

# TRIZ

Theory of Inventive Problem-Solving

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# Introduction

- Developed by Soviet engineer Genrich Altshuller and his colleagues, 1946.
- Studied more than 300,000 patents and discerned inventive principles were often present in the most successful cases.



# What is TRIZ?

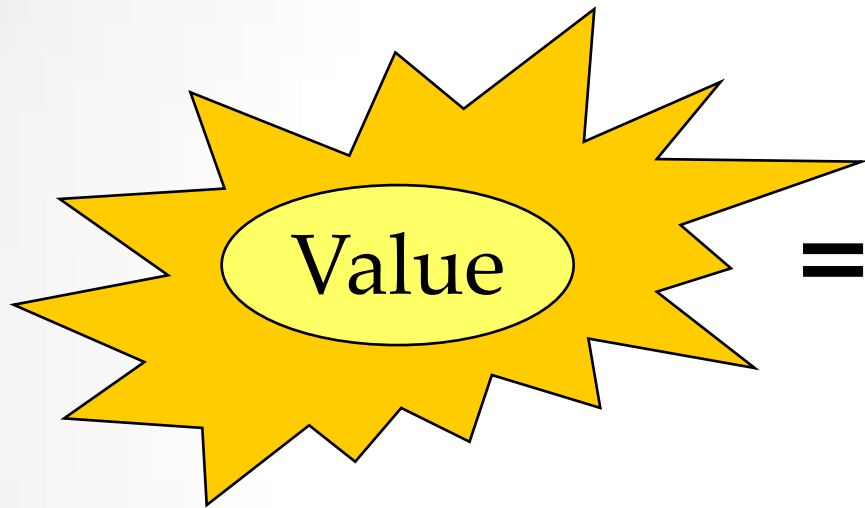
TRIZ is an evolving, open-ended system for enhancing human inventiveness through:

- Systematic identification of problems and **ideal** solutions
- Concentrating on all the **resources** available, to get more out of less
- Overcoming various blocks through approaches that have worked in other disciplines

# TRIZ Principles

- Don't accept compromises. Eliminate them.
- Somebody, someplace, has already solved your problem or one similar to it. Creativity means finding that solution and adapting it to the current problem.
  - Pharmaceutical industry needed a way to deal with excess foam from a pharmaceutical process, solution came from the beer industry

