

The Concept of Physical Contradiction
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1 A history to the birth of Physical Contradiction

1) (Altshuller et al. - 1975¹)

* In 1946 Altshuller started the work to establish a scientific method for invention by studying the problems great inventors had faced and the solutions they had discovered.

* Soon afterward he found that:

“the solution for an inventive problem is good (strong) if the former overcomes a technical contradiction which is included in the original problem, and, on the contrary, it is bad (weak) when the technical contradiction is not revealed or overcome.”

2) The concept of “Contradiction” in Altshuller's first paper published in 1956²

It was clearly stated there that a problem solving is to reveal and overcome a technical contradiction. (Altshuller - 1986³) The following is the original statement in the said paper.

“To solve a new technical problem in creative fashion, regardless of the technical field it belongs, following three fundamental requirements are indispensable.

A Formulation of the problem and identification of the contradiction, which prevents its solution through an ordinary and/or familiar method.

B Removal of the cause of the contradiction in order to achieve a new -higher- technical effect.

C Bringing other elements into the improved system in line with the element changed by the solution (the system gets a new form corresponding to the newly achieved level of technical contents). ”

3) Inventive Principles and the Contradiction Table

* The first Contradiction Table was made in 1964 at a stage of the process to develop a scientific method for inventions. (The author has not personally confirmed the contents of the

¹СОВРЕМЕННОЕ СОСТОЯНИЕ ТЕОРИИ РЕШЕНИЯ ИЗОБРЕТАТЕЛЬСКИХ ЗАДАЧ, Альтшуллер Г.С., Фильковский Г.Л., 1975

²О ПСИХОЛОГИИ ИЗОБРЕТАТЕЛЬСКОГО ТВОРЧЕСТВА//Вопросы психологии, № 6, Альтшуллер Г.С., Шапиро Р.Б., 1956, - с. 37-49

³ИСТОРИЯ РАЗВИТИЯ АРИЗ (конспек), Альтшуллер Г.С., 1986

first Table.)

* The table in ARIZ-1965⁴ is a 16 parameters x 16 parameters matrix and refers to 35 inventive principles.

* The table which is used by many people today was made in 1971⁵.

4) In 1971 a prototype of the Physical Contradiction was introduced to ARIZ-71⁶.

* “Into the Analysis Block of the ARIZ steps were introduced which ask to identify the part which need to satisfy contradictory requirements.”

(ARIZ-71 refers to the Contradiction Table and Inventive Principles in the Operative Block which was designed to help generate ideas for solutions. In the original plan, the Analysis Block was to prepare for the idea generation. However, it turned out that the Analysis Block is more powerful to find solutions than the Operative Block.)

5) Recognition of limitation of the Table and Inventive Principles → Discovery of Physical Contradiction (Altshuller et al. 1975⁷)

* It was noticed that;

“very strong solutions were always achieved not by one Principle but by a combination of certain set of Principles. ---- a Pair of Principles (a Principle and the anti-Principle) --- ”

* The prototype of the Physical Contradiction in ARIZ-71 made the Table and the list of Inventive Principles obsolete!

“The study of Inventive Principles continued a quarter-century, but the appearance of ARIZ-71 practically devalued the Table and the list of Inventive Principles: there is a deeper analysis in ARIZ-71 – identification of the Physical Contradiction. The problem is usually solved at this stage, and if it is not solved, it is better to repeat and deepen the analysis, and not to return to "more superficial steps" of the Technical Contradiction.”

⁴ВНИМАНИЕ: АЛГОРИТМ ИЗОБРЕТЕНИЯ! ОН ПОВЫШАЕТ К.П.Д. ТВОРЧЕСКОГО ПРОЦЕСС,

Альтшуллер Г.С. Технико-экон. знания: Приложение к «Экономической газете». — 1965, 1 сент. — Вып. 27(41).

⁵ТАБЛИЦА ПРИМЕНЕНИЯ ПРИЕМОВ РАЗРЕШЕНИЯ ТЕХНИЧЕСКИХ ПРОТИВОРЕЧИЙ, Альтшуллер

Г.С. Алгоритм изобретения. - М.: Московский рабочий, 1973 - Приложение 1.

⁶АЛГОРИТМ РЕШЕНИЯ ИЗОБРЕТАТЕЛЬСКИХ ЗАДАЧ <АРИЗ-71>, Альтшуллер Г.С. Алгоритм решения изобретательских задач АРИЗ-71. – Баку: ОИИТ при ЦК ЛКСМ Азербайджана и Азербайджанском РС ВОИР, 1971. – С.18. – Приложения.

⁷СОВРЕМЕННОЕ СОСТОЯНИЕ ТЕОРИИ РЕШЕНИЯ ИЗОБРЕТАТЕЛЬСКИХ ЗАДАЧ, Альтшуллер Г.С., Фильковский Г.Л., 1975

- * Discovery of a theoretical difference between Technical and Physical Contradictions

“Identifying and overcoming physical contradiction is not simply a method of solving problems. It is an objectively necessary step in the development of technical systems. ”

“In contrast to the Technical, the Physical Contradiction is organically linked with the operation to overcome the contradiction, i.e, the transformation of the technical system. Because of this, with the transition to physical contradictions, a transition from the Contradiction Table to the Theory of overcoming Physical Contradictions should occur. From this point of view and the Inventive Principles should be modified. A System of Operators should be there rather than a list of Inventive Principles.”

