WHAT IS “TRIZ” ?

A Russian acronym:

Theoria **R**esheneyva **I**sobretatelskehuh **Z**adach

Теория Решения Изобретательских Задач

(Theory of Inventive Problem Solving)

TRIZ

- 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.

Use the **Defect** as a Resource to Solve the Problem

SYSTEM PROPOSAL AND CHALLENGE

- Replace inspectors with a $200K video inspection system
- High return project, but capital is not available
- Boss says, that's a great idea, but "Find another way!!"

GOOD PILLS/BAD PILLS

- What is IDEALITY/IDEA FINAL RESULT?

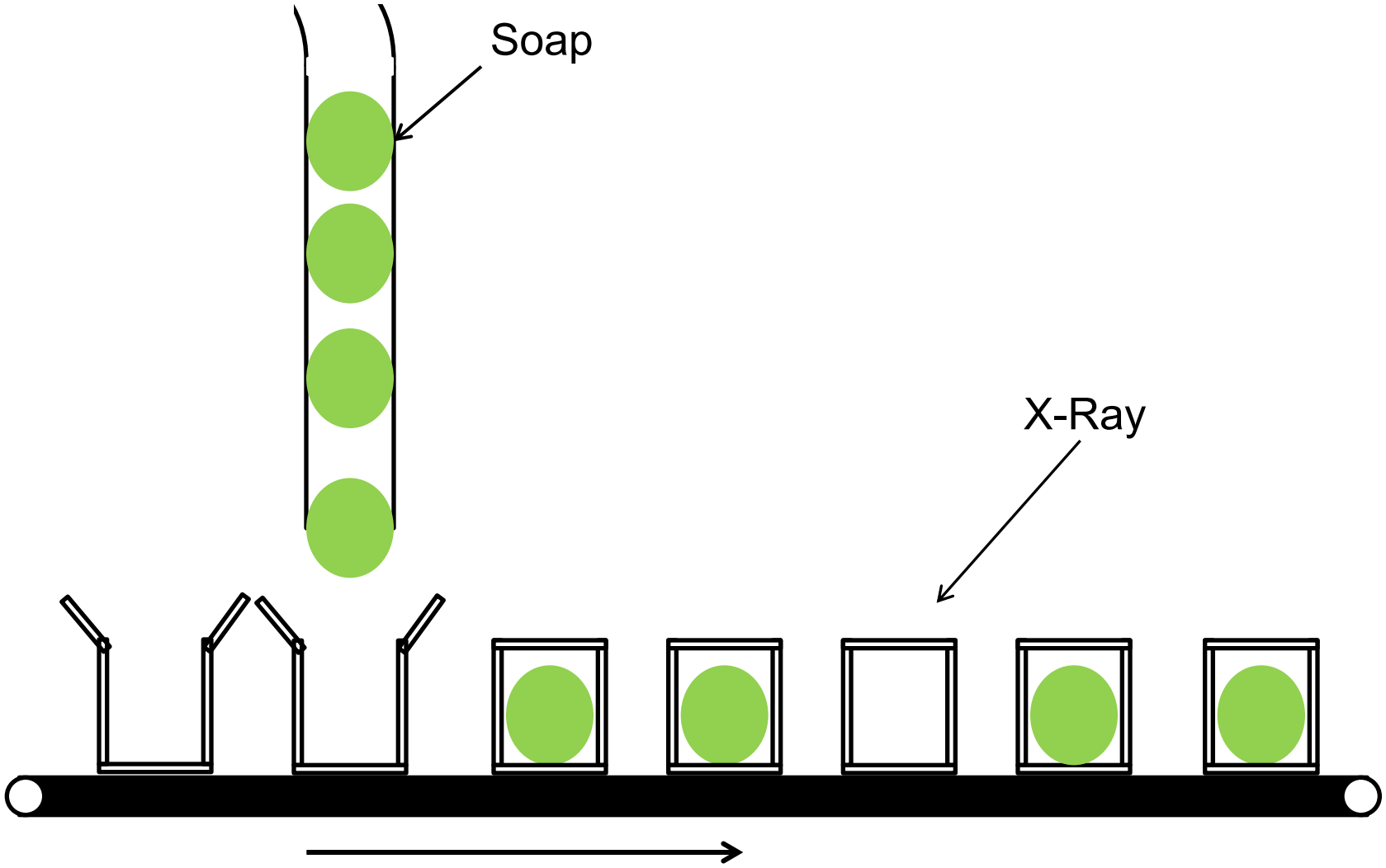
We do not want any bad pills in the bottles.