# TRIZ Ideality Approach

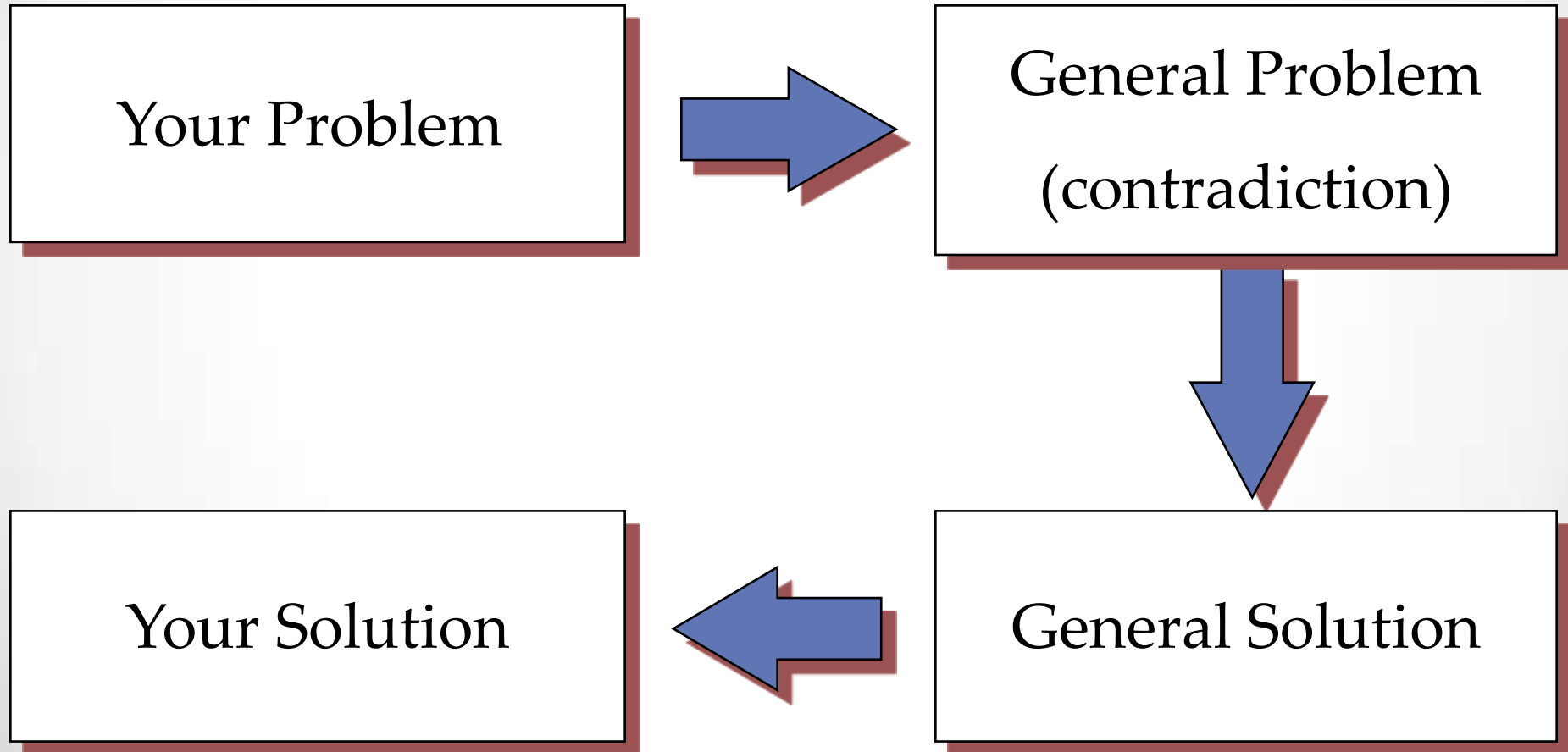

$$\text{Value} = \frac{\text{Benefits}}{\text{Cost} + \text{Harm}}$$

- The ideal system performs a required function without actually existing.
- Start by focussing on solutions not problems, then ask how can we use the resources to achieve this?

# Traditional Tradeoffs

- Technical Contradictions: something gets better, something else gets worse
  - Stronger at cost of additional weight
  - Greater bandwidth requires more power
  - Faster airbag deployment requires greater force
- Physical Contradictions: one object has contradictory requirements
  - Coffee hot enough to enjoy but not so hot as to burn
  - Software powerful features but easy to use
  - A pen tip should be sharp to draw fine lines, but blunt to avoid tearing paper

# Overall Approach



# TRIZ Dissolution Constraints





- Technical contradictions solved through 39 elimination principles
- Physical contradictions solved through 4 basic principles to look at supersystems, subsystems, separation of time and space.





# Technical Contradiction Matrix

This information was organized in a matrix.

	<b>Worsening Feature</b>  <b>Improving Feature</b> 	Weight of moving object	Weight of stationary object
		1	2
1	Weight of moving object		
2	Weight of stationary object		
3	Length of moving object		
4	Length of stationary object		

**Consider Using Inventive Principles:**

- 28 - Mechanics Substitution
- 29 - Pneumatics and Hydraulics
- 35 - Parameter Changes
- 40 - Composite Materials



# 40 Principles of Invention

1. SEGMENTATION
2. TAKEOUT
3. LOCAL QUALITY
4. ASYMMETRY
5. MERGING
6. UNIVERSALITY
7. NESTED DOLL
8. ANTI-WEIGHT
9. PRELIMINARY ANTI-ACTION
10. PRELIMINARY ACTION
11. BEFOREHAND CUSHIONING
12. EQUIPOTENTIALITY
13. OTHER WAY ROUND
14. SPHEROIDALITY
15. VARIABILITY or DYNAMICISM
16. PARTIAL or EXCESSIVE ACTION
17. ANOTHER DIMENSION
18. MECHANICAL VIBRATIONS
19. PERIODIC ACTIONS
20. CONTINUITY OF USEFUL ACTION
21. "SKIP"
22. BLESSING IN DISGUISE
23. FEEDBACK
24. INTERMEDIARY
25. SELF-SERVICE
26. COPYING
27. SERVICE LIFE - cheap/short vs. expensive/long
28. MECHANICS SUBSTITUTION
29. PNEUMATIC or HYDRAULIC CONSTRUCTIONS
30. FLEXIBLE SHELLS and THIN FILMS
31. POROUS MATERIALS
32. CHANGE OF COLOR
33. HOMOGENEITY
34. DISCARD and RECOVER
35. CHANGE PHYSICAL or CHEMICAL PARAMETERS
36. PHASE TRANSITIONS
37. THERMAL EXPANSION
38. STRONG OXIDANTS
39. INERT ATMOSPHERE
40. COMPOSITE MATERIALS

