OTSM-TRIZ: Introduction to Problem Solving Technology

"Jonathan Livingston" Project

Nikolai **KHOMENKO, 1997**

Minsk OTSM-TRIZ Centre
(Republic of Belarus)

- **1974 -** Invention Machine project starts
- **1976** - Valery Tsurikov founds the Minsk TRIZ center
- **1983** - Research stage of Jonathan Livingston (JL) starts
- **1987 -** The Invention Machines laboratory set up
- **1991 –** The Invention Machine project enters the USA market
- **1992** - Practice stage of the JL project starts
- **1994 –** Education professionals from Russia and Ukraine join the JL project
- **1995** - Main ideas of the JL project included in the programme for reforming the education system in the Republic of Belarus

Nikolai KHOMENKO

Leader of the Minsk TRIZ centre and the JL project

- 1980 - first acquaintance with TRIZ at a seminar of the Minsk TRIZ centre
- 1983- beginning of the Jonathan Livingston Project
- 1984-1986 - learning TRIZ at G. Altshuller's monthly seminars
- Since 1986 - leader of the Minsk TRIZ center

17 years experience in using
TRIZ problem solving technology for various areas: engineering, business process re-engineering, advertising and election campaigns.

17 years experience in teaching and researching

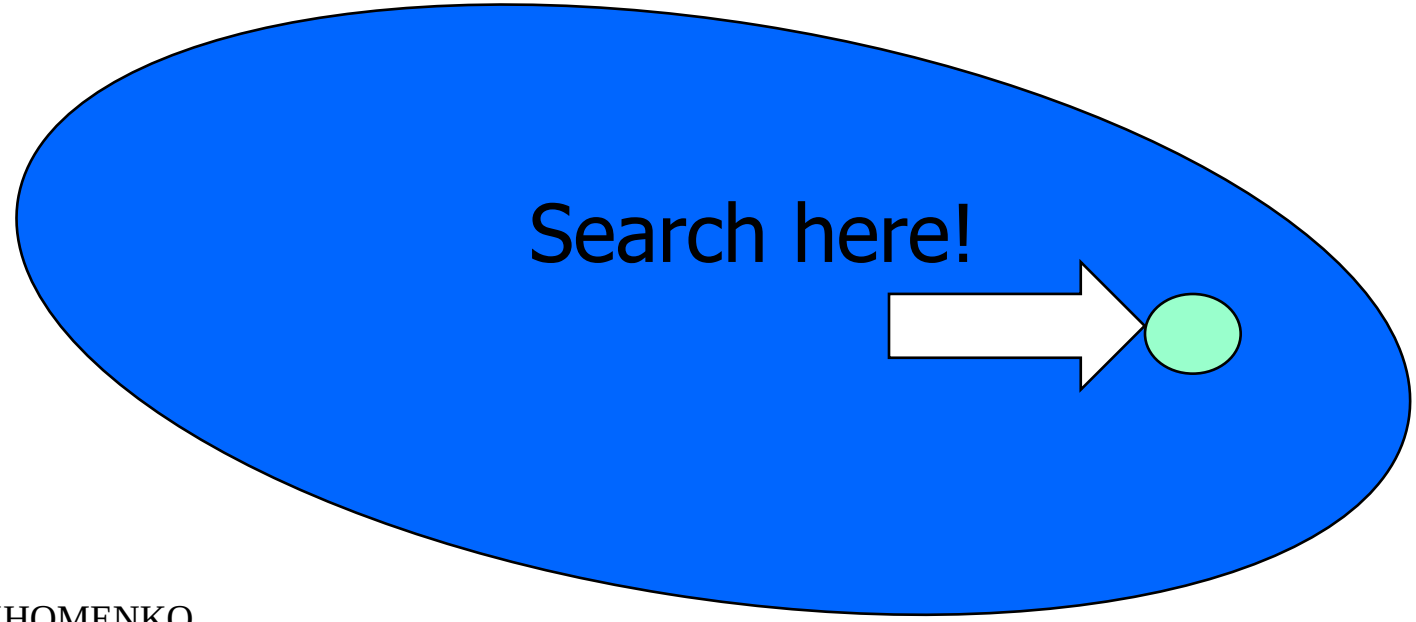
Main problem TRIZ deals with
(Main Problem in Problem Solving Process MP-PSP):

How to reduce the Solution Search Area

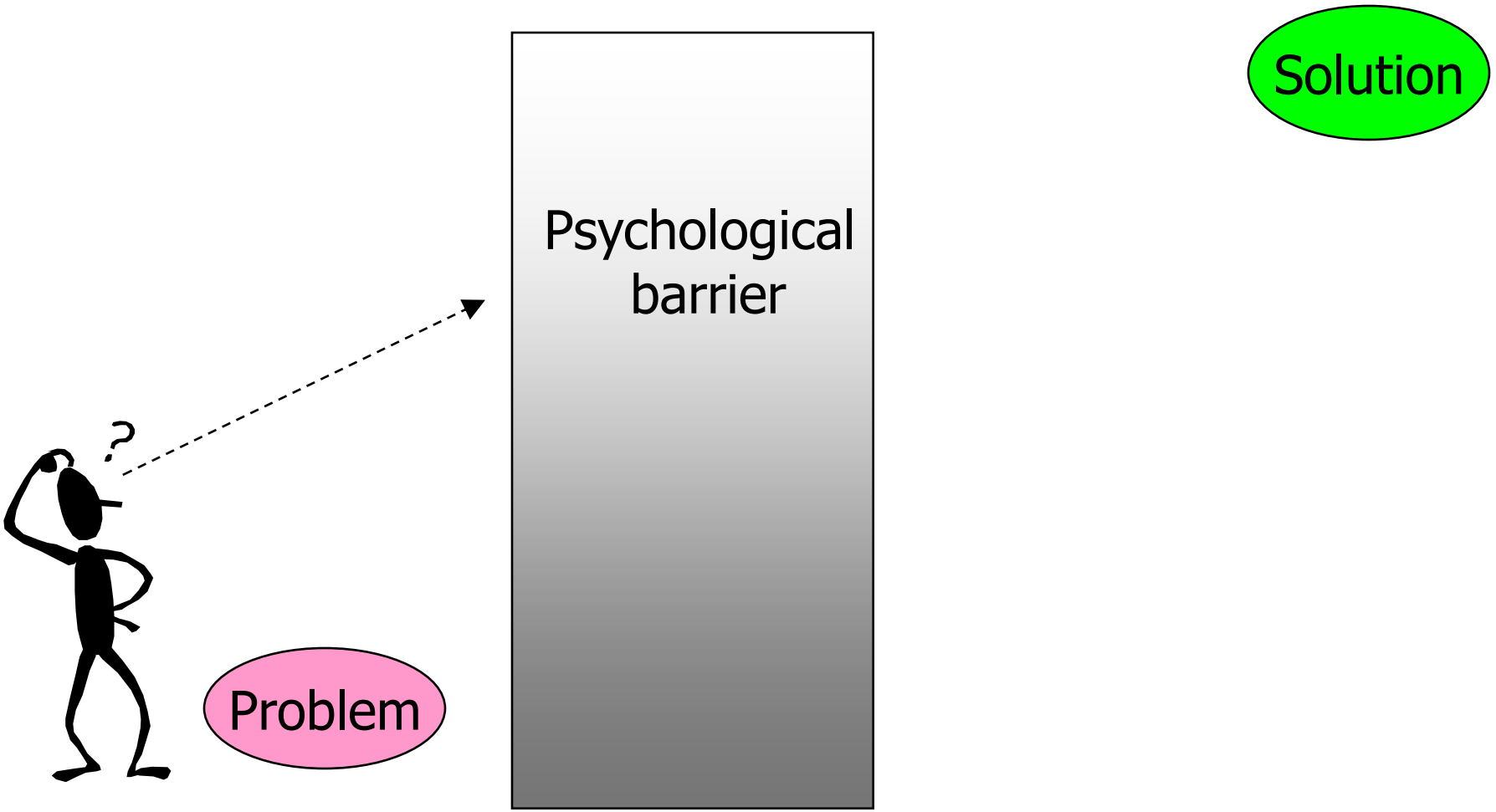
without many trials and errors

and avoiding the mental inertia

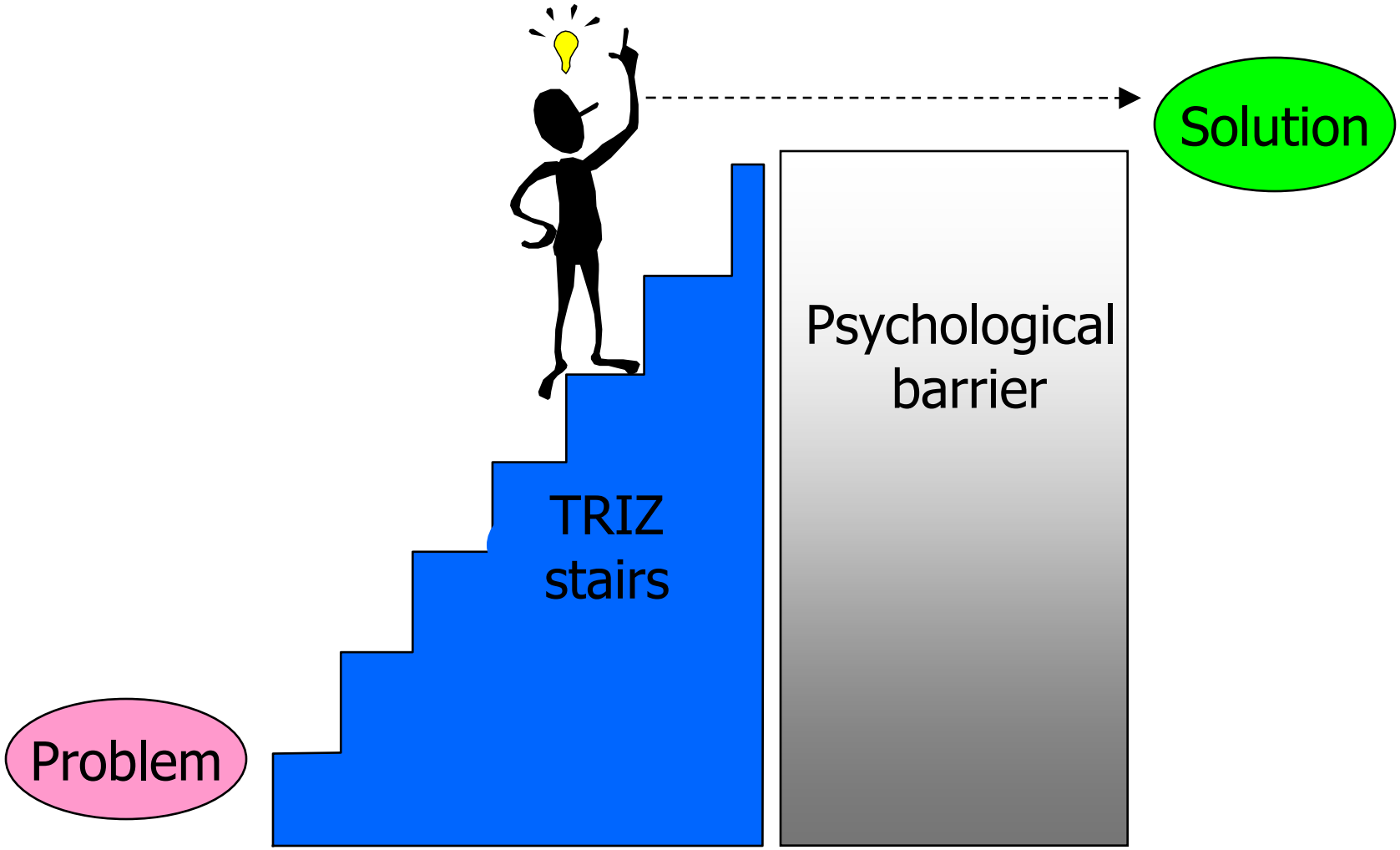
while not degrading the quality of solution?



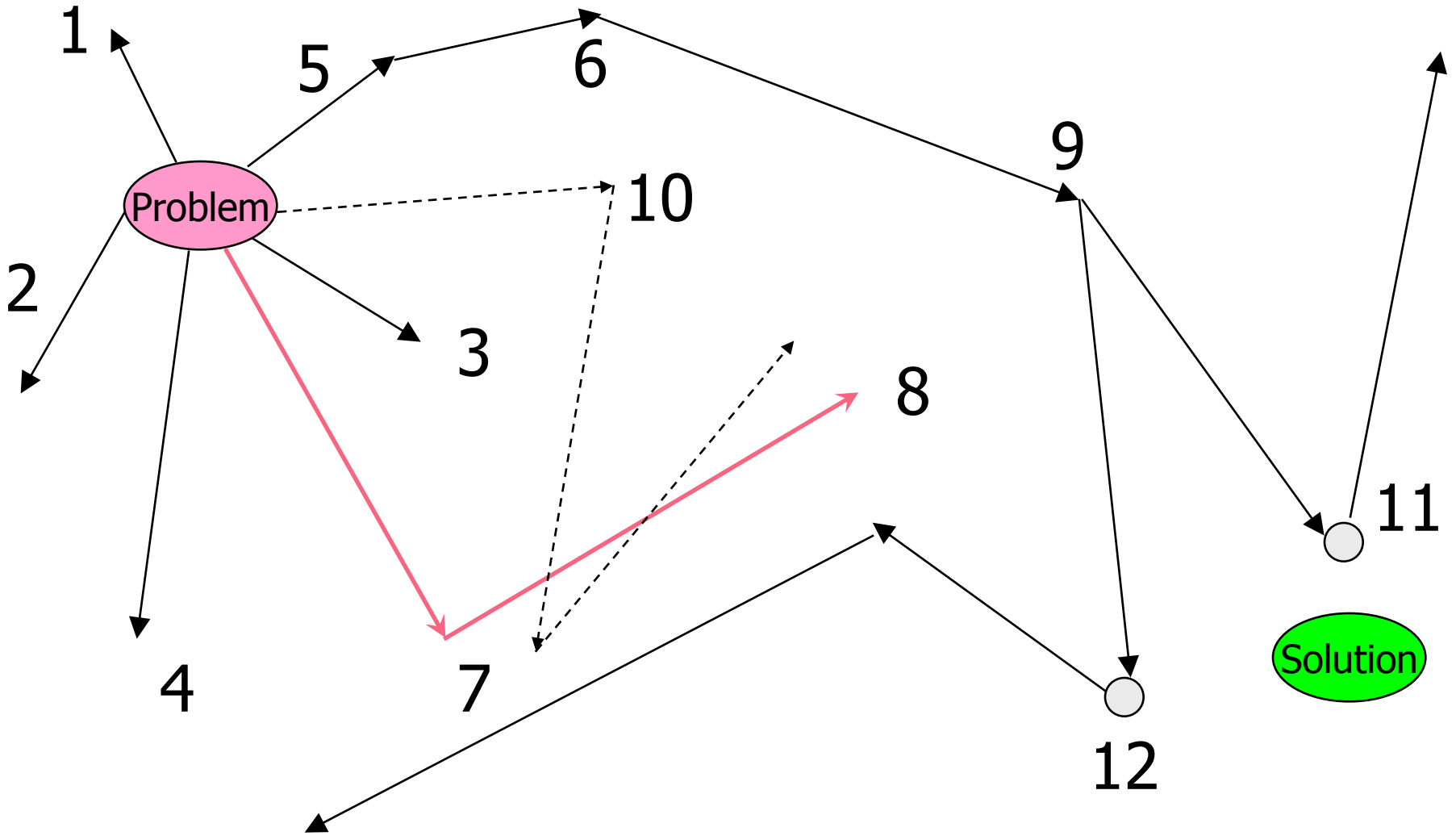
How can TRIZ reduce mental inertia?



TRIZ gives us “stairs”

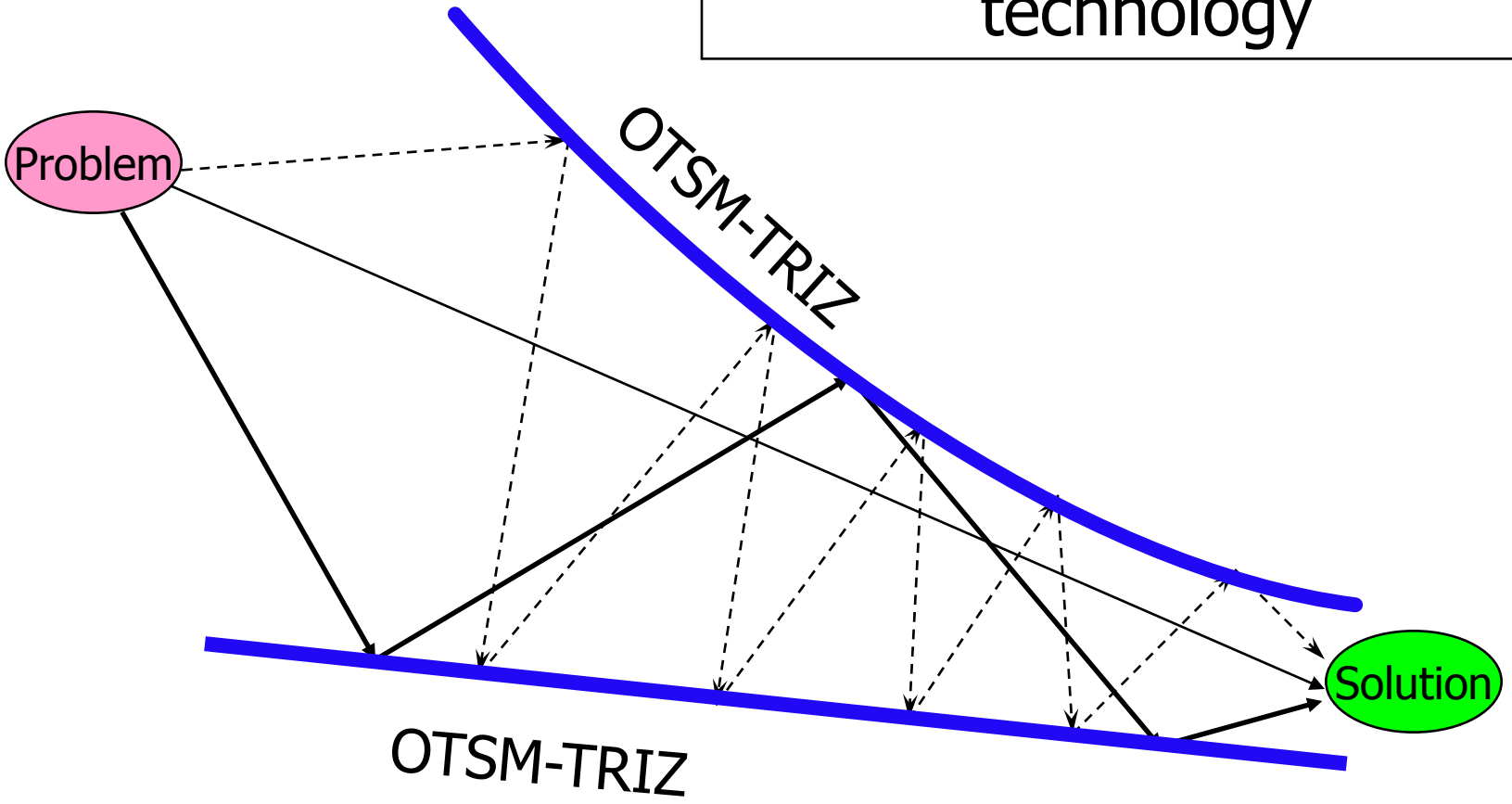


Usual Way: There is no direction
(many attempts without result)



TRIZ technology offers direction
(each step brings closer to result)

"Typical solutions" technology



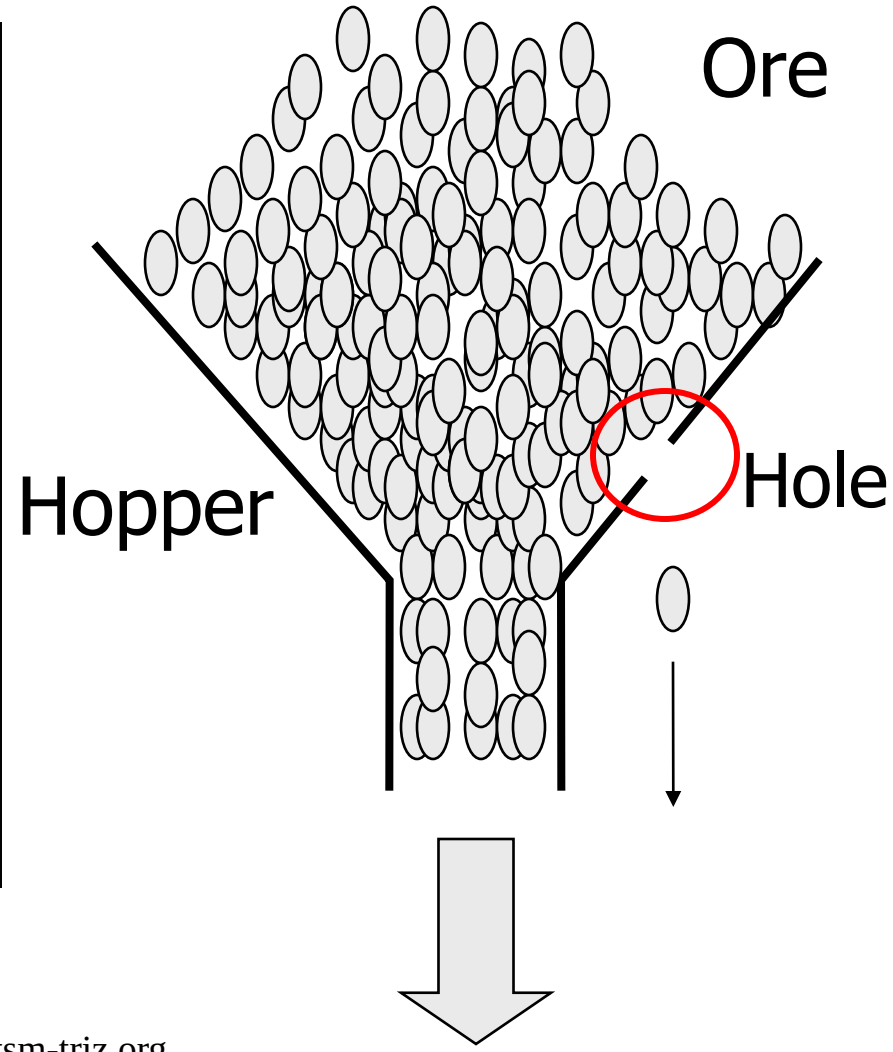
Hopper problem (1)

This problem was solved during two hours using Invention Machine (version 1.0.) in 1989.

Solution saved $200 000.

Problem: Friction between ore and hopper produces holes.

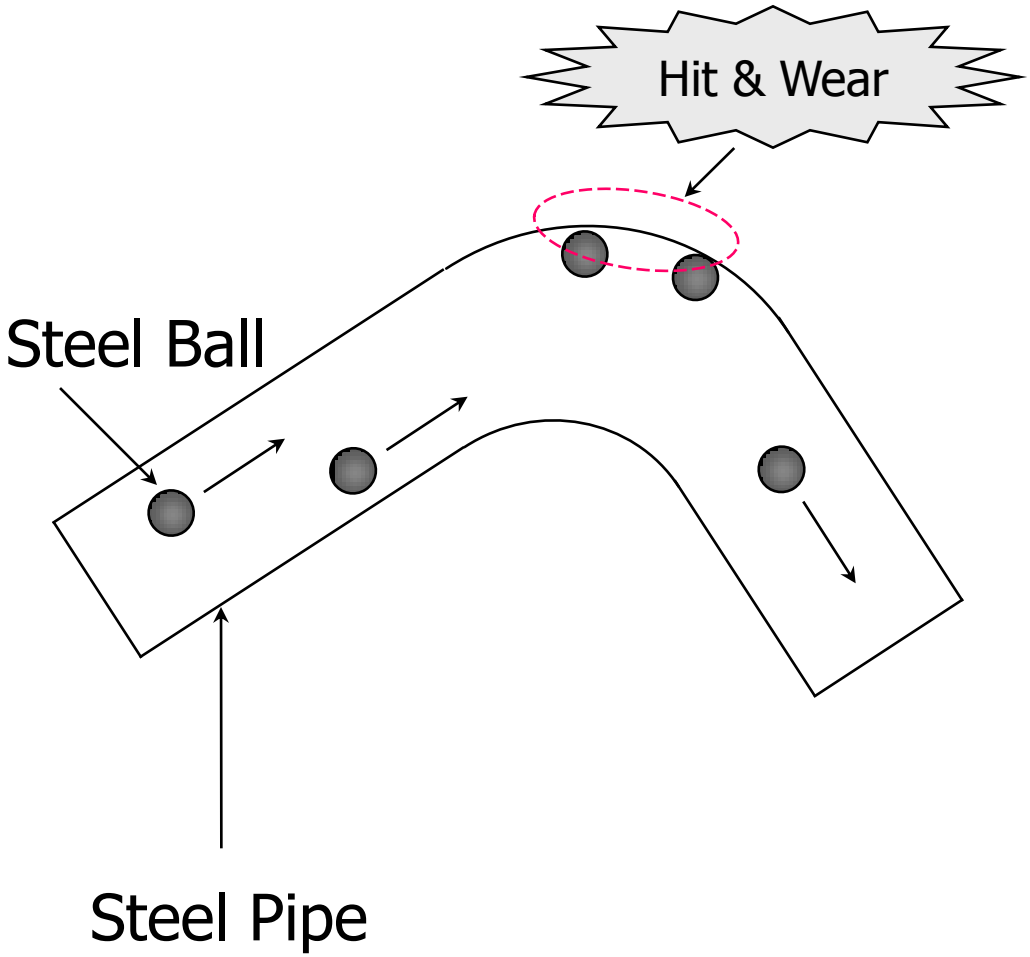
What can be done?



Problem 1: Mechanical engineering

Steel balls in a steel pipe hit the bending region and wear it out !

