



Proactive Design Innovation (TRIZ)

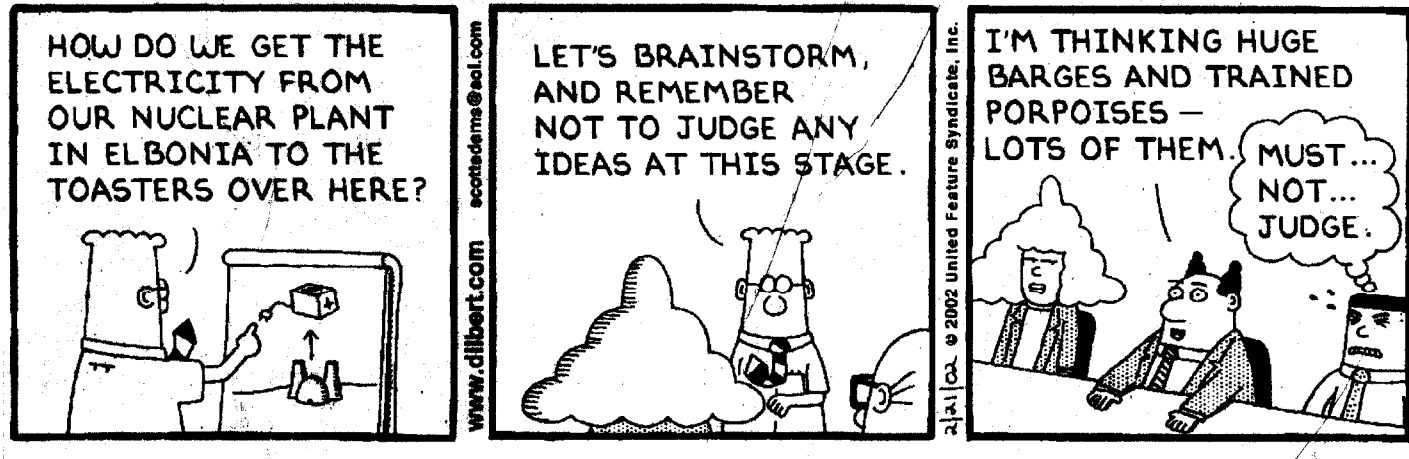
Roy Laun

CONNSTEP, Inc.

