THE HISTORY OF ARIZ DEVELOPMENT[1]

The following article has been condensed from information presented at the seminar "Theory of Inventive Problem Solving" held at the School of Management, Simferopol, Ukraine, 1986

WHY WE NEED THIS SESSION

- ARIZ looks like a complicated subject. This session will demonstrate the logical way new ARIZ elements are introduced
- ARIZ is evolving quickly. It is important to understand the systematic way in which it has evolved
- ARIZ represents a mechanism of systemic thinking. Analyzing its evolution helps develop various algorithms for solving problems in non-technical areas (science, the arts, etc.).

The notion that technological systems evolve according to certain patterns that can be understood and purposefully used to solve problems emerged in 1946. Since 1948, the work in this area has become vitally important.

Initially, the intention was to build a method for inventing as a set of rules such as: "Solving a problem means finding and resolving a technical contradiction," or "For any given solution, the less material, energy, space and time used, the more powerful it is." This method was intended to include typical innovation principles such as segmentation, integration, inversion, changing the aggregate state, replacing a mechanical system with a chemical system, etc. These rules and principles were to be (and are) based on research and information compiled about the inventive activities of famous inventors, by interviewing known inventors, the analysis of personal inventive practices, and other available technical information including the history of technology.

A PRE-PROGRAM ACHIEVEMENT

ARIZ-56

ARIZ-56 is a set of steps for problem solving rather than an algorithm or program (in the way that a Table of Contents is not yet a book). It was influenced by the practices of the best inventors of the past; the analysis of patents was not yet a main tool for ARIZ development. The operational part of ARIZ-56 recalls Synectics because of its reliance on analogic thinking (primarily in its use of natural prototypes). Journal: Questions of Psychology, 1956, #6.

Strengths of ARIZ-56:
- It was precisely stated that solving a problem means revealing and resolving a technical contradiction;
- It incorporated the concept of reaching beyond the boundaries of the immediate subject.

An example of the practical implementation of ARIZ-56 is the solution of the problem of developing a thermal protection suit.

[1] Source of English text: http://www.ideationtriz.com

In the mid-1950s, a strong understanding had grown that all inventors, even the most successful ones, work extremely ineffectively. They used trial-and-error methods and it was therefore senseless to attempt to uncover and put to use the "secrets of creativity." What did make sense was to build a completely new technology based on the objective patterns of technological evolution, which could be revealed through a systematic analysis of the extensive bulk of patent information.

THE SYNTHESIS OF A PROGRAM FOR PROBLEM-SOLVING BEGINS

ARIZ-59

ARIZ-59 represents the beginning of a long journey toward a structured algorithm supported by a set of tools for sequential use (operators, knowledge base units, etc.). The first steps, a chain of operations, appears. As of yet there is no system – the steps can be interchanged. "Natural prototypes" are moved to the end of the operational portion of ARIZ. A new and important step is introduced: identification of the Ultimate Final Result (Solution). Journal: Inventor and Innovator, 1959, #10.

ARIZ-59 resulted from a number of seminars conducted in the construction industry of Azerbaijan. Examples of practical implementation: thermal-electric jack, spiral binding for clamps (J.A.Ismailov), and a grape espalier without poles.

By the end of the 1950s it became obvious that a "method of inventing" must include, besides ARIZ, the patterns of technological evolution and the constantly growing knowledge base. In fact, what was originally intended, as a "method of inventing" would be more appropriately termed a science of invention. There was strong resistance – those opposed to the notion of a science of invention had become accustomed to the existence of a "method of inventing." After all, it merely amounted to a set of useful recommendations based on analysis of the experience of inventors. A science of invention, however, threatened more than a few "sacred cows." It denied the uniqueness of history's great inventors and intruded upon the common perception of the incomprehensible nature of the creative process. While "method of inventing" helped in terms of gaining insight to inventive thinking, a "science of invention" in effect cancelled the old notions, including that of creativity as an innate capability. This, in other words, was nothing less than pure heresy . . .

ARIZ-61

ARIZ-61 was an improved version of ARIZ-59, based on a set of seminars conducted in cities other than Baku in Donetsk, Tambov, Ryazan. The operational part of ARIZ-61 is extended but the rules for fulfilling the recommendations of each step are still missing, as well as the special steps later incorporated for controlling psychological inertia. (G.Altshuller, HOW TO LEARN TO INVENT. Tambov Book Publishing House, 1961).