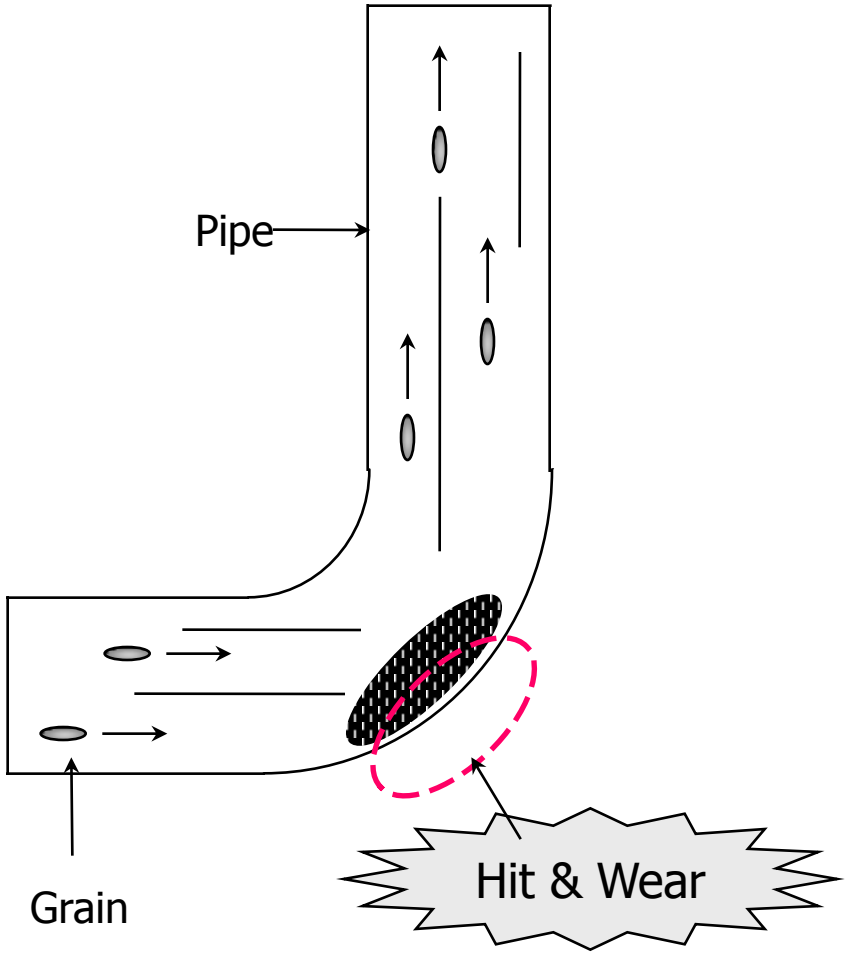
How can it be prevented?



Problem 2: Agriculture

Grains in a threshing machine hit and wear the bending region of the pipe and wear it out !

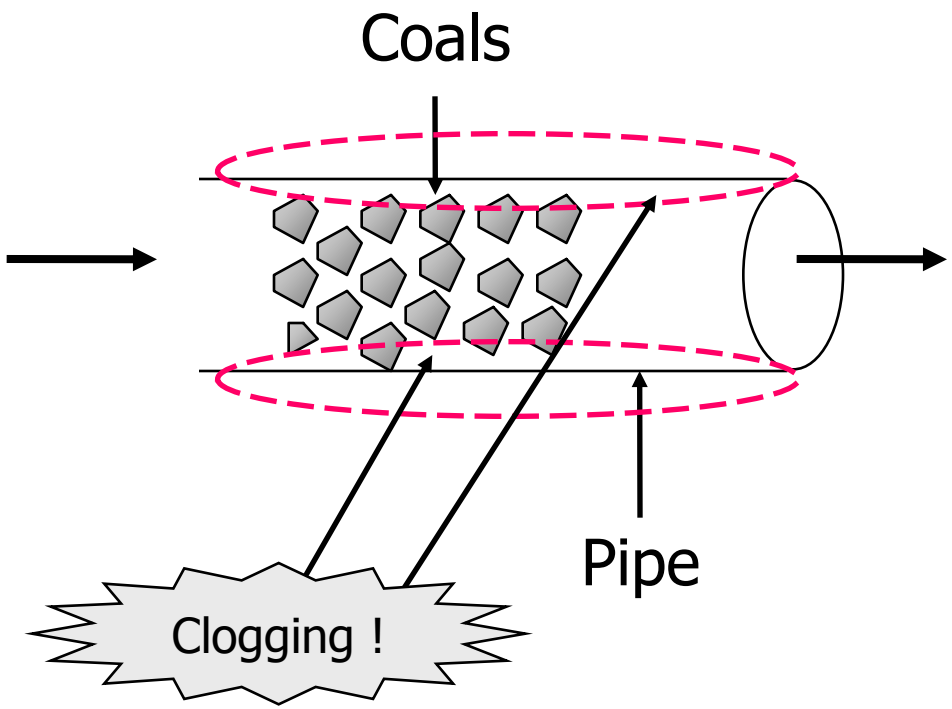
How can it be prevented?



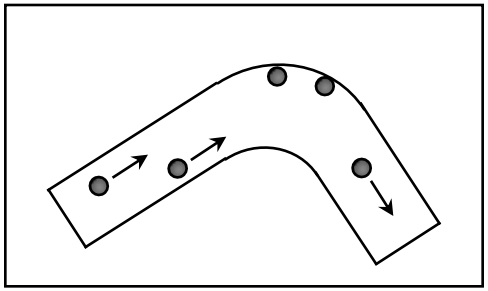
Problem 3: Electric power plant

In power station, coals are use for generating heat for steaming. Coals flow inside the pipe. When the coals are dry, they flow smoothly in the pipe. However, when they are wet, they are clogged because they tend to stick to the pipe and to each other.

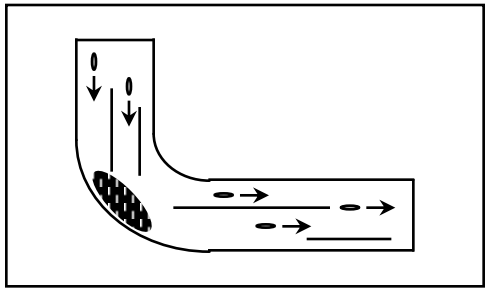
How to prevent this ?



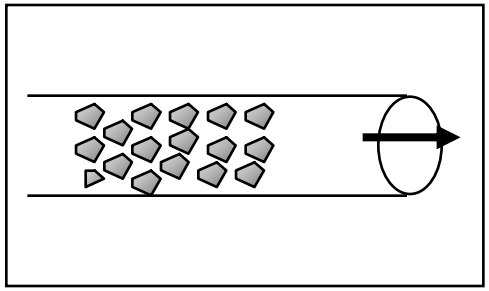
What is common?



Mechanical engineering



Agriculture



Electric power plant

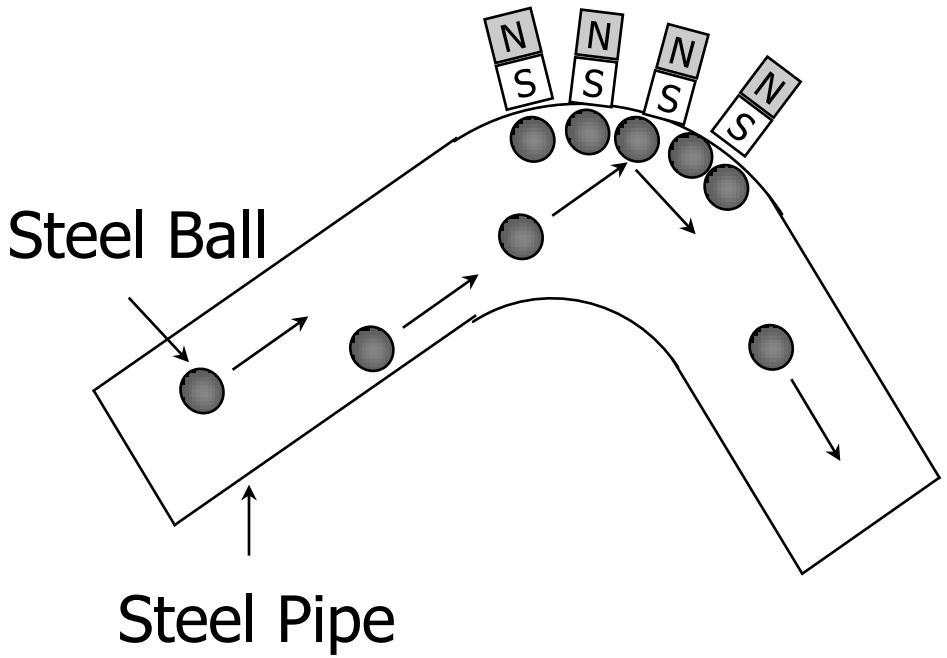
?

Problem 1: Mechanical engineering

Solution:

Install magnet in the bending region.

Steel balls attached to the bending region forms several layers and steel balls flowing in the pipe will hit the layers, not pipe

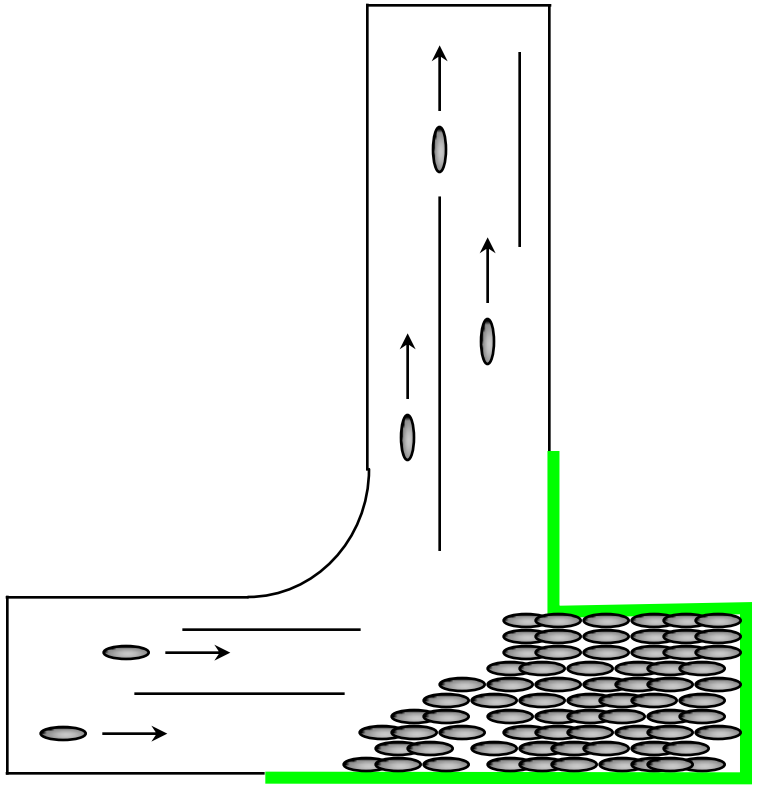


Problem 2: Agriculture

Solution:

Install a box in the bending region.

Grains accumulated in the box prevents grains flowing in the pipe from hitting the bending region directly, thus, preventing the wear.



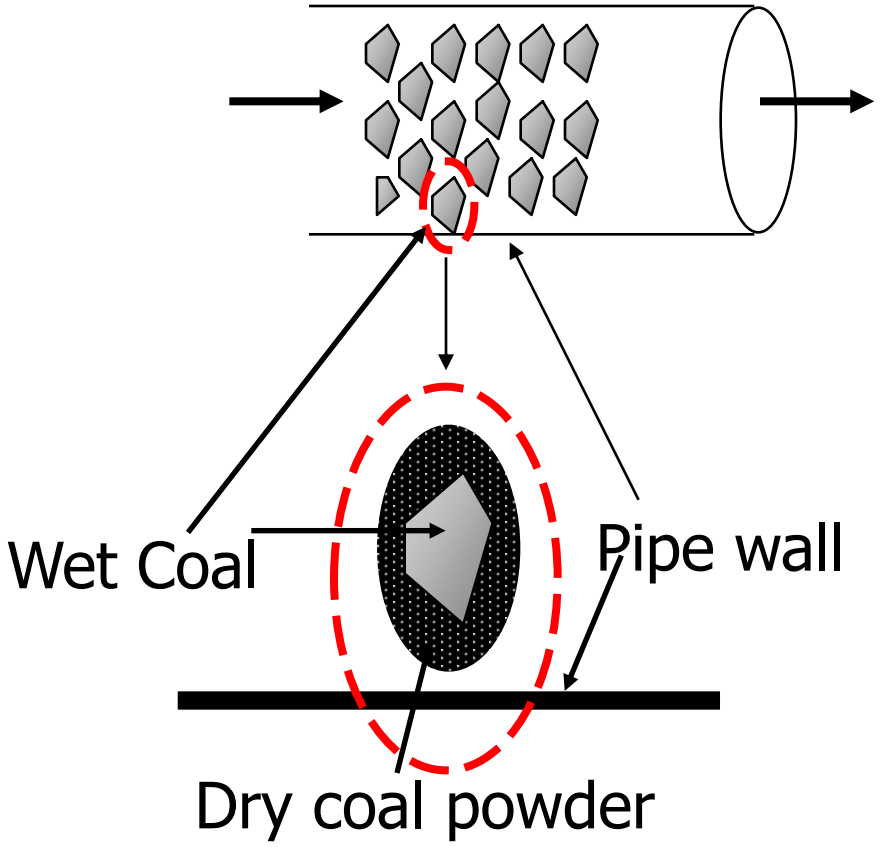
Problem 3: Electric power plant

Solution:

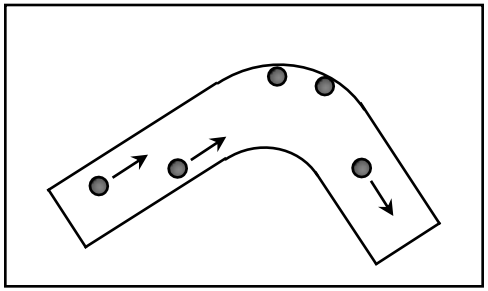
Coat the coals with dry coal powder before coals go into the pipe.

Coals covered with dry coal powder do not stick to each other.

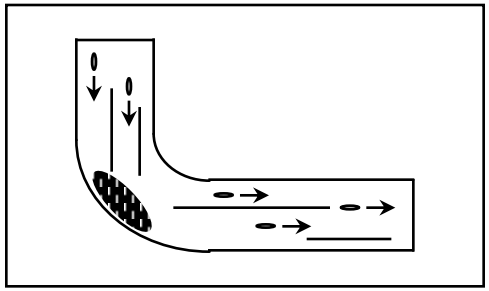
They also move smoothly along the pipe wall.



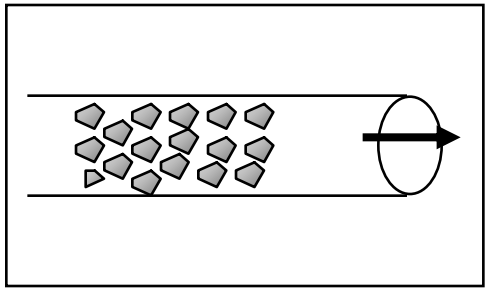
What is common for these problems?



Mechanical engineering



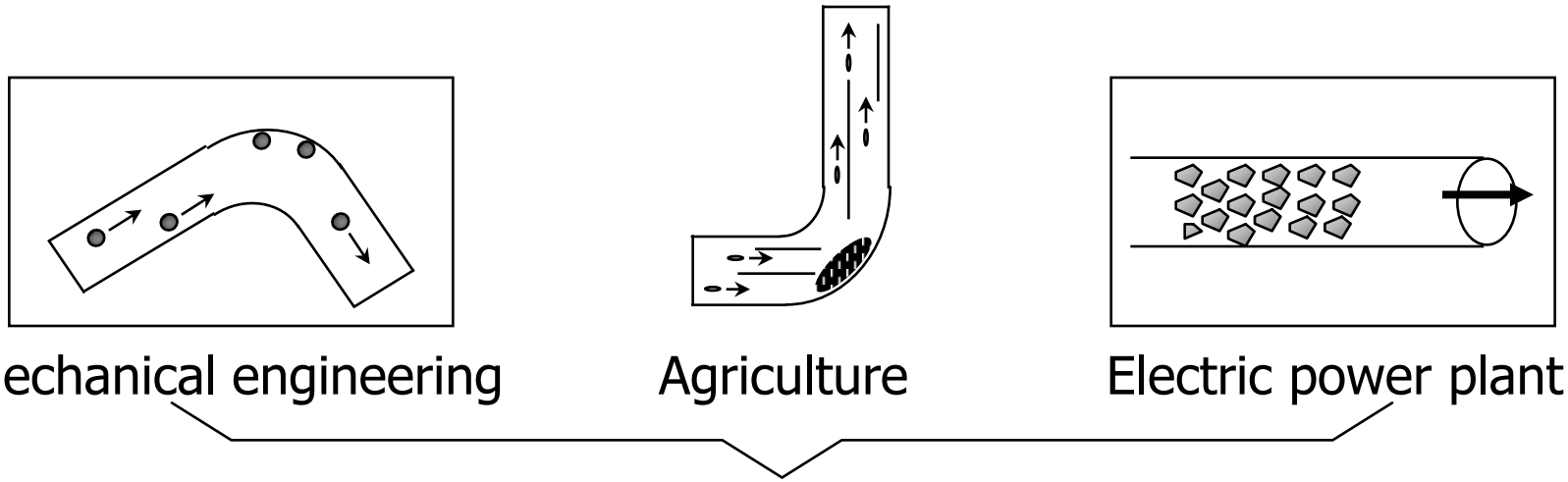
Agriculture



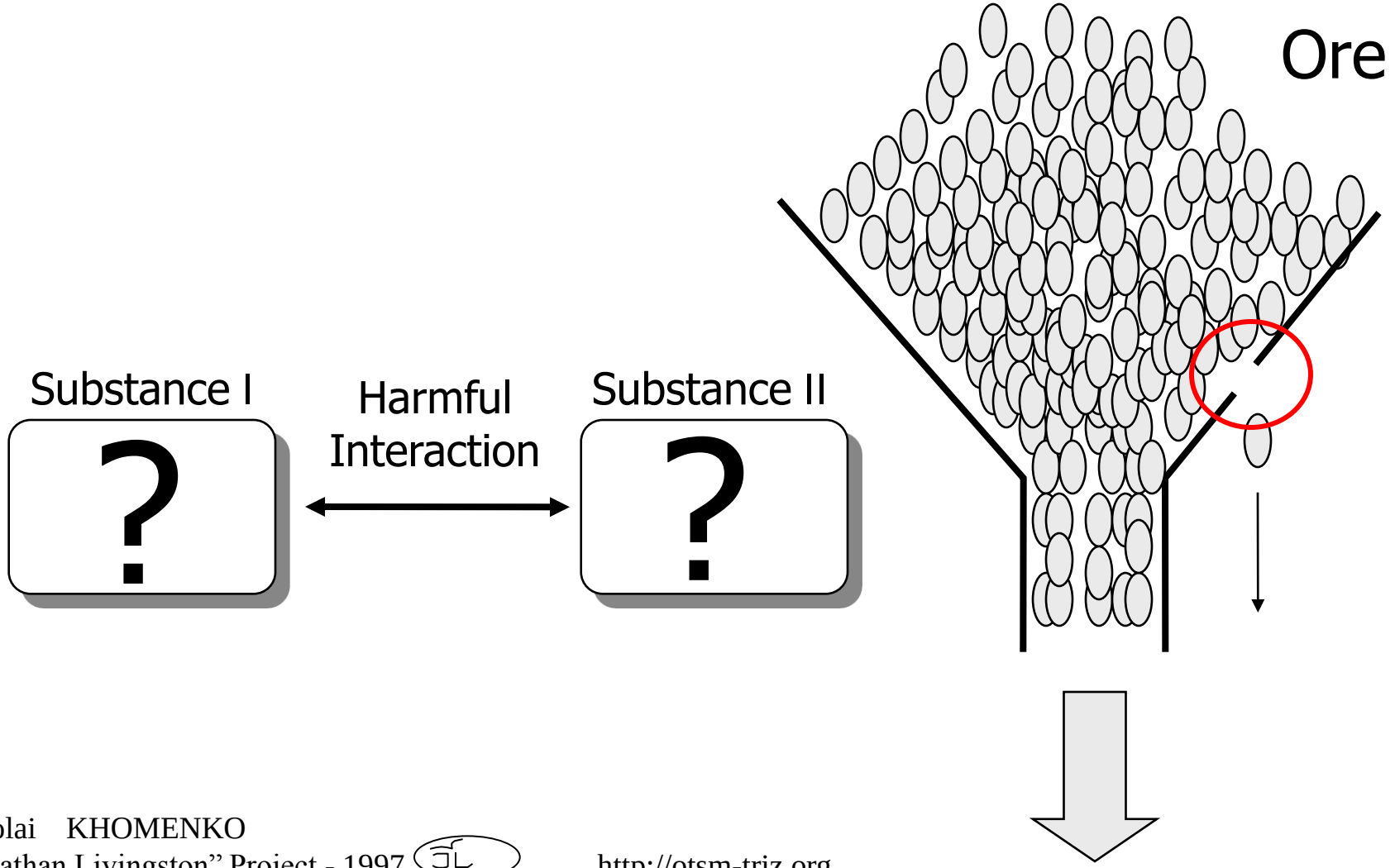
Electric power plant

?

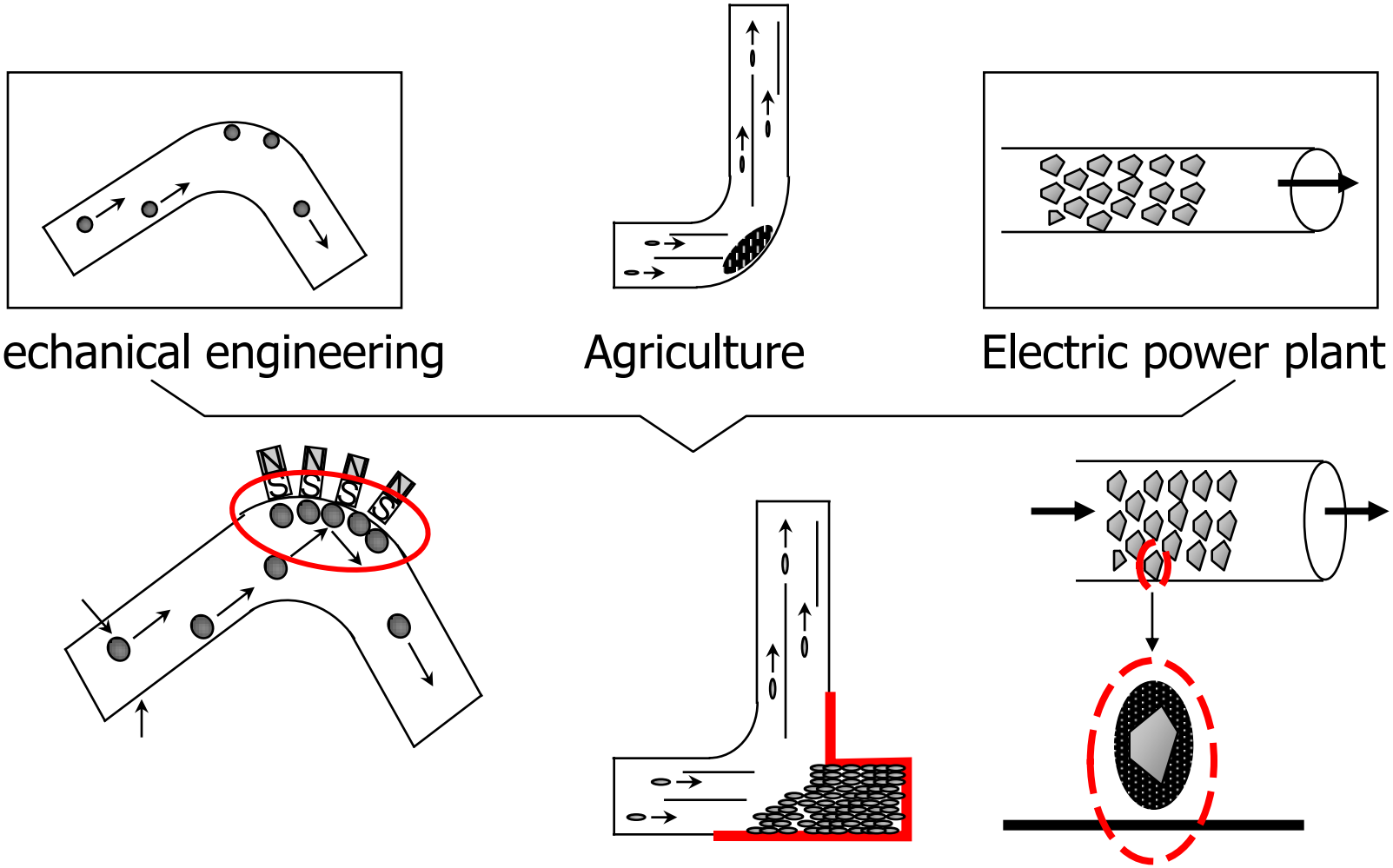
Different problems have the same model!



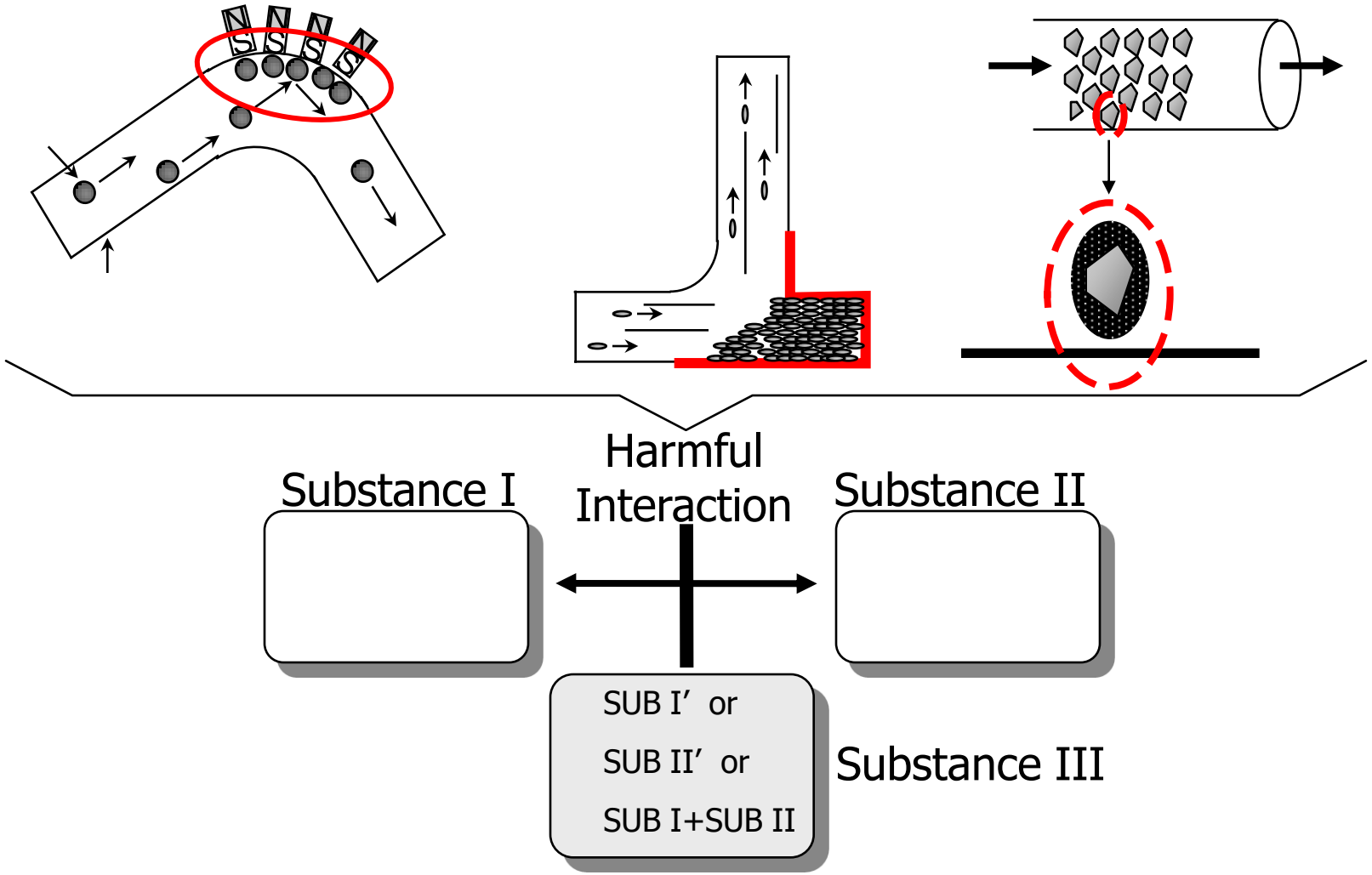
Hopper problem (2)



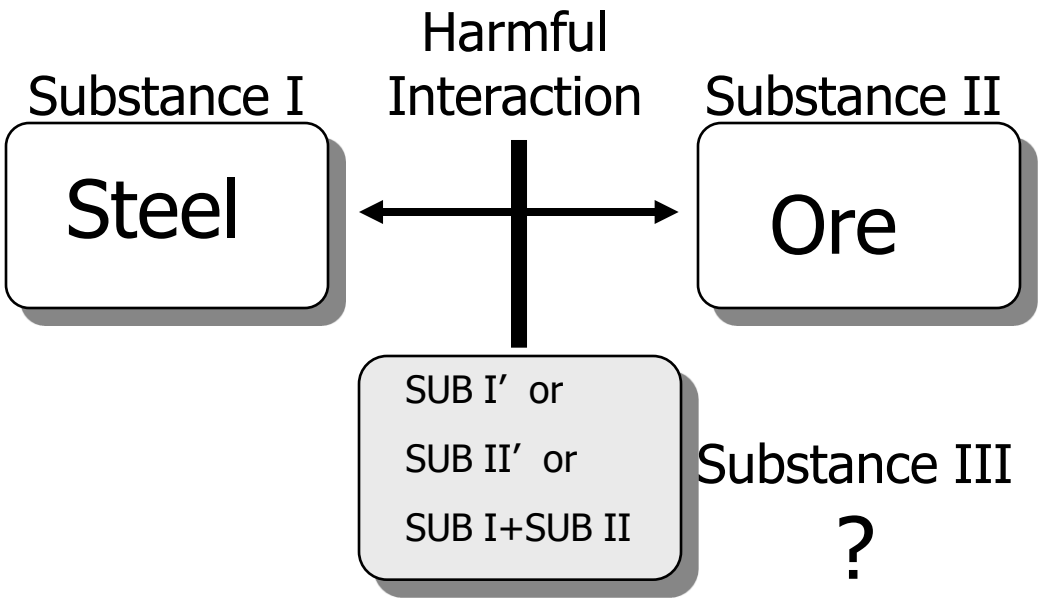
What is common for these solutions?

