PRIZM GAME FOR PROBLEM SOLVING AND INNOVATION CREATION.

Aleksejs Busarovs
PhD student, RISEBA, alex@innomaniacs.eu

Abstract:

Presented paper thoroughly describes business game PRIZM, reveals its advantages and potential in terms of problem solving and innovation creation. PRIZM was created by researcher from Bath University (UK) Anja-Karina Pahl. The base of this game is principals discovered by Russian engineer, H. Altshuller, the author of well known TRIZ. PRIZM Game, as well as TRIZ is designed to solve problems, but it isn't limited only to technical problems, it could also be applied for creation of social innovation. The main difference between TRIZ and PRIZM Game is simplicity and speed of application of the last. PRIZM Game doesn't require protracted education of participants, but is able in the end to deliver solutions, which meet such criterion as cheap, simple and beautiful.

Creators of PRIZM Game has ambitious plan to distribute this method on global scale, through workshops for youth with task to develop solution for environment protection and sustainable development of humankind. The initial objective of initiative group is to deliver series of workshops in ten major languages, in all continents to 10'000 participants.

Current work summarizes previous research on TRIZ and PRIZM Game methods, as well provide results of interviews with game facilitators and participants. Main conclusion is that PRIZM Game shows high efficiency rate in problem solving, provide opportunity of rapid application, doesn't require prolonged training. The only shortcoming of this method is high costs, that significantly narrows opportunity of its application, maintaining economical feasibility. Particularly this fact can explain that major client of this game is aerospace giant – Airbus.
Alongside with dissemination of this method is logical to talk about future research of PRIZM Game, particular interest is concerned about ability of this method to develop radical innovation, which can deliver breakthrough in technological domain, or business model field, thereby creating enterprise of the future.

Keywords: TRIZ, PRIZM Game, innovation, radical innovation.

TRIZ - Theory of Inventive Problem Solving is domain of knowledge, exploring the mechanisms of development of technical systems to provide a practical method for inventive problem solving. "*The goal of TRIZ: based on the study of the objective laws of development of technical systems, to give rules for the organization of a multi-screen scheme of thinking*. "The author of TRIZ - H. Altshuller. (Альтшуллер, 1991).

Work on TRIZ was initiated by H. Altshuller and his colleagues in 1946. The first publication was made in 1956 (Альтшуллер, Шапиро, 1956) - is a technology of creativity, based on the idea that *"the inventive creativity is associated with changes in technology, evolving according to certain"* and that "*laws of the creation of new work equipment must, regardless of the subjective relation to this, subject to objective laws."* (Альтшуллер, Шапиро, 1956) The appearance of TRIZ has been prompted by the need to accelerate the inventive process, the elimination of the elements of chance: a sudden and unpredictable insight, blind sorting and discarding options, depending on persons mood, etc. In addition, TRIZ is designed to improve the quality and increase the level of inventions for by removing the psychological inertia and enhance the creative imagination.

The main functions and the application of TRIZ are:

1. Inventive solution of problems of any complexity and orientation;
2. Forecasting of technical-systems;
3. Awakening, training and smart use of natural human abilities in the innovation process (primarily figurative imagination and systemic thinking) ;
4. Improvement teams (including creative), moving in the direction of their ideal (when tasks are performed, but it does not require any cost).

TRIZ is not a rigorous scientific theory. TRIZ is a collective experience of invention and studying the laws of science and technology.

As a result, its development has gone beyond TRIZ inventive problem solving in the technical field, and today is also used in non-technical fields (business, art, literature, education, politics, etc.).

Introduction

Soviet patent engineer, inventor, writer and scientist Altshuller was convinced of the opportunities identified from the experience of predecessors steadily recurring techniques of successful inventions, and the opportunity to learn this technique. For this purpose, was conducted a study of over 40'000 patents, based on identified patterns of development of technical systems and devices inventions developed Theory of Inventive Problem Solving (TRIZ), the banner which was a call to makean art of invention into an exact science. (Альтшуллер, 2004)

History of TRIZ

H.Altshuller began to invent an early age. At age 17 he received his first certificate of authorship (November 9 1943),and by 1950 the number of inventions exceeded ten. It is widely believed that the invention came suddenly, with insight, but Altschuler, being a scientist and engineer, set out to identify how to make the invention, and whether their creative patterns. To do this, he in the period from 1946 to 1971, studied over 40 000 patents, classified solutions for 5 levels of ingenuity and identified 40 standard methods used by inventors. In conjunction with the algorithm of inventive problem solving (ARIZ), it became the nucleus of TRIZ.

Originally "method of invention" was conceived as a set of rules such as "solve the problem - it means to find and overcome the technical contradiction."