Examples of practical implementation are problems related to a mine pile (Donetsk) and the sequential transport of oil products (Stavropol).

CLARIFICATION OF THE PROGRAM

ARIZ-64

ARIZ-64 introduces the section on "Clarifying and verifying the problem statement." This is a significant change and one that indicates a new direction in ARIZ development – as that of a tool for obtaining powerful solutions to difficult problems. The rules for fulfilling the recommendations have been introduced (step 2.1). The first table of Innovation Principles has been developed. (G.S.Altshuller: 1964, *THE FONDATION OF INVENTION*, Centralno-Chernozemnoe izdatelstvo, Voroneg.).

Example of practical implementation: Washing windows in a manufacturing plant.

ARIZ-65

In ARIZ-65 the first limited contradiction table is introduced. The operational portion still contains the analysis of natural prototypes. The word "algorithm" has been introduced as an indication of the long-term objective for the development of ARIZ. (G.Altshuller. "Attention, an Algorithm of Invention." economics newspaper, September 1, 1965).

A trend

If certain steps in the evolution of TRIZ are identified as A, B, C, D, E, F, G, H, I, J, K, etc. and currently TRIZ is, for example, on step E, TRIZ allows us to see steps F, G, and H, for example. In contrast, the opponents have so far accepted steps A, B, and C. They are doubtful but silent about steps D and E, and are aggressively arguing against F and G. Then TRIZ moves to step F, after which the opponents accept step D, do not want to talk about E and F, and argue against G, which (to others) is utterly obvious as the step that follows F, and so on . . .

When we spoke of a "method of inventing," rivals were insistent that we refer to nothing more than a collection of useful recommendations, considering an algorithmic approach absolutely out of the question. When TRIZ emerged, they accepted the notion of an "algorithm" and transferred their resistance and aversion to TRIZ, TRTS (Theory of Evolution of Technological Systems) and OTSM (General Theory of Powerful Thinking) . . .

ARIZ-68

The first chapter of ARIZ-68 is divided into two parts: Selection of the problem and clarification of the problem statement. Special steps for handling psychological inertia are introduced. The knowledge base is significantly extended and structured: systematic analysis of patents has revealed 35 Innovation Principles and the next version of the Contradiction Table. Paleo-bionics has been introduced instead of natural prototypes. (G.Altshuller. "ALGORITHM OF INVENTION," 1st edition, Moscow Worker, 1969).

Example of practical implementation: Icebreaker problem.

Until 1968, enhancements to ARIZ were based on the analysis of patent information. Seminars were conducted from time to time; I was the only individual teaching TRIZ. After 1968 the situation was different. In anticipation of the mass utilization of TRIZ, the preparation of teachers and modification of ARIZ for a general audience became necessary.

During the next three years – from 1968 to 1971 – TRIZ seminars were organized in the following cities (all within the former Soviet Union): Sverdlovsk, Kaunas, Moscow, Dzintary, Dushanbe, Baku, and Gomel. A comprehensive course in TRIZ was completed in the inventive schools for youth in Baku. Selected portions of ARIZ were tested via surveys. Altogether, more than 5,000 records related to 150 problems were available and provided for the transition to the next version: ARIZ-71.

THE PROGRAM BECOMES ONE OF THE ALGORITHMIC TYPE

ARIZ-71

With ARIZ-71 the program becomes more rigorous. In the process of analysis, the operational zone and its contradictory requirements have been identified (a prototype to the later physical contradiction). A psychological operator for modifying Dimensions, Time and

Cost (DMC) has been introduced. The Contradiction Table has been brought to completion and additional Innovation Principles have been identified (up to 40 and, later, to 50). (G.Altshuller. "ALGORITHM OF INVENTION," 2nd edition, Moscow Worker, 1973).

Recommendations, notes and examples of use have been added. The main operations are integrated into a system and the links between steps are more rigid. A new section for evaluating ideas that have been found has been introduced.

ARIZ-75

On one hand, ARIZ-75 is a logical continuation of ARIZ-71: more precise recommendations for each of the steps and stricter requirements for completing them. Continued analysis has revealed the existence of physical contradictions.