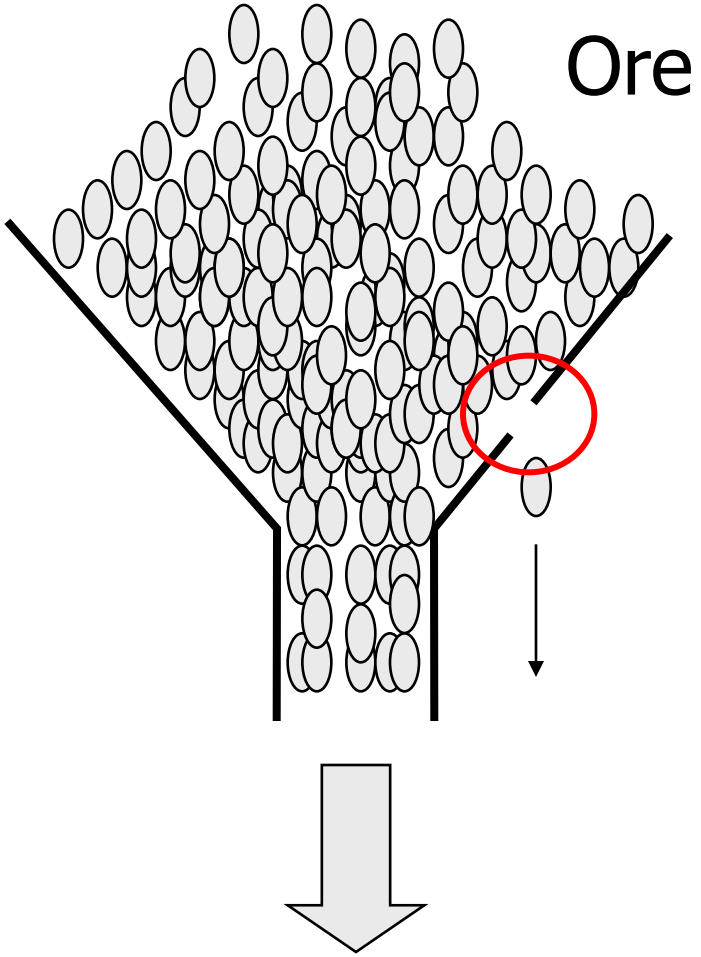


Different problems have the same solution model



Hopper problem (3)

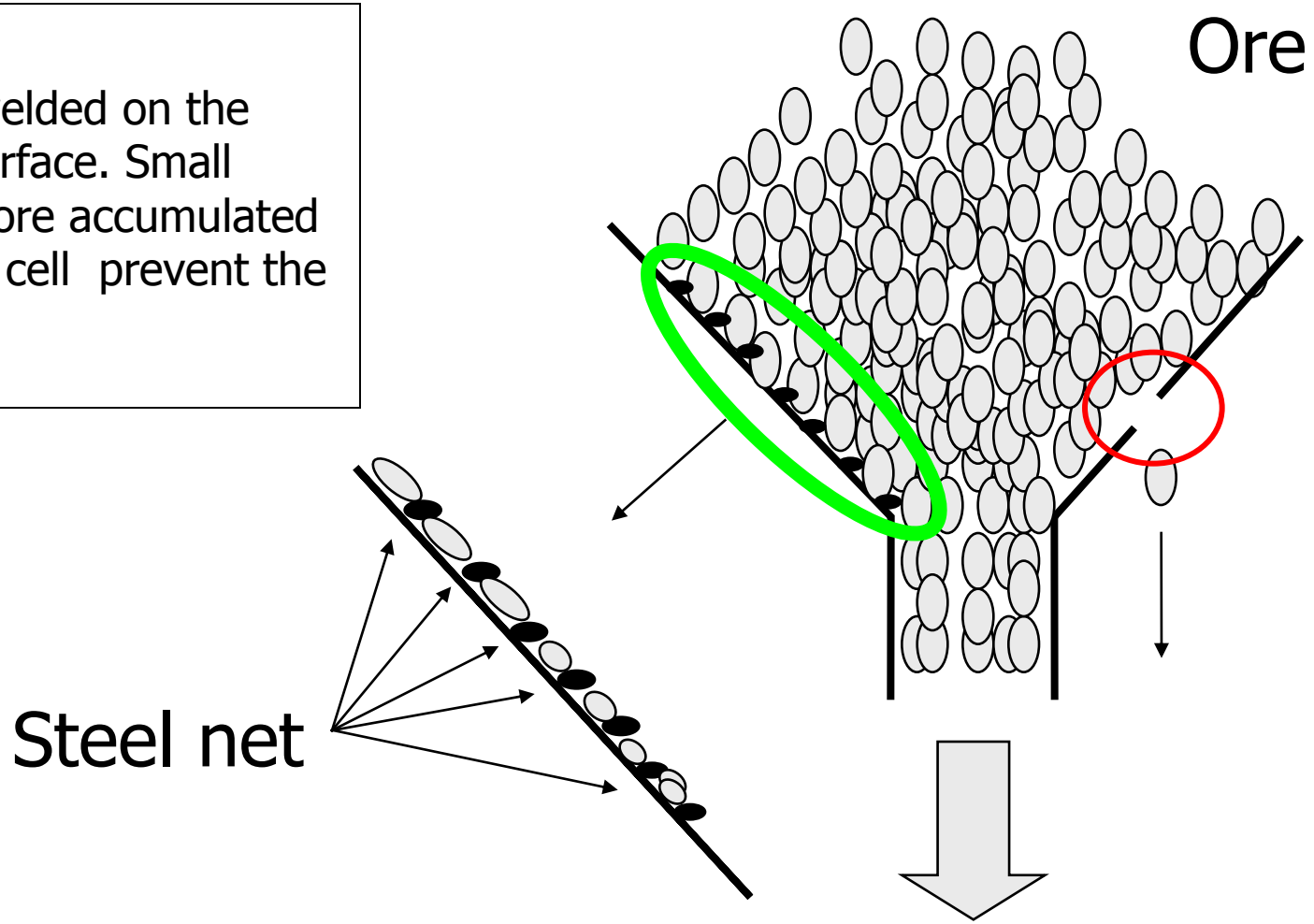




Hopper problem (4)

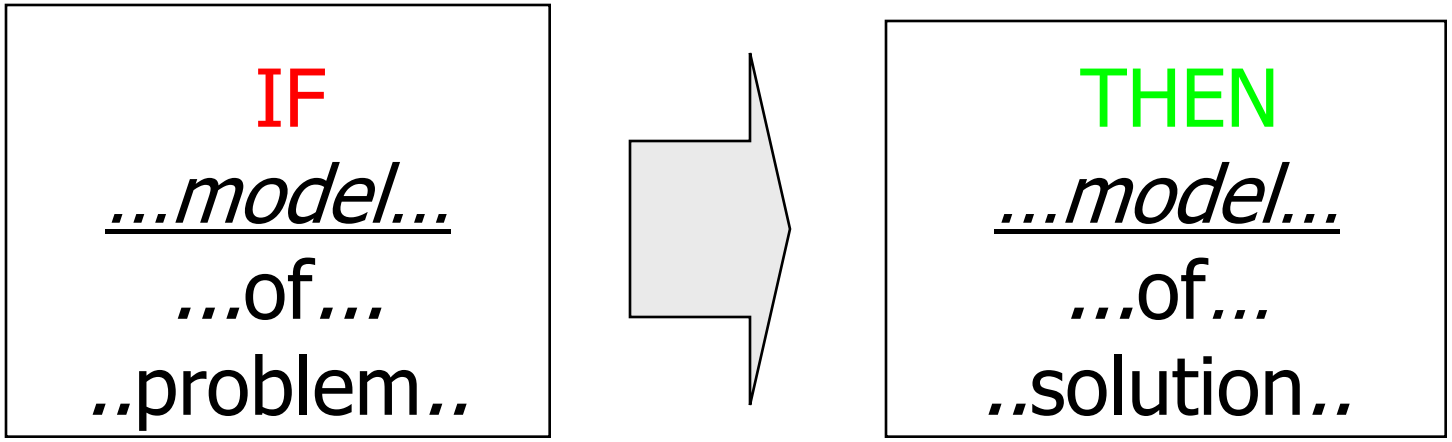
Solution:

Steel net is welded on the hopper surface. Small pieces of ore accumulated in the net cell prevent the wear.



General typical solution description

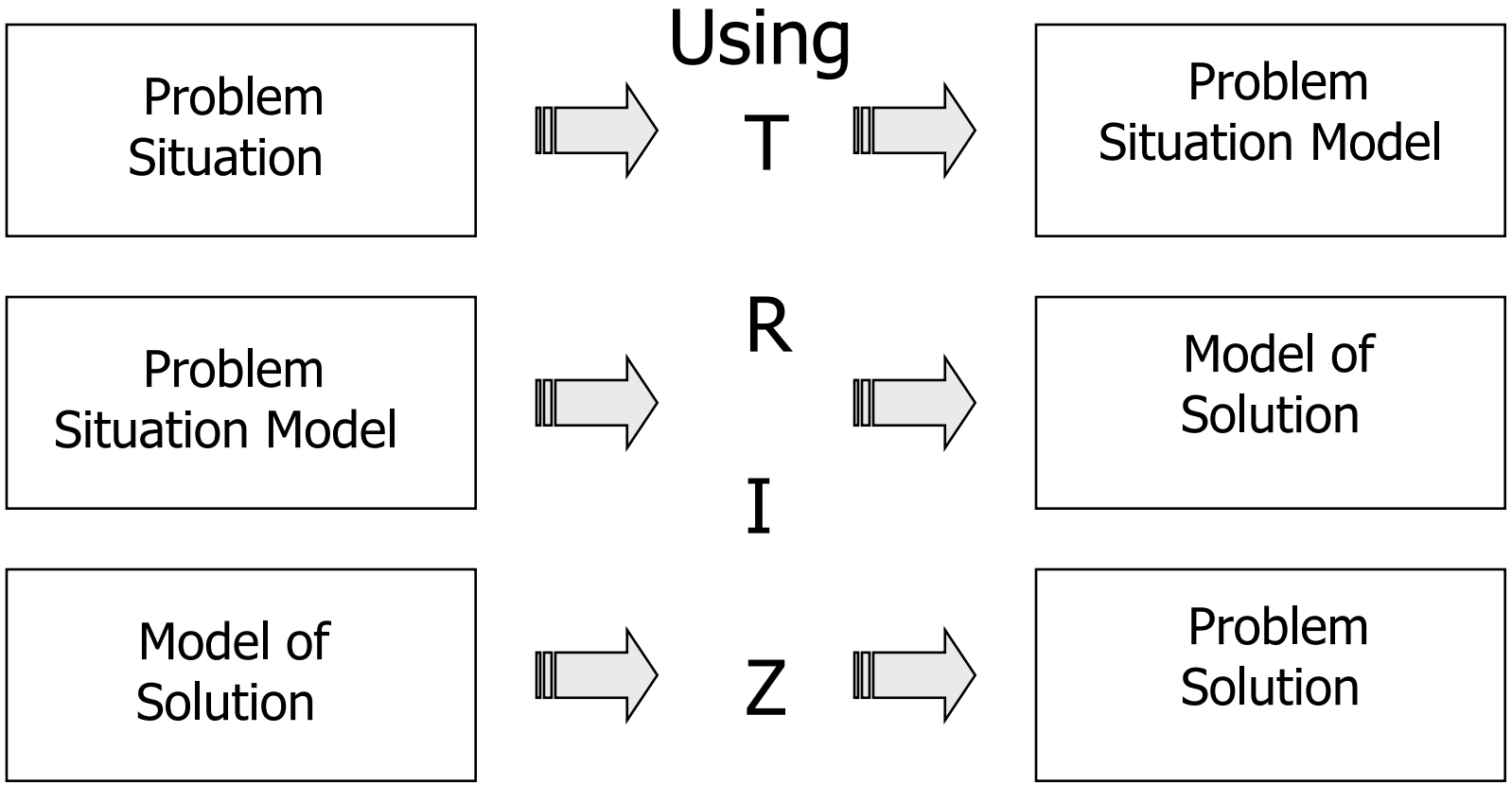
- If: ....(**model** of problem)….
- Then: ….(**model** of solution)….



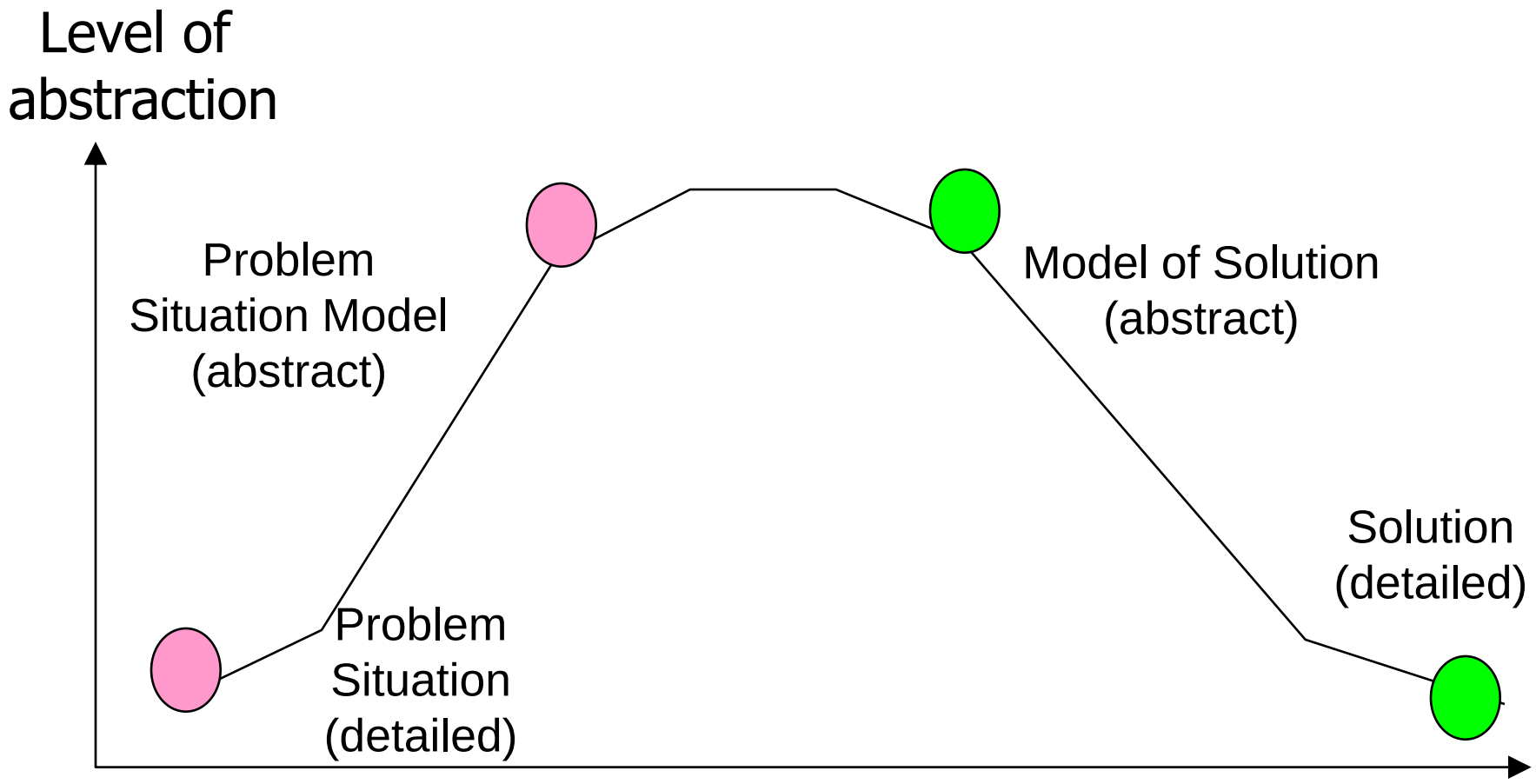
TRIZ tools for typical problems

- *Laws* (8) of systems evolution
- *Standards* (76) - SF-models
- *Principles* (50 principles and more than 1500 problem models) of engineering contradictions resolution
- *Pointers of effects* for inventors:
  - Physics,
  - Chemistry,
  - Geometry

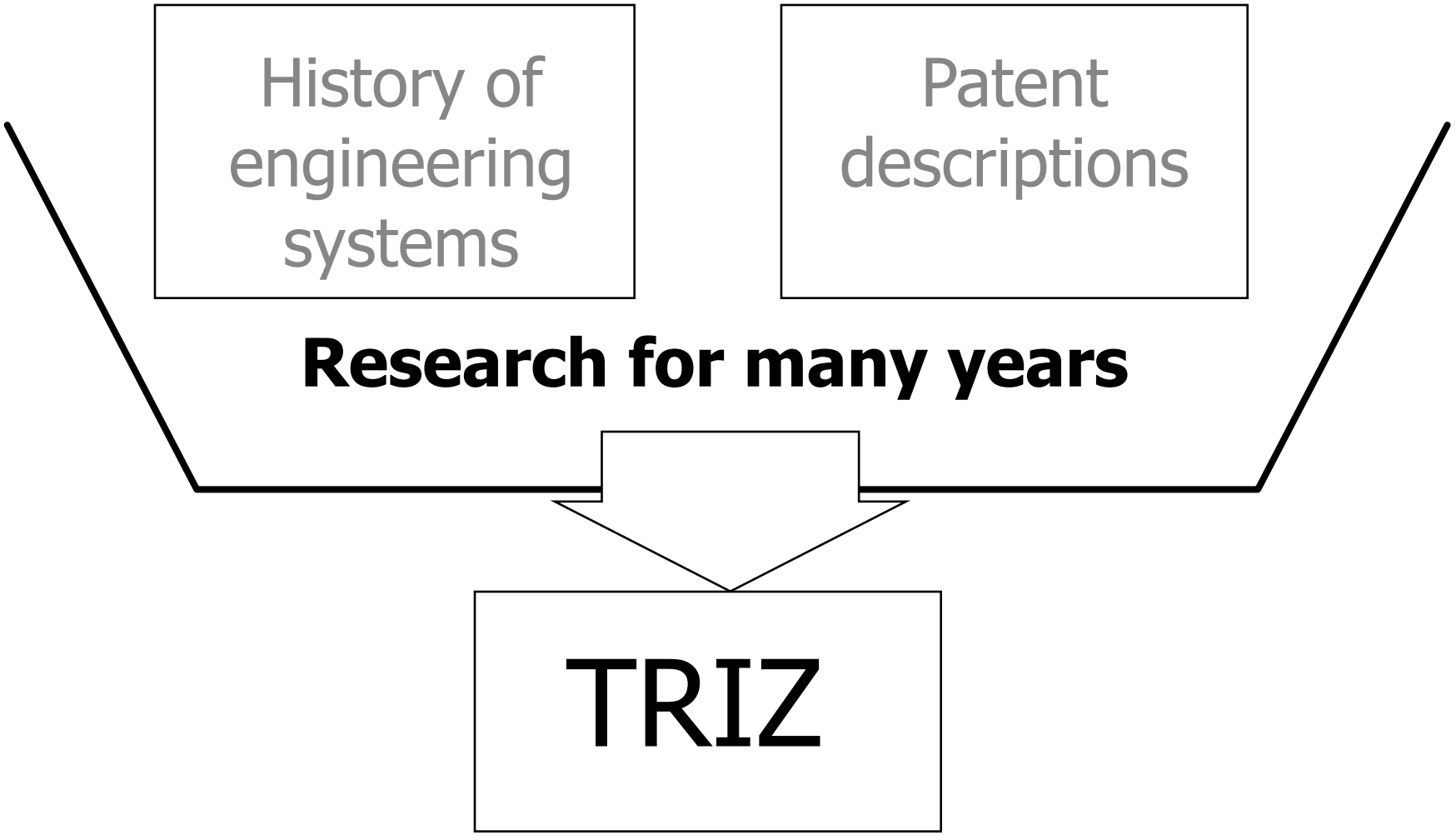
General way for using TRIZ typical solutions
(General scheme)



General way for using TRIZ typical solutions
(Level of abstraction diagram)

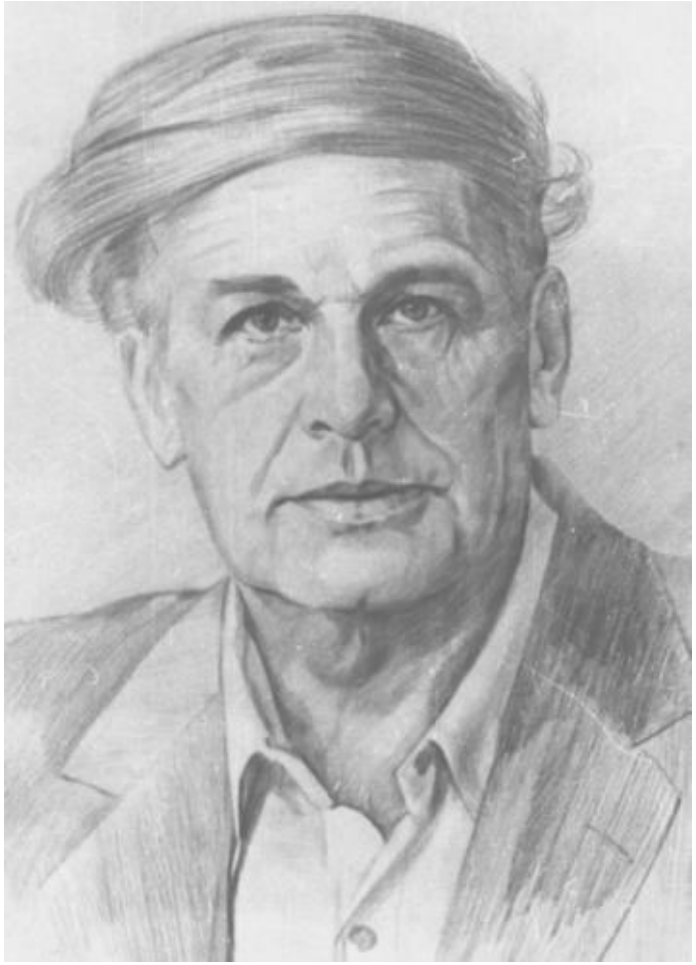


What is the source of these typical solutions and TRIZ in general?



Who developed this research?

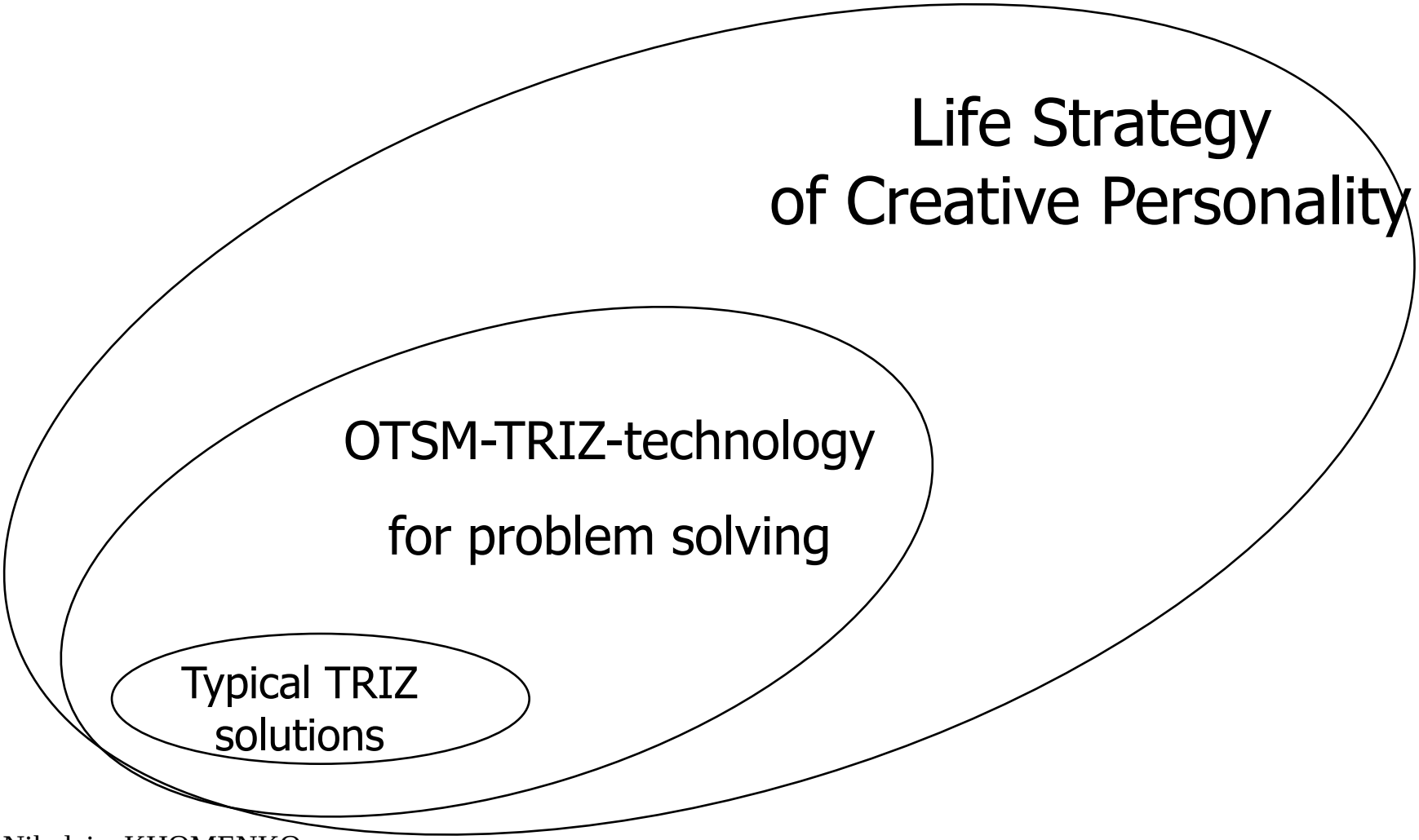
Genrich Altshuller still continues his work on OTSM-TRIZ that he started from 1946.