Further development continued and Altshuller completed his theory of evolution technical systems (TRTS) explicitly formulated the main laws of technical systems (Петров, 2002). Over

60 years of development, thanks to the Altshuller and his disciples and followers, the knowledge base of TRIZ TRTS constantly supplemented with new techniques and physical effects, and has undergone several improvements.. The general theory was supplemented by experience in implementation of the inventions is concentrated in its life strategy of the creative personality (ZHSTL). Subsequently, this unified theory has been given the name of the general theory of strong thinking (OTSM).

Structure and function of TRIZ (Петров, a)

1. Laws of technical systems (TS) (Петров, 2002a)
2. Information Fund TRIZ (Петров, b)
3. VePol analysis (structural analysis of the real field) of the technical systems (Петров, Злотина 2002)
4. Algorithm of Inventive Problem Solving - ARIZ (Петров, 1999)
5. The methods of creative imagination

Inventive problem and Inventive situation

When a technical problem arises before the inventor, it is usually vague and does not contain any references to solutions. In TRIZ, a form of staging is *inventive* situation. Its main drawback is that the engineer has to try many ways and methods of solution. Through them all the time-consuming and expensive, and the random selection of paths leads to inefficient trial and error method.

So the first step on the path to the invention - to reformulate the situation so as to cut off the very wording of hopeless and ineffective solutions. This raises the question of which solutions are effective, and which - no?

H. Altschuller suggested that the most effective solution - one that is achieved "by itself", but at the expense of existing resources. Thus he came to the formulation of the ideal final result (IFR): "A certain element (X-cell) system or the environment *itself* eliminates the harmful effects while retaining the ability to perform beneficial effects."

In practice, the ideal final result is rarely achievable in full, but it serves as a guide for inventive thinking. The closer the solution to the IFR, the better.

Having clipping tool ineffective solutions, we can reformulate the inventive situation in a standard *mini-task, "according to IFR, everything should remain as it was, but it harmful part should disappear, or receive new, useful quality*". The main idea of a mini-problem is to avoid the significant (and expensive) changes, and consider first the simplest solution.

Formulation of a mini-problem contributes to a more precise description of the problem:

- What the components of the system, how do they interact?
- What connections are harmful, nuisance what - neutral, and what - helpful?
- What parts of the connection and can be changed, and what - you can not?
- What changes can improve the system, and what - to a deterioration?

Controversy

After a mini-problem is formulated and the system is analyzed usually quickly discovered that trying to change in order to improve some parameters of the system lead to deterioration of other parameters. For example, increasing the strength of an airplane wing can lead to an increase in its weight, and vice-versa - lightening the wing leads to a reduction in strength. In the system there is a conflict, a **contradiction.**

TRIZ distinguishes three types of contradictions (in ascending order of resolution):

- **administration of a contradiction**: *"We must improve the system, but I do not know how (do not know how, I have no right) to do* so." This contradiction is the weakest and may be withdrawn or the study of additional material, or the adoption / removal of administrative decisions.
- **Technical** contradiction: *"the improvement of one parameter of the system leads to a deterioration of another parameter.*" Technical contradiction - this is staging **an inventive** problem. The transition from administrative to technical controversy dramatically reduces the dimension of the problem, narrows the field to find solutions and allows us to go on trial and error method for inventive problem solving algorithm, which either suggests applying one or more standard techniques, or (in the case of complex tasks) indicates one or some physical contradictions.
- **physical** contradiction: *"to improve the system, some part of it should be in different physical states at the same time that it is impossible."* Physical conflict is the most fundamental, because it rests on the inventor of the constraints imposed by the physical laws of nature. To solve the problem the inventor must use the reference table and the physical effects of their use.

Information Fund consists of:

- **techniques to eliminate contradictions** and **tables for their** application;
- **system of standards for the solution of inventive problems** (standard solutions specific class of tasks);
- **technological effects** (physical, chemical, biological, mathematical, in particular, the most developed of them now - geometry) and tables for their use;
- **resources** *nature and technology* and how to use them.

System of techniques

Analysis of many thousands of inventions revealed that, across a variety of technical contradictions, most of them solved 40 basic techniques.
Work on a list of such methods was initiated by H. Altshuller still in the early stages of the theory of inventive problem solving. Needed for their detection analysis of more than 40 000 patents (Официальный Фонд Г. С. Альтшуллера). These techniques are now and for the inventors of great heuristic value. Their knowledge is largely facilitates the search response.
But these methods only show the direction and the area where there may be a strong solution. A concrete solution as they are. This work is for man.

The system of techniques used in TRIZ includes **simple** and **paired** (device-anti-proton).
Simple techniques can resolve technical contradictions. Among the simple things are the most popular **40 major** steps.

Paired devices (Петров, 1980) consist of a approach and anti-approach, they can be used to resolve physical contradictions, since in this case considering two opposing actions, states, properties.

