FOUR VIEWS ON TRIZ

Valeri Souchkov

Published in The TRIZ Journal, March, 1999

First, this article should not be regarded as scientific. The only idea it discusses is how to view on TRIZ. I found this issue extremely important, because there is a lot of misunderstanding of what TRIZ is, in particular, by those who encounter with TRIZ for the first time. The questions I hear over and over again (even from those who took training in TRIZ) are 'what is TRIZ? Is it a problem-solving method? Is it a science? Is it a methodology? Is it a toolbox? Is it something to help us with breaking our mental barriers and improve our creativity?' And so on. So I decided to make a brief overview of what TRIZ really is, to shed some light on these questions.

In my professional opinion, modern TRIZ comprises four distinct directions:

1. Theory of technology origins and evolution.
2. Techniques for overcoming mental inertia.
3. Techniques for analyzing, formulating and solving inventive problems.
4. Pointers, which organize mapping between technical functions and specific design solutions, technologies, and knowledge of natural science.

In TRIZ, these directions did not evolve independently. However this could not be otherwise, as TRIZ originated from extensive studies of technical and patent information and has been developing since as a methodology for improving engineering creativity, and not as a science.

TRIZ was born as a problem-solving tool based on a systemic view of the technological world. The primary idea behind TRIZ approach to solving problems is that information about a specific problem must be first generalized, a solution concept has to be generated, and then the concept should be specialized in terms of a feasible solution. Generalization is a very powerful tool aimed at identifying new problems with pre-defined solution patterns, which can be found in TRIZ.

Studies of patent collections by Altshuller indicated that only two per cent of solutions were truly pioneering inventions; the rest presented the use of previously known idea or a concept but in a novel way. Thus the conclusion was that an idea of a solution to a new problem might be already known. But where this idea could be found? TRIZ helps to avoid numerous trials and errors and solve problems by using generalized patterns of previous solutions. Basic assumption behind TRIZ is that if two problems from different technological areas result in identical models, they must have similar solution patterns.

Later, it was found that common patterns exist not only between individual solutions. Similar patterns were observed between evolution of different technical systems and design products over the time. A conclusion was made that the evolution of technology is regular, not random, and further studies were pursued in this direction. Thus TRIZ acquired a solid scientific foundation and turned out to be more than a stand-alone design methodology or a collection of problem solving techniques.

Theory of technology origins and evolution.

As seen from the proposed schema, TRIZ can only be regarded as a science at the level of the theory for technology origins and evolution. Major theoretical findings and discoveries reside here. Among them are:

- Statement that technology evolves through resolving contradictions.
- Definition of an invention as a result of eliminating a contradiction between potentially conflicting parameters.
- A new categorization of inventive solutions.
- The concept of ideality.
- Discovery of generic regularities and patterns of evolution of the technology.
- Formulation of the laws and trends of the technology evolution.

Today, TRIZ does not yet belong to a category of exact, formal science. This would be hardly possible considering the great diversity of inexact knowledge categories that TRIZ deals with. But the creation of a formal theory behind TRIZ is a question of time, as I tend to believe.

Mental Inertia.

Techniques for overcoming psychological inertia are used to free inventor's mind from mental blockage and help to improve thinking at metaphoric level. As known from psychology, verbal information is strongly related to visual information, so it does not matter in what way an individual reasoning process is organized, there might be a mental block inside human mind. Even simple operation of avoiding specific terms sometimes helps to solve difficult problems.

TRIZ introduces the following methods for tackling mental inertia:

- Multi-screen diagram of advanced thinking.
- Thinking in terms of Ideal Functions and Ideal Systems.
- Different techniques for eliminating psychological inertia and thinking out-of-the-box, for instance, Operator "Size-Time-Costs".
- Modeling with miniature dwarfs.
- The strategy for forming creative personality, etc.

As noted by Altshuller, a main distinction between talented (or 'advanced') and traditional ways of thinking is that the former always sees the problem in its interrelations with other problems as well as with the rest of a system where the problem arose. Apart from that, another property of the advanced thinking is that brain produces causal analysis of relationships within a system and its environment. Although these abilities are usually regarded as a prerogative of those who possess 'visionary' way of reasoning, systems thinking can be trained and mastered, and TRIZ techniques are of a great help with that.

Problem Solving.

