Feedback

24-Mediator

25-Self service

26-Copying

27-Disposable

15-Dynamicity

16-Partial or Excessive Action

17-Transition to a new Dimension

28-Replacement of Mechanical System

29-Penumatic or Hydraulic Construction

30-Flexible Membrane or Thin Films

31-Porous Materials

32-Changing the Colour

33-Homogeneity

34-Rejecting and Regenerating Parts

35-Transformation of Properties

36-Phase Transition

37-Thermal Expansion

38-Accelerated Oxidation

39-Inert Environment

40-Composite Material

Design Thinking

- **End-user-centric product development**
- **Holistic approach; follows a systematic process**
- **Iterative; relies on repetitious steps**
- **Suitable for small product developments**
- **Experimental; culture of prototyping**
- **Values user feedback; "show don't tell" culture**
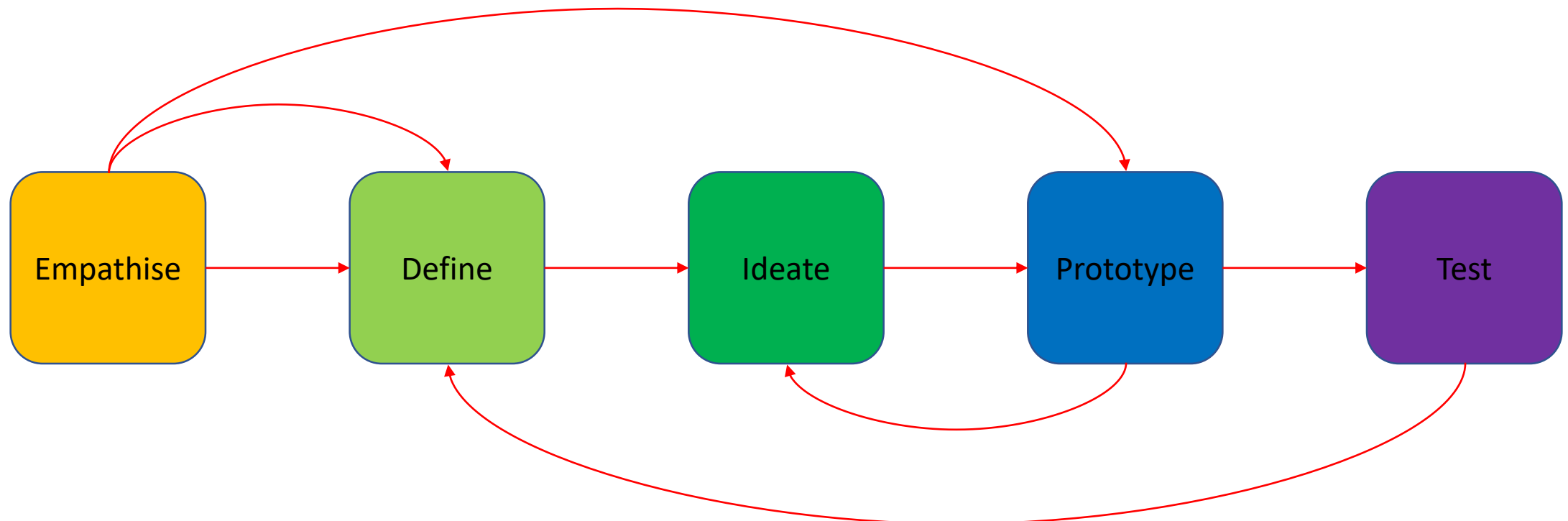
SCAMPER

- **SCAMPER is an acronym made up of different Innovation strategies**
- **Relies on asking directed questions**
- **Distilled version of an original 10 point system introduced by Alex Osborne, the father of the Brain-storming technique**

