N. Khomenko

Workshop Program: «Theory and Practice of Development and Use of Tools for Solving Non-Standard, Creative Problems on the Basis of OTSM[1] and Classical TRIZ»

The course duration is 72 hours

Instructor:

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TRIZ Master certified by the author of TRIZ Genrikh Altshuller. Diploma № 59.

The author of OTSM (General Theory of Powerful Thinking)

OTSM is a branch of TRIZ that was first proposed by Genrikh Altshuller.

In the mid-70s, the author of TRIZ set a goal of transforming TRIZ into OTSM and proposed some basic ideas which laid the foundation for the work on OTSM in the mid 80s.

From 2004 to 2009 Nikolai was the research manager of the program "Advanced Master in Innovative Design" for specialists and managers of design departments and research centers. The program was accredited by the international association of universities Conference Des Grand Ecoles. Successful

[1] In the mid-70s, the creation of classic TRIZ was largely completed. In its turn, there arose a question of further development of TRIZ, expansion of the TRIZ tools application field beyond the technical problem domain. The TRIZ author determined the new TRIZ development trend – the General Theory of Powerful Thinking (OTSM) and proposed initial ideas. In the mid 80's of the last century, Nikolai Khomenko joined this work and started development of the proposed ideas under the guidance and in a regular contact with the TRIZ author. In 1997, G.S. Altshuller positively evaluated the results achieved in the creation of the first generation of OTSM and its tools and allowed Nikolai Khomenko to use the term OTSM, proposed by the TRIZ author, for his theory of development of universal tools for solving complex interdisciplinary problem situations. The OTSM-based tools are universal and do not depend on the field of application. At the same time, it should be noted that the application of OTSM tools does not imply abolishment of professional knowledge. These tools are meant for processing the knowledge of a problem in order to obtain an acceptable way out of a problem situation.

graduation works were rewarded with 60 Euro-points to the education level. The total length of the course is 11 weeks. Eight of them were dedicated to the study of OTSM-TRIZ.

INSA Strasbourg, France

From 2004 to 2009 - acted as the OTSM Expert in dealing with complex interdisciplinary projects at the European Institute for Energy Research (EFER), Karlsruhe, Germany

From 2000 to 2009 – worked as the Associate Professor (PAST) at INSA Strasbourg, France.

From 2000 to 2003 – was the External Expert in OTSM TRIZ, Samsung. Trained several hundred specialists in TRIZ basics. Suwon, South Korea.

1997, 1999 - The first Russian TRIZ Expert invited to Korea by LG-Electronics Production Research Center (LG – PRC). Pyeongtaek, South Korea.

From 1994 to now – independent researcher and OTSM-TRIZ expert and trainer in dealing with complex interdisciplinary problem situations. Clients: Samsung, LG-Electronics, Peugeot-Citroen, Ford, the European Aeronautic Defence and Space Company (EADS), Bosh-Siemens, Bombardier, European Institute for Energy Research, Forecia, ArvinMeritor, Bourjois-Chanel, etc.

From 1988 to 1994 – one of the founders of the Invention Machine Laboratory (IMLAB). System architect of the "Invention Machine" software product (the project author is Valery Tsourikov), versions 1.1 and 1.5.

Participant Requirements

There are no special participant requirements. Knowledge of the secondary school program is sufficient. It is desirable that the participants have got the experience in applying some fundamental tools of the Classical TRIZ in real life, e.g. the system of standard inventive solutions, the Algorithm of Inventive Problem Solving (ARIZ). Elementary technical and scientific background is also an advantage.

Participants should bring short descriptions (one or two paragraphs) of two or three professional problems they are dealing with and about which they can give appropriate information and with respect to which they can answer questions occurring in the course of solving. These problems will be used as an illustration of applying this or that tool. However, we do not aim at resolving all the problems during the seminar.

What will the training result be like?

As a result of this course students

1. will be introduced to

a. a detailed analytical review of basic tools based on the theoretical propositions of OTSM and Classical TRIZ;

b. ways of overcoming stereotypes in the organization of the innovation process based on tools of OTSM-TRIZ concept «Think out of the Box»;

c. educational technologies for solving non-standard problems; the basic theoretical propositions of nonlinear training technologies and some methods of nonlinear training in solving creative, non-standard problems, exemplified by the organization of the students in the courses;

d. the basics of the Theory of Creative Personality Development (TRTL);

e. specifics of the individual activity in the innovation process, types of conflict management in the innovation process.

2. Possess basic knowledge of the basic theory and practice of developing and perfecting tools for dealing with data in the process of solving more complicated, non-standard (creative, inventive) problem situations.

3. Master the tools built on a theoretical basis OTSM-TRIZ of entry-level, that will constitute the basis for further learning of more complex instruments.

4. Form the skills of reflective thinking to facilitate the organizing of the innovation process based on overcoming of stereotypes (paradigms).

The training course content

1. The theory of the development of tools for dealing with non-standard problems.

1.1. Why do we need applied scientific theories?

The main purpose of applied scientific theories is increasing the effectiveness of the professional everyday activity. The structure of a scientific theory is as follows: key problems solved by a theory; postulates underlying the theory; basic models employed by the theory for building applied tools; applied tools of the theory designed for professional everyday work on problem situations. The trial-and-error method and applied scientific theories. Creative and routine work. The working definition of the notion of creativity used within the framework of OTSM development and use.

1.2. Classical TRIZ as an applied scientific Theory.

The birth of the Theory.