Standards for the solution of inventive problems

Standards for the solution of inventive problems are complex techniques that use physical or other effects to eliminate contradictions. It is a kind of formula, which resolved the problem. To describe the structure of these techniques Altshuller established a real-field (VePolny) analysis.

Standards System consists of classes, subclasses and specific standards. This system includes 76 standards. With this system you can not only solve, but to identify new targets and to predict the development of technical systems.

Technological effects of

Technological effect - the conversion of some technological effects in others, may require the involvement of other effects - physical, chemical, etc.

Physical effects

Is known about five thousand of physical effects and phenomena. In various areas of technology can be used different groups of physical effects, but there are also commonly used. There are about 300-500.

Chemical Effects

Chemical effects - is a subclass of physical effects, which only changes the molecular structure of substances, and a set of fields is limited mostly fields of concentration, velocity and heat. Confining ourselves only chemical effects, can often accelerate the search for an acceptable solution.

Biological Effects

Biological effects - is the effects produced by biological objects (animals, plants, microbes, etc.). Application of the biological effects of the technique allows not only to expand the capabilities of technical systems, but also get results without harming nature. With the help of the biological effects you can perform various operations: discovery, transformation, generation, absorption of matter and fields, and other operations.

Mathematical effects

Among the most developed mathematical effects are geometric. **Geometric Effects** (Викентьев, 2002) - is the use of geometric shapes for a variety of technological transformation. It is widely known to use a triangle, for example, using a wedge or sliding against each other two triangles.

Resources

Real-field resources - a resource that can be used to solve problems or develop the system. Use of resources increases the ideality of the system.

Laws of Technical Systems

Studying changes (evolution) of the technical systems in time, Altshuller identified laws of technical systems development, knowledge of which helps engineers predict the possible ways to further improve the product. For the first time formulated by H. Altshuller in his book "Creativity as an Exact Science" (M., "Soviet Radio", 1979,), the laws have been grouped into three conditional block:

- *Static* - Laws 1-3 define the conditions for the occurrence and formation of the TS (technical system);
- *Kinematics* - Laws 4-6, 9 define the patterns of development, regardless of the impact of physical factors. They are important for the early period of growth and prosperity of TS;
- *Dynamics* - the laws of 7.8 define patterns of development from the effects of TS-specific physical factors. They are important to the final stage of development and transition to the new system.

The most important law considers "ideality" (one of the basic concepts in TRIZ) system.

Real-Field (VePolny) analysis

Vepol (matter + field) - a model of interaction in the minimal system, which uses characteristic symbols.

H. Altshuller developed methods for the analysis of resources. Several of the principles he discovered are considering various substances, and fields for conflict resolution and increase of ideality of technical systems. For example, the "teletext" uses the television signal for data transmission, filling frequent intervals between television images of the signal.

Another technique that is widely used by inventors is the analysis of substances, fields, and other resources that are not being used and which are in system, or next to it.

ARIZ - algorithm of inventive problem solving

Algorithm for inventive problem solving (ARIZ) - turn-based program (sequence) to identify and resolve the contradictions, that is the solution of inventive problems (about 85 steps).

ARIZ includes:

- the actual program,
- information, eating out of information collection
- management practices by psychological factors, which are an integral part in the development of methods of creative imagination.

Alternative approaches

There are other approaches that can help an inventor to disclose their creativity. Most of these methods are heuristic. They were all based on psychology and logic, and none of them aspires to the role of scientific theory (as opposed to TRIZ).

1. The method of trial and error

2. Brainstorming
3. Method of synectics
4. Morphological analysis of the
5. Method of focal objects
6. Method of test questions

Criticism of TRIZ

After the death of Altshuller, TRIZ has experienced stagnation in its development and some difficulty in the practical application of the theory, according to critics there are following problems: (Барышников)

- There is a methodological problem solving, in spite of her attempts to form the basis of certain patterns of development of technology.
- The distortion of the dialectical approach to the introduction of some new concepts .
- The appearance of new modifications of ARIZ complicated algorithm instead of eliminating the inaccuracies.
- There was no suitable mechanism for real-world problems of transition from conflict to formulated to solve it.
- A lot of the TRIZ tools were a bust of options despite the declaration of refusal from them.
- VePol use in the analysis of physical fields, the existence of which is not proven.
- Impossibility of introducing TRIZ into production because of the strong dependence on the personal choice of the person.

Modern TRIZ

Modern TRIZ includes some schools that develop classical TRIZ and adding new sections that are missing from the classics. Well-developed technical core of TRIZ (receptions, ARIZ VePol analysis) remains practically unchanged, and the activities of the modern school is mainly aimed at rethinking, restructuring and promotion of TRIZ, it is more philosophical and advertising than technical, nature. In this regard, modern school of TRIZ often reproached in infertility and verbiage. TRIZ is actively used in advertising, business, art, early childhood development and so on, but was originally designed for technical creativity.