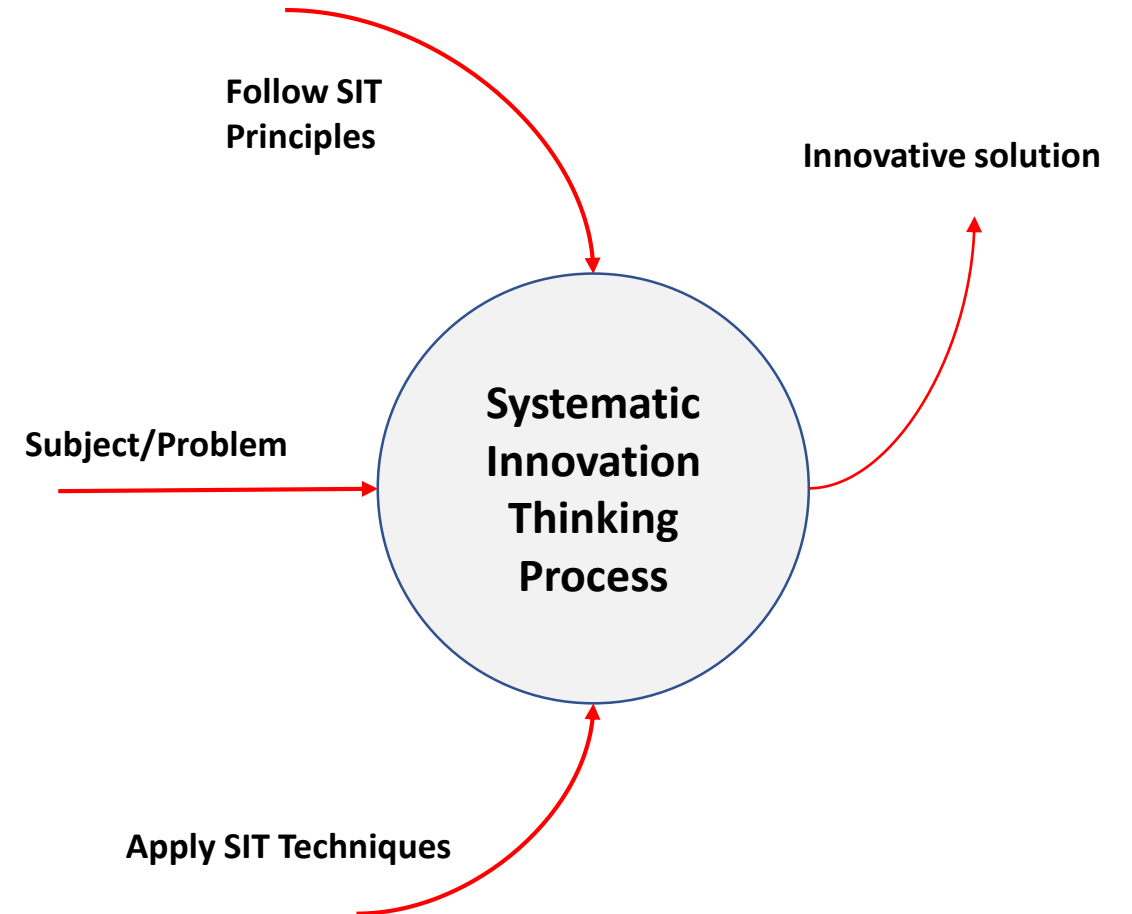|	
Substitute	Which material/part/resource can be changed to improve the product?
Combine	Can products be combined with another or to produce a new product or outcome?
Adapt	Can the products be adapted for a different use in a new context?
Modify/Magnify	What could be changed/emphasized to add value or create a new product?
Purpose	Who else can use this product or can its waste be used or recycled?
Eliminate/Minify	What features and components can be left out to improve the product?
Rearrange/Reverse	What happens if the product is reversed or assembled in a different order?

Systematic Inventive Thinking (SIT)

IEEE SISIG

- **Creativity is not random but a logical process**
- **Creativity can be learned and improved by practice**
- **Keys to innovation are in plain sight**
- **Innovation is about adding value**
- **Contradictions are not blocks to creativity but lead to it**
- **Creativity must be sought inside the box and not out (closed world principle)**

Principles

Follow SIT Principles

Innovative solution

Systematic Innovation Thinking Process

Subject/Problem

Apply SIT Techniques

Process

SIT; Techniques

Subtraction
Removing some of the components and examining its results; could it deliver the same or improved results?

Division
Breaking up an existing unit into components before reconfiguring those components to create a new benefit or deliver existing benefits?

Multiplication
Multiplying a component one or several times, and then ascribing unique characteristics to each of the multiplied components to identify a new source of value

Task Unification
Keep all components /features in their current configuration, assign an additional responsibility to a component within the Closed World—unifying tasks that were previously independent

Attribute Dependency
Make two unrelated attributes or characteristics dependent on each other in a way that adds value. As one thing changes, another thing changes

Systematic Innovation; a Recap

- All highlighted methodologies follow a structured process

- They have underlying frameworks with philosophies, principles, and specific techniques to produce results

- Primarily focus on inventive problem solving and not the entire process and vary in complexity and ease of application

- Biased according to developer's field of expertise and the knowledge, beliefs and the attitudes in the context of their time

- They are all Process-centric; i.e. human element is considered as a constant

- Despite differences there are distinct similarities in their chosen techniques: i.e.