# Separation principles

- Opposite physical states can be separated:
  - In Time
  - In Space
  - Between the system and its components
- A characteristic exists at the system level but not at the component level (or vice versa)
  - Kitchen sieve is solid at macro scale, porous at micro scale
  - Bicycle chain has rigid links but is flexible at system level

*“Naturally creative  
people think in  
time & space”*

# Air bag problem

Airbags need to inflate before contacting occupants to prevent forward motion. We would like to inflate the air bags faster while decreasing the adverse effects

- Principle 16: Partial or Excessive Action
  - Use a lower powered air bag. By using less power the acceleration of the bag is less, and injuries will be reduced.
  - Use smaller air bags with higher power. These bags will reach full inflation sooner.

# Air bag problem

- Principle 21: Rushing Through
  - Inflate the air bag faster than current practice.
- Principle 40: Composite materials
  - Airbag material that can't grab skin as it is deployed

Or:

- Car intellectual system to avoid crashes
- Social system that prevents small persons from front seat

We usually accept a compromise, but this is often not necessary. Powerful solutions are the ones that don't accept the trade-offs. Compromise when necessary.

# Can TRIZ be applied in pharmaceuticals?

Using TRIZ to Accelerate  
Technology Transfer...

# Improve test models

- Eye medication and rabbits:
  - Rabbits have been used to test the irritation index of both medication and consumer products, but have a very different blink rate from humans, and a different pattern of eyelid shear during blinking. The diffusion flow cell has now replaced rabbits. Use of principles 17 and 27.
- Trans-follicular kinetics:
  - Because of the high variability of the number and size of hair follicles on human skin, it has been difficult to isolate the trans-dermal (skin) and trans-follicular(through the hair follicles) effects. Snake skin is an excellent model for the hairless skin. Use of principles 2 and 3.

# Distribution

- Eye medication—assure correct time and dose:
  - very easy to dispense the proper quantity when liquid, but, the drain into the cul de sac of the eye. The solution: liquid in the bottle and when being dispensed, but form a gel when it contacts the tears, and is activated by body temperature. Principle 35.
- Protect potency of proteins during shipment:
  - The protein should be liquid (for easy use) but it should not be liquid (for easy handling and shipping). The solution is to freeze-dry the protein material, ship it in the dry powder form, and reconstitute it at the point of use. Principle 35, or principle of separation in time.



# Scale up for full commercialization

- Avoid foam problems:
  - When liquids are shipped it can lead to the formation of foam. A very simple TRIZ solution does not solve the problem of foam creation, but it make foam not cause problems for downstream processes: apply Principle 13 and extract the liquid from the bottom of the tank, to get pure liquid without any foam.
- Improve medication uniformity by electrostatic deposition:
  - Although pill production by compressing powder is a well-established technology, there are many drugs that require higher accuracy and uniformity than the powder compression method can provide. Considerable improvement in uniformity has been achieved by electrostatically depositing the material on a continuous web of edible material. Principle 28.

# Summary

- TRIZ combines right-brain and left-brain techniques
- Reduces subjectivity
- Very effective methodology when appropriately applied
- Able to find solutions outside the field where they were developed
- Time and cost-effective
- Can be applied for many various purposes
- Flexible to environmental changes



# Some Good Links

- The TRIZ Journal: <http://www.triz-journal.com/>
- TRIZ in Detail: <http://www.mazur.net/triz/>
- 40 Inventive Principles...
  - ...with technical examples
    - <http://www.triz-journal.com/archives/1997/07/b/index.html>
  - ...with business examples
    - <http://www.triz-journal.com/archives/1999/09/a/index.htm>
  - ...with social examples
    - <http://www.triz-journal.com/archives/2001/06/a/index.htm>