- What are the RESOURCES we have?

Can we use the defect as a resource to solve the problem?

Empty Bath Soap Boxes

Soap Defect



Empty Bath Soap Boxes

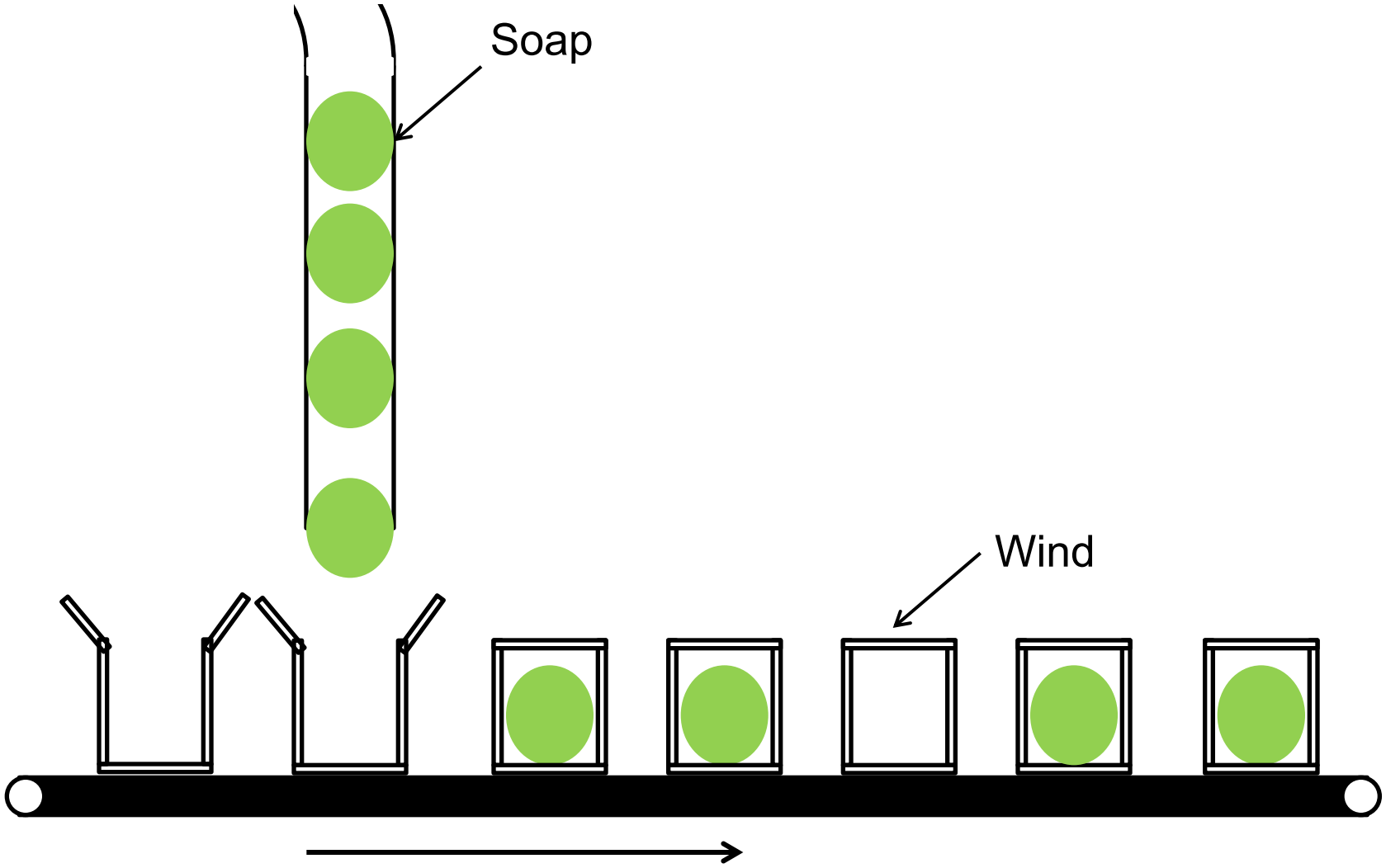
- What is IDEALITY/IDEA FINAL RESULT?