The TRIZ problem solving techniques deal with the process of abstraction. We extract a core of a problem, then generalize it. We do not use every piece of information about the product where the problem resides, we only focus on its part which causes the problem. The way to generalize over a specific situation is to represent a problem as a contradiction, or a substance-field model, or just as a required function. Then we use a guideline or a generic solution pattern and transform the problem into a solution concept. The next step is to find such an instance of the concept that produces a specific feasible solution. If we do not succeed with specialization, we refine and reformulate the problem.

TRIZ problem solving techniques are:

- Inventive Principles for elimination of technical contradictions.
- Principles for elimination of physical contradictions.
- Inventive Standards.
- Algorithm for Inventive Problem Solving.
- Function and Cost Analysis, and trimming.
- Feature transfer, and other techniques.

What is missing in TRIZ is the specialization part. The concepts resulted from problem solving are usually very general and lack details that allow us to made conclusions about feasibility of the concepts. Failure to specialize does not necessarily mean that the concept generated is wrong – probably we just do not possess specific knowledge that solves the problem? The pointers to effects and technologies often help to find the needed knowledge at this phase, since they include more specific knowledge than TRIZ principles and solution patterns. However, it is not always possible. Nevertheless, my experience shows that, if the subject matter expert solves the problem with the use of TRIZ tools, the chances of coming up with a real solution are rather high. Simply because TRIZ helps to look at problems differently.

However, there are two separate methods of how TRIZ deals with problems. The first method proposes to model a problem in terms of a contradiction or a substance-field model and then transform the problem to a solution using TRIZ patterns and guidelines. According to the second method, we can transform the problem to a solution by following the trends of the technology evolution. TRIZ does not produce a clear answer when and what method to use, the general recommendation is that the second method should be used when we want to predict how the design product will evolve in the future. On the other hand, many specific patterns of evolution are incorporated into TRIZ problem solving techniques. This situation might create confusion when a newcomer starts learning TRIZ and has no clear picture of TRIZ as a system of knowledge.

Function-Effect Mapping.

The pointers (or indices) to effects bridge a gap between exact sciences and technology. TRIZ offers the following pointers:

- Pointers to physical, chemical, and geometrical phenomena and effects.
- Pointers to specific technologies which can have a broad range of applications.

The pointers are probably the most easy to use tools in TRIZ, but they are not easy to create. Pointers offer purely functional approach: they establish mapping between technical functions and effects that can deliver these functions. Effects are natural effects and phenomena known in physics, chemistry, and geometry. In addition, pointers relate the generic technical functions and specific technologies.

Although the pointers can be used directly to solve a problem, in most cases a thorough analysis of the problem is still required, in particular, when we deal with ill-defined problem formulation. Knowledge of what particular function is needed to solve the problem is not always available at the very beginning of the problem solving process.

Conclusions.

The view on TRIZ proposed helps to systematize TRIZ knowledge and brings more clarity into the issue of what TRIZ is and how to look at it. I also highlighted some problems, which require further research.

Developing TRIZ, Altshuller created an extremely potential background for further studies in every direction. He and his associates attempted to bring all four categories together in a problem-solving technique, known as the Algoritm of Inventive Problem Solving (ARIZ). Needless to say, ARIZ is the most powerful TRIZ tool aimed at solving most tough inventive problems that involve physical contradictions.

Today, the approach to solving problems introduced by Altshuller expands to other, non-technological areas. Modern TRIZ should not only be seen as a methodology for solving engineering problems or a new product development process; main ideas behind TRIZ become a powerful tool for managing knowledge and solving problems that contain contradictions in many areas. As reported, many successful results were obtained in solving social, business, marketing, and managerial problems. In the recent past, I also had very successful experience with using TRIZ concepts to solve business problems, which previously seemed unsolvable because any known solution did not eliminate a core contradiction. This is possible due to generic nature of TRIZ, which organizes thinking in a systematic and non-blinded by mental inertia ways and proposes patterns for innovative change.

Acknowledgements

Many thanks to Dmitry Koutcheriavy, Yuri Salamatov, and Maria Strogaya for useful discussions of the subject.

About the author.

Valeri Souchkov, has over 10 years of experience with TRIZ-related activities. His major scientific and practical background is in the areas of knowledge-based systems development and knowledge engineering. He is a co-founder and head of product development at Insytec B.V., an international corporation with headquarters in the Netherlands, which focuses on the development of innovation and quality knowledge management systems.