On the other hand, ARIZ-75 is the first modification built like TRIZ and is intended to work together with the Patterns of Technological Evolution, substance-field transformations and the compiled guides of effects. G.Altshuller. "Analysis of Invention Case Studies." Collection of articles entitled "The Theory and Practice of Inventive Problem Solving". Gorkiy, 1976.

ARIZ-77

ARIZ-77 is a logical completion of the line that began with ARIZ-71: an algorithmic type of program has been constructed. Again the rigorousness of the program is significantly improved. The text includes multiple rules, notes and examples. A prototype of the physical contradiction on a micro-level (Micro-PhC) is introduced (Step 4.1). Analysis of the solution process has been included as well. Bridging of the steps and the knowledge base (substance-field transformations and effects) has begun. The Contradiction Table remains as an auxiliary unit. (G.Altshuller. CREATIVITY AS AN EXACT SCIENCE. Sovietskoe radio, Moscow, 1979.).

The 1970s represent a stormy time in the evolution of TRIZ. Dozens of TRIZ schools, courses, seminars, etc. are teaching TRIZ, various mistakes and information helpful for fixing them are quickly being revealed. All TRIZ subjects are in existence: the algorithm, standard solutions, substance-field analysis, knowledge about the Patterns of Technological Evolution and innovation guides. Methods of teaching TRIZ improve.

On the cusp between the 1970s and 1980s, new information necessary to provide for the next step from TRIZ to TRTS (Theory of the Evolution of Technological Systems) started to accumulate within TRIZ. After 1982 educational programs change, with the main objective is preparation to teach TRTS and, further, to teach OTSM (General Theory of Powerful Thinking), that is, to the theory of solving problems in any area.

Beginning with ARIZ-82, a paradoxical process of specialization/generalization begins. In technology, ARIZ is targeted specifically toward the solving of difficult non-typical problems and the development of new standard solutions. At the same time, ARIZ gains some universal features as it is applied toward the solving of scientific problems, problems in the arts, etc.

ARIZ-82 (modifications A, B, C and D) and ARIZ-85A

Information on educational and practical applications of the algorithm quickly accumulates. Other TRIZ tools and applications improve as well, contributing toward the further enhancement of ARIZ.

A new trend is in action: all recommendations and notes made by a teacher must be incorporated into the algorithm. All chapters of ARIZ (with the exception of the first) are improved, especially the operators having to do with transitioning from a physical contradiction to methods for eliminating it. A unit for analyzing the problem model has been

introduced. A definition of "micro-physical contradictions" and the second (refined) Ideal Ultimate Result (IUR-2) have been introduced as well. (For ARIZ-82 see "Technology and Science," 1983, #2-4, 6. For ARIZ-85A see G.Altshuller, B.Zlotin, V.Philatov. PROFESSION: TO SEARCH FOR NEW. Kartya Moldovenyaska Publishing House, Kishinev, 1985).

ARIZ-85B and C

Significant changes in structure are introduced, including the second line of operations and the analysis of substance-field resources. The former first chapter is no longer part of the algorithm as it is not rigorous enough compared to the other chapters. The orientation towards ideality strongly increases as a void (empty space) is recognized as the most effective resource.

The link between the algorithm, the system of standard solutions, and the patterns of technological evolution becomes stronger. The second half of the algorithm – that devoted to the development and utilization of ideas that have been found – is improved as well. (G.Altshuller. "ARIZ-85B and ARIZ-85C." Dnepropetrovsk, 1984, 1985: pre-prints made for the seminars conducted at continuos education courses held by the Ministry of Iron Metallurgy, Ukraine.)

WHAT WILL THE NEXT STEPS BE IN THE DEVELOPMENT OF ARIZ?

The following main directions can be highlighted:

1. The tradition of increased rigorousness in the evolution of ARIZ continues due to more thorough and increased utilization of the Patterns of Technological Evolution.
2. Significant strengthening of the bridge between physical contradictions and the methods for resolving them.
3. Extension of the knowledge base and strengthening of the bridge between ARIZ and the standard solutions.
4. Separation of the second portion of ARIZ (the development and utilization of ideas) into a separate algorithm
5. Development of a new first chapter (or a separate algorithm) for revealing new problems to be solved.
6. Strengthening of the philosophical function of ARIZ as a tool for developing the skills for powerful thinking.
7. Continual increase of universality (i.e., encompassing more types of problems other than technical).