THEORY OF PROBLEM SOLVING METHODOLOGY IN DEVELOPING INNOVATIVE PRODUCTS

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ABSTRACT: *An account of innovative products, processes and services is a tough process which is possessed of approaches that have modern designs and structure. Nowadays, companies want to be more productive and more efficient. However, sudden and large changes have happened in competitive conditions and to prevail in this competitive and rapidly changing and expanding world, scientific developments had to be followed. To gain competitiveness, the companies need to procreate new products or removing the existing contradictory states. In these cases, TRIZ (Theory and Innovative Problem Solving) methodology is one of the most competent scientific approaches, used by managers or inventors. In this study, TRIZ methodology was explained in detail with innovation concepts. At the end, an example about TRIZ application has been explained*

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1. Introduction:

TRIZ is "a problem-solving, analysis and forecasting tool derived from the study of patterns of invention in the global patent literature".[1] It was developed by the Soviet inventor and science-fiction author Genrich Altshuller (1926-1998) and his colleagues, beginning in 1946. In English the name is typically rendered as "the **theory of inventive problem solving**",[2][3] and occasionally goes by the English acronym **TIPS**.

Following Altshuller's insight, the theory developed on a foundation of extensive research covering hundreds of thousands of inventions across many different fields to produce a theory which defines generalisable patterns in the nature of inventive solutions and the distinguishing characteristics of the problems that these inventions have overcome.

An important part of the theory has been devoted to revealing patterns of evolution and one of the objectives which has been pursued by leading practitioners of TRIZ has been the development of an algorithmic approach to the invention of new systems, and to the refinement of existing ones.

2. History

TRIZ in its classical form was developed by the Soviet inventor and science fiction writer Genrich Altshuller and his associates. He started developing TRIZ in 1946 while working in the "Inventions Inspection" department of the Caspian Sea flotilla of the Soviet Navy. His job was to help with the initiation of invention proposals, to rectify and document them, and to prepare applications to the patent office. During this time he realised that a problem requires an inventive solution if there is an unresolved contradiction in the sense that improving one parameter impacts negatively on another. He later called these "technical contradictions".

His work on what later resulted in TRIZ was interrupted in 1950 by his arrest and sentencing to 25 years in the Vorkuta Gulag labor camps. The arrest was partially triggered by letters which he and Raphael Shapiro sent to Stalin, ministers and newspapers about certain decisions made by the Soviet Government, which they believed were erroneous.[5] Altshuller and Shapiro were freed during the Khrushchev Thaw following Stalin's death in 1953 [6] and returned to Baku.

The first paper on TRIZ titled "On the psychology of inventive creation" was published in 1956 in "Issues in Psychology" (Voprosi Psichologii) journal.[7]

By 1969, Altshuller had reviewed about 40,000 patent abstracts in order to find out in what way the innovation had taken place and developed the concept of technical contradictions, the concept of ideality of a system, contradiction matrix, and 40 principles of invention. In the years that followed he developed the concepts of physical contradictions, SuField analysis (structural substance-field analysis), standard solutions, several laws of technical systems evolution, and numerous other theoretical and practical approaches.

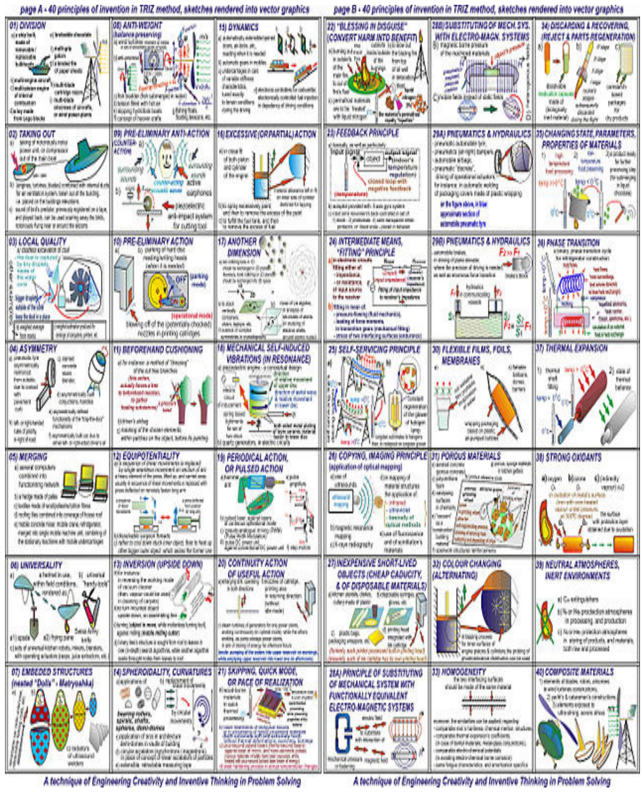
Altshuller also observed clever and creative people at work: he uncovered patterns in their thinking, and developed thinking tools and techniques to model this "talented thinking". These tools include Smart Little People [8] and Thinking in Time and Scale (or the Screens of Talented Thought).[9]

In 1971 Altshuller convinced The Inventors Society to establish in Baku the first TRIZ teaching facility, called the Azerbaijan Public Institute for Inventive Creation and the first TRIZ research lab called The Public Lab for Inventive Creation. Altshuller was appointed the head of the lab by the society. The lab incubated the TRIZ movement and in the years that followed other TRIZ teaching institutes were established in all major cities of the USSR.

From 1986 Altshuller switched his attention away from technical TRIZ, and started investigating the development of individual creativity. He also developed a version of TRIZ for children, which was trialled in various schools.[[10]] In 1989 the TRIZ Association was formed, with Altshuller chosen as President.