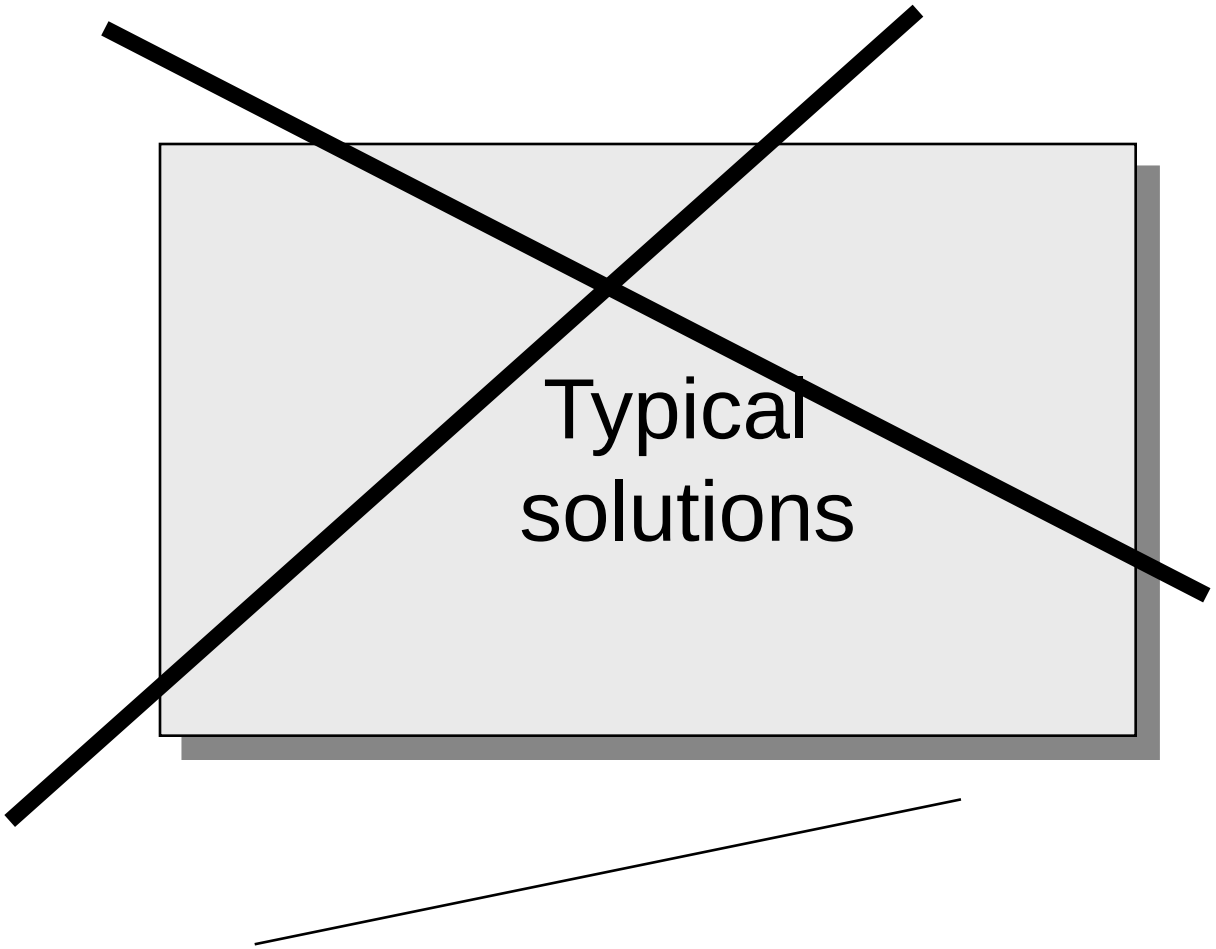
At that time he was 20 years old

[G.Altshuller passed away in 1998]

TRIZ typical solutions is only a small part of Altshuller's research



What is to be done if typical solutions cannot be applied?

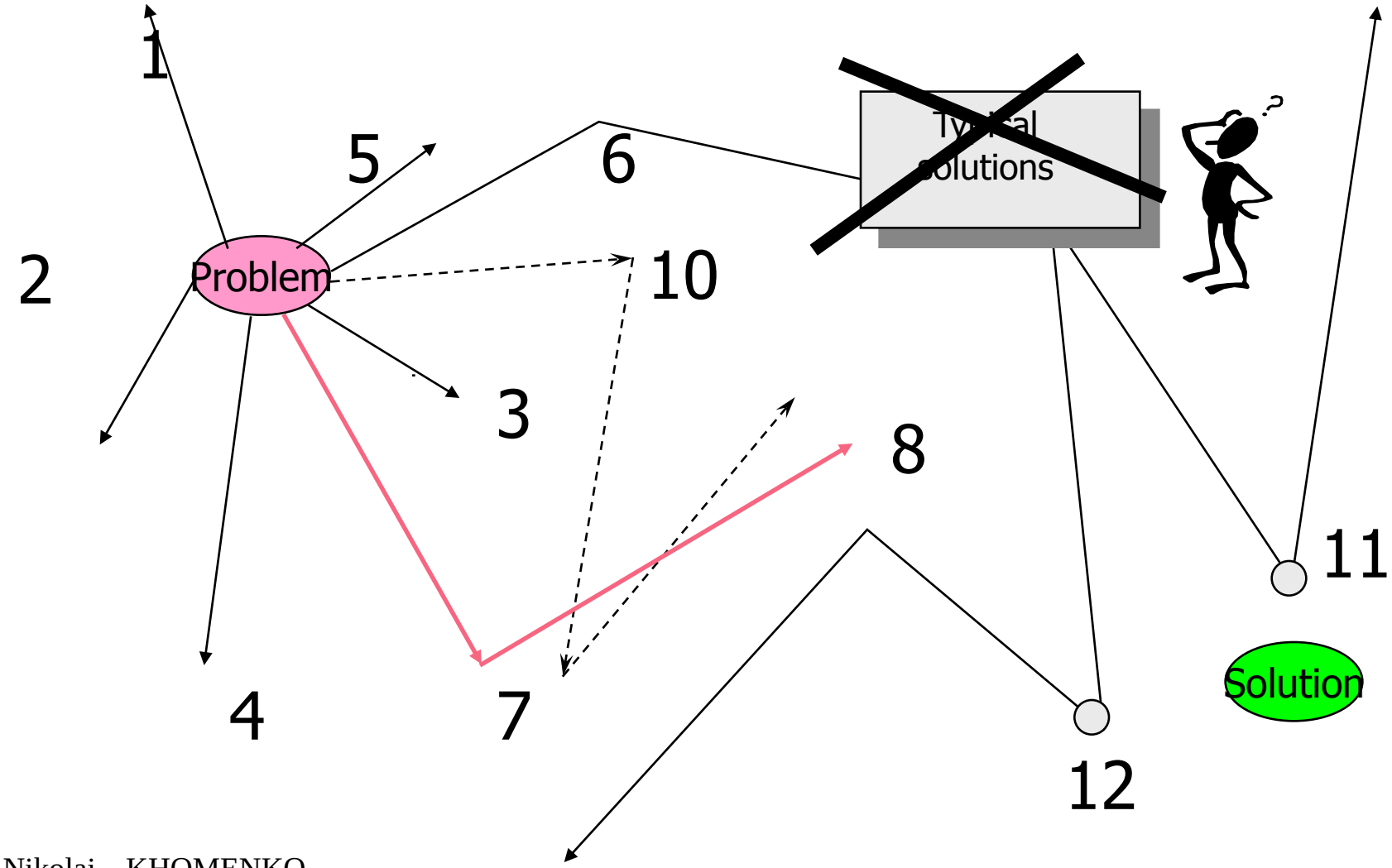


Conclusion: there are two kinds of problems:

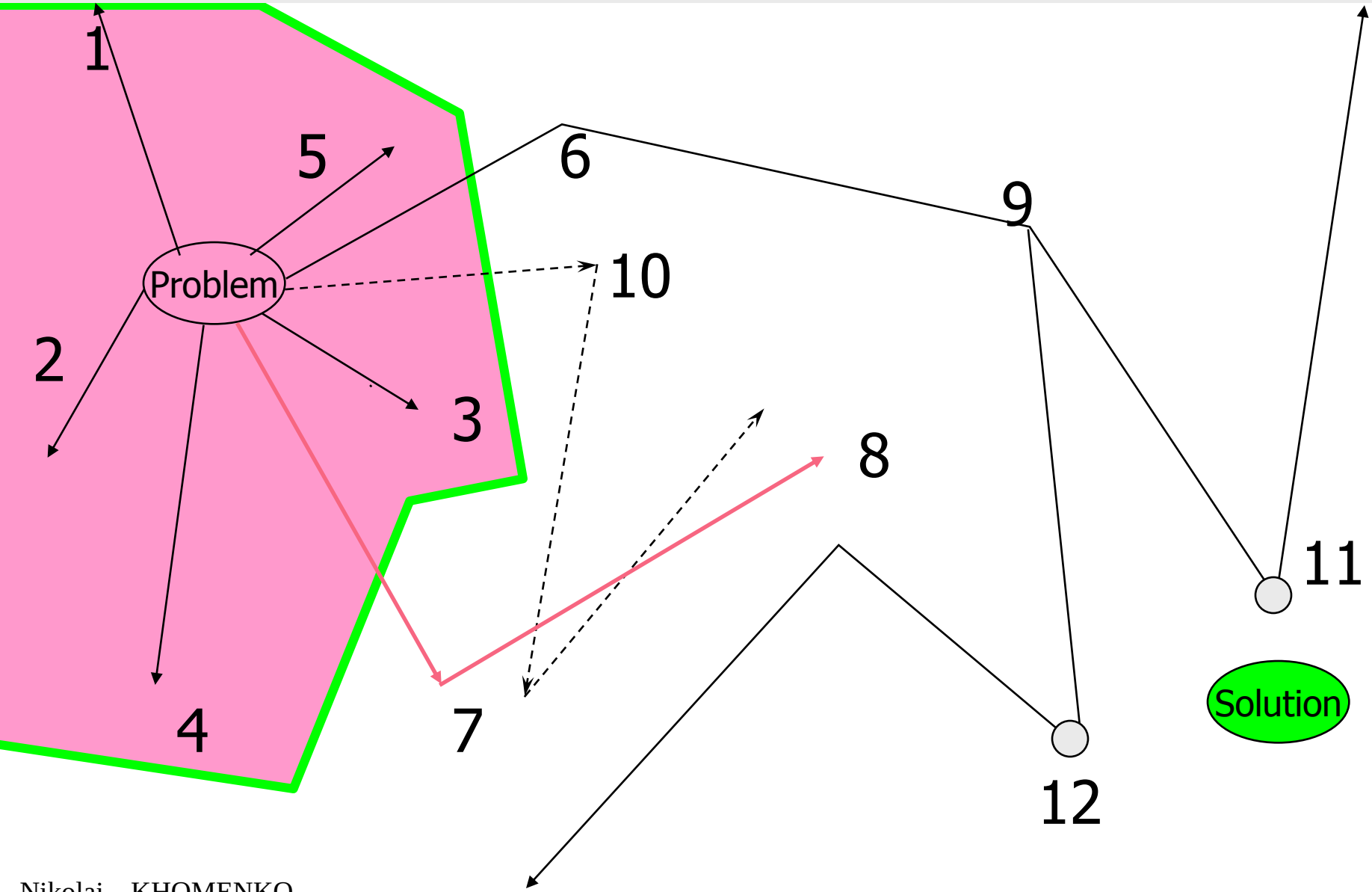
- *Typical Problem* - for solving this kind of problem one's experience or TRIZ Typical Solutions (extracted from the experience of many inventors) can be used.

- *Non-typical Problem* - neither TRIZ typical solutions, nor the experience (one's own or somebody else's) can help in resolving the problem.

What can be done in this case?

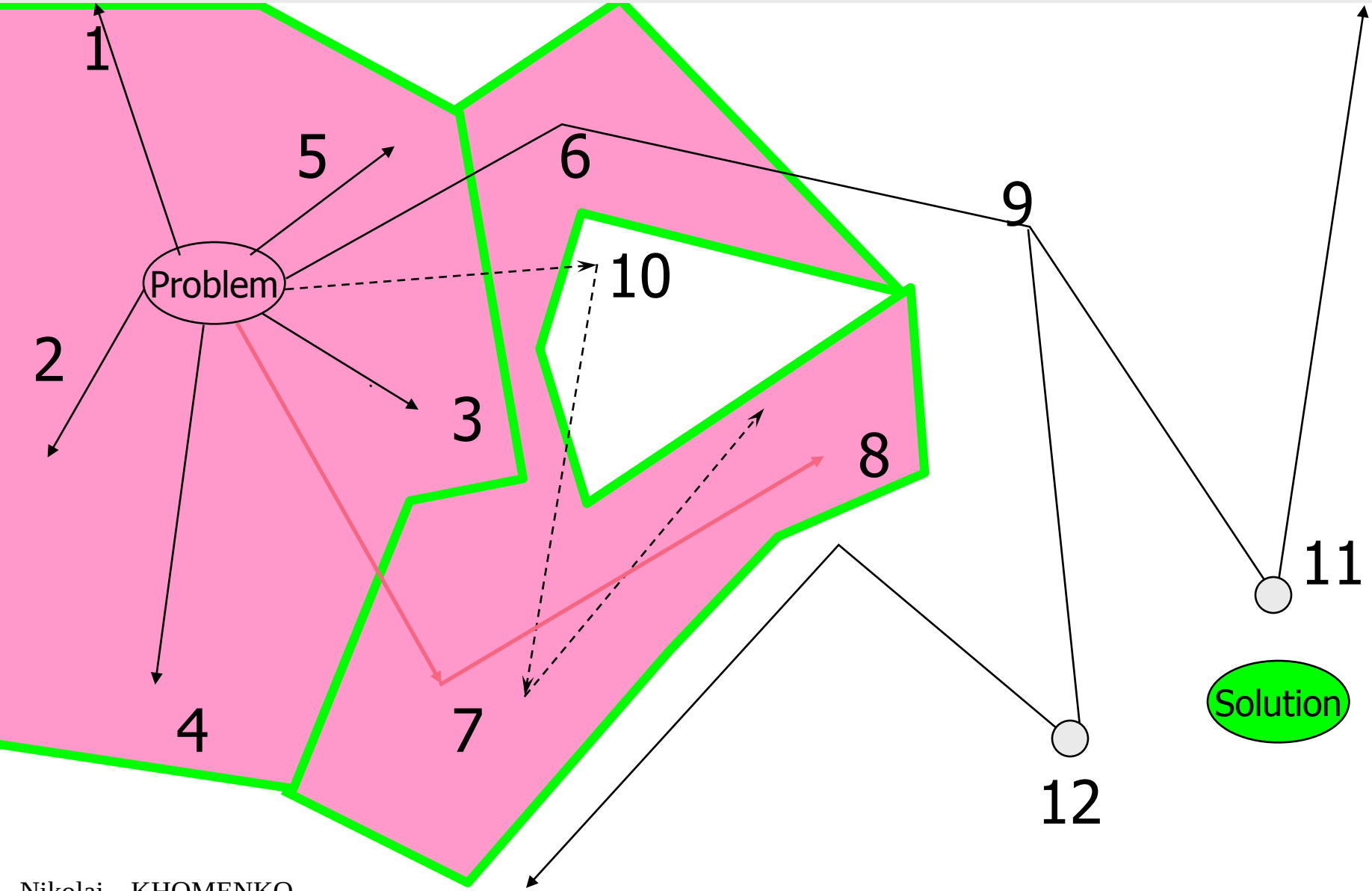


Trial and Error Method



Nikolai KHOMENKO
"Jonathan Livingston" Project - 1997

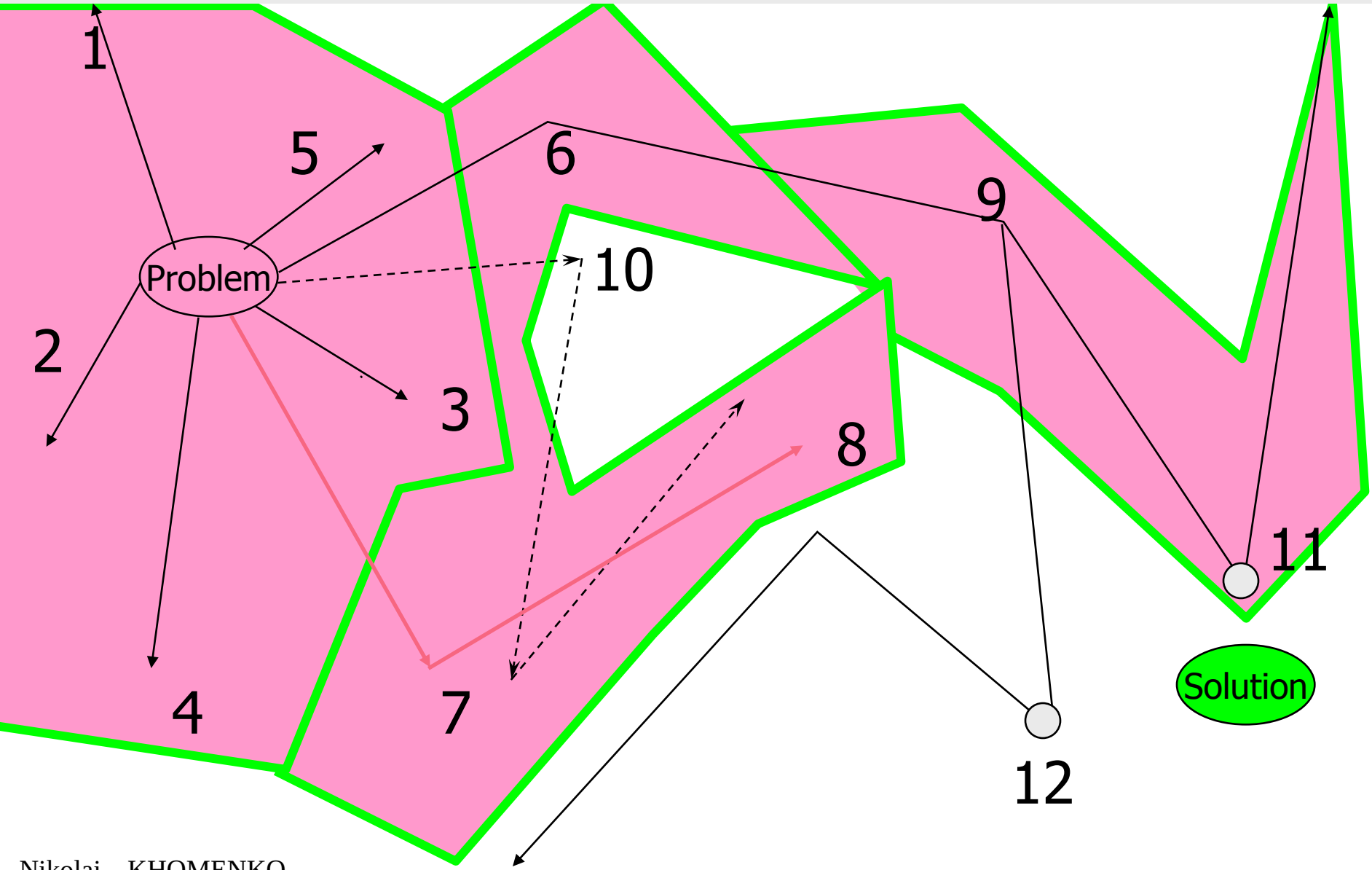
Trial and Error Method



Nikolai KHOMENKO
"Jonathan Livingston" Project - 1997

http://otsm-triz.org

Trial and Error Method



Nikolai KHOMENKO
"Jonathan Livingston" Project - 1997

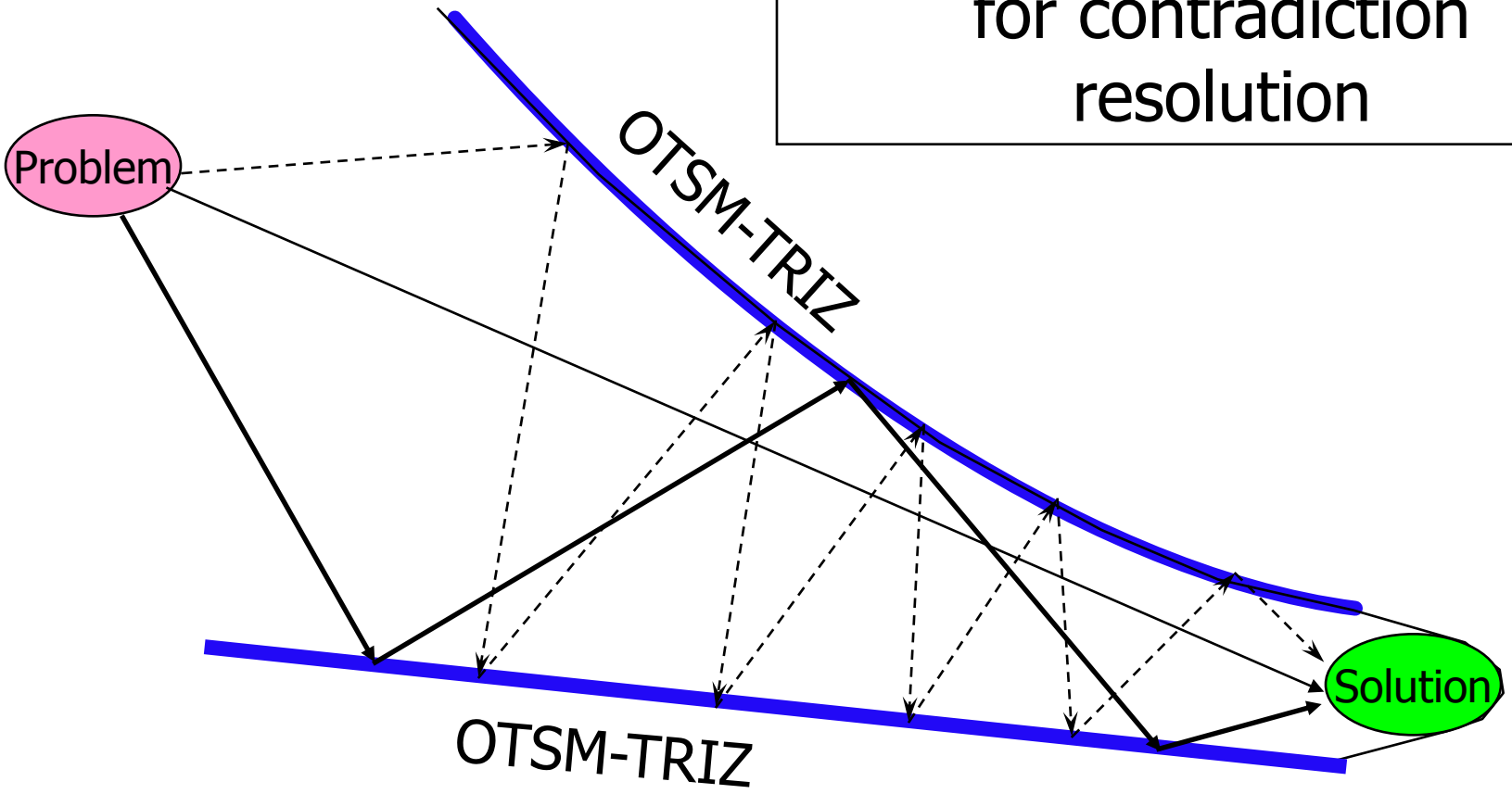
http://otsm-triz.org

People
spend a lot of time
to find solutions of problems.