  Extraction (TRIZ) & Subtraction (SIT) & Elimination (SCAMPER)

Innovactive; principles

- Innovation is a skill that can be learned and mastered through practice

- Focus on people (human-centric), whilst considering processes and organisation

- Model the entire process not just the ideation or inventive problem solving

- Follows a structured approach to raise quality, repeatability and simplicity

- Keep enterprise at the heart of the innovation process

- Prioritise using already known tools and techniques from different domains

- Deploy quantitative techniques to simplify and guide decision making

- Promote collaborative innovation to utilise the pool of innovative talents

- Embrace all previous developments and adopt any appropriate elements

- Value ideas and their abundance; avoid idea classification

Innovactive process model

7 Step Systematic Innovation Model
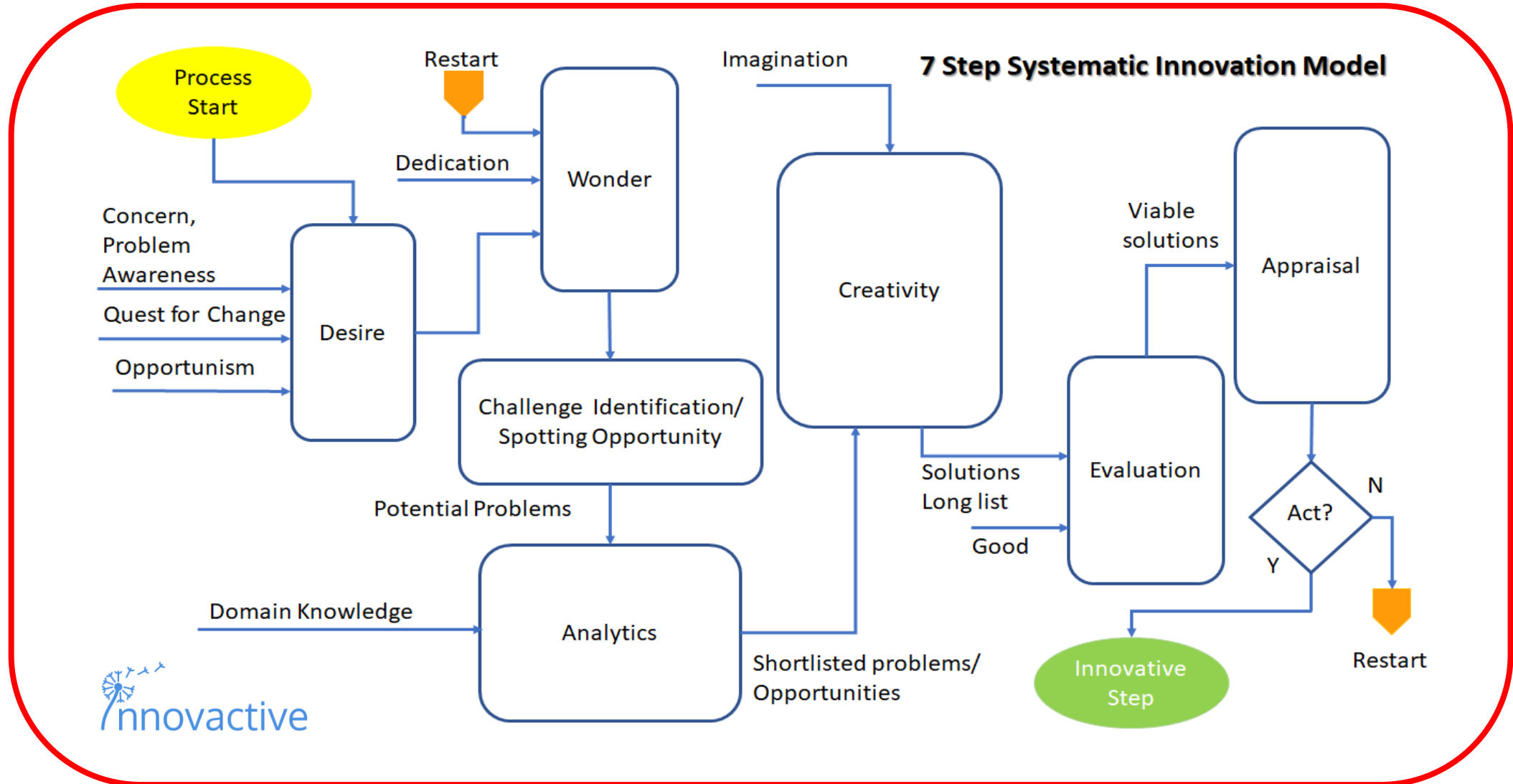
Step 1: Desire

Sources of Motivation

Status/Esteem

Self-fulfillment

Sense of Belonging

Pleasure /Enjoyment

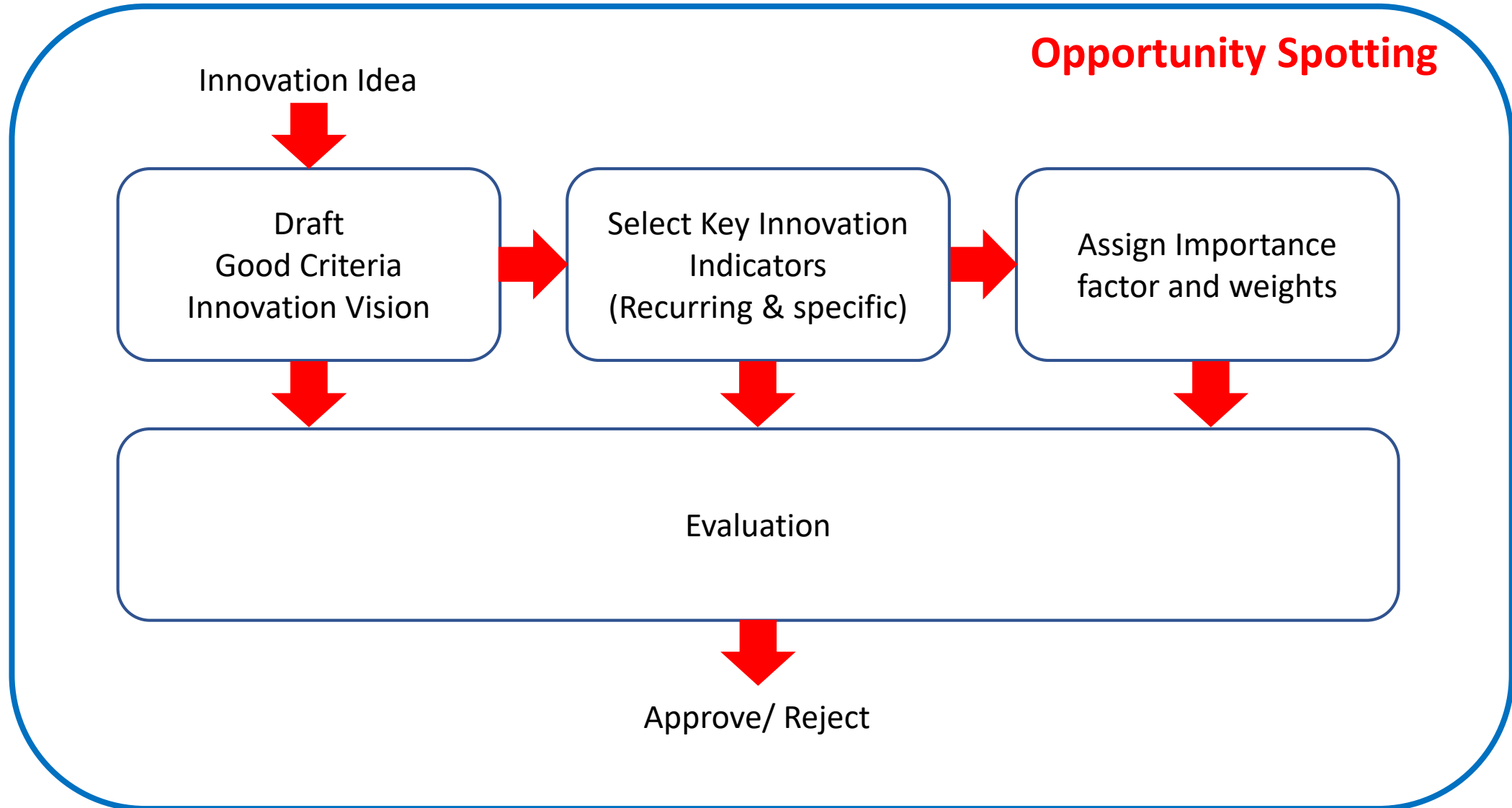**Mate Acquisition/Retention**

Self-Protection

Physiological Needs

Step 3, Opportunity spotting

Opportunity Spotting

Innovation Idea

Draft
Good Criteria
Innovation Vision

Select Key Innovation
Indicators
(Recurring & specific)

