

# WHAT IS “TRIZ” ?

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A Russian acronym:

Theoria Resheneyva Isobretatelskehuh Zadach

*ТЕОРИЯ РЕШЕНИЯ ИЗОБРЕТАТЕЛЬСКИХ ЗАДАЧ*

**(Theory of Inventive Problem Solving)**

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# TRIZ

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- One can think of TRIZ as another way of Lateral Thinking.

- TRIZ is based on two basic principles

--Somebody, sometime, somewhere has already solved your problem or one similar to it. Creativity means finding that solution and adapting it to the current problem.

--Don't accept contradictions. Resolve them.

# TRIZ Everyday Examples

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- Automobile air bags deploy quickly to protect the passenger (good),

but

the more rapidly they deploy, the more likely they are to injure or kill small or out-of-position people (bad).

# TRIZ Everyday Examples con't

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- Cell phone networks should have excellent coverage so users have strong signals (good),

but

cell phone towers are not very nice to look at (bad).

# TRIZ Everyday Examples con't

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- The email spam filter should be efficient enough to remove all my junk emails (good),

but

then it is more likely to screen some emails that I actually want to receive (bad).

# 39 TRIZ Features

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|                                |                                        |                                 |
|--------------------------------|----------------------------------------|---------------------------------|
| 1: Weight of moving object     | 14: Strength                           | 27: Reliability                 |
| 2: Weight of stationary object | 15: Durability of moving object        | 28: Measurement accuracy        |
| 3: Length of moving object     | 16: Durability of non moving object    | 29: Manufacturing precision     |
| 4: Length of stationary object | 17: Temperature                        | 30: Object-affected harmful     |
| 5: Area of moving object       | 18: Illumination intensity             | 31: Object-generated harmful    |
| 6: Area of stationary object   | 19: Use of energy by moving object     | 32: Ease of manufacture         |
| 7: Volume of moving object     | 20: Use of energy by stationary object | 33: Ease of operation           |
| 8: Volume of stationary object | 21: Power                              | 34: Ease of repair              |
| 9: Speed of object             | 22: Loss of Energy                     | 35: Adaptability or versatility |
| 10: Force (Intensity)          | 23: Loss of substance                  | 36: Device complexity           |
| 11: Stress or pressure         | 24: Loss of Information                | 37: Difficulty of detecting     |
| 12: Shape                      | 25: Loss of Time                       | 38: Extent of automation        |
| 13: Stability of the object    | 26: Quantity of substance              | 39: Productivity                |

# TRIZ Features

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| Title              | Explanation                                                                                                                                                                                  |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Moving objects     | Objects which can easily change position in space, either on their own, or as a result of external forces. Vehicles and objects designed to be portable are the basic members of this class. |
| Stationary objects | Objects which do not change position in space, either on their own, or as a result of external forces. Consider the conditions under which the object is being used.                         |

# TRIZ Features

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| Title                          | Explanation                                                                                                                                                                                                      |
|--------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.. Weight of moving object    | The mass of the object, in a gravitational field. The force that the body exerts on its support or suspension.                                                                                                   |
| 2. Weight of stationary object | The mass of the object, in a gravitational field. The force that the body exerts on its support or suspension, or on the surface on which it rests.                                                              |
| 3. Length of moving object     | Any one linear dimension, not necessarily the longest, is considered a length.                                                                                                                                   |
| 4. Length of stationary object | Same.                                                                                                                                                                                                            |
| 5. Area of moving object       | A geometrical characteristic described by the part of a plane enclosed by a line. The part of a surface occupied by the object. OR the square measure of the surface, either internal or external, of an object. |
| 6. Area of stationary object   | Same                                                                                                                                                                                                             |
| 7. Volume of moving object     | The cubic measure of space occupied by the object. Length x width x height for a rectangular object, height x area for a cylinder, etc.                                                                          |
| 8. Volume of stationary object | Same                                                                                                                                                                                                             |