Altshuller posed the following question:

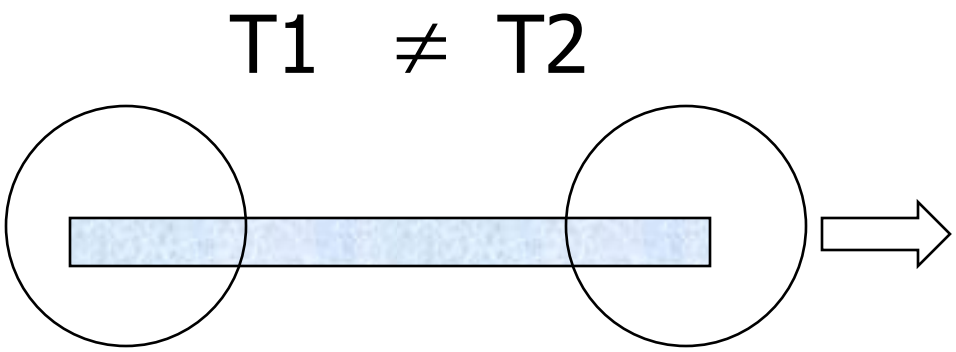
TRIZ technology gives direction

"Contradiction" technology for contradiction resolution

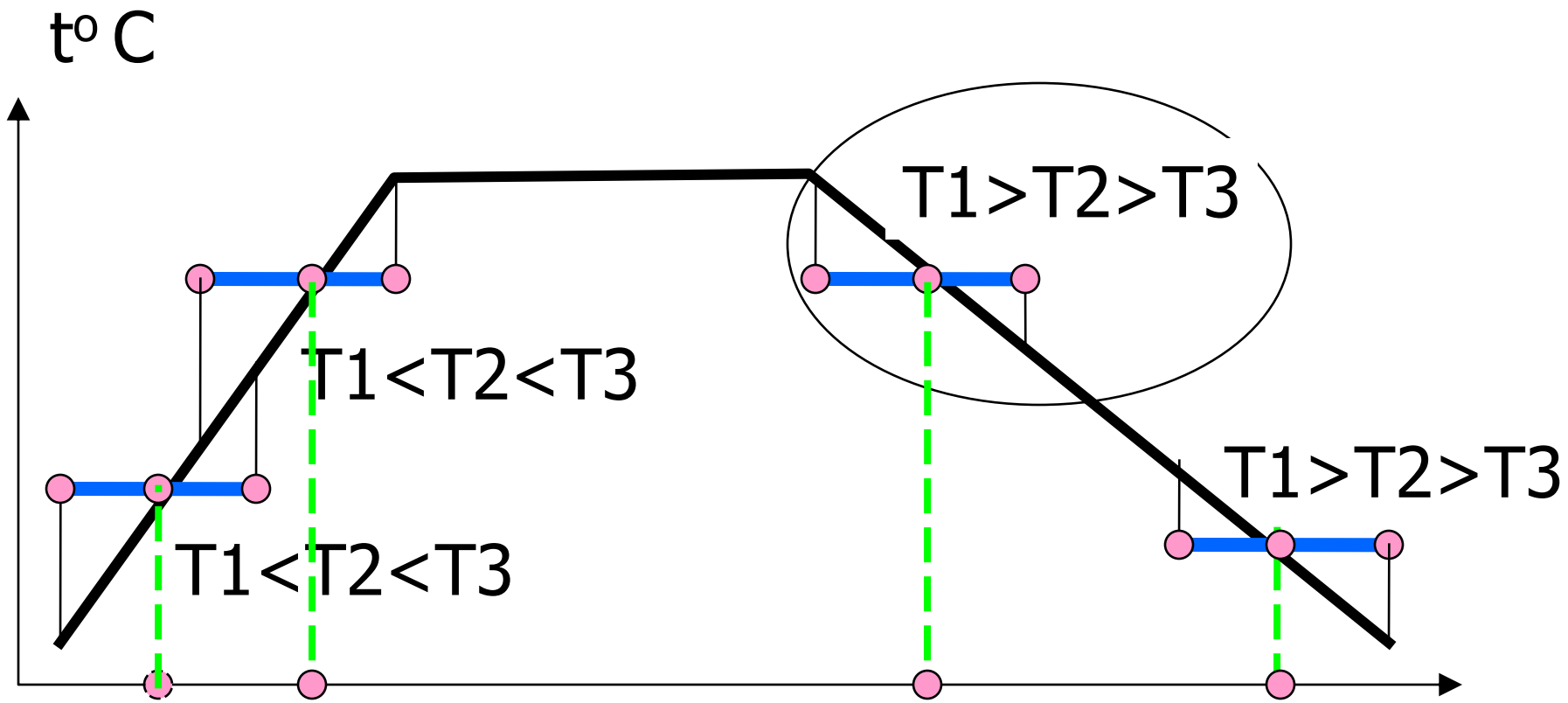


Example of non-typical problem
(Problem situation)

During the production process, a crack appears in the glass panel. The analysis shows that one of the reasons is the temperature difference between forward and backward edges of the glass panel.
What can be done?

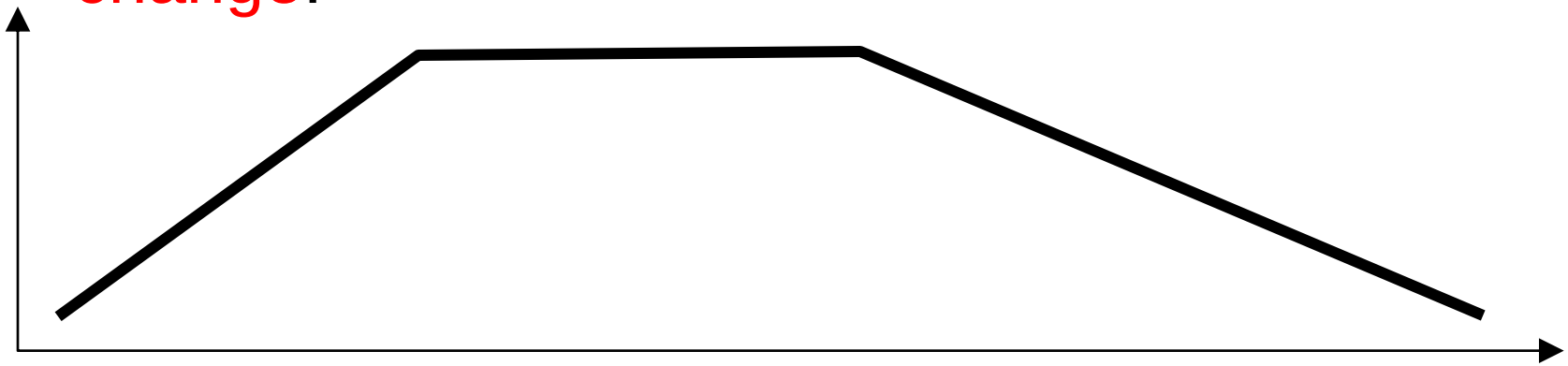


Example of non-typical problem
(More abstracted description of the problem situation)



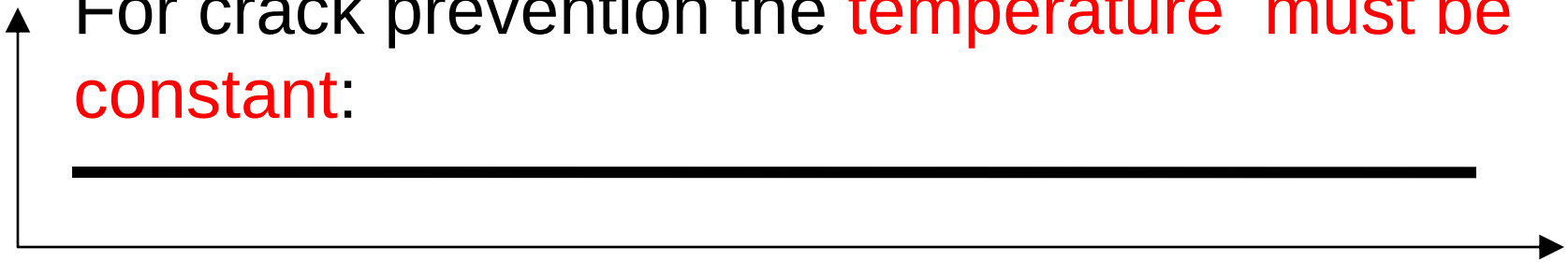
Example of non-typical problem
(Contradiction)

For the production process temperature must change:

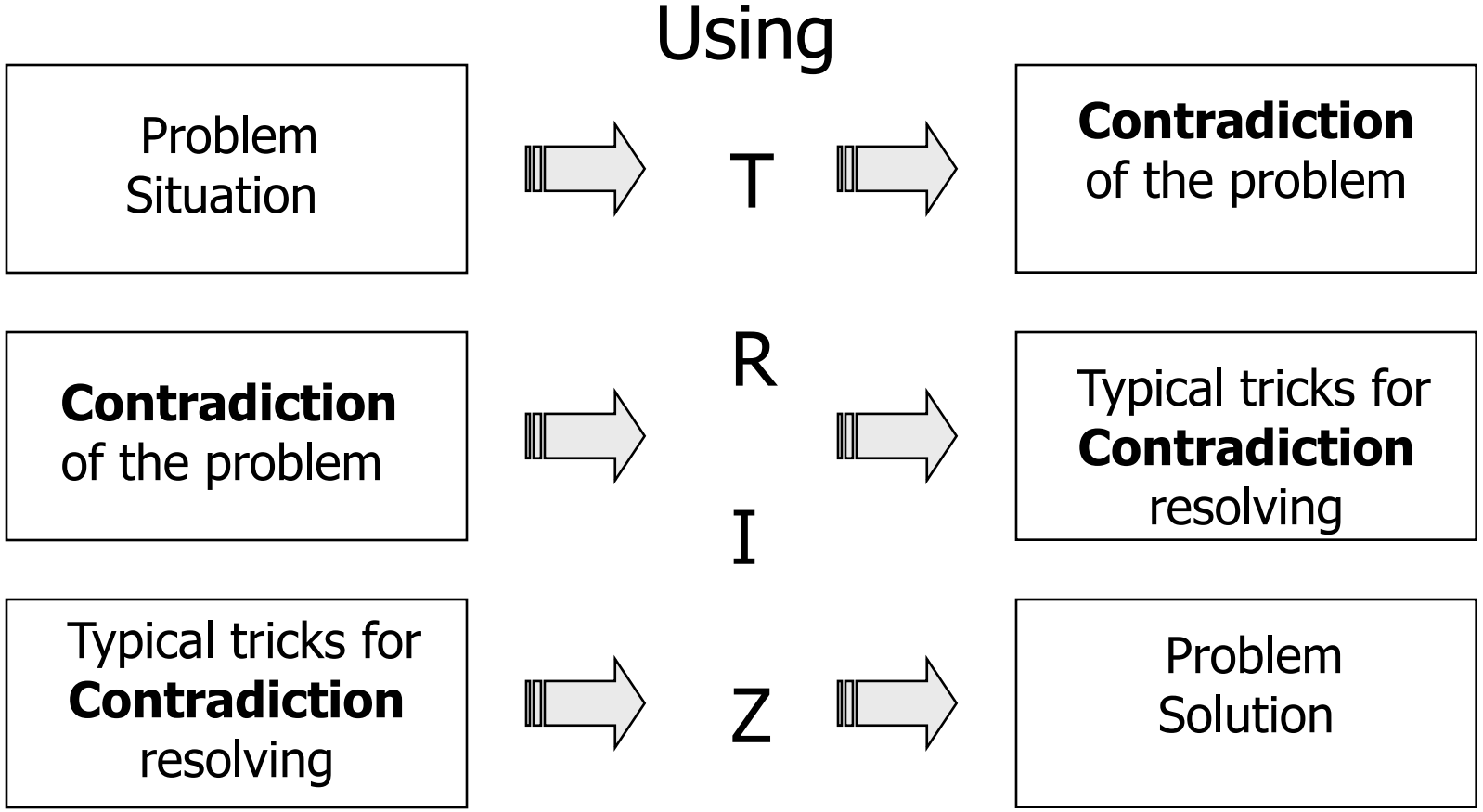


BUT

For crack prevention the temperature must be constant:



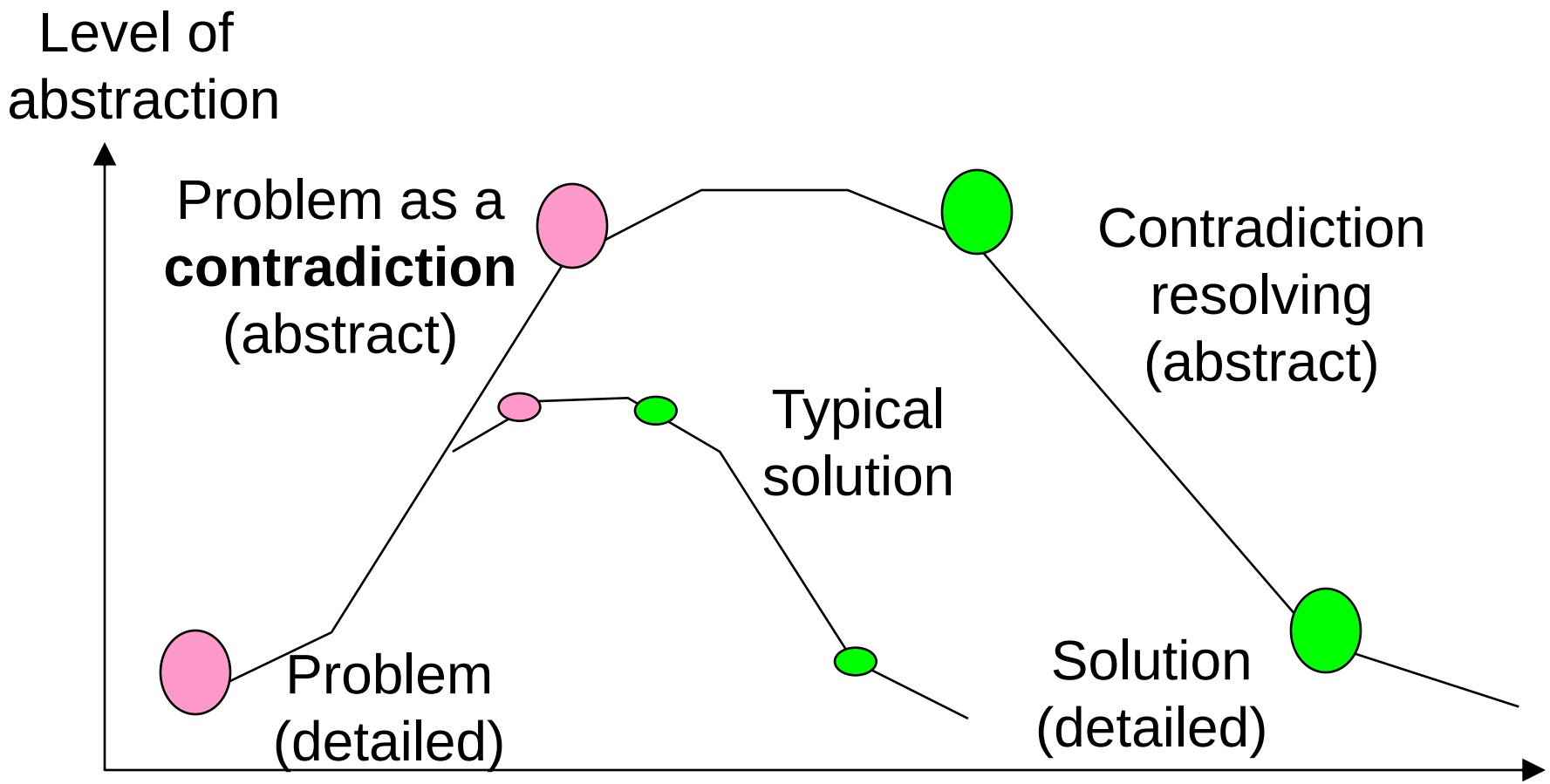
How can **Contradiction** be used
(Common Scheme)



Nikolai KHOMENKO
"Jonathan Livingston" Project - 1997

How to use **Contradiction**

(Level of Abstraction Diagram)



Nikolai KHOMENKO
"Jonathan Livingston" Project - 1997

Example of non-typical problem
(Contradiction resolution)

One of TRIZ recommendations for contradiction resolution is the use of one of the "s*ystem transition" principles, eg* :

the "whole" must be one,
but
its "parts" must be the opposite.

Example of non-typical problem
(Contradiction resolving)

TRIZ gave the direction - first of all one has to think:

What is - the “whole”?

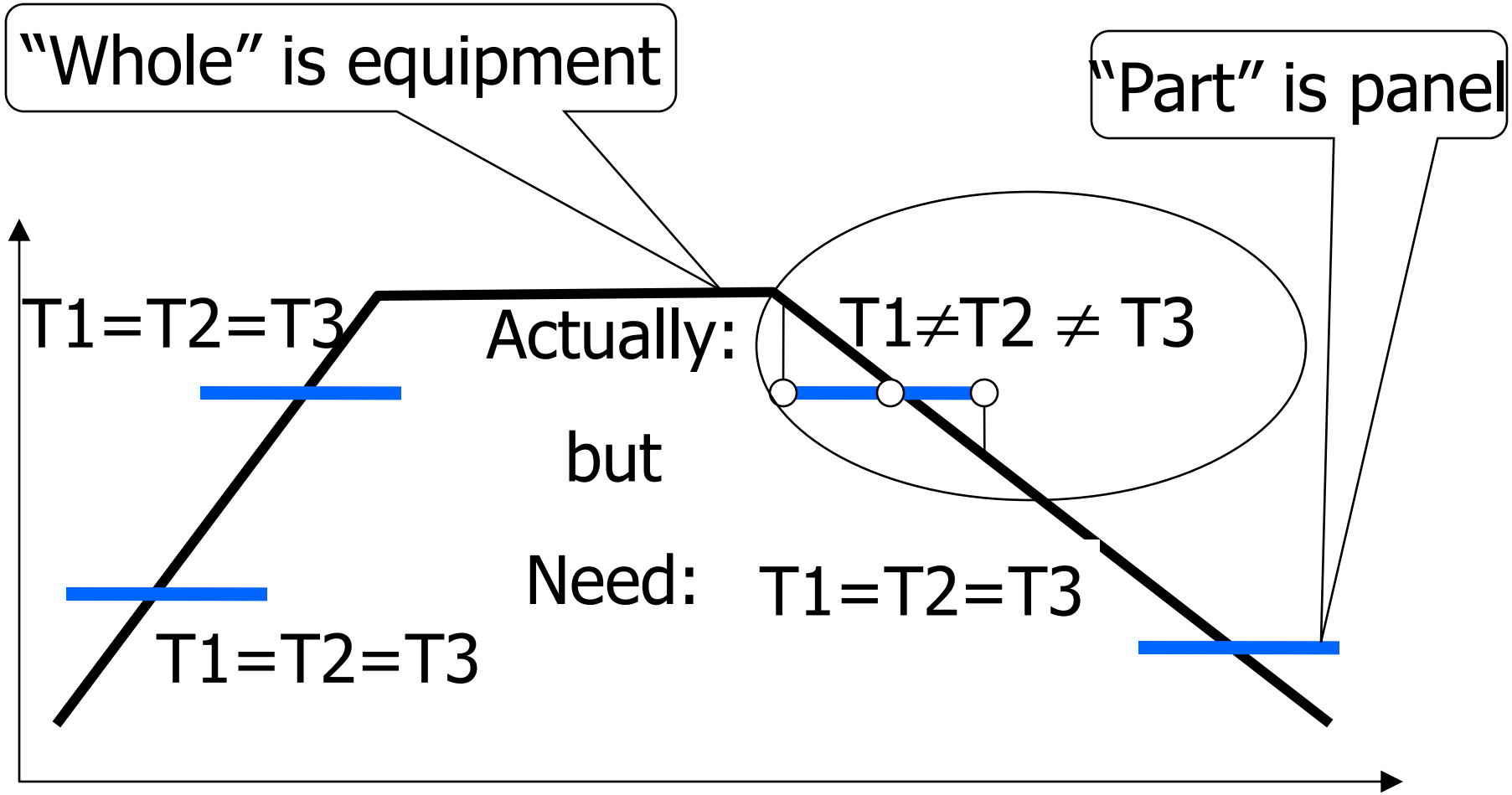
&

What is - its ”parts”?

TRIZ
is a tool
for
thinking
but
not instead of thinking

G. Altshuller

Example of non-typical problem
(Contradiction resolution)



Example of non-typical problem
(Solution)

TRIZ gave the direction - now one has to think about the following:

How can this idea be implemented? How can equal temperature for every point of the panel be sustained when the environment temperature is very changeable?

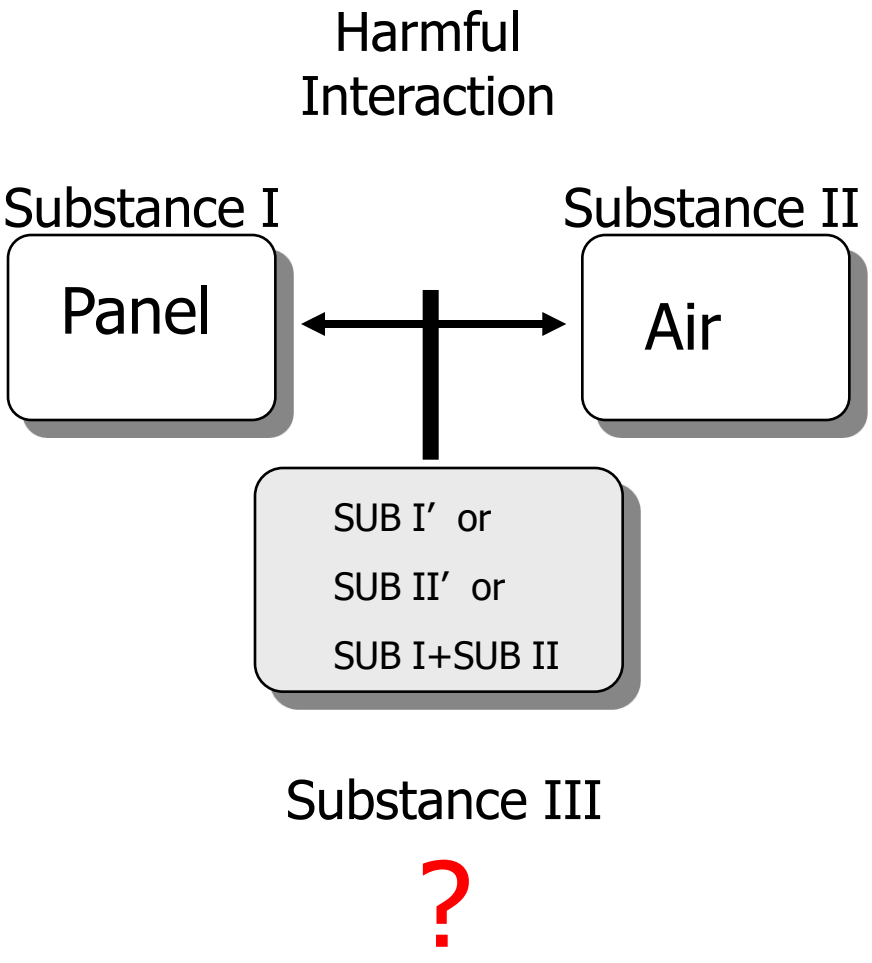
Warning!
Now the problem description has changed and TRIZ Typical Solutions can be applied

Example of non-typical problem
(Solution)

How can the temperature of the panel's surface be sustained when the temperature of the environment varies significantly?

There is an interaction between the air and the panel. As a result, different points of the panel have different temperature.

How can this harmful interaction be prevented?



Example of non-typical problem
(Solution)

TRIZ gave the direction - now one has to think about the following:

What is (Panel)'?
What is Air+Panel?
What is (Air)'?
How can Air be transformed to (Air)'? How can this be done inside the equipment?

Example of non-typical problem
(Solution)

Air flow is like this:

T1 ≠ T2 ≠ T3

T1 ≠ T2 ≠ T3

BUT

Air flow should be like this:

T1 ≠ T2 ≠ T3

T1 = T2 = T3

Nikolai KHOMENKO
"Jonathan Livingston" Project - 1997

Attention!

Use of the TRIZ Typical Solution led to the new contradiction:

One kind of air flow is available

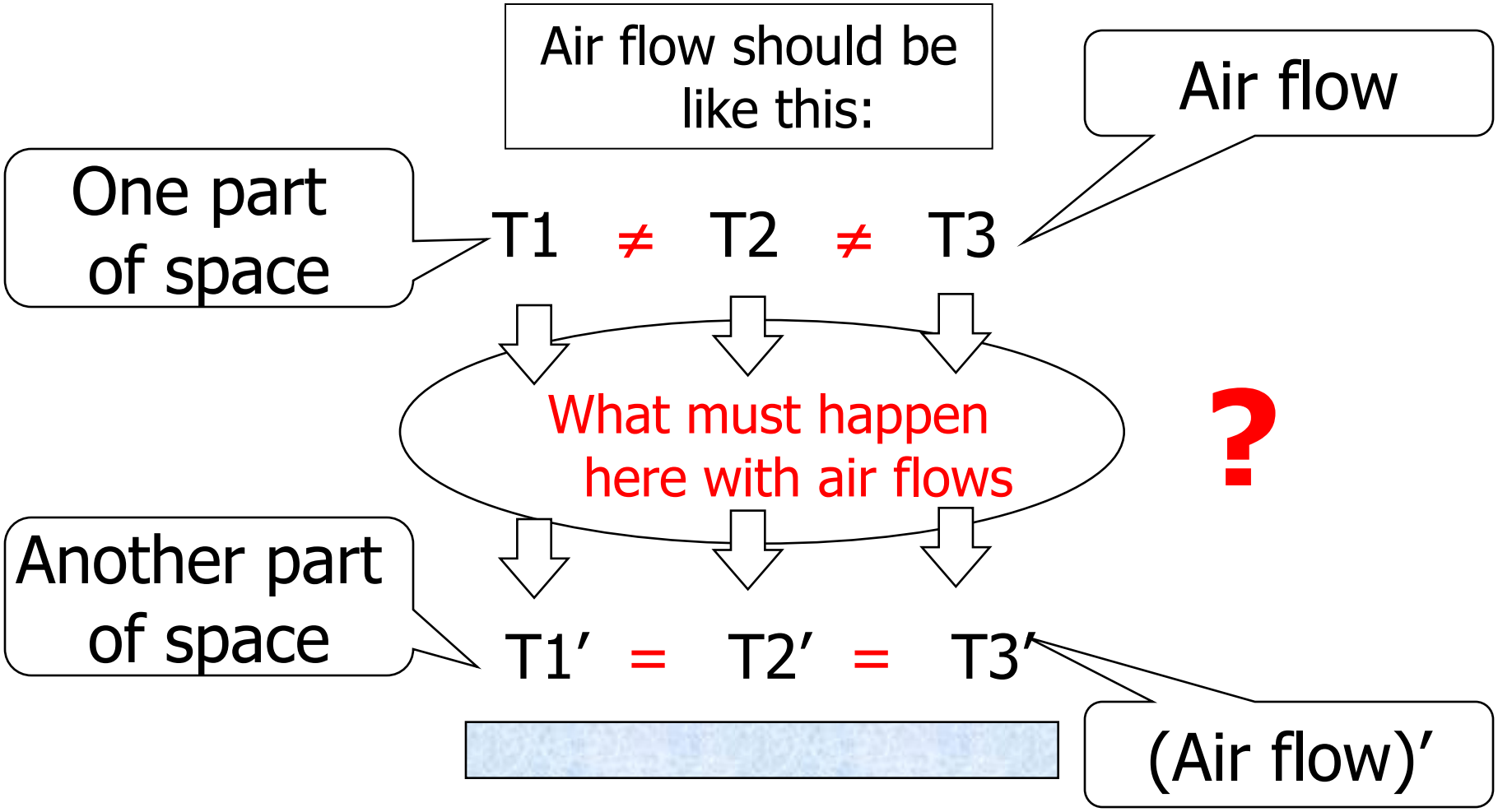
but

another kind of the air flow is required

For resolving this contradiction
one can use one of OTSM-TRIZ principles
for contradiction resolution -"transition to macro level":

one part of space *must be one*
but
another part of space *must be opposite*

Example of non-typical problem
(Solution)



Example of non-typical problem
(Solution)

TRIZ gave the direction – now one has to think about the following:

Air Flow has three parts with different temperature.
(Air Flow)' must have three parts with same temperature.

What is the value of temperature?

Attention!