Assign Importance
factor and weights

Evaluation

Approve/ Reject
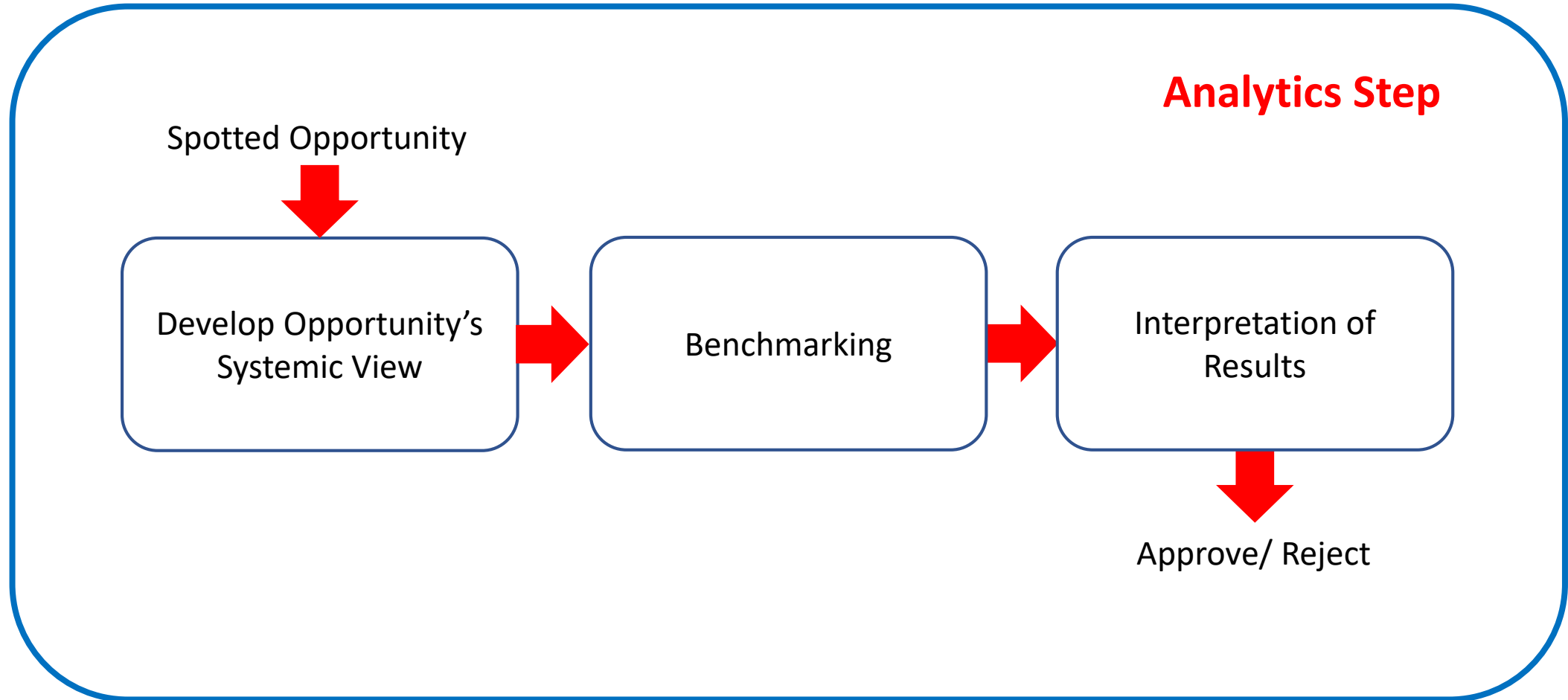