We do not want to ship any empty soap boxes

- What are the RESOURCES we have?

Can we use the **defect** as a resource to solve the problem?

Soap Defect



TRIZ Everyday Examples

- 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

- 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

- 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

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

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.

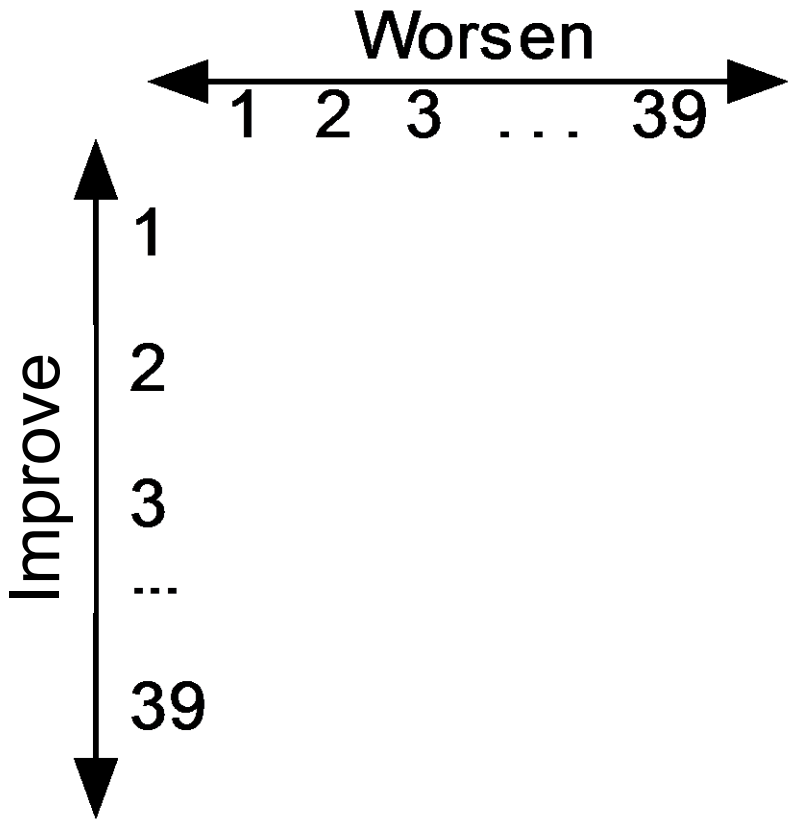
TRIZ Features

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

TRIZ Web Site

http://www.triz40.com/

39x39 Contradiction Matrix



TRIZ Contradiction Matrix

Improving Feature	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	6: Area of stationary object
1: Weight of moving object	*	-	15, 8 29, 34	-	29, 17 38, 34	-
2: Weight of stationary object	-	*	-	10, 1 29, 35	-	35, 30 13, 2
3: Length of moving object	8, 15 29, 34	-	*	-	15, 17 4	-
4: Length of stationary object	-	35, 28 40, 29	-	*	-	17, 7 10, 40
5: Area of moving object	2, 17 29, 4	-	14, 15 18, 4	-	*	-
6: Area of stationary object	-	30, 2 14, 18	-	26, 7 9, 39	-	*
7: Volume of moving object	2, 26 29, 40	-	1, 7 4, 35	-	1, 7 4, 17	-
8: Volume of stationary object	-	35, 10 19, 14	19, 14	35, 8 2, 14	-	-
9: Speed of object	2, 28 13, 38	-	13, 14 8	-	29, 30 34	-
10: Force (Intensity)	8 1 37 18	18 13 1 28	17 19 9 36	28 10	19 10 15	1 18 36 37
11: Stress or pressure	10 36 37 40	13 29 10 18	35 10 36	35 1 14 16	10 15 36 28	10 15 36 37
12: Shape	8 10 29 40	15 10 26 3	29 34 5 4	13 14 10 7	5 34 4 10	-
13: Stability of the object	21 35 2 39	26 39 1 40	13 15 1 28	37	2 11 13	39
14: Strength	1 8 40 15	40 26 27 1	1 15 8 35	15 14 28 26	3 34 40 29	9 40 28

Altshuller's 40 Principles of TRIZ

1. Segmentation
2. Taking out
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. The other way around
14. Spheroidality
15. Dynamics
16. Partial or excessive actions
17. Another dimension
18. Mechanical vibration
19. Periodic action
20. Continuity of useful action
21. Skipping
22. "Blessing in disguise"
23. Feedback
24. 'Intermediary'
25. Self-service
26. Copying
27. Cheap short-living
28. Mechanics substitution
29. Pneumatics and hydraulics
30. Flexible shells and thin films
31. Porous materials
32. Color changes
33. Homogeneity
34. Discarding and recovering
35. Parameter changes
36. Phase transitions
37. Thermal expansion
38. Strong oxidants
39. Inert atmosphere
40. Composite material films

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40 Inventive Principles With Examples

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.

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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.

40 Inventive (Business) Principles With Examples

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

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!*

Example Application of TRIZ

A New Structural Material for Bullet Proof Garment

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

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A New Structural Material for Bullet Proof Garment

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Step 1 – Identify the contradiction(s)

Strength (improves) versus
Weight (worsens)

Example Application of TRIZ

A New Structural Material for Bullet Proof Garment

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

Step 1 – Identify the contradiction(s)

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

Strength – #14

Weight – #2

Example Application of TRIZ

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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)

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Strength – #14
Weight – #2

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

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

	2: Weight of stationary object
1: Weight of moving object	*
2: Weight of stationary object	-
3: Length of moving object	8, 15 29, 34
4: Length of stationary object	-
5: Area of moving object	2, 17 29, 4
6: Area of stationary object	-
7: Volume of moving object	2, 26 29, 40
8: Volume of stationary object	-
9: Speed of object	2, 28 13, 38
10: Force (Intensity)	8 1 37 18
11: Stress or pressure	10 36 37 40
12: Shape	8 10 29 40
13: Stability of the object	21 35 2 39
14: Strength	40,26 27,1

Example Application of TRIZ

A New Structural Material for Bullet Proof Garment

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

1. Segmentation
2. Taking out
3. Local Quality
4. Asymmetry
5. Merging
6. Universality
7. "Nested doll"
8. Anti-weight
9. Preliminary anti-action
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14. Spheroidality
15. Dynamics
16. Partial or excessive actions
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19. Periodic action
20. Continuity of useful action
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23. Feedback
24. 'Intermediary'
25. Self-service
26. Copying
27. Cheap short-living
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35. Parameter changes
36. Phase transitions
37. Thermal expansion
38. Strong oxidants
39. Inert atmosphere
40. Composite material films

Example Application of TRIZ

A New Structural Material for Bullet Proof Garment

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

Principle 1. Segmentation

A. Divide an object into independent parts.

40 Inventive Principles With Examples

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.

40 Inventive (Business) Principles With Examples

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')*

Example Application of TRIZ

A New Structural Material for Bullet Proof Garment

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.

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.

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 occurance 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.

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.

TRIZ

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

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.

The airplane engine is the moving object. We would need the engine air intake and the fuel injection casing to be larger so the improving feature is engine volume. the but if we increase the volume of the engine it will decrease the clearance distance between the bottom of the engine and the ground (worsening feature). The improving feature is number 7.“Volume of moving object (engine) and the worsening feature is “3. Length (diameter) of the moving object (clearance).