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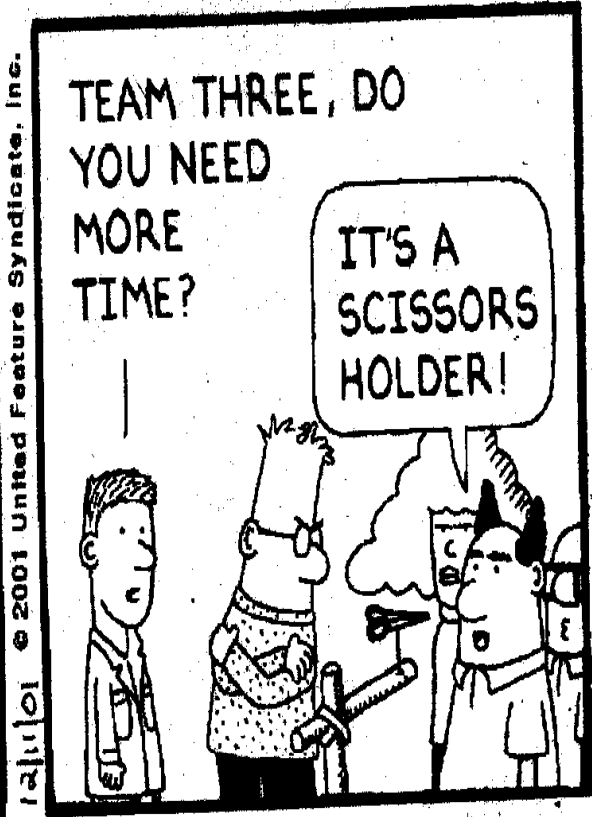
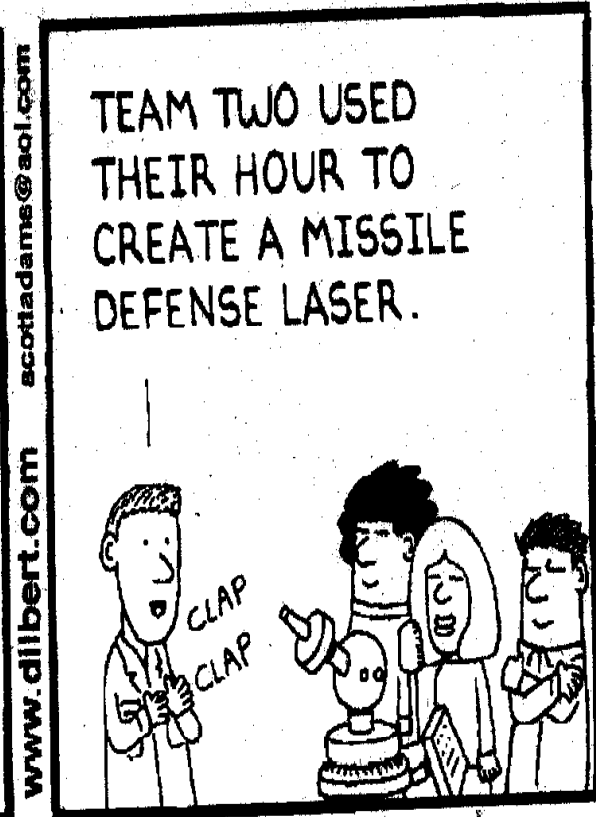
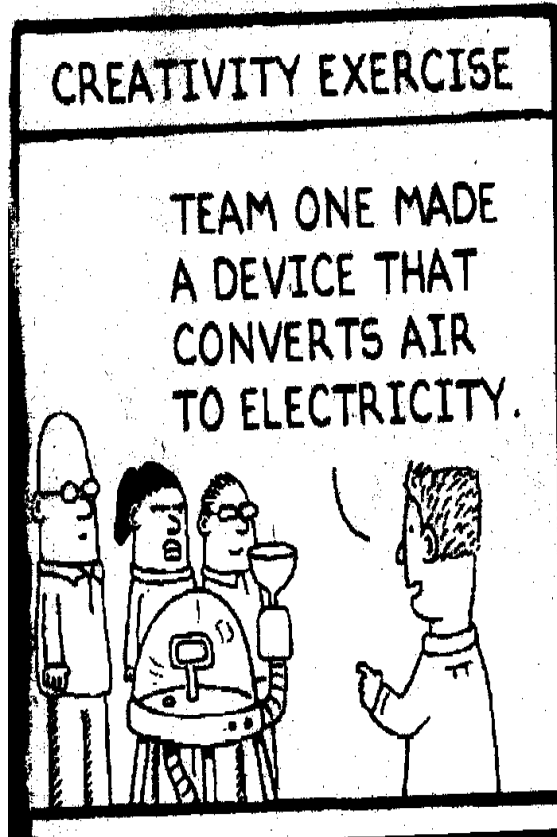
Dilbert's View of Innovation

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Objectives

- Familiarize you with the basic concepts of Inventive Problem Solving/TRIZ
- Explain and demonstrate TRIZ or Pro-active Innovation
- ***Change the way you think*** about solving problems

What is “TRIZ” ?

A Russian acronym:

Theoria Resheneyva Isobretatskehuh Zadach

(Theory of Solving Problems Inventively)

ТЕОРИЯ РЕШЕНИЯ ИЗОБРЕТАТЕЛЬСКИХ ЗАДАЧ

What is “TRIZ” ?