# Altshuller's 40 Principles of TRIZ

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- |                                  |                                    |
|----------------------------------|------------------------------------|
| 1. Segmentation                  | 21. Skipping                       |
| 2. Taking out                    | 22. "Blessing in disguise"         |
| 3. Local Quality                 | 23. Feedback                       |
| 4. Asymmetry                     | 24. 'Intermediary'                 |
| 5. Merging                       | 25. Self-service                   |
| 6. Universality                  | 26. Copying                        |
| 7. "Nested doll"                 | 27. Cheap short-living             |
| 8. Anti-weight                   | 28. Mechanics substitution         |
| 9. Preliminary anti-action       | 29. Pneumatics and hydraulics      |
| 10. Preliminary action           | 30. Flexible shells and thin films |
| 11. Beforehand cushioning        | 31. Porous materials               |
| 12. Equipotentiality             | 32. Color changes                  |
| 13. The other way around         | 33. Homogeneity                    |
| 14. Spheroidality                | 34. Discarding and recovering      |
| 15. Dynamics                     | 35. Parameter changes              |
| 16. Partial or excessive actions | 36. Phase transitions              |
| 17. Another dimension            | 37. Thermal expansion              |
| 18. Mechanical vibration         | 38. Strong oxidants                |
| 19. Periodic action              | 39. Inert atmosphere               |
| 20. Continuity of useful action  | 40. Composite material films       |

# 40 Inventive Principles With Examples

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## **Principle 2. Taking out**

- A. Separate an interfering part or property from an object, or single out the only necessary part (or property) of an object.

# 40 Inventive Principles With Examples

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## Principle 2. Taking out

- A. Separate an interfering part or property from an object, or single out the only necessary part (or property) of an object.

*Locate a noisy compressor outside the building where compressed air is used.*

*Use fiber optics or a light pipe to separate the hot light source from the location where light is needed.*

*Use the sound of a barking dog, without the dog, as a burglar alarm.*

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# 40 Inventive (Business) Principles With Examples

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## Principle 7. “Nested Doll”

A. Place one object inside another; place each object, in turn, inside the other.

- *Store-in-store (Kinkos FedEx)*

# 40 Inventive (Business) Principles With Examples

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## Principle 7. “Nested Doll”

B. Make one part pass through a cavity in the other.

- *Plug holes in organisation structure*
  - *Door sensors count customers into and out of a store/office, etc (use data for market profiling, etc)*
  - *Casino hotel architecture (Las Vegas style): The guest must pass through the gaming area to get to the restaurant, the hotel registration, even the lavatories!*
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# Example Application of TRIZ

## A New Structural Material for Bullet Proof Garment

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- ***Statement:*** Bullet proof vests should be strong, but not heavy.

# Example Application of TRIZ

## A New Structural Material for Bullet Proof Garment

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**Statement:** *Bullet proof vests should be strong, but not heavy.*

Step 1 – Identify the contradiction(s)  
Strength (improves) versus  
Weight (worsens)

# Example Application of TRIZ

## A New Structural Material for Bullet Proof Garment

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**Statement:** Bullet proof vests should be strong, but not heavy.

- Step 1 – Identify the contradiction(s)  
Strength (improves) versus  
Weight (worsens)
- Step 2 – Look at the list of features and identify those important to your contradiction.  
Strength – #14  
Weight – #2

# Example Application of TRIZ

## A New Structural Material for Bullet Proof Garment

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**Statement:** Bullet proof vests should be strong, but not heavy.

Step 1 – Identify the contradiction(s)  
Strength (improves) versus  
Weight (worsens)

Step 2 – Look at the list of features and identify those important to your contradiction.

Strength – #14

Weight – #2

Step 3 Identify Which Are Improving Features and Which Are Worsening Features

Strength (feature 14) improves  
Weight (feature 2) worsens

# Example Application of TRIZ

## A New Structural Material for Bullet Proof Garment

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### Step 4 –

Refer to the TRIZ Contradiction Matrix to learn which of Altshuller's Principles may be useful for this problem.

The intersection of Column 2 and Row 14 gives the following principles

1  
26  
27  
40

# Altshuller's 40 Principles of TRIZ

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- |                                  |                                    |
|----------------------------------|------------------------------------|
| 1. Segmentation                  | 21. Skipping                       |
| 2. Taking out                    | 22. "Blessing in disguise"         |
| 3. Local Quality                 | 23. Feedback                       |
| 4. Asymmetry                     | 24. 'Intermediary'                 |
| 5. Merging                       | 25. Self-service                   |
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# Example Application of TRIZ

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### Step 4 –

Refer to the TRIZ Contradiction Matrix to learn which of Altshuller's Principles may be useful for this problem.

Row 14 (Strength) and Column 2 (Weight) of the Contradiction Matrix indicate the following Principles may be useful: 40, 26, 27, and 1. We now look at the Principles list to learn that these numbers correspond to

- 1. Segmentation.**
- 26. Copying**
- 27. Cheap short living**
- 40. Composite materials**

Next we brainstorm how we could use these four Principles to solve our problem.