Step 4, Analytics

Step 4, Analytics benchmarking
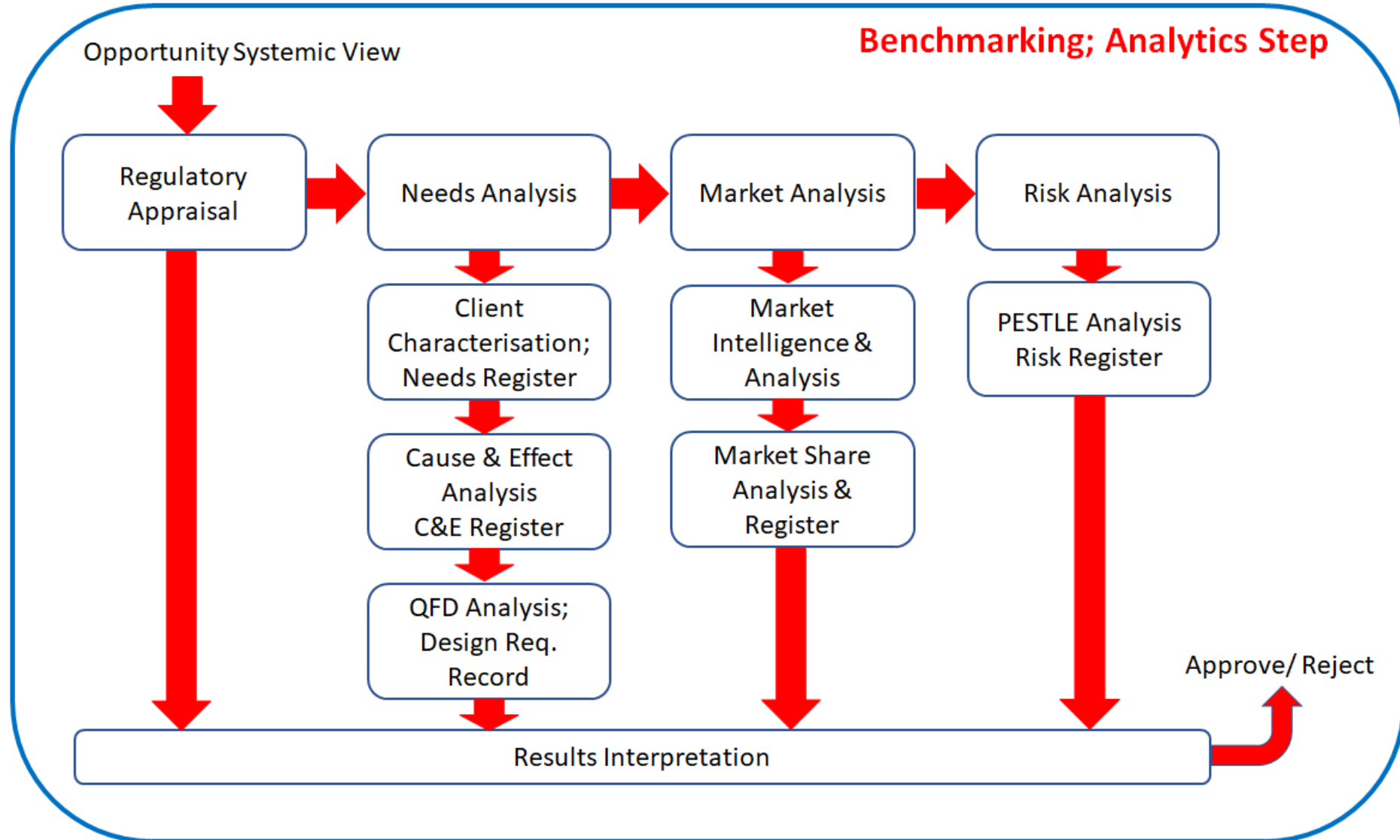
Step 5, Creativity
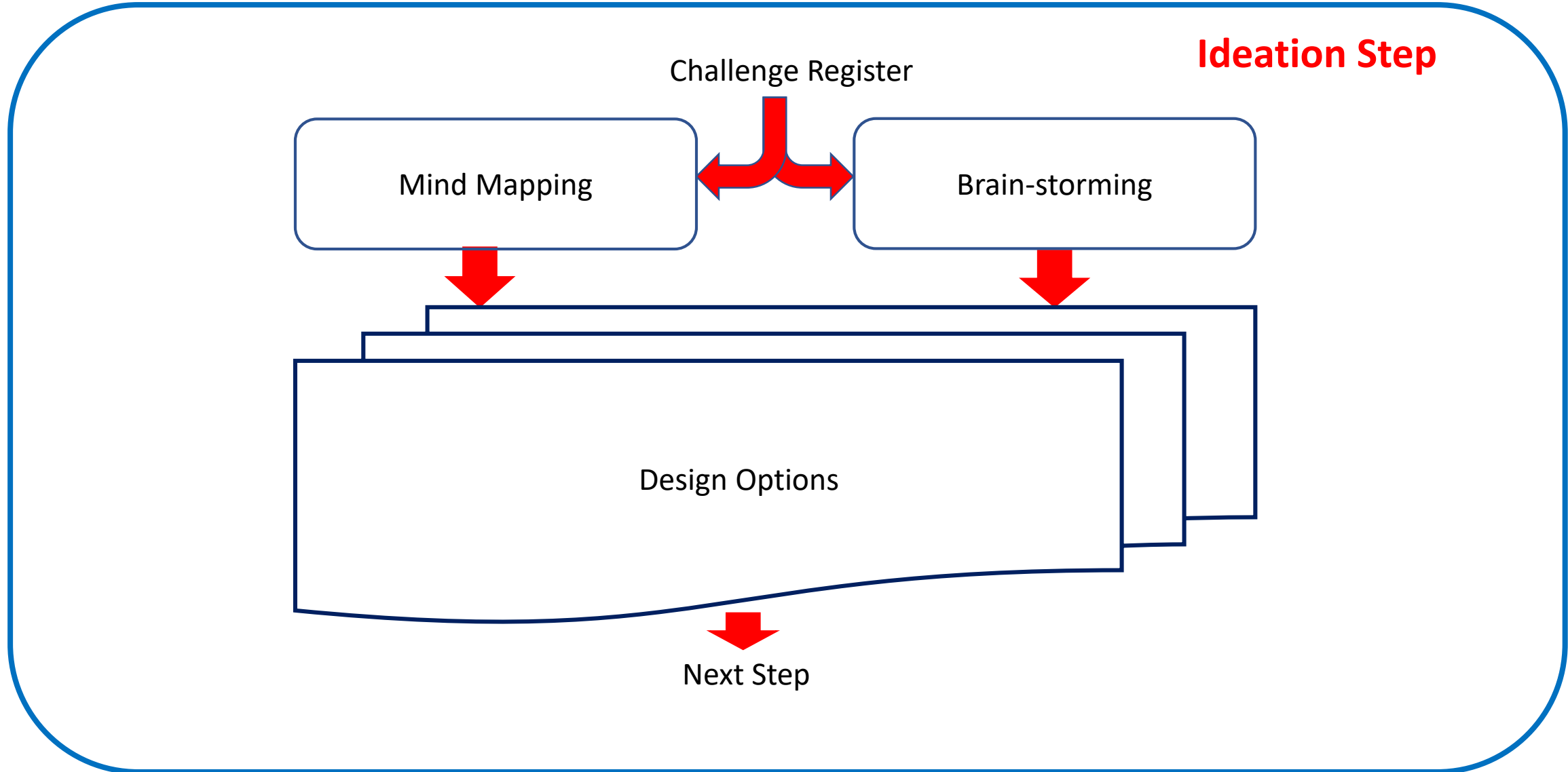