A new problem:

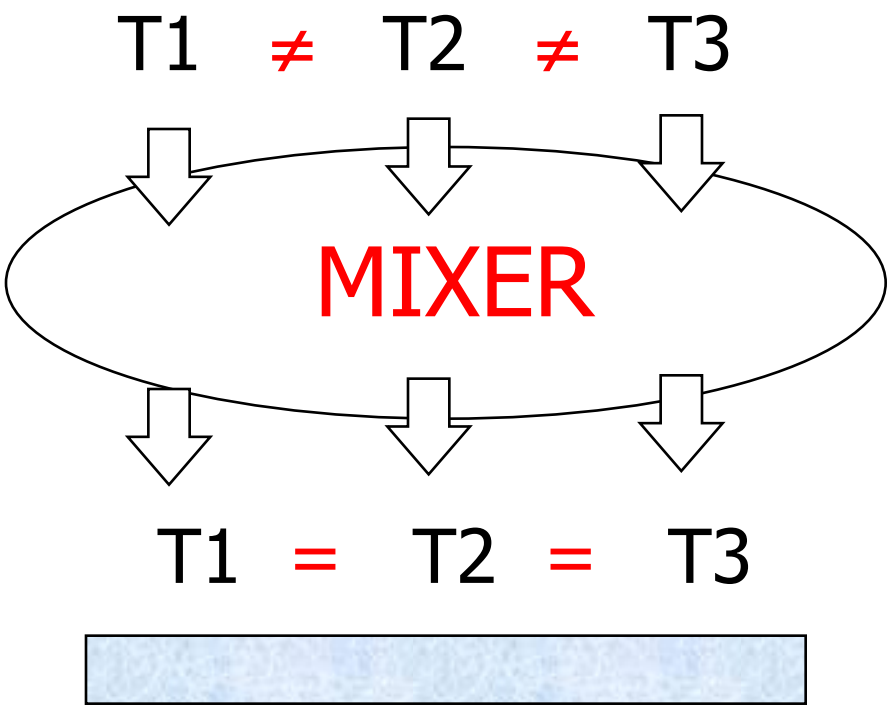
How can “the value of temperature” be understood?

This question can be answered without TRIZ, using one's experience or the laws of physics:

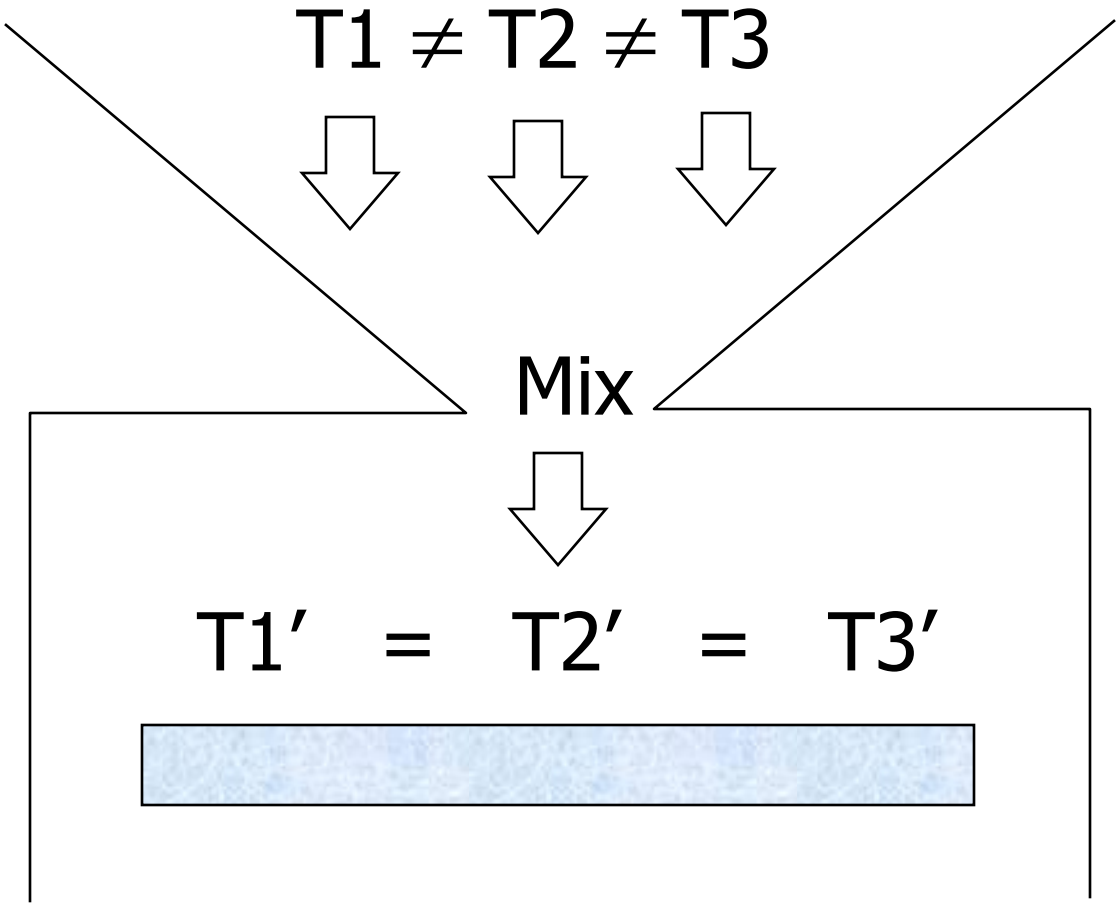
T1<T?<T3 or T1>T?>T3

Example of non-typical problem
(Solution)

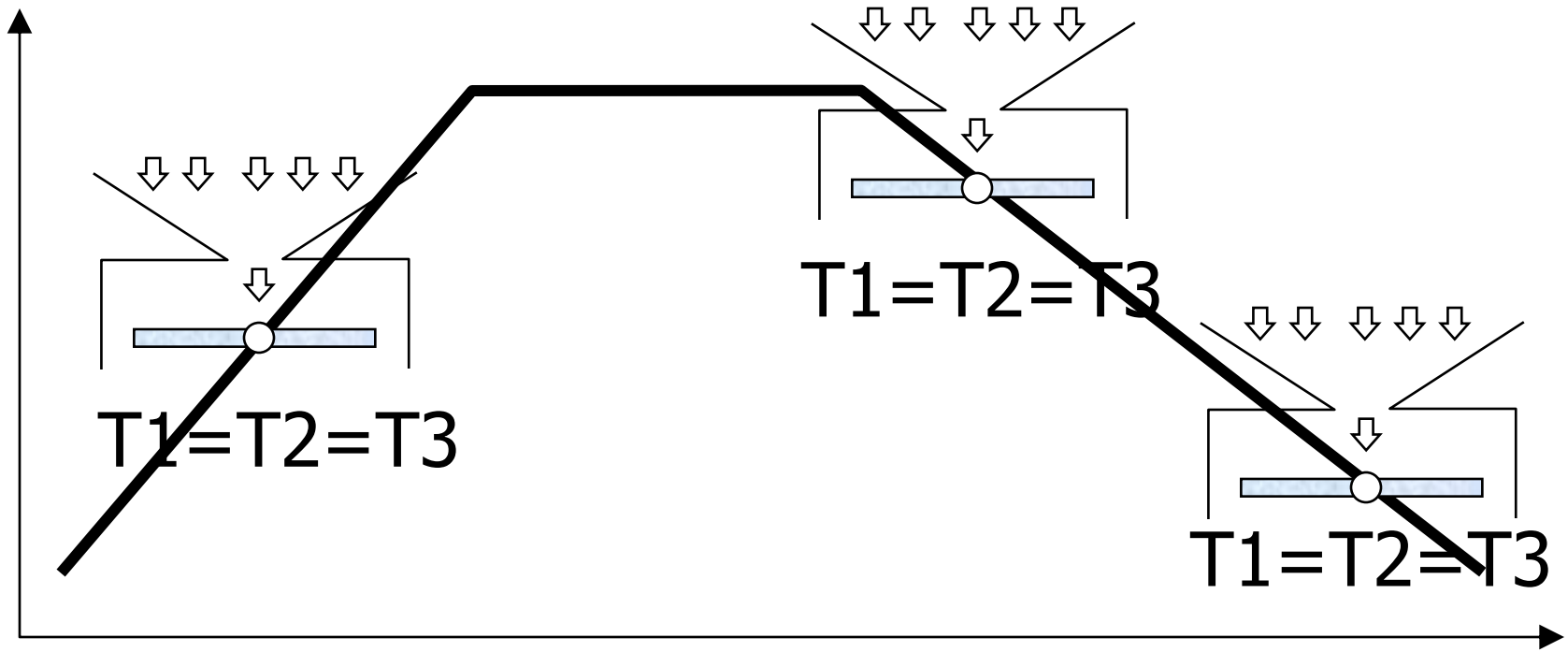
Air flow should be like this:



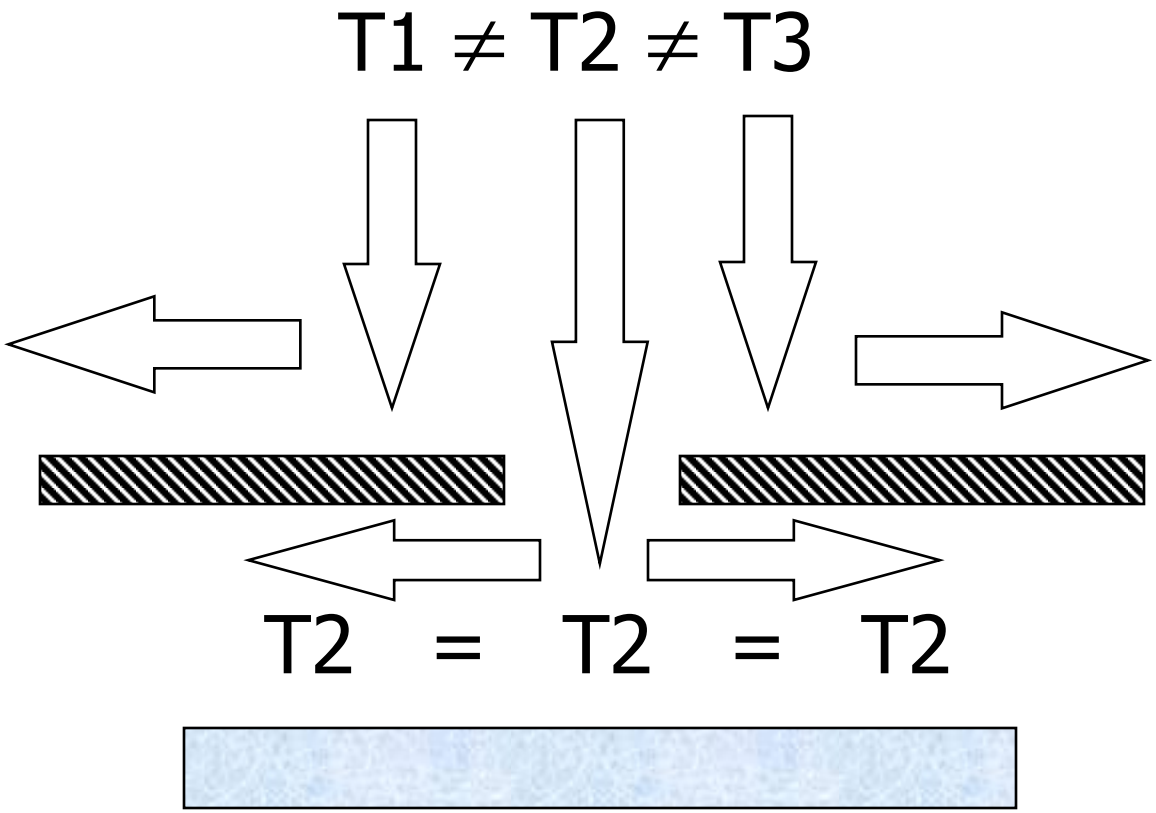
Example of non-typical problem
(Solution)



Example of non-typical problem
(Solution)



Example of non-typical problem
(Final Solution)



What can one do when neither typical solutions nor contradiction can be applied?

Typical solutions

Contradiction

One must look for contradiction!

- One needs specific rules that can help identify contradiction.
- When the contradiction of the problem is identified, one can use all TRIZ tools for resolving this contradiction.
- What are these rules?

These rules must be more general and universal rules:

This rule must help one when faced with a “New Problem”:

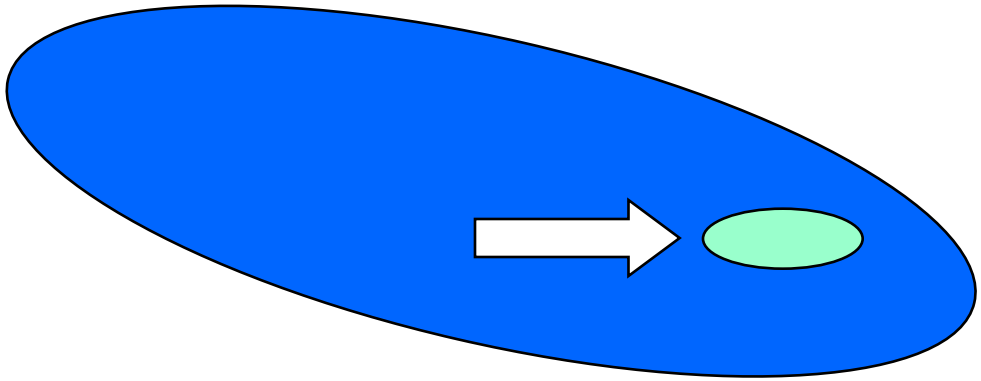
- ⇒ Nobody knows how to solve this problem.
- ⇒ Nobody has any tools for solving this problem.
- ⇒ Nobody knows what kind of information or research is needed for solving this problem

List of OTSM-TRIZ rules for solving “New Problem”:

- The main problem OTSM-TRIZ deals with (MP-PSP)
- Three main ideas of OTSM-TRIZ:
  - Objective laws idea
  - Contradiction idea
  - Particular situation idea
- Axioms of OTSM-TRIZ
- OTSM-TRIZ Full Scheme of “Powerful Thinking” (Full Scheme)
- Main model of OTSM-TRIZ for problem analysis: **Element** - **Name** of Feature - **Value** of Feature (ENV-model)

Main problem TRIZ deals with
(Main Problem in Problem Solving Process - MP-PSP):

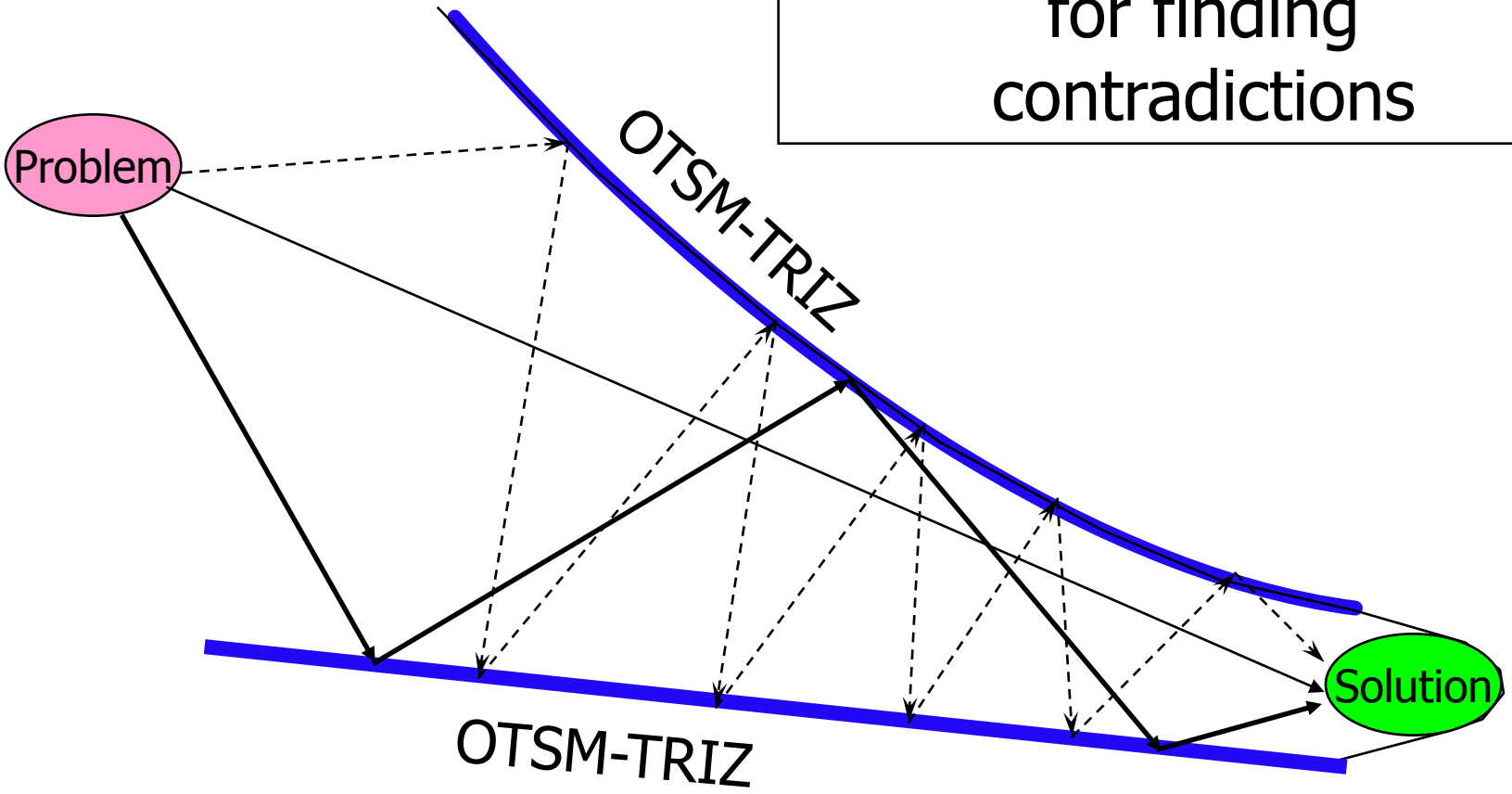
How to reduce the Solution Search Area without many trials and errors, avoiding mental inertia while not degrading the quality of the solution?



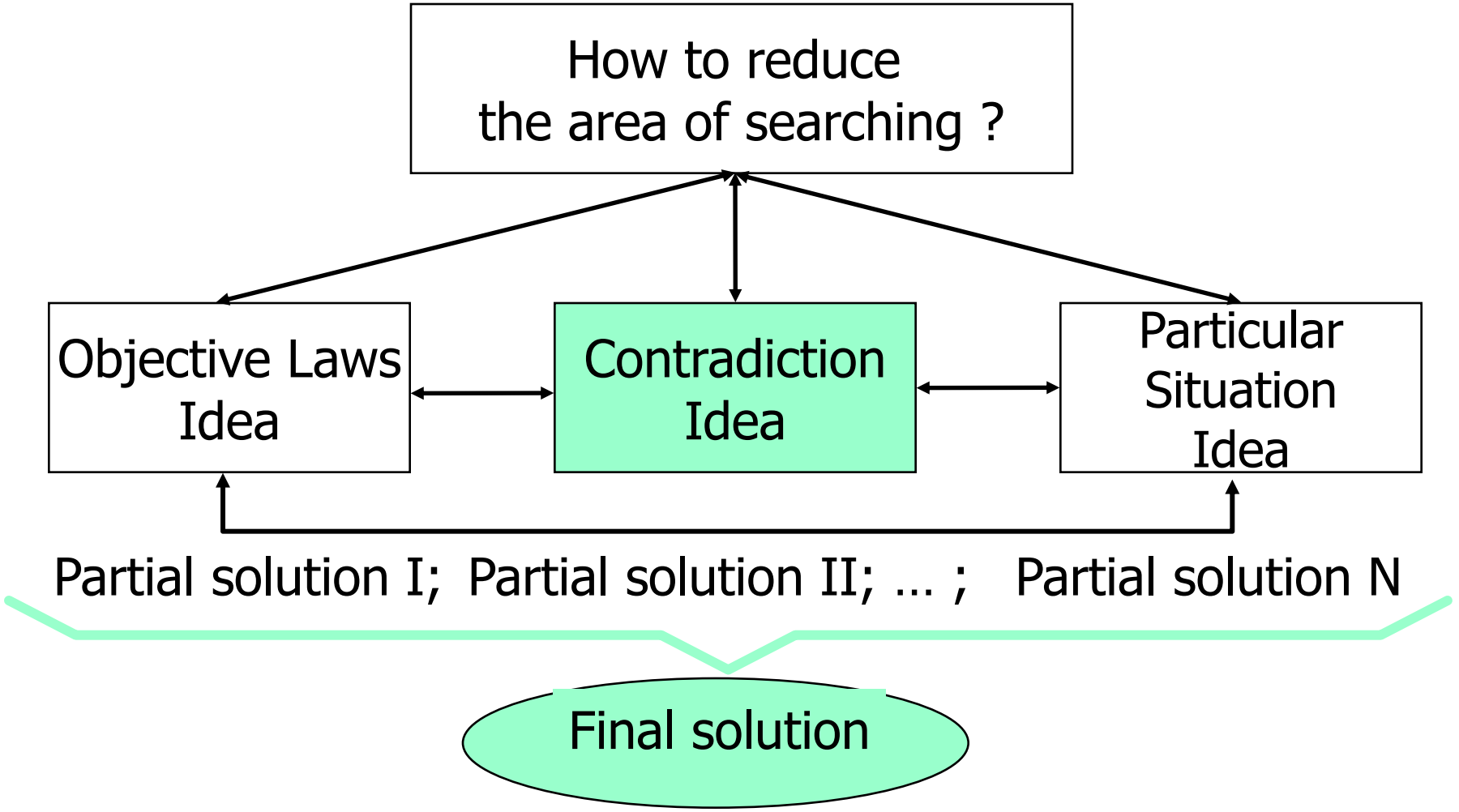
OTSM-TRIZ uses its three main ideas and develops a system of rules for the analysis of the initial problem situation.

TRIZ technology gives direction

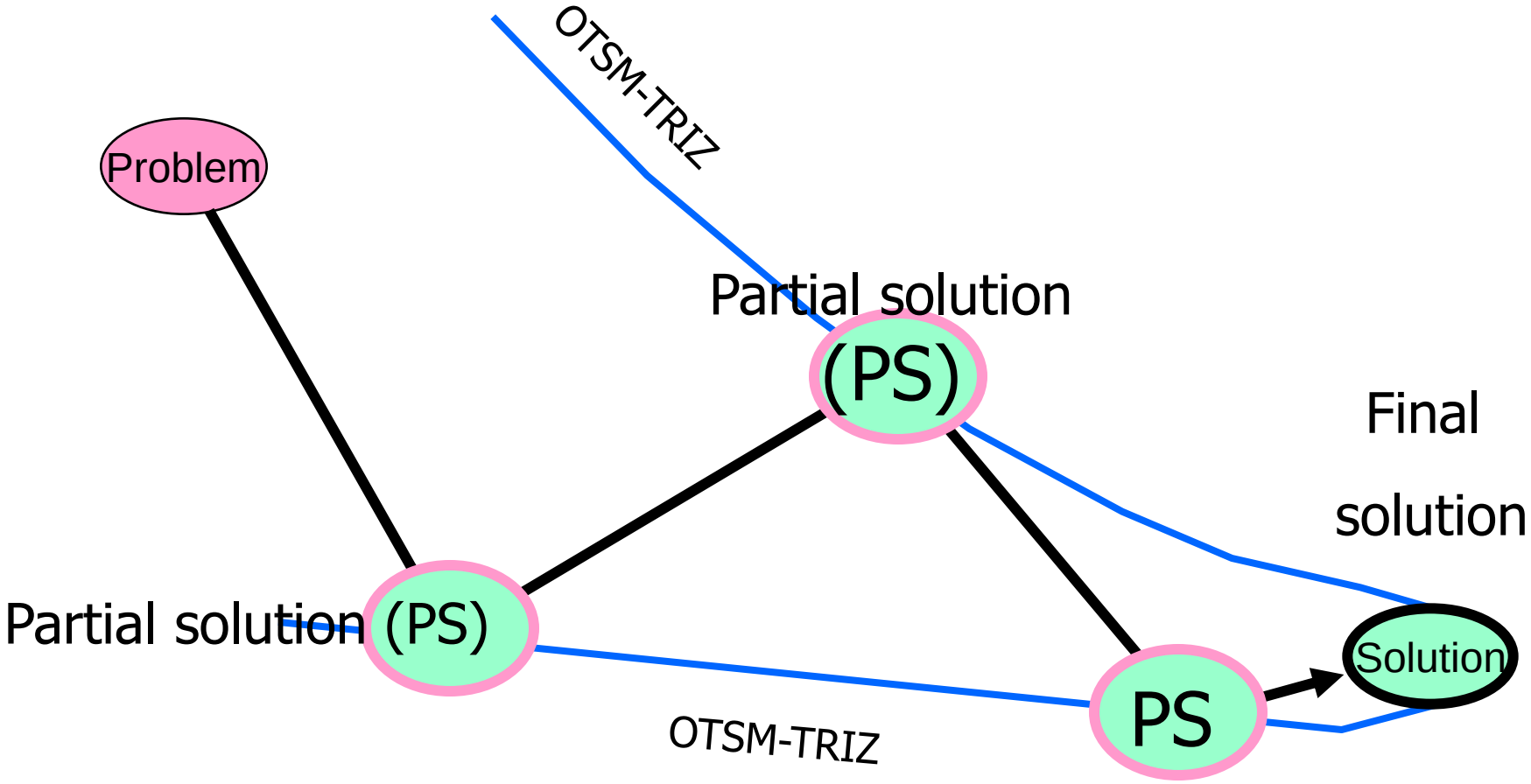
"New Problem" technology for finding contradictions



System of rules for solving "New Problem"

