

Collaborative Engineering

Product Concepts: TRIZ Technique



- TRIZ Ideology
- Engineering Parameters
- Design Principles
- Table of Contradictions

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Introduction

Russian acronym meaning:

"Theory of Inventive Problem Solving"

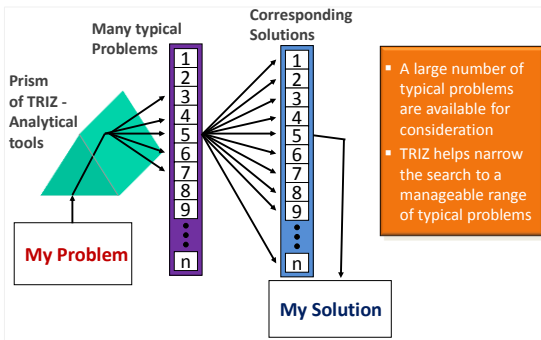
- Evolved by G.S. Altshuller (1947) after studying 40,000 patents

Principle:

- Systematic identification of problems and ideal solutions
- Overcoming various blocks through heuristics and approaches that have worked in other disciplines



TRIZ Ideology



Engineering Design Parameters

1. Weight	11. Strength	21. Reliability
2. Length	12. Durability	22. Accuracy
3. Area	13. Temperature	23. Harmful effects
4. Volume	14. Brightness	24. Manufacturability
5. Shape	15. Energy Spent	25. Convenience
6. Speed	16. Power	26. Reparability
7. Force	17. Waste of energy	27. Adaptability
8. Tension	18. Waste of substance	28. Complexity
9. Pressure	19. Loss of information	29. Automation
10. Stability	20. Waste of time	30. Automation

- TRIZ uses conflicts in design task to get to an inventive solution
- Conflicts/Contradictions arise among above parameters

Example






- **A beverage can** (An engineered system to contain a beverage)
- **Resources:** weight of filled cans, internal pressure of can, rigidity of can construction.
- **Effects:** cost of materials, producing can and waste of storage space.
- **Ideal result:**
 - Thin wall (low Cost)
 - Thick wall (Better strength for stacking)

The Contradicting Parameters

- #4 Length of nonmoving object (wall thickness to be changed)
- #11 Stress (need of high stress bearing capacity)

40 Inventive Design Principles

Inventive Design Principles of TRIZ	Example
1. Segmentation	Replace large truck by truck & trailer → 
2. Extraction	Locate a noisy compressor outside
3. Local quality	Lunch box with special sections → 
4. Asymmetry	Asymmetrical mixing vessels
5. Combining	Medical instruments that analyze multiple blood parameters at once
6. Universality	Handle of a toothbrush with paste → 
7. Nesting	Extending radio antenna

40 Inventive Design Principles

Inventive Design Principles of TRIZ	
8. Counterweight	19. Periodic action
9. Prior counteraction	20. Continuity of useful action
10. Prior action	21. Rushing through
11. Cushion in advance	22. Convert harm into benefit
12. Equipotentiality	23. Feedback
13. Inversion	24. Mediator
14. Spheroidality	25. Self-service
15. Dynamicity	26. Copying
16. Partial or overdone action	27. Inexpensive short-lived object
17. Moving to new dimension	28. Replacement of mech. system
18. Mechanical vibration	29. Use of pneumatic/hydraulics

40 Inventive Design Principles

Inventive/Design Principles of TRIZ	
30. Use of flexible film or thin membrane	Examples for each TRIZ principle at: www.triz-journal.com
31. Use of porous material	
32. Change color	
33. Homogeneity	
34. Rejecting and regenerating parts	
35. Parameter Changes	
36. Phase transition	
37. Thermal expansion	
38. Use strong oxidizers	
39. Inert environment	
40. Composite materials	

Table of Contradictions

- It is a matrix, elements of which identify design elements which will resolve the contradiction

	Undesired Result – conflict (1-39)	Can Example	1	11. Stress	...
Feature to improve (1-39)	Combinations of suggested solutions in terms of the design principles	1...			
		4. Thickness of nonmoving object			
		...			
		39.			

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		4. Thickness of nonmoving object			Principle # 1, 14 and 35
		...			
		39.			

- The Table[s] of Contradiction can be found on the internet
- If you are really lazy, the matrix has also been automated

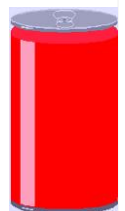
Example continued

- Inventive Principle #1: Segmentation**
 - Divide an object into independent parts
 - Make an object sectional
 - Increase the degree of an object's segmentation
- Examples:**
 - Sectional furniture, folding wooden ruler
 - Garden hoses can be joined together to form any length needed
- Inventive Principle 1c**
 - the wall changed from one smooth continuous wall to a corrugated or wavy surface
 - increased edge strength with thinner material



Example continued

- Inventive Principle #14: Spheroidality**
 - Replace linear parts or flat surfaces with curved ones
 - Use rollers, balls spirals
 - Replace a linear with rotating movement; utilize a centrifugal force
- Example:**
 - Use arches and domes for strength in architecture
- Inventive Principle 14a**
 - the perpendicular angle at which most can lids are welded to the can wall can be changed to a curve.



Example continued

- **Inventive Principle #35: Parameter Changes**
 - Change an object's aggregate state
 - Change density distribution
 - Change degree of flexibility, temperature
- **Examples:**
 - Vulcanize rubber to change its flexibility and durability
 - Liquid hand soap is concentrated and more viscous than bar soap at the point of use, making it easier to dispense in the correct amount and more sanitary when shared by several people
- **Change the composition to a stronger metal alloy used for the can wall to increase the load bearing capacity.**

Summary

- TRIZ is a systematic approach towards identification of problem and the appropriate solution
- TRIZ provides an inventor with reliable and repeatable results that do not depend on personal (psychological) issues
- It provides a means to access proven knowledge (patents)
- **Step1:** Identification of contradicting engineering principles
- **Step2:** Employing contradiction matrix to identify the inventive design principles to be used
- **Step3:** Provide inventive solutions using these design principles