3. Basic principles:

TRIZ presents a systematic approach for understanding and defining challenging problems: difficult problems require an inventive solution, and TRIZ provides a range of strategies and tools for finding these inventive solutions. One of the earliest findings of the massive research on which the theory is based is that the vast majority of problems that require inventive solutions typically reflect a need to overcome a dilemma or a trade-off between two contradictory elements. The central purpose of TRIZ-based analysis is to systematically apply the strategies and tools to find superior solutions that overcome the need for a compromise or trade-off between the two elements.

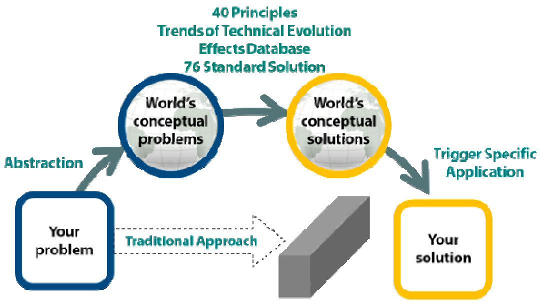


4. Basic terms:

- Ideal final result (IFR) - the ultimate idealistic solution of a problem when the desired result is achieved by itself. Note that the Ideal Final Result is also an ARIZ term for the formulation of the inventive problem in the form of a Technical Contradiction (IFR-1) and a Physical Contradiction (IFR-2);
- Administrative contradiction - contradiction between the needs and abilities;
- Technical contradiction - an inverse dependence between parameters/characteristics of a machine or technology;
- Physical contradiction - opposite/contradictory physical requirements to an object;
- Separation principle - a method of resolving physical contradictions by separating contradictory requirements;
- Vepol or Su-field - a minimal technical system consisting of two material objects

(substances) and a "field". "Field" is the source of energy whereas one of the substances is "transmission" and the other one is the "tool";

- Fepol or Ferfiel - a sort of Vepol (Su-field) where "substances" are ferromagnetic objects;
- Level of invention;
- Standard solution - a standard inventive solution of a higher level;
- Laws of technical systems evolution;
- Algorithm of inventive problems solving (ARIZ), which combines various specialized methods of TRIZ into one universal tool;
- Talented Thinking or Thinking in Time and Scale;



Identifying a problem: contradictions:

Altshuller has shown that at the heart of some inventive problems lie contradictions (one of the basic TRIZ concepts) between two or more elements, such as, "If we want more acceleration, we need a larger engine; but that will increase the cost of the car," that is, more of something desirable also brings more of something less desirable, or less of something else also desirable.

These are called *technical contradictions* by Altshuller. He also defined so-called physical or inherent contradictions: More of one thing and less of the same thing may both be desired in the same system. For instance, a higher temperature may be needed to melt a compound more rapidly, but a lower temperature may be needed to achieve a homogeneous mixture.

An *inventive situation* which challenges us to be inventive, might involve several such contradictions. Conventional solutions typically "trade" one contradictory parameter for another; no special inventiveness is needed for that. Rather, the inventor would develop a creative approach for resolving the contradiction, such as inventing an engine that produces more acceleration without increasing the cost of the engine.

5. Inventive principles and the matrix of contradictions:

Altshuller screened patents in order to find out what kind of contradictions were resolved or dissolved by the invention and the way this had been achieved. From this he developed a set of 40 inventive principles and later a matrix of contradictions. Rows of the matrix indicate the 39 system features that one typically wants to improve, such as speed, weight, accuracy of measurement and so on. Columns refer to typical undesired results. Each matrix cell points to principles that have been most frequently used in patents in order to resolve the contradiction.

For instance, Dolgashev mentions the following contradiction: increasing accuracy of measurement of machined balls while avoiding the use of expensive microscopes and elaborate control equipment. The matrix cell in row "accuracy of measurement" and column "complexity of control" points to several principles, among them the Copying Principle, which states, "Use a simple and inexpensive optical copy with a suitable scale instead of an object that is complex, expensive, fragile or inconvenient to operate." From this general invention principle, the following idea might solve the problem: Taking a high-resolution image of the machined ball. A screen with a grid might provide the required measurement. As mentioned above, Altshuler abandoned this method of defining and solving "technical" contradictions in the mid 1980s and instead used SuField modeling and the 76 inventive standards and a number of other tools included in the algorithm for solving inventive problems, ARIZ.

6. Use of TRIZ methods in industry:

Case studies on the use of TRIZ are difficult to acquire as many companies believe TRIZ gives them a competitive advantage and are reluctant to publicise their adoption of the method. However some examples are available: Samsung is the most famous success story, and has invested heavily in embedding TRIZ use throughout the company, right up to and including the CEO; "In 2003 TRIZ led to 50 new patents for Samsung and in 2004 one project alone, a DVD pick-up innovation, saved Samsung over $100 million. TRIZ is now an obligatory skill set if you want to advance within Samsung.".[citation needed]
Rolls-Royce, BAE Systems and GE are all documented users of TRIZ TRIZ is a Whizz article;

Mars has documented how applying TRIZ led to a new patent for chocolate packaging.
TRIZ has also been used successfully by Leafield Engineering, Smart Stabilizer Systems and Buro Happold to solve problems and generate new patents (ref www.imeche.org articles).
Various promoters of TRIZ reported that car companies Rolls-Royce,[14] Ford, and Daimler-Chrysler, Johnson & Johnson, aeronautics companies Boeing, NASA, technology companies Hewlett Packard, Motorola, General Electric, Xerox, IBM, LG, Samsung, Intel, Procter and Gamble, Expedia and Kodak have used TRIZ methods in some projects.[6][15][16][17]

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