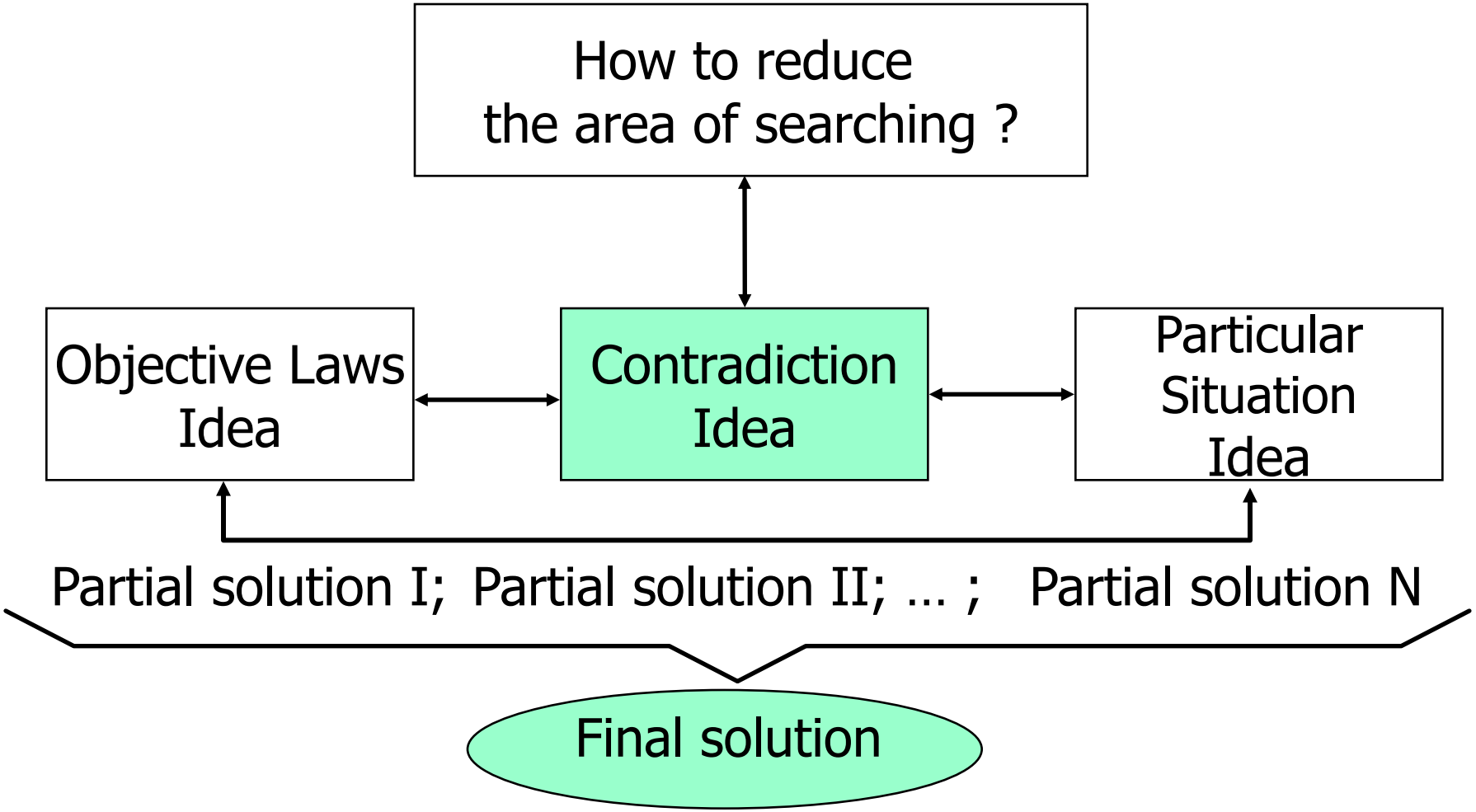


Partial and final solutions



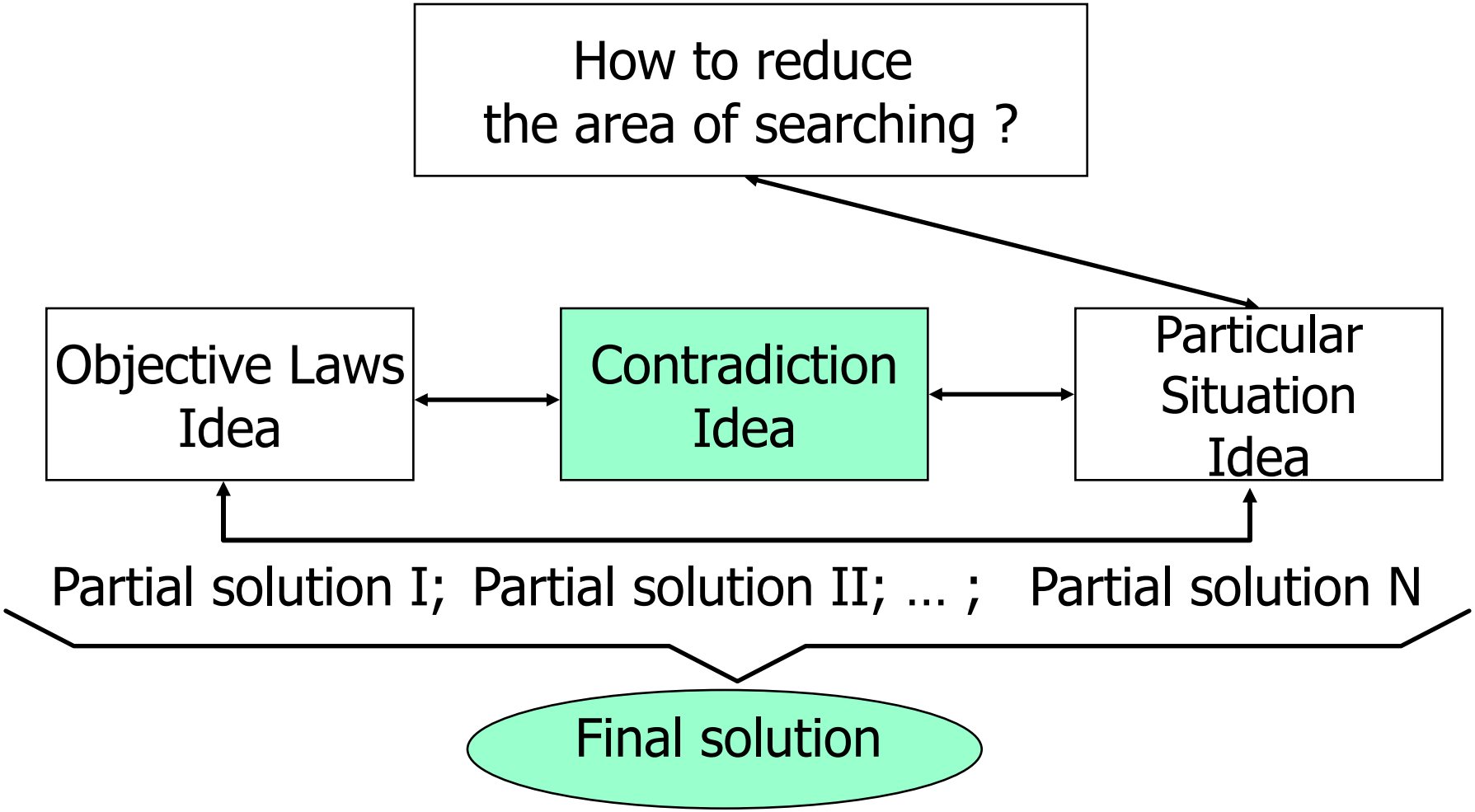
Variant 1:

There is information on laws and particular situation



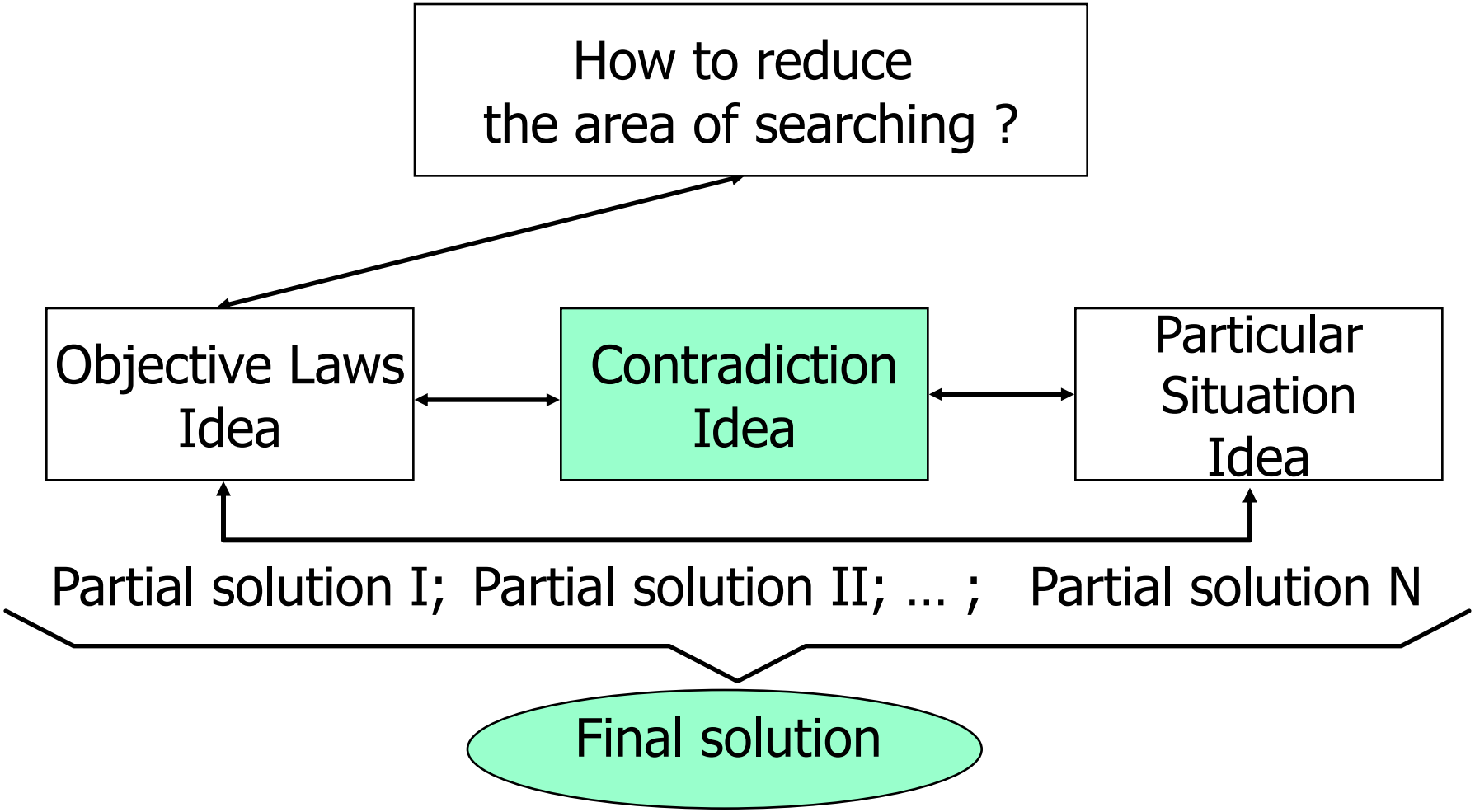
Variant 2:

There is information on objective laws only



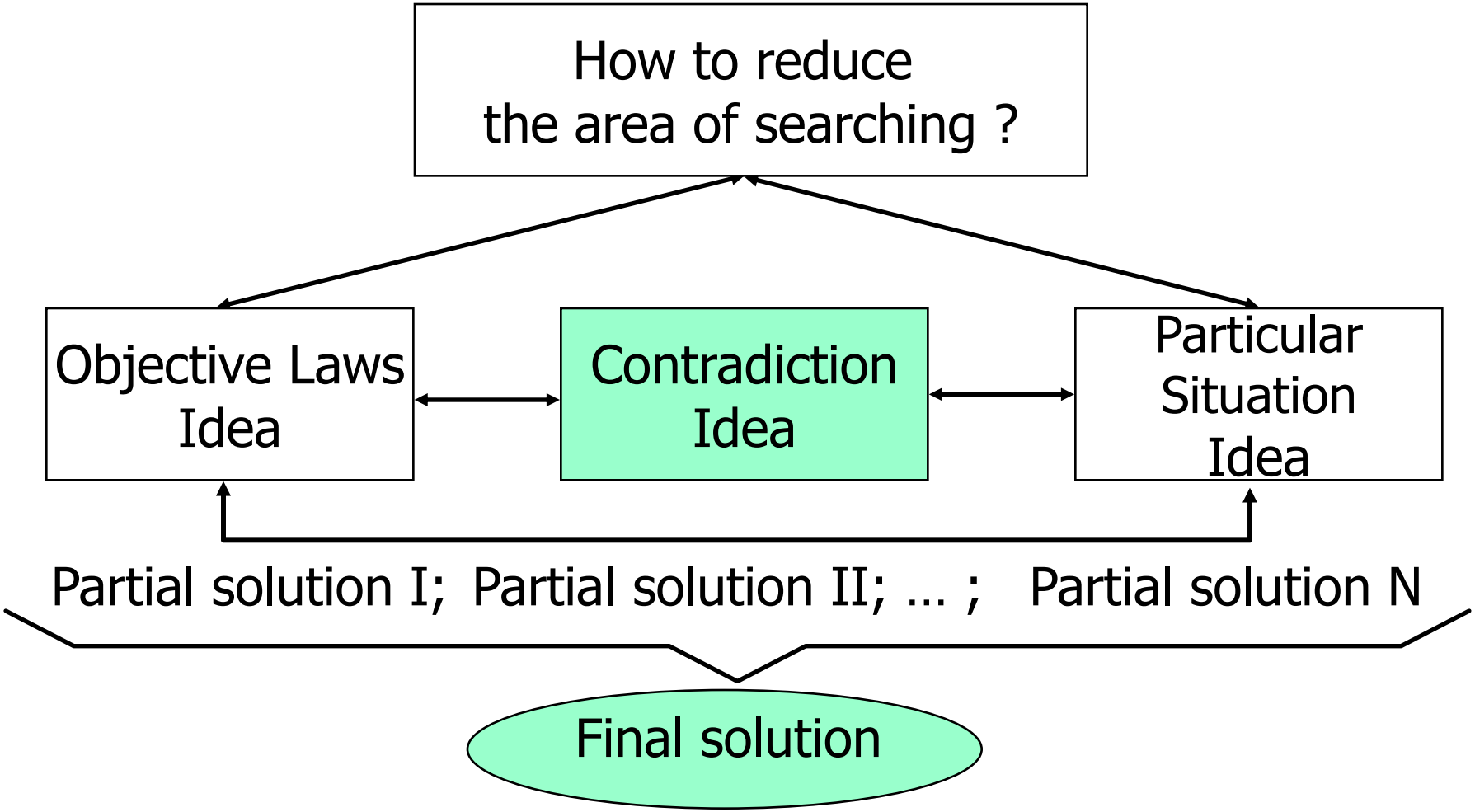
Variant 3:

There is information on situation only

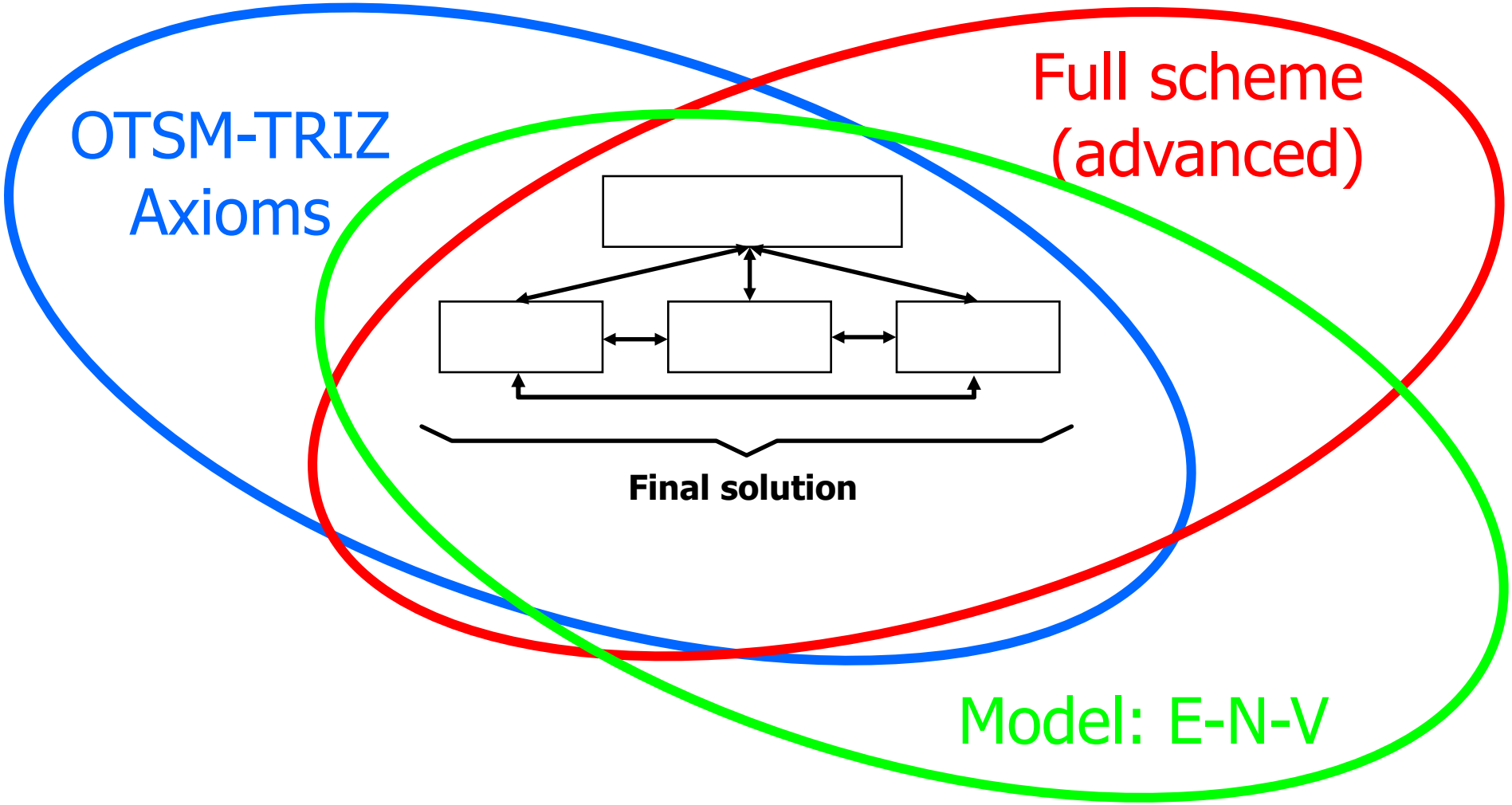


Variant 3:

Information on neither laws nor situation is available



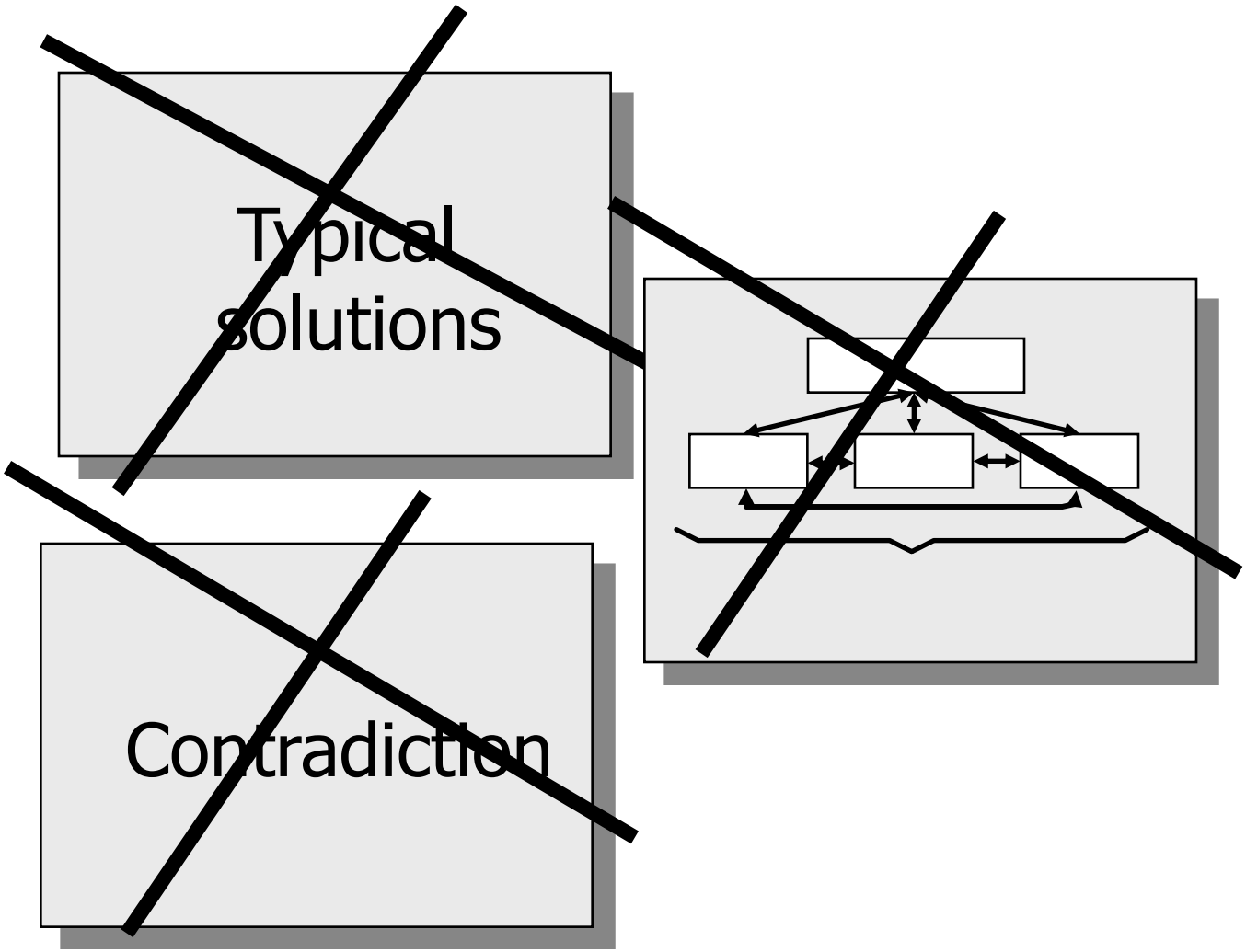
Rules for dealing with the “New Problem”



Main goal of the "New Problem" technology

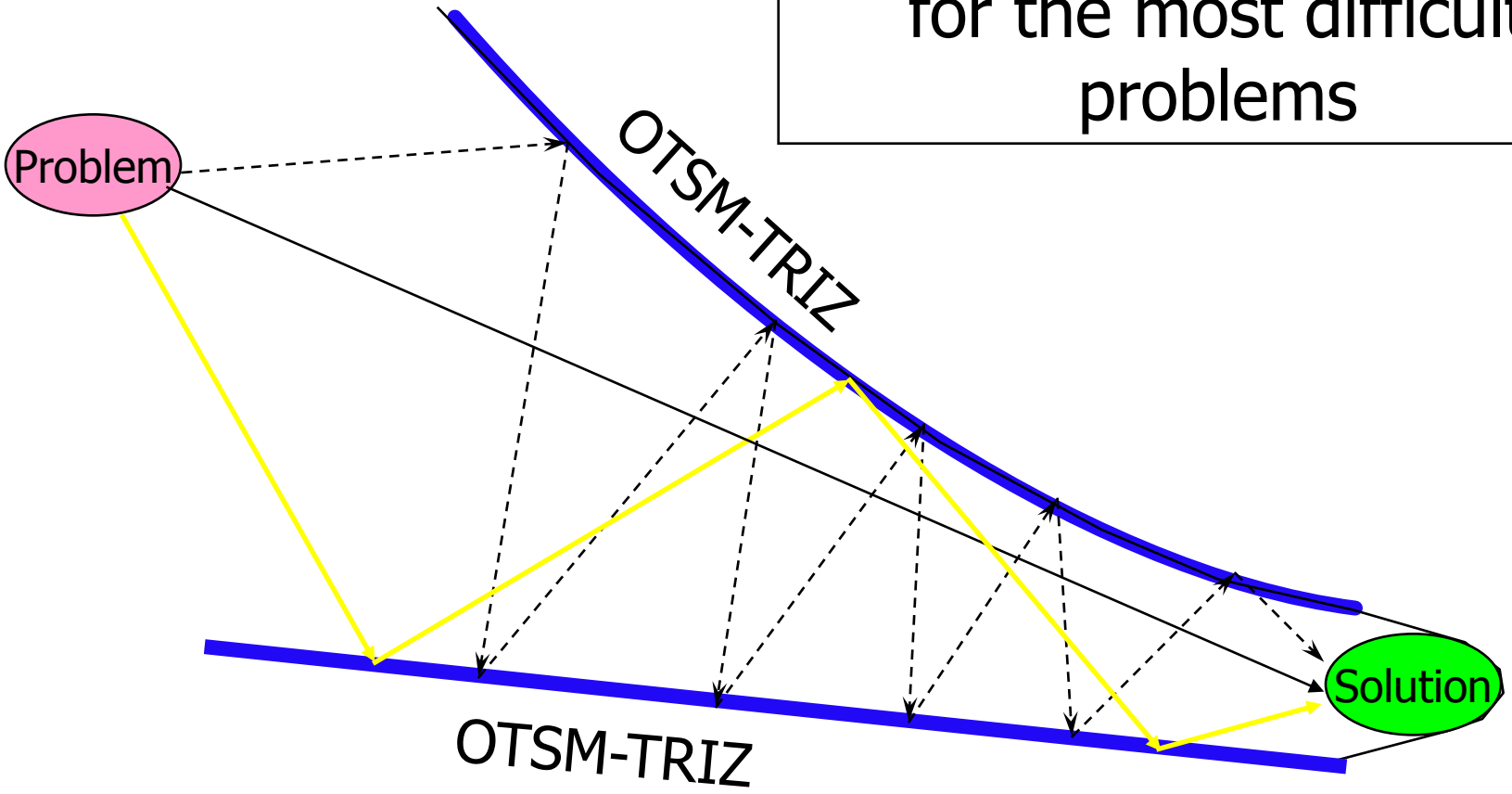
- First one has to understand which objective law (connected with a particular situation) contradicts the wish of the problem-solver.
- Then one has to apply the "Contradiction technology" for resolving this contradiction.
- For this one has to try to use resources available in a given particular situation.

The most difficult problem!