# 40 Inventive Principles With Examples

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## **Principle 1. Segmentation**

A. Divide an object into independent parts.

# 40 Inventive Principles With Examples

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## **Principle 1. Segmentation**

A. Divide an object into independent parts.

*Replace mainframe computer by personal computers.*

*Replace a large truck by a truck and trailer.*

*Use a work breakdown structure for a large project.*

B. Make an object easy to disassemble.

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# 40 Inventive (Business) Principles With Examples

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## Principle 1. Segmentation

B. Make an object easy to disassemble.

- *Use of temporary workers on short-term projects*
- *Flexible Manufacturing Systems*
- *Modular furniture/offices*
- *Container shipment*

C. Increase the degree of fragmentation or segmentation.

- *'Empowerment' - segmentation of decision making.*
  - *Distance learning (also 'Taking Out')*
  - *Virtual office/remote working (also 'Taking Out')*
-

### 1. Segmentation

Perhaps we could consider several different coverings for different parts of the body (pants, vest, etc.) rather than a one-piece suit.

Maybe different materials to cover the critical areas such as chest and head, each taking advantage of specific properties that would be customized for their differing applications.

# Example Application of TRIZ

## A New Structural Material for Bullet Proof Garment

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### 26. Copying

The explanation of this Principle from the TRIZ website is:

- Instead of an unavailable, expensive, fragile object, use simpler and inexpensive copies.
- Replace an object, or process with optical copies.

*We could copy the design of abbreviated scuba diving wet suits for use as a bullet proof garment.*

# Example Application of TRIZ

## A New Structural Material for Bullet Proof Garment

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### 27. Cheap short-living objects

The explanation of this Principle from the TRIZ website is:

- Replace an inexpensive object with a multiple of inexpensive objects, comprising certain qualities (such as service life, for instance).

*This Principle does not appear to be readily applicable to this problem. This occurrence is not necessarily unusual, because these Principles are only general suggestions to help focus our thinking in areas that have proven fruitful in previous problems.*

# Example Application of TRIZ

## A New Structural Material for Bullet Proof Garment

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### 40. Composite materials

The explanation of this Principle from the TRIZ website is:

#### **Change from uniform to composite (multiple) materials.**

- *Composite epoxy resin/carbon fiber golf club shafts are lighter, stronger, and more flexible than metal. Same for airplane parts.*
- *Fiberglass surfboards are lighter and more controllable and easier to form into a variety of shapes than wooden*

*For lighter-weight, stronger vests, the use of composites is an active area of research.*

*Polymers (Kevlar) reinforced with carbon nanofibers are currently being investigated as a strong lightweight alternative to steel for structural materials.*

Kevlar vests are now common place among police officers and soldiers

## Epilog

By identifying problem contradictions, the elements of TRIZ can be used to help reach a solution. Using the TRIZ method, we were able to generate two additional ideas.

TRIZ Motto: If the tools of TRIZ are used in an effective manner the major challenges of today will be resolved more rapidly to produce the success stories of tomorrow.

# The Boeing 737

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A TRIZ problem solving team was called to the Boeing factor in Seattle, Washington to see how the capacity of the Boeing 737-100 could be increased.

## TRIZ Contradiction Matrix

|                   |                                | Worsening Feature          |                                |                            |                                |                          |
|-------------------|--------------------------------|----------------------------|--------------------------------|----------------------------|--------------------------------|--------------------------|
|                   |                                | 1. Weight of moving object | 2. Weight of stationary object | 3. Length of moving object | 4. Length of stationary object | 5. Area of moving object |
| Improving Feature | 1. Weight of moving object     | *                          | —                              | 15, 8<br>29, 34            | —                              | 29, 17<br>38, 34         |
|                   | 2. Weight of stationary object | —                          | *                              | —                          | 10, 1<br>29, 35                | —                        |
|                   | 3. Length of moving object     | 8, 15<br>29, 34            | —                              | *                          | —                              | 15, 17<br>4              |
|                   | 4. Length of stationary object | —                          | 35, 28<br>40, 29               | —                          | *                              | —                        |
|                   | 5. Area of moving object       | 2, 17<br>29, 4             | —                              | 14, 15<br>18, 4            | —                              | *                        |
|                   | 6. Area of stationary object   | —                          | 30, 2<br>14, 18                | —                          | 26, 7<br>9, 39                 | —                        |
|                   | 7. Volume of moving object     | 2, 26<br>29, 40            | —                              | 1, 7<br>4, 35              | —                              | 1, 7<br>4, 17            |