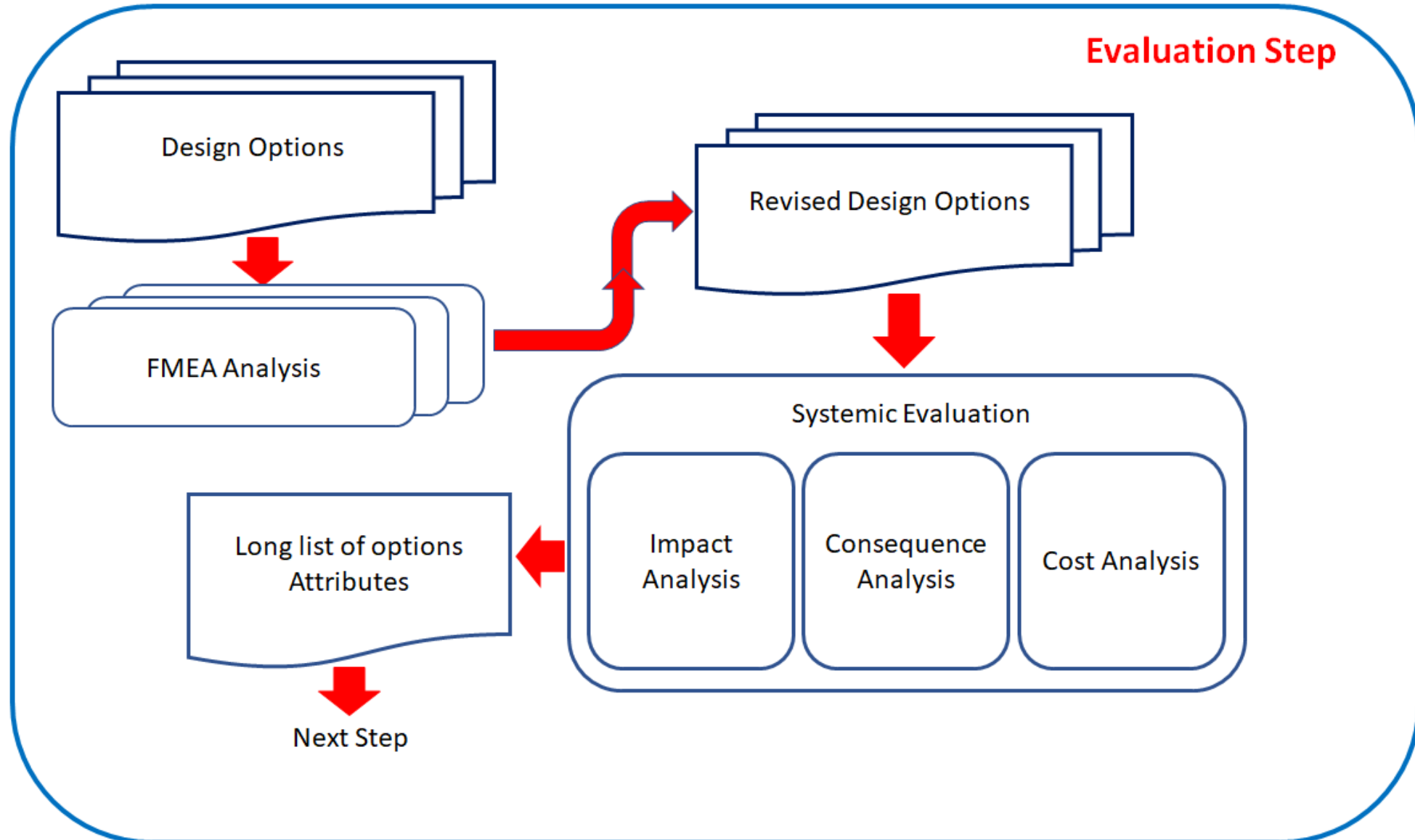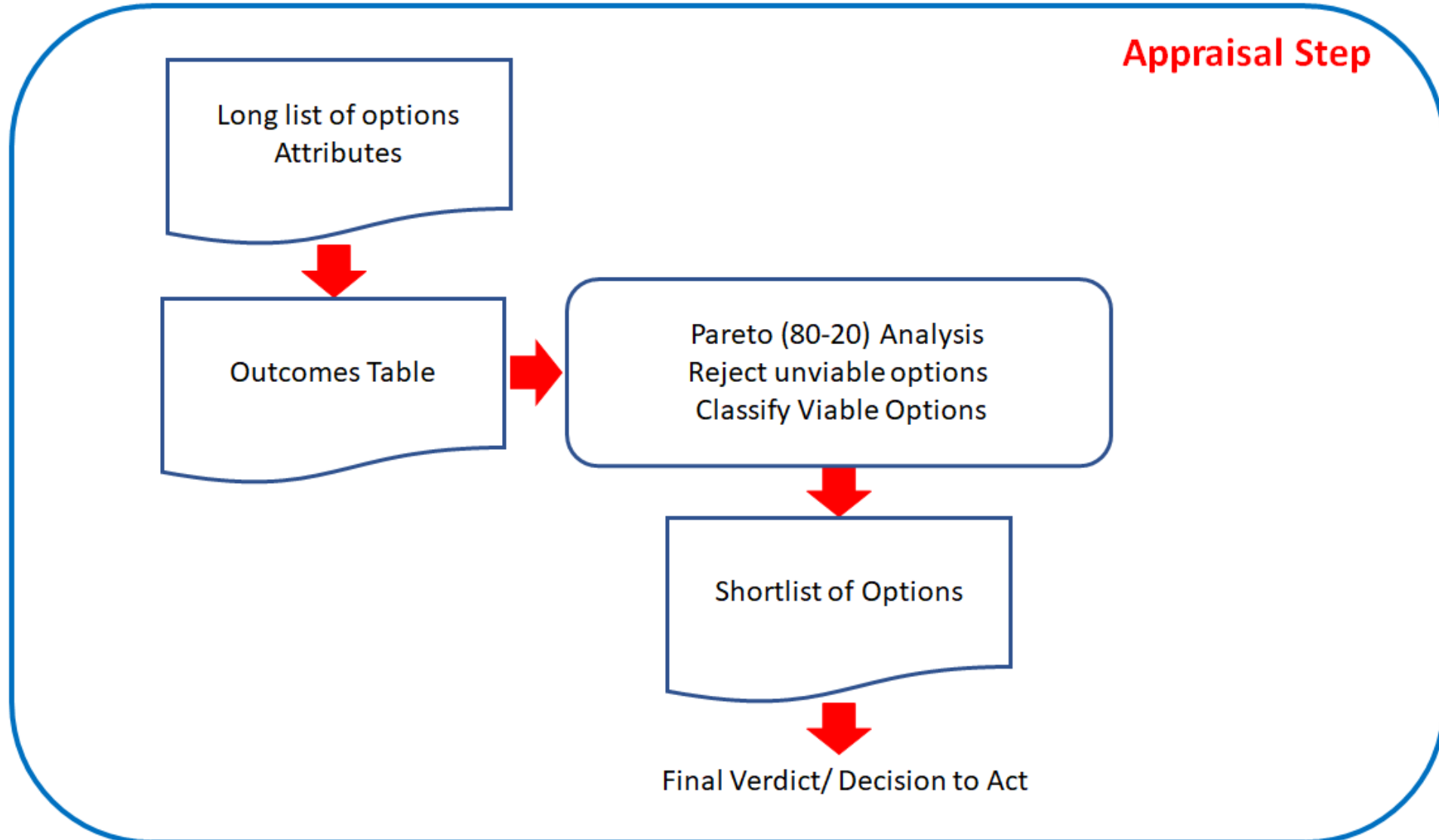
Ideation Step