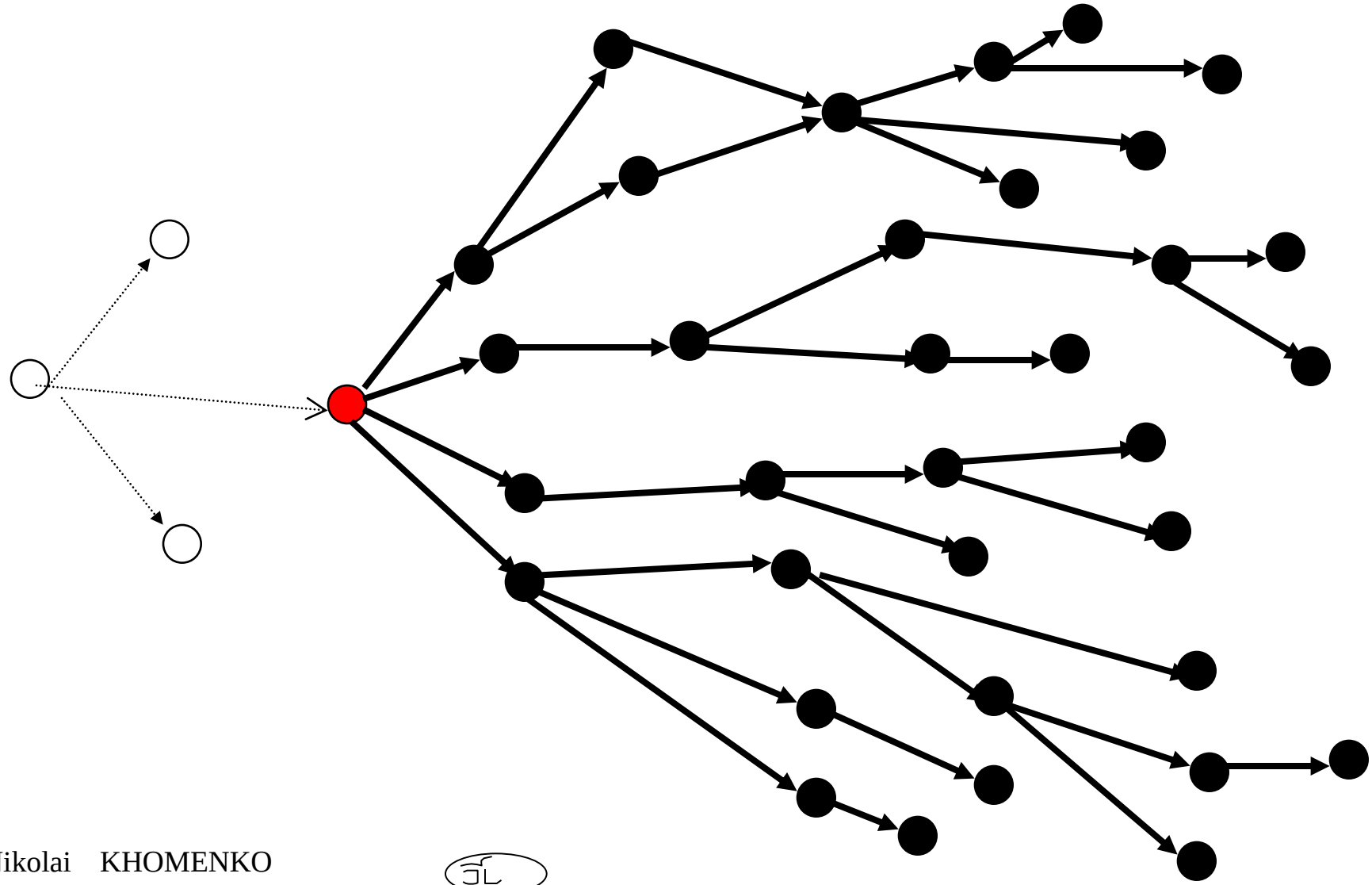


TRIZ technology gives direction

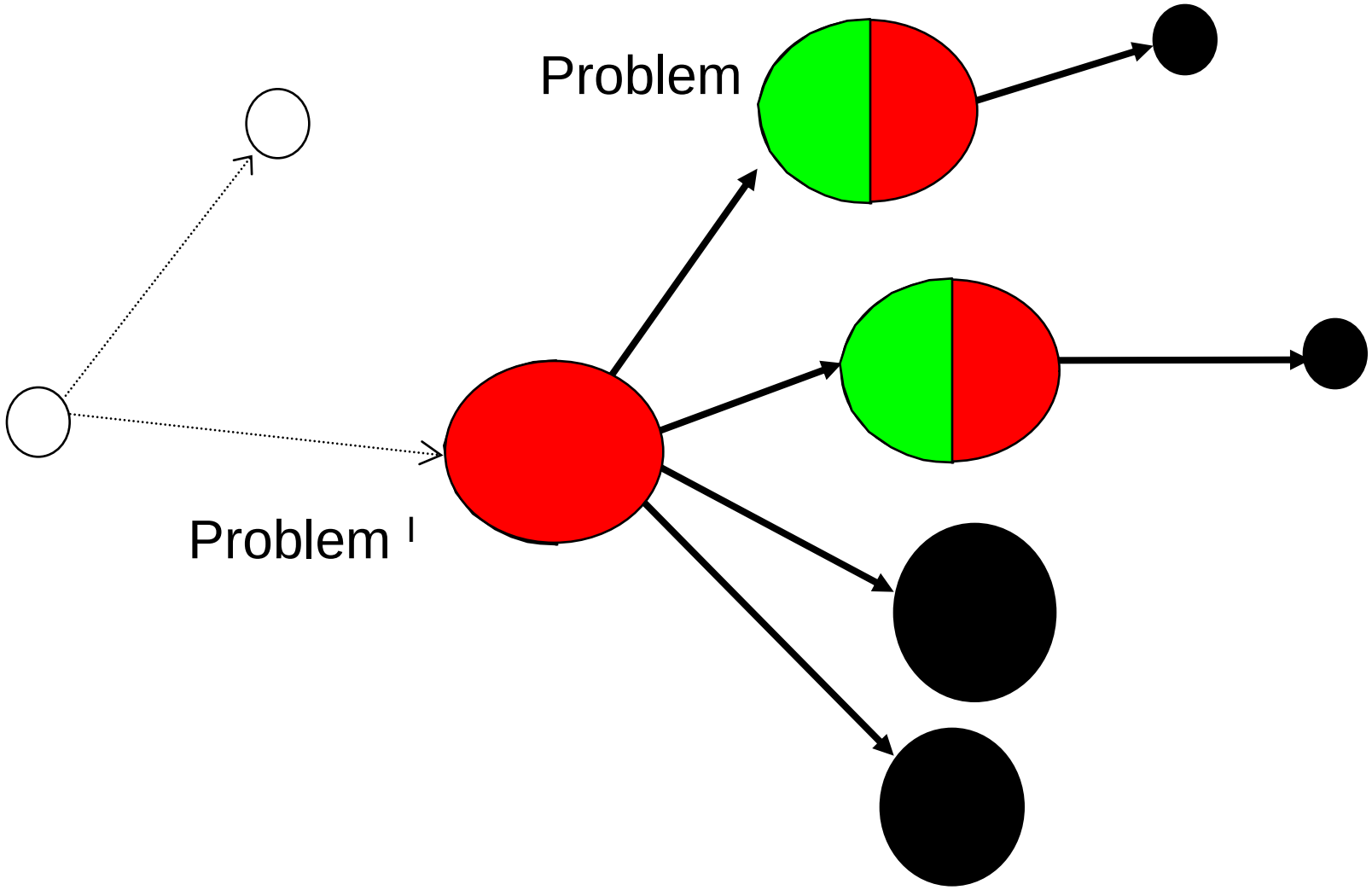
"Problem Flow" technology for the most difficult problems



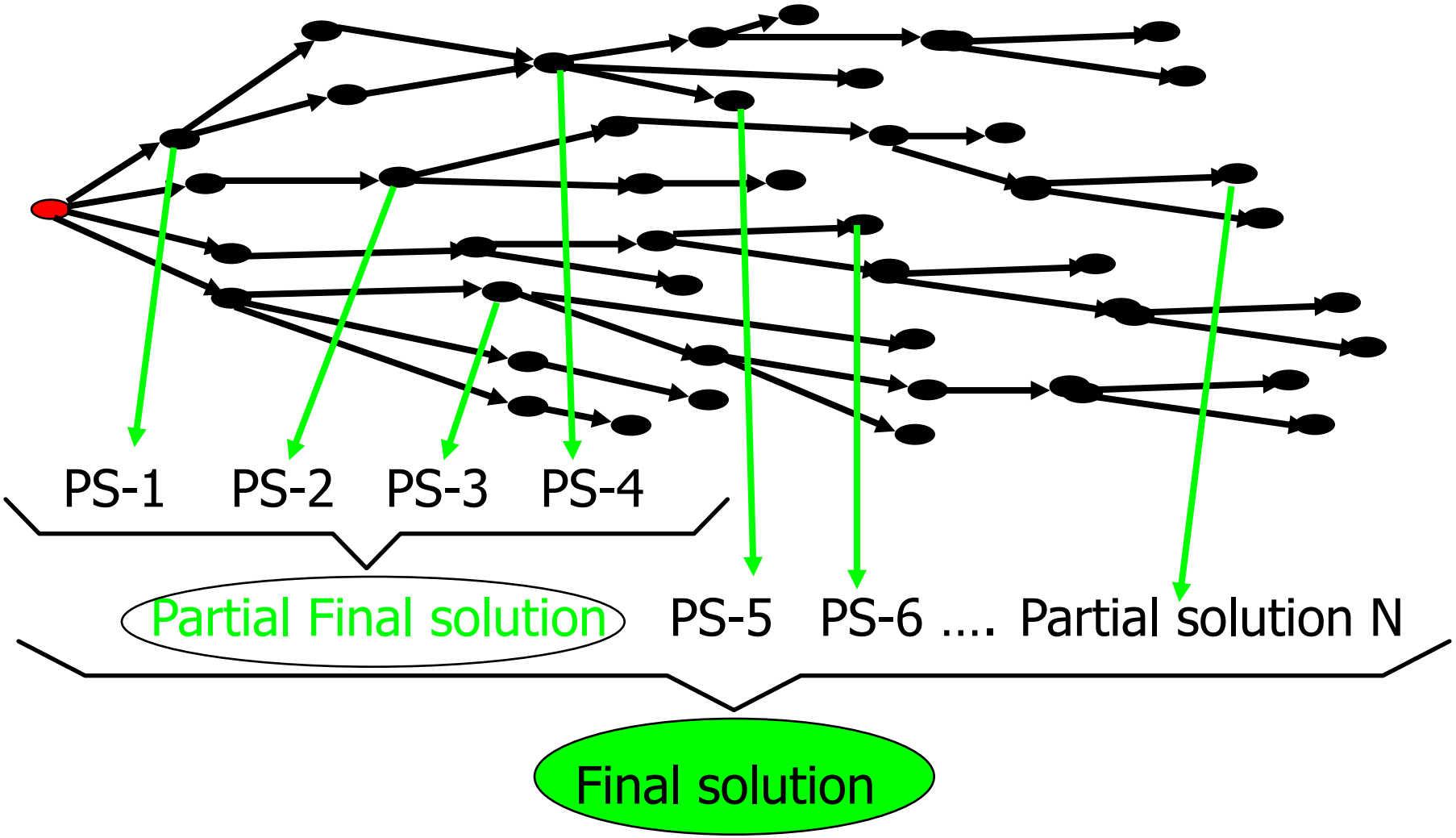
Problem division



Problem= Solution of (Problem)'



“Problems Flow” technology



How partial solutions are transformed into the final solution?

- Each partial solution is a small piece of information about the final solution.
- OTSM-TRIZ technology helps one get as many “Partial Solutions” as possible to shape the “Final Solution”.
- It looks like solving a riddle:

How partial solutions are transformed into the final solution?

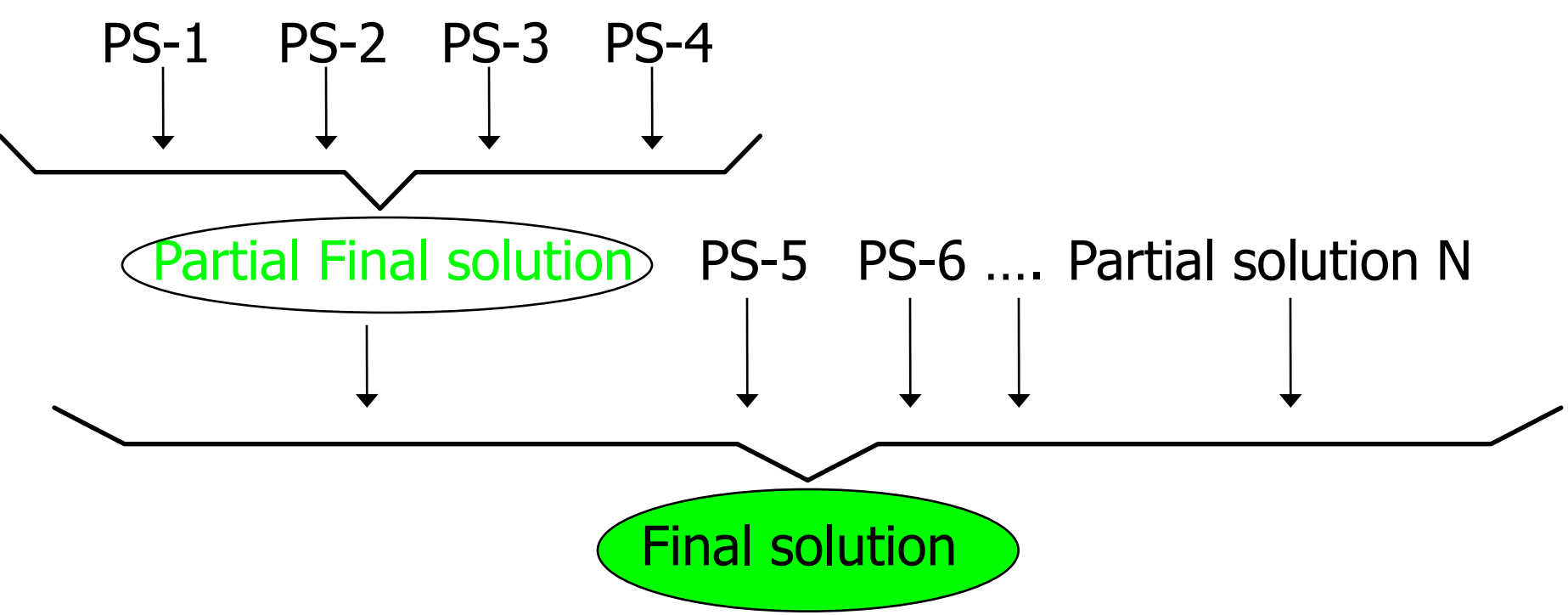
- What is it that looks like a ball,
- But stands still and does not fall
- Off its thin and graceful legs?
- Children like to turn it round,
- Rivers, mountains, lakes are found,
- Countries, states and their towns
- Can be seen all around

How partial solutions are transformed into final solution?

One's brain summarizes all of these pieces of information and the answer becomes obvious:

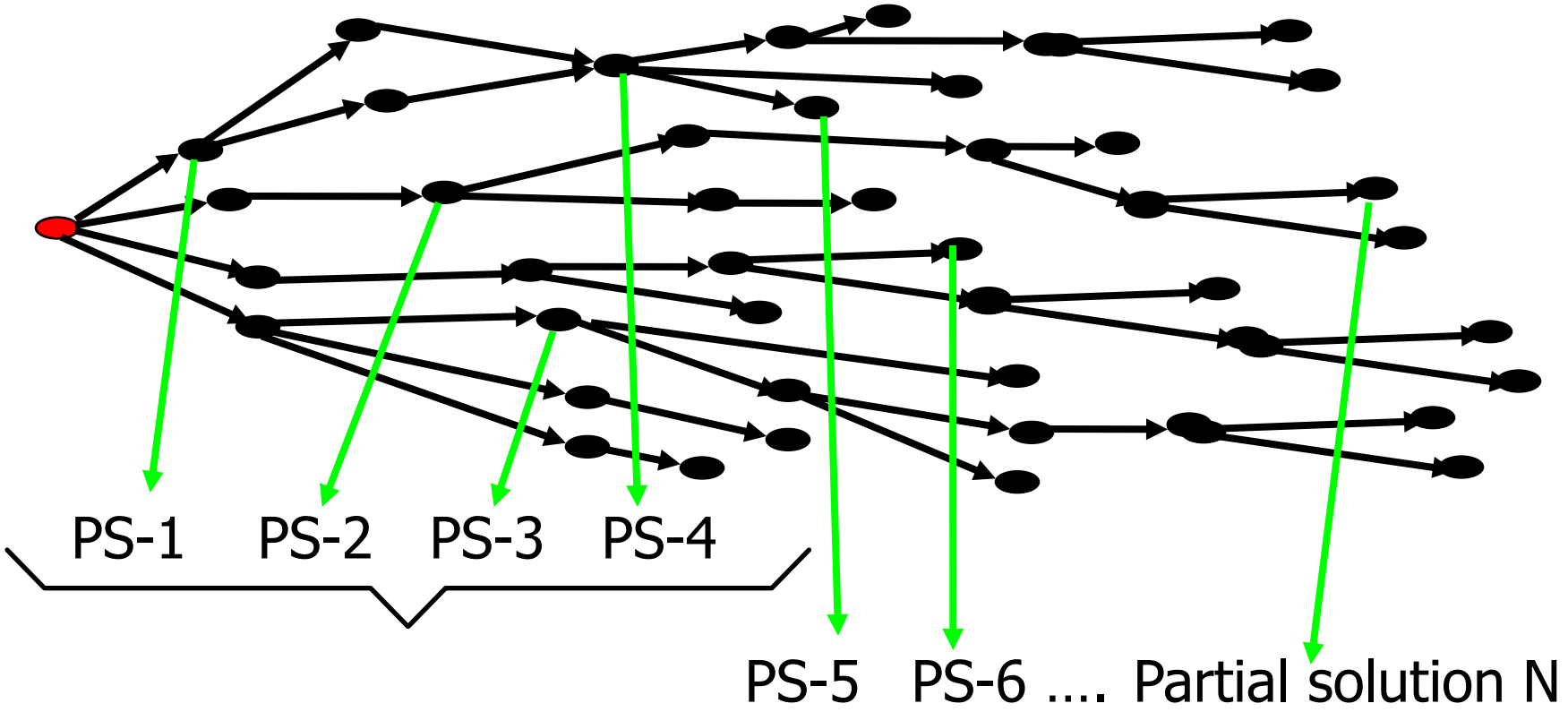
it is a globe!!!

“Parallel Thinking” - uncontrollable



Uncontrollable parallel thinking:
many Partial Solutions are transformed into Final Solution

“Step by Step Thinking” - controllable



Controllable thinking:

If 1, then 2. → If 2, then 3. → If 3 then 4. → If….

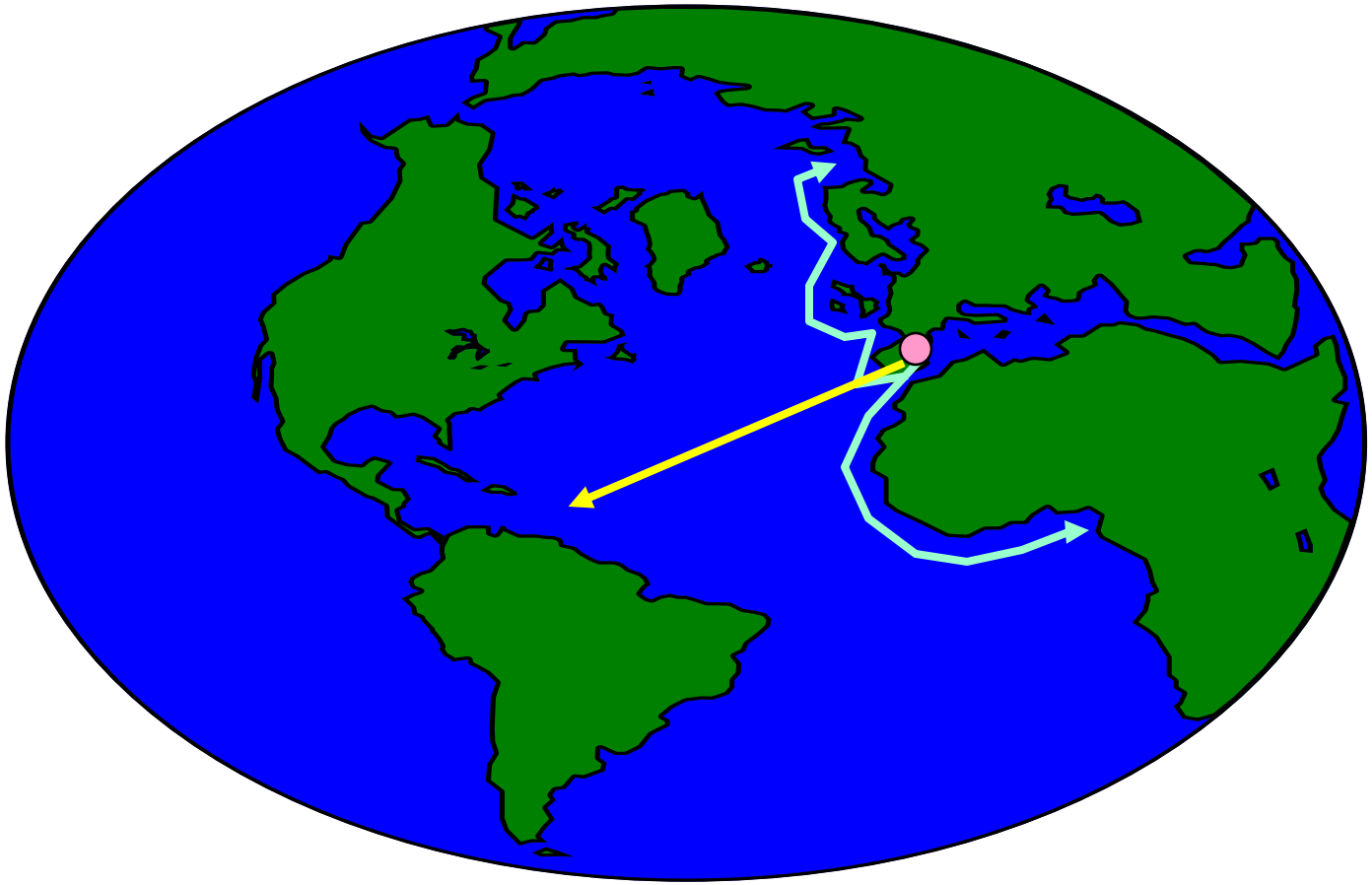
During problem solving process, one uses both ways of thinking

- Controllable step by step thinking:
  - *Problem analysis,*
  - *Problem division,*
  - *Searching partial solutions.*
- Uncontrollable parallel thinking:
  - *Summarizing all information and searching for final solutions.*

During problem solving process one faces two kinds of problems

- Typical:
  - *Own or someone else's experience or TRIZ typical solutions can be applied*
- Non-typical:
  - *Experience cannot help, the contradiction approach is to be applied*

For solving a difficult problem one **must** use unusual ways



OTSM-TRIZ knowledge base

TRIZ technologies for:

⇒Typical problems:
Standards, Laws, Principles, Effects

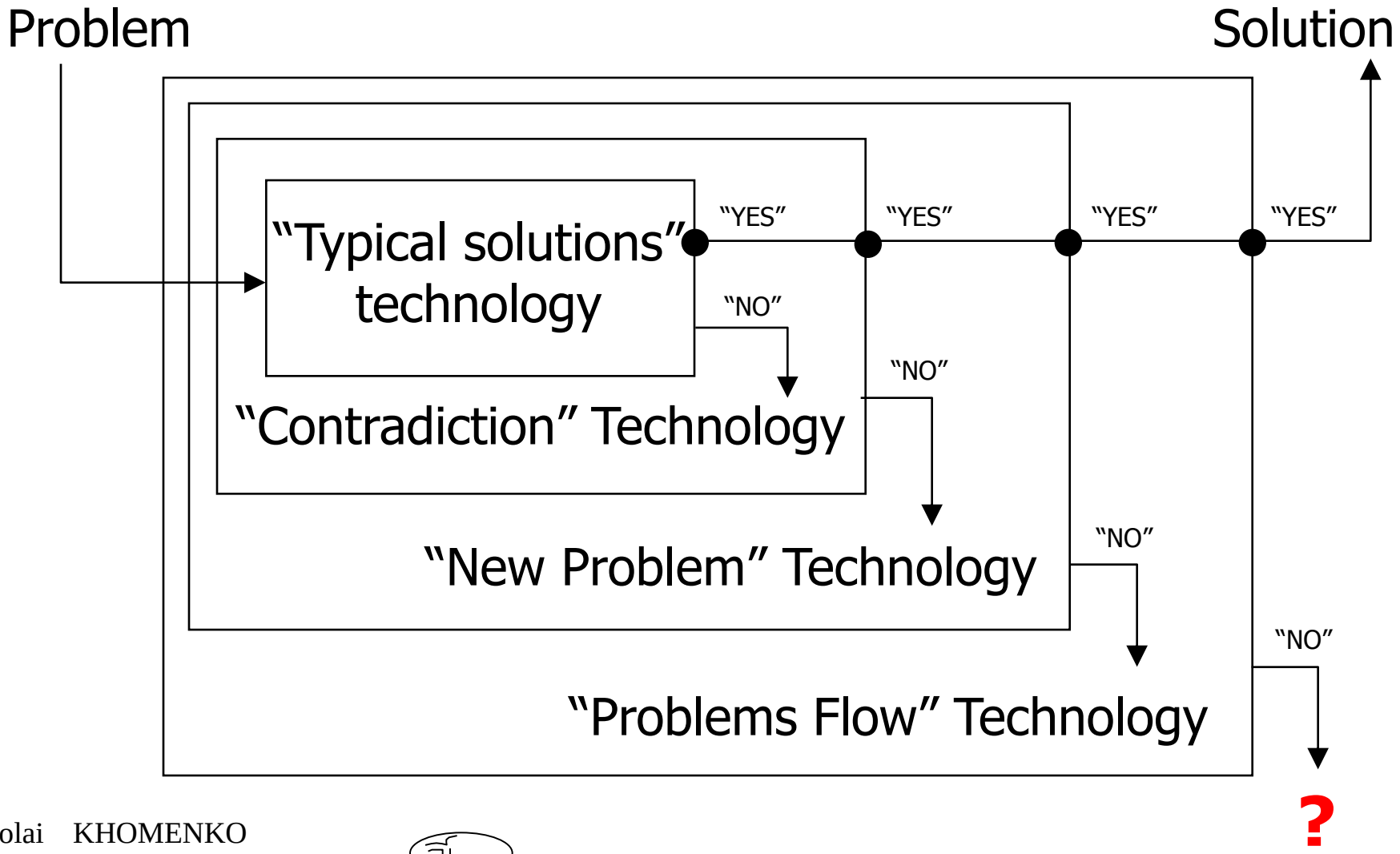
⇒Non-typical problems: contradiction - ARIZ

⇒New problem: Main TRIZ task, Main Ideas, Full Scheme, OTSM Axioms, ENV Model

⇒Most difficult problems: Problems Flow Technology

TRTL: ⇒ Life Strategy of Creative Personality

How can one use OTSM-TRIZ technologies?



TRIZ cannot solve every problem!

- In this case, using OTSM-TRIZ leads to:
  - better understanding about the barriers preventing one from solving the problem.
  - understanding what kind of information is necessary for solving the problem.
  - understanding what kind of research is required to find necessary information
- After that one can solve the problem.

How a TRIZ consultant can work in different areas?

Team work and function division:

- **TRIZ consultant** - *knowledge in the problem solving process*
- **Experts in a particular situation** - *knowledge in a particular problem situation*
- **Experts in the problem** - *common knowledge in this kind of problem area*
- **Expert in potential solution area** - *knowledge in partial and final solution area*

Main advantages of OTSM-TRIZ problem solving technology

- High efficiency.
- OTSM-TRIZ technology doesn't depend on a particular area like mathematics, which can be applied for quantitative thinking (although OTSM-TRIZ is qualitative rather than quantitative).
- If a solution is not found:

- One can understand what kind of research is needed.
  - One can get better understanding about the barriers on the way to solving the problem.
  - One understands what kind of information is necessary for solving the problem.

Possible results of our collaboration with your specialists

- A specific solution to a specific problem. OR:
- Concepts of problem solutions. OR:
- New ideas and directions for the next stage of problem solving processes. OR:
- Better understanding of the reasons that prevent from solving the problem. OR:
- Understanding what kind of information and research is required for solving the problem.

Contact

Nikolai Khomenko's archive

http://otsm-triz.org

contact@otsm-triz.org