Classical TRIZ is a general technical version. For practical use of the technique must have a number of specialized versions of TRIZ, differing nomenclature and content of information assets. Some large corporations have used TRIZ elements, adapted to their areas of expertise.

There is currently no special version of TRIZ to stimulate discoveries in the sciences (physics, chemistry, biology and so on).

The main obstacle in the development of TRIZ - the lack of methodology for the analysis of the original problem situation, diagnosis and prediction problems as a source of goal-setting improvements in socio-technical systems. To overcome this lack of development of modern methodology aimed futuredisign - "design solutions that are adequate to the Future."

One of the trends of technical progress is the intensification of the struggle for copyright product developers. Therefore, increase of demand for innovation and respectively for the methodology and software of development. From this perspective, we should expand the database with a full range of theoretical approaches. Meanwhile, the heirs of the Altshuller divest any deviation from the position in the primary source. They are right to insist on its interpretation of the name of "TRIZ" and on the humanitarian work in an environment to pedagogy to art until his memoirs. The alternative is a loyalty to new approaches, propped up by TRIZ as a brand of theoretical developments. New aspects of the modeling of the innovation process can, in order to avoid excessive controversy, to find a new name, the more that TRIZ consists of words known to the birth of Altshuller.

The differences between TRIZ & PRIZM.

PRIZM is a game that consists of a desk map, set of cards bearing the clues to solve a specific character. Time of game is one day, while it may be involved several teams looking for the solution of the same problems, each team consists of five people. It is advisable to select team members from different departments, to enhance multidisciplinary, which promotes creativity and reduces group-think. To carry out the game needed a trained facilitator, whose task to monitor the timely performance of participants in their assignment on each stage of the game before the advance to the next. The game is organized in two attempts, first - this is a test, attempt to find solution to the problem is not related to team members. This is a test phase, whose mission to familiarize players with the rules of the game in action and get the personal experience of performing tasks in real time. Typically this stage begins in the morning and last until lunchtime, during which participants are given the opportunity to rest and prepare for the second phase, which follows the same pattern as the first except that during the second phase addressed the real issue, which met addressed the group.

The game is built on combination of two kinds of thinking, they are divergent and convergent type of thinking. (Pahl, Newnes, 2007b) The first type of thinking is used to find the true causes of the problem being addressed. In the initial stages of the game, gradually scrutinizing the problem till the smallest non divisible particles that is causing the problem. By mid-game stage, when the divergent thinking ends and start searching for the solution of problems. For this purpose PRIZM cards are used, which include 40 principles developed by Altshuller. 40 principles of TRIZ together with 39 factors, which gives a matrix of TRIZ, which is extremely inconvenient to use because of its big size.. During the divergent thinking the source of problems are divided into groups depending on their type, for each group used a unique set of cards containing clues to solve problems. After the end of this phase begins filtering process in order to find solutions which will be beautiful, simple and chip. (Pahl, et. al. 2007a)

Strengths and weaknesses of PRIZM.

PRIZM is itself a continuation of the evolution of TRIZ, and differs from it for the better by the fact that participants do not need to take special and long-term training, as in the case of TRIZ methods. PRIZM allows you to find a solution during one day. The fact that work is organized in team reduces the personal factor, which is characteristic for TRIZ. The main drawback is the prism of his high price, one day costs $ 4700 (Deardorff, 2010), which can afford only large corporations like Airbus to address high costs problems (Bernard, Pahl, 2009).

Future of PRIZM.

Creators of PRIZM Game has ambitious plan to distribute this method on global scale, through workshops for youth with task to develop solution for environment protection and sustainable development of humankind. The initial objective of initiative group is to deliver series of workshops in ten major languages, in all continents to 10'000 participants.

An alternative way of PRIZM is to move it from the physical domain to the on-line version. Thus the main PRIZM's problem will be fixed is its high price due to the absence of the facilitator, whose role will be automated. One of the challenges is to follow the lead time and the players return to their specific tasks, when they lose their attention. The physical separation of the players in the space, and limited form of communication over the Internet eliminates the problem of group dynamics, thereby diverting attention and the efficient use of time.

Conclusions.

PRIZM has shown itself well in solving the existing problems that are in their nature are incremental innovation. The main difficulty for a PRIZM to create a radical innovation is the proper problem definition. As Einstein said, it is not possible to solve the problem while at the same level of understanding that led to this problem. At this point in the PRIZM is more suitable for incremental innovation, the question about its ability to create radical innovations should be addressed latter in future when online version will be implemented and a much larger number of people will have personal experience with this method.

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