Challenge Register

Mind Mapping

Brain-storming

Design Options

Next Step

Step 6, Evaluation

Evaluation Step

Design Options

FMEA Analysis

Revised Design Options

Systemic Evaluation

Impact Analysis

Consequence Analysis

Cost Analysis

Long list of options Attributes

Next Step

Step 7, Appraisal

Appraisal Step

Long list of options
Attributes

Outcomes Table

Pareto (80-20) Analysis
Reject unviable options
Classify Viable Options

Shortlist of Options

Final Verdict/ Decision to Act

SISIG mission

- **Providing a forum to focus on Systematic Innovation by bringing together interdisciplinary experts and practitioners to promote vibrant discussions and information exchange in order to:**
  - **Further enhance overall understanding of innovation processes and pave the way for development of new tools and techniques in its support**
  - **Promote further R&D in systematic innovation and direct developments through collaborative multi-disciplinary research programmes**
  - **Analyse existing innovation and entrepreneurship training materials with a view to develop enhanced programmes according to prevailing needs, to promote innovation and up-skill trainees and facilitate wider participation**
- **Consider and seek support to drive the SISIG agenda**

SISIG suggested activities

- **Organise meetings, produce regular publications representing different perspectives.**

- **Organise working groups/forums/ collaborative research programmes to**

  - **Investigate the potential application of emerging technologies (AI, social media, optimisation, etc.) in systematic innovation**
  - **Define a custom language for describing innovative ideas and the various processes involved in innovation.**
  - **Promote education of SI at every level by lobbying decision makers to incorporate SI within the UK education system**