- 2 The structure of birth of contradictions according to the contemporary TRIZ theory.
 - 1) Three fundamental premises of TRIZ
 - A Systems approach

A world view which recognize every meaningful object of the world in a network of matters mutually interconnected by cause-effect links. Because the network inevitably has a hierarchy structure, every unit “matter” in the network can be seen as a system.
 - B The laws of evolution

Recognition of objective laws (patterns, trends) in the process of artificial matters; including Evolution towards Ideality, Evolution towards enhances dynamism, Rhythm of evolution, Cycle of systems evolution, Unbalance in the evolution and etc.
 - C Resources of evolution

Resources are relatively new concept in TRIZ. However, the concept has a root in another concept of Ideality which has a much longer history and it is now one of the most important concepts in TRIZ.

 - 2) Three Premises and the Contradiction
 - A Systems develop at the expense of resources

It is inevitable to use some new resources (or resources left unused in the preceding systems) in order to improve any system.
 - B There always is a limit for any resources in any system

Any system has a set contents identified by its definition. In other words, it has a set domain with its own limitations. Consequently, resources in the domain have their limitations.
 - C Any system is destined reach a limit of some resources

If a system continues to develop it will inevitably come across with the exhaustion of one or another kind of resources.

D The limit of resources causes a Contradiction

If you try to further develop a system at the expense of resources which have been exhausted, you need to use said resources already in use for other purposes, which inevitably causes some problems. This is the theoretical cause of TRIZ Contradictions.

Summary: Development at the cost of resources → Inevitable exhaustion of resources → Generation of a Contradiction

3 How to overcome a Physical Contradiction

1) What is ARIZ-85C ?

* Tolls for solving Standard Problems

Simple problems: Principles (individually, with the Table, as a pair of Principles)

Standard problems: Subject-Field Analysis + Standard Solutions

* ARIZ85C is a tool to solve difficult non-standard problems

ARIZ85C helps identify and solve a Physical Contradiction which lies on the base of a difficult non-standard problem.

2) Relationship between Technical and Physical Contradictions (They are different statements of the same situation – Different Forms and Contents of the statements)

A Difference in the Forms

* Technical Contradiction: Statement of a dilemma between two different Parameters

<If you try to improve Parameter A, it causes deterioration of Parameter B>

Illustration: If you try to improve Strength of the system, it increases system's weight, which is bad.

* Physical Contradiction: A dilemma where two contradictory conditions are required for the same element of a system.

<From one view point, parameter A should have value X, but from another view point, parameter A should have value non-X.>

Illustration:

From view point of system's strength, materials of its structure should be thick, but from the view point of system's weight, materials of its structure should be thin.

B Difference in the Contents

* Technical Contradiction: It states the situation as a task of Problem Solving

<Such such situation is the Problem!>

Illustration:

It is required to improve system's strength without increasing its weight.

* Physical Contradiction: It states the situation as a task for improvement (innovation, evolution) of a system

<You need to achieve such such target to improve the system!>

Illustration: You need to achieve one of the following targets to improve the system!

- To make a material which is thick (and strong) but light enough, or
- To make a material which is thin but has enough strength

3) Method to find a solution for a Physical Contradiction

Different methods are proposed in the framework of TRIZ. The author introduces one of the simple steps.

Step 1: There is a task to improve an existing system. Find a traditional method to improve it!

If the traditional method improves the system without causing any secondary problems, the task is achieved and there is no Contradiction. If there is (an) unacceptable secondary problem(s) go to Step 2.

Definition of Technical Contradiction:

Technical Contradiction is a statement model of the problem situation which includes both positive and negative results of an actual change introduced to a technical system.

(Remarks: Traditional way of a problem statement in TRIZ is a statement of the situation when one or another existing method is applied to the problem.)

Step 2: Identify the situation when the traditional method is applied!

- * Which parameter (Parameter A) you tried to improve at Step 1?
- * How do you want to change the value of the Parameter A?
- * Which parameter (Parameter B) is caused to deteriorate by the change?
- * How does the value of Parameter B deteriorate by the change?

Step 3: Identify a parameter which should have two different values in order that original improvement is achieved without the secondary problem!

It would be Parameter A in the simplest case.

Definition of Physical Contradiction:

Physical Contradiction is a statement model of a problem where two mutually contradicting requirements present for a single element of a system.

Step 4: Find a way to overcome the Physical Contradiction!

1) Separation

The basic approach to solve a Physical Contradiction is to divide the given problem situation into two separate parts (or sides) and satisfy one of the two contradictory requirement in the first part while satisfying the other in the second. The division is made based on;

- * Time,
- * Space and/or
- * many other parameters.

2) Transition to a different system

If it is not possible to solve a Physical Contradiction by the Separation, the system should be changed fundamentally so as that the Contradiction does not exist any more.

(For example: Solve the problem by introducing a fundamentally different method to achieve the required function.)

Appendix: (Abridged in the English translation)

“Table 2: Solution of Physical Contradiction” attached to ARIZ-85C