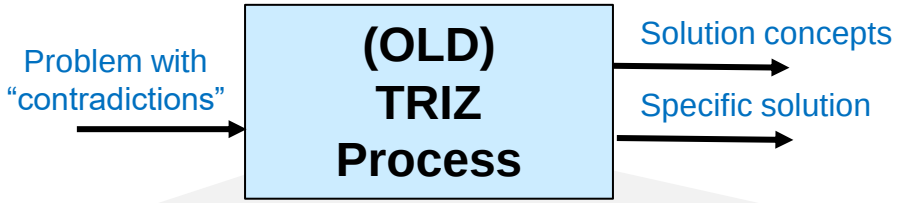
Theory of Inventive Problem Solving (TRIZ)

Problem
How to identify ideas to solve a problem?

Difficulty
Work with an SME

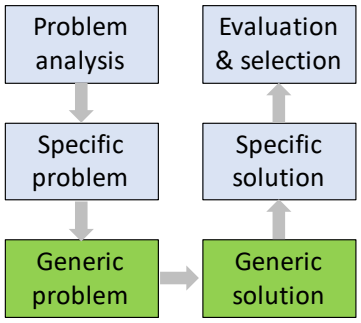
- **TRIZ** is a problem-solving tool obtained from invention patterns in the patent literature.
- TRIZ's approach is that a solution, for something close to your problem, has already been found. The goal is to find that solution and adapt it to your problem.
- Modern TRIZ uses "76 standard solutions."
- (OLD) TRIZ – easier to describe & illustrate – identified technical & physical contradictions involving "39 universal features." All solutions are then one or more of the "40 inventions."



1. Create a specific problem statement.
   - Identify a **contradiction** among the **39 universal features**. That is, identify contradiction between features (A) and (B).
2. Create **generic problem** statement:
   - Want to change (A) yet (B) deteriorates
3. Use **contradiction table** to identify which of the generic solutions, among the **40 invention principles,** eliminates the contradiction
4. **Brainstorm** the generic solutions to **create potential solutions** for your problem
5. Evaluate the potential solutions

39 Universal Features
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 non-moving object
7. Volume of moving object
8. Volume of stationary object
9. Speed
10. Force
…
38. Extent of automation
39. Productivity

40 Invention Principles
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
…
39. Inert atmosphere
40. Composite materials



Solution approach	Standard solutions
Improving the system with no or little change	13
Improving the system by changing the system	23
System transitions	6
Detection and measurement	17
Strategies for simplification and improvement	17
total	**76**

TRIZ (OLD) – Example – Improving a Beverage Can

(1) Problem: Want to *improve* can wall thickness subject to *undesirable* effect of stress on can wall

➔ A=("#4, length of a stationary object“)

➔ B=("#11, stress“)

(2) Look up (#4,#11) in universal “contradictions table” (upper left corner shown below) to find applicable invention principles: {1, 14, 35}

- 1 → Segmentation
- 14 → Spheroidality
- 35 → Change physical or chemical properties

Improving Feature \ Worsening Feature	1	2	3	4	5	6	7	8	9	10	11	12
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
2: Weight of stationary	-	*	-	10 1 29 35	-	35 30 13 2	-	5 35 14 2	-	8 10 19 35	13 29 10 18	13 10 29 14
3: Length of moving object	8 15 29 34	-	*	-	15 17 4	-	7 17 4 35	-	13 4 8	17 10	1 8	1 8
4: Length of stationary object	-	35 28 40 29	-	*	-	17 7 10 40	-	35 8 2 14	-	28 1	1 14 35	3 14 15 7
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
6: Area of stationary	-	30 2 14 18	-	26 7 9 39	-	*	-	-	-	1 18 35 36	10 15 36 37	-
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
8: Volume of stationary	-	35 10 19 14	35 8	-	-	-	*	-	2 18	24 35		7 2

Cell at (row 4, column 11) has 3 entries: invention principles {1, 14, 35}

- https://commons.wikimedia.org/wiki/File:Soft_Drink.svg
- https://commons.wikimedia.org/wiki/File:Titanium.svg

(3) For each invention principle, look up description for inspiration. For example:

Invention principle #1: *Segmentation Principle*

- 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
- Make an object easy to disassemble.
  - Modular furniture
  - Quick disconnect joints in plumbing
- Increase the degree of fragmentation or segmentation.
  - Replace solid shades with Venetian blinds.

(4) Brainstorm on each of the 3 suggested invention principles to determine a solution.

#1 Segmentation Principle

- Make the can wall corrugated – increases material for the same burst strength.

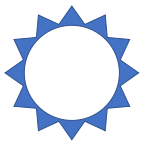
#14 Spheroidality Principle

- Remove corners from the can, make it with rounded walls or make it a sphere – reduces material for the same burst strength.

#35 Change physical or chemical properties

- Make the can out of a stronger or lighter material. Changes amount of material needed, and weight, for the same burst strength.

(5) Possible results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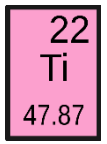

TRIZ – Notes

Slide 1

1. TRIZ was invented by Genrich Altshuller and his colleagues, beginning in 1946.
2. The main value of TRIZ is that it can speed up the process of finding solutions to complicated problems.
3. Benefits of TRIZ
   A. You don't need to reinvent the wheel
   B. Quicker path to solution
   C. Based on engineering solutions
4. Among all the TRIZ tools, contradiction analysis is the most frequently used method to address problems needing to eliminate a problem's contradictions.
5. TRIZ assumes that every technological system follows the same "evolutionary laws." There are 9 laws in 3 categories of laws: Static, Kinematic, and Dynamic.
6. ARIZ (algorithm of inventive problems solving) is a 9 step process with about 85 procedures to solve contradictions.
   It improves on other TRIZ tools (e.g., Sufield analysis, 40 inventive principles). It is challenging to describe in a few sentences.

Slide 2

1. The straightforward steps shown are for OLD TRIZ
   A. Identify contradictions of universal features
   B. Use the contradictions table to find potential solutions
   C. Brainstorming using those potential solutions
2. The problem statement said "Improve can wall thickness" – which could mean increasing or decreasing the material used in the can wall.