

TheoRy of Inventive problem Zolving (TRIZ)

(Anglicized as TIPS – never caught on)

G.S. Altshuller, USSR, c.1950-1980

Holdings:

- There exist patterns in patent claims
Patents are based on similar Working Principles (WP's)
- Study of 1×10^6 patents to derive patterns
Team effort

5 Categories of design

1. Routine design – parametric advancement
2. Routine design – rearrangement of configuration
3. Identify and solve conflict between WP's
4. Identify new WP's
5. Identify new functions

3 Observations

1. Design evolution follows a pattern
Independent of domain
2. Conflicts drive invention
Methodology of conflict elimination is independent of domain
3. Physical principles are best applied systematically
 $\Sigma(\text{team knowledge}) < \text{all applicable knowledge}$

TRIZ Process

- Start – functional decomposition and functional structure
- Plus – other benchmarks, specifications, constraints
- Identify – conflicts between above data
- State – conflicts in terms of generalized parameters
- Apply – design principles to resolve conflicts
- Refine – resulting concepts

Generalized Parameters

1	Weight of moving object	21	Power
2	Weight of stationary object	22	Energy loss
3	Length of moving object	23	Substance loss
4	Length of stationary object	24	Information loss
5	Area of moving object	25	Waste of time
6	Area of stationary object	26	Quantity of a substance
7	Volume of moving object	27	Reliability

8	Volume of stationary object	28	Accuracy of measurement
9	Velocity	29	Manufacturing precision
10	Force	30	Harmful actions affecting the design object
11	Stress or pressure	31	Harmful actions generated by the design object
12	Shape	32	Manufacturability
13	Stability of an object's composition	33	User friendliness
14	Strength	34	Repairability
15	Duration of action generalized by moving object	35	Flexibility
16	Duration of action generalized by stationary object	36	Complexity of design object
17	Temperature	37	Difficulty to control or measure
18	Brightness	38	Level of automation
19	Energy consumed by moving object	39	Productivity
20	Energy consumed by stationary object		

Design Principles

http://www.triz40.com/aff_Principles.htm

Actions for evolving a design

Correlation matrix of Generalized Parameters to Design Principles

http://www.triz40.com/aff_Principles.htm (same place)

Design Principle that can be used to solve conflicts between two Generalized Parameters

Match “what wants to be improved” v. “what gets worse as a result”

Design Principles can be used directly to solve design problems

http://www.triz40.com/aff_Principles.htm (same place again)

Example – clothes iron

Function 1 – transfer force to clothing (to remove wrinkles)

Function 2 – reduce force on user (for comfortable use)

Conflict – heavy for function 1; light for function 2

Generalized function 1 – force (no.10)

Generalized function 2 – weight of moving object (no.1)

Applicable principles – 1,8,18,37

1 – Segmentation → levered counterweight

8 – Anti-weight → foot-operated sandwich

18 – Mechanical vibration → vibrating eccentric weight (another conflict – user comfort)

37 – Thermal expansion → water spray

Example – piping system for transport of metal shot (more specifically, getting pneumatically transported shot around a bend in the pipe without wearing out the pipe)

Function 1 – coating desired to reduce wear

Function 2 – coating not desired because of increased cost and maintenance

Apply principle – Universality (no.6) → use magnet to hold shot in bend to perform coating function

Example – cell phone

Function 1 – be small in the pocket

Function 2 – span from ear to mouth when in use

Apply principle – Dynamism (no.15) → foldable