Two development stages of Classical TRIZ. Empirical stage: Methods, Problem-Solving Algorithm. Historical period of formation: mid 40's – mid 70's. Theoretical stage: organizing the accumulated empirical knowledge into the theory of creating tools for solving complicated non-standard (creative, inventive) problems. Historical period of formation: mid 70's – mid 80's.

The basic aspects of the solving process within the framework of TRIZ approaches:

1. Problem solving as a process of moving a system to a new evolution level. The necessity of understanding the general laws of system evolution for applying them to practical problem solving. The necessity of revealing and studying the mechanisms of manifestation of these laws

in the evolution of specific systems.
Problem solving as a process of moving a system to a new evolution stage.

2. Problem solving as going beyond the limits of professional thinking stereotypes – "Think out of the Box" ("Think beyond the box of stereotypes"). The need for effective tools for overcoming professional mental inertia for changing the thinking paradigms existing within a specific subject area. Going beyond the initial field of knowledge where the problem occurred into the field of knowledge where a solution may lie. For example, for mechanics: going beyond the area of mechanical solutions to the area of chemical or optical solutions to a given mechanical problem. The necessity of transforming the initial problem description into a kind which initially seems unsolvable and impossible for achieving posed goals in order to go beyond the stereotypes of professional everyday thinking. The necessity of a new view of old well-known things. Transition to new system models, rules and limits describing this subject area, which are new to a given subject area, i.e. changing the paradigm about the subject area. **Problem solving as a process of overcoming mental inertia leading to a change in the paradigm about the problem object.**

3. The problem solving process as a permanent analytical modification of the problem description aimed at revealing and eliminating the deep roots of the problem by presenting them in the form of deep seated contradictions. Using the TRIZ tools for resolving the revealed contradictions, revealing the fragments of the future solution image and building an integral image of an acceptable solution. The necessity of building and perfecting the tools for analytical and synthetic mental operations.
The problem solving process and as a program of intellectual analytical actions aimed at the stimulation of subconscious creative synthetic processes.

4. Problem solving as step-by step procedures leading to a purposeful, controlled building of an acceptable solution. TRIZ is bringing new thinking technologies and tools to replace a chaotic search by the creative problem solving techniques based on trial-and-error method. These new idea generation technologies provide a step-by-step development and purposeful building of ideas for solving a specific problem in preset specific conditions. The necessity of changing the paradigms of understanding the insight and creative processes which lead to obtaining a solution. The necessity of comprehending the fact that the quality of an acceptable solution depends not on the number of generated ideas but on their quality only. The necessity of creating mechanisms which would only provide generation of ideas capable of merging to form a single solution and eventually to help solve a non-standard creative problem. **Problem solving as a process of purposeful engineering of a creative solution to a non-standard (creative) problem.**

5. The process of creative problem solving as the activation and stimulation of subconscious creative processes by means of TRIZ-based tools.

The Theory Structure.

The key problem solved by Classical TRIZ: abandoning the search for a solution to a non-standard problem by the trial-and-error method and replacing it with intellectual systematic procedures of purposeful building of a creative solution to a specified non-standard problem.

Using both in the everyday life and for the development of new or perfection or already available thinking tools.

Three Classical TRIZ postulates proposed by the author of this theory: the postulate of objective laws of system evolution; the postulate of system evolution through contradictions; the postulate of a specific situation context.

The direct use of postulates in everyday work on problems and for the development of new problem-solving tools. G. Altshuller's system of laws of technical system evolution. The direct use of laws. The system of standard solutions to inventive problems as a more detailed tool for applying the system of laws to solving non-standard problems.

Basic models of Classical TRIZ. A model for describing problem situation elements - Multi-Screen Scheme of Powerful Thinking. Problem-solving models proposed in the course of Classical TRIZ evolution: "Funnel" model, "Tong" model, "Hill" model, "Problem Flow" model.

Basic tools of Classical TRIZ. Standard and Non-Standard problems. TRIZ tools for problems that are typical from the TRIZ standpoint but seem creative and non-standard to narrow specialists from specific subject areas. Altshuller's system of standard solutions to inventive problems. The system structure and its relation to the system evolution laws. Other typical procedures of Classical TRIZ: situation exaggeration according to the DTC method, "Golden Fish" method for defining a problem and transforming the "Impossible" into the "Possible", etc. Classical TRIZ tools for dealing with problems which cannot be considered typical even from the Classical TRIZ viewpoint. The algorithm of inventive problem solving – ARIZ. History of Creation. Evolution. Structure and composition. Application examples.

Analysis of psychological aspects of creative activity while working with ARIZ, illustrated by a specific problem.

ARIZ Goals (Functions). The Main Goal of ARIZ is developing a problem solving tool; the Meta-Goal (the main production process) of ARIZ is the pedagogical technology of forming a thinking style effective in dealing with non-standard problems.

1.3. OTSM as an applied scientific theory.

The Birth of the Theory

Formulation by G.S. Altshuller of the goal of creating a universal problem-solving tool.

The need for a canonical procedure which would minimize necessary trials and errors in the course of building a solution to non-standard problems. The necessity of tools for reducing various problems to a form required for the application of a canonical procedure.

What do all processes of solving non-standard (creative, inventive) problems in various fields of knowledge and human activity have in common?

Defining a problem to be solved as a modification of the initial situation description aimed at revealing the problem core. Accumulation of partial solutions for building the