- Solution to Boeing 737

TRIZ Contradiction Matrix

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2. Weight of stationary object	—	*	—	10, 1 29, 35	—
3. Length of moving object	8, 15 29, 34	—	*	—	15, 17 4
4. Length of stationary object	—	35, 28 40, 29	—	*	—
5. Area of moving object	2, 17 29, 4	—	14, 15 18, 4	—	*
6. Area of stationary object	—	30, 2 14, 18	—	26, 7 9, 39	—
7. Volume of moving object	2, 26 29, 40	—	1, 7 4, 35	—	1, 7 4, 17

The engine intake area and the cowl with the fuel lines make up the engine volume, thus an improving feature will be the “7. Volume of the moving object” and the worsening feature again “3. Length (engine diameter, i.e., clearance).” This intersection gives

4. Asymmetry
1. Segmentation
7. Nested Dolls
35. Parameter Changes

We note the 737-200 engines are circular in both the intake area and the area plus the casing.

Now let's look at Atlshuler Principle 1. Segmentation.

We have the engine air intake area and the area of the casing surrounding the intake. The intake area must be circular because of the spinning blades inside the engine.

Now let's look at the principle number 4. Asymmetry.

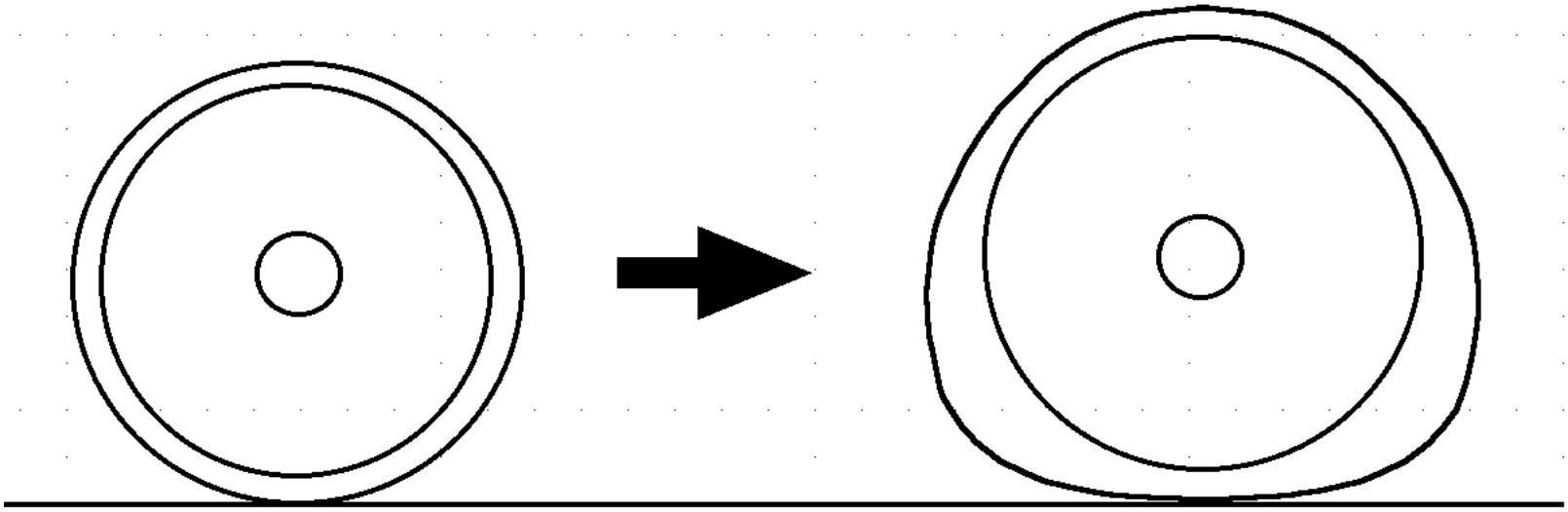
Does the intake area *plus* the casing need to be symmetric? No it does not.

Let's look at number 7. Nesting.

Could the symmetrical blades and moving parts be "nested" inside an asymmetrical casing?

What if we were to make the air intake area symmetrical but make the casing plus intake area asymmetrical so as to flatten the bottom and thus leave a great clearance?

If you look at the engines of the new 737s you will notice this solution was implemented.



Solution : Cylindrical Intake but Oval Engine Casing