TRIZ is

- A way of thinking
- A family of solution paths compiled from the observations of Genrich Altshuller
- Intelligent problem solving or based on other solutions to similar problems for *different* applications

The History of TRIZ

- A discovery of a patent examiner for the Russian navy, Genrich Altshuller
 - Studied hundreds of thousands of patents
 - Recognized that problem solving principles were predictable and repeatable—***Literally anyone can invent!***

What to Use TRIZ for

- Level 2-4 problems
 - 1--straight forward engineering design
 - **2--simple contradictions**
 - **3--difficult design and manufacturing contradictions**
 - **4--extremely difficult system design problems**
 - 5--invention of new science
 - Level 4 can require looking at hundreds of thousands of potential solutions and take many years of effort within an organization
 - TRIZ shortens the time, substantially

The Output of the TRIZ Process

- Generates solution paths and concepts of solution, NOT engineering drawings and detailed plans
- A better, more clearly defined problem statement and project direction
- New and nearly exhaustive sets of concepts

Deficiency in the Process

- Stimulus for ideas is still limited by the expertise and knowledge of the team
- Paths (ideas) derived from the TRIZ process may not all apply to problem being solved

The TRIZ Toolkit

- Altshuller created a matrix of 39 engineering characteristics that could have a contrary or unwanted result requiring a solution
- He defined 40 Innovative or Engineering Principles to help solve the contradiction
- He devised these from his observations of patents and new inventions

Table of Contradictions (Example)

Undesired Result (Conflict) Feature to Improve		1	2	3	4	5	6	7	8	9	10	11	12	13
		Weight of moving object	Weight of non-moving object	Length of moving object	Length of non-moving object	Area of moving object	Area of non-moving object	Volume of moving object	Volume of non-moving object	Speed	Force	Tension, pressure	Shape	Stability of object
1	Weight of moving object			15,8, 29,34		29,17, 38,34		29,2, 40,28		2,8, 15,38	8,10, 18,37	10,36, 37,40	10,14, 35,40	1,35, 19,39
2	Weight of non-moving object				10,1, 29,35		35,30, 13,2		5,35, 14,2		8,10, 19,35	13,29, 10,18	13,10, 29,14	26,39, 1,40
3	Length of moving object	8,15, 29,34				15,17, 4		7,17, 4,35		13,4, 8	17,10, 4	1,8, 35	1,8, 10,29	1,8, 15,34
4	Length of non-moving object		35,28, 40,29				17,7, 10,40		35,8, 2,14		28,10	1,14, 35	13,14, 15,7	39,37, 35
5	Area of moving object	2,17, 29,4		14,15, 18,4				7,14, 17,4		29,30, 4,34	19,30, 35,2	10,15, 36,28	5,34, 29,4	11,2, 13,39
6	Area of non-moving object		30,2, 14,18		26,7, 9,39						1,18, 35,36	10,15, 36,37		2,38
7	Volume of moving object	2,26, 29,40		1,7, 4,35		1,7, 4,17				29,4, 38,34	15,35, 36,37	6,35, 36,37	1,15, 29,4	28,10, 1,39
8	Volume of non-moving object		35,10, 19,14	19,14	35,8, 2,14						2,18, 37	24,35	7,2, 35	34,28, 35,40
9	Speed	2,28, 13,38		13,14, 8		29,30, 34		7,29, 34			13,28, 15,19	6,18, 38,40	35,15, 18,34	28,33, 1,18
10	Force	8,1, 37,18	18,13, 1,28	17,19, 9,36	28,10	19,10, 15	1,18, 36,37	15,9, 12,37	2,36, 18, 37	13,28, 15,12		18,21, 11	10,35, 40,34	35,10, 21
11	Tension, pressure	10,36, 37,40	13,29, 10,18	35,10, 36	35,1, 14,16	10,15, 36,25	10,15, 35,37	6,35, 10	35,24	6,35, 36	36,35, 21		35,4, 15,10	35,33, 2,40
12	Shape	8,10, 29,40	15,10, 26,3	29,34, 5,4	13,14, 10,7	5,34, 4,10		14,4, 15,22	7,2, 35	35,15, 34,18	35,10, 37,40	34,15, 10,14		33,1, 18,4
13	Stability of object	21,35, 2,39	26,39, 1,40	13,15, 1,28	37	2,11, 13	39	28,10, 19,39	34,28, 35,40	33,15, 28,18	10,35, 21,16	2,35, 40	22,1, 18,4	
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	10,15, 14,7	9,14, 17,15	8,13, 26,14	10,18, 3,14	10,3, 18,40	10,30, 35,40	13,17, 35
15	Durability of moving object	19,5, 34,31		2, 19, 9		3,17, 19		10,2, 19,30		3, 35, 5	19,2, 16	19,3, 27	14,26, 28,25	13,3, 35
16	Durability of non-moving object		6,27, 19,16		1,10, 35					35,34, 38				39,3, 35,23
17	Temperature	36,22, 6,38	22,35, 32	15,19, 9	15,19, 9	3,35, 39,18	35,38	34,39, 40,18	35,6, 4	2,28, 36,30	35,10, 3,21	35,39, 19,2	14,22, 19,32	1,35, 32
18	Brightness	19,1, 32	2,35, 32	19,32, 16		19,32, 26		2,13, 10		10,13, 19	26,19, 6		32,30	32,3, 27
19	Energy spent by moving object	12,18, 28,31		12,28		15,19, 25		35,13, 18		8,15, 35	16,26, 21,2	23,14, 25	12,2, 29	19,13, 17,24
20	Energy spent by non-moving object		19,9, 6,27								36,37			27,4, 29,18

Table of Inventive Principles (Example)

1. Segmentation

- a. Divide an object into independent parts
- b. Make an object sectional
- c. Increase the degree of an object's segmentation

Examples:

Sectional furniture, modular computer components, folding wooden ruler

Garden hoses can be joined together to form any length needed

2. Extraction

- a. Extract (remove or separate) a "disturbing" part or property from an object, or
- b. Extract only the necessary part or property

Example:

To frighten birds away from the airport, use an audio recorder to reproduce the sound known to excite birds. (The sound is thus separated from the birds.)



Contradictions - Jet Engine

Boeing wanted to install larger engines on a redesigned 737. A larger air intake would reduce ground clearance to unacceptable levels.



Contradiction:
Increasing air intake
reduces ground
clearance

Control parameter:
Intake radius

#5 VS. #3 in table

Table of Contradictions (Example)

Undesired Result (Conflict) Feature to Improve		1	2	3	4	5	6	7	8	9	10	11	12	13
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1	Weight of moving object			1,8, 29,34		29,17, 38,34		29,2, 40,28		2,8, 15,38	8,10, 18,37	10,36, 37,40	10,14, 35,40	1,35, 19,39
2	Weight of non-moving object				10,1, 29,35		35,30, 13,2		5,35, 14,2		8,10, 19,35	13,29, 10,18	13,10, 29,14	26,39, 1,40
3	Length of moving object	8,15, 29,34				15,17, 4		7,17, 4,35		13,4, 8	17,10, 4	1,8, 35	1,8, 10,29	1,8, 15,34
4	Length of non-moving object		35,28, 40,29				17,7, 10,40		35,8, 2,14		28,10	1,14, 35	13,14, 15,7	39,37, 35
5	Area of moving object	2,17, 29,4		14,15, 18,4				7,14, 17,4		29,30, 4,34	19,30, 35,2	10,15, 36,28	5,34, 29,4	11,2, 13,39
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7	Volume of moving object	2,26, 29,40		1,7, 4,35		1,7, 4,17				29,4, 38,34	15,35, 36,37	6,35, 36,37	1,15, 29,4	28,10, 1,39
8	Volume of non-moving object		35,10, 19,14	19,14	35,8, 2,14						2,18, 37	24,35	7,2, 35	34,28, 35,40
9	Speed	2,28, 13,38		13,14, 8		29,30, 34		7,29, 34			13,28, 15,19	6,18, 38,40	35,15, 18,34	28,33, 1,18
10	Force	8,1, 37,18	18,13, 1,28	17,19, 9,36	28,10	19,10, 15	1,18, 36,37	15,9, 12,37	2,36, 18,37	13,28, 15,12		18,21, 11	10,35, 40,34	35,10, 21
11	Tension, pressure	10,36, 37,40	13,29, 10,18	35,10, 36	35,1, 14,16	10,15, 36,25	10,15, 35,37	6,35, 10	35,24	6,35, 36	36,35, 21		35,4, 15,10	35,33, 2,40
12	Shape	8,10, 29,40	15,10, 26,3	29,34, 5,4	13,14, 10,7	5,34, 4,10		14,4, 15,22	7,2, 35	35,15, 34,18	35,10, 37,40	34,15, 10,14		33,1, 18,4
13	Stability of object	21,35, 2,39	26,39, 1,40	13,15, 1,28	37	2,11, 13	39	28,10, 19,39	34,28, 35,40	33,15, 28,18	10,35, 21,16	2,35, 40	22,1, 18,4	
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	10,15, 14,7	9,14, 17,15	8,13, 26,14	10,18, 3,14	10,3, 18,40	10,30, 35,40	13,17, 35
15	Durability of moving object	19,5, 34,31		2, 19, 9		3,17, 19		10,2, 19,30		3, 35, 5	19,2, 16	19,3, 27	14,26, 28,25	13,3, 35
16	Durability of non-moving object		6,27, 19,16		1,10, 35				35,34, 38					39,3, 35,23
17	Temperature	36,22, 6,38	22,35, 32	15,19, 9	15,19, 9	3,35, 39,18	35,38	34,39, 40,18	35,6, 4	2,28, 36,30	35,10, 3,21	35,39, 19,2	14,22, 19,32	1,35, 32
18	Brightness	19,1, 32	2,35, 32	19,32, 16		19,32, 26		2,13, 10		10,13, 19	26,19, 6		32,30	32,3, 27
19	Energy spent by moving object	12,18, 28,31		12,28		15,19, 25		35,13, 18		8,15, 35	16,26, 21,2	23,14, 25	12,2, 29	19,13, 17,24
20	Energy spent by non-moving object		19,9, 6,27								36,37			27,4, 29,18

Inventive Principle #4

4. **Asymmetry**

- a. Replace a symmetrical form with an asymmetrical form
- b. If an object is already asymmetrical, increase the degree of asymmetry

Examples:

Make one side of a tire stronger than the other to withstand impact with the curb

While discharging wet sand through a symmetrical funnel, the sand forms an arch above the opening, causing irregular flow. A funnel of asymmetrical shape eliminates the arching effect.

Inventive Principle #14

14. Spheroidality

- a. Replace linear parts or flat surfaces with curved ones; replace cubical shapes with spherical shapes
- b. Use rollers, balls spirals
- c. Replace a linear motion with rotating movement; utilize a centrifugal force

Example:

Computer mouse utilized ball construction to transfer linear two-axis motion into vector motion

Inventive Principle #15

15. Dynamicity

- a. Make an object or its environment automatically adjust for optimal performance at each stage of operation
- b. Divide an object into elements which can change position relative to each other
- c. If an object is immovable, make it movable or interchangeable

Example:

A transport vessel with a cylindrical-shaped body.

Inventive Principle #18

18. Mechanical vibration

- a. Set an object into oscillation
- b. If oscillation exists, increase its frequency, even as far as ultrasonic
- c. Use the resonant frequency
- d. Instead of mechanical vibrations, use piezio-vibrators
- e. Use ultrasonic vibrations in conjunction with an electromagnetic field

Example:

To remove a cast from the body without injuring the skin

Inventive Principle #4

4. Asymmetry

- a. Replace a symmetrical form with an asymmetrical form.
- b. If an object is already asymmetrical, increase the degree of asymmetry

Examples:

Make one side of a tire stronger than the other to withstand impact with the curb

While discharging wet sand through a symmetrical funnel, the sand forms an arch above the opening, causing irregular flow. A funnel of asymmetrical shape eliminates the arching effect.

Contradictions - Jet Engine

Resolve the contradiction by
Asymmetry (inventive principle #4)



Asymmetric shaped
Engine Inlet

Make the radius
large laterally for
high air flow.

Make the radius
smaller downward
for high ground
clearance.

In Conclusion...

- TRIZ is a Valuable Creativity Tool
- Using knowledge of individual styles can greatly enhance the TRIZ problem solving process
- Adding TRIZ to any existing creativity or enterprise process can improve their value and productivity

Additional Information

- Altshuller Institute, www.aitriz.org
- Books
 - “And Suddenly the Inventor Appeared” (Altshuller)
 - “Hands on Systematic Innovation” (Mann)
 - “Simplified TRIZ” (Rantanen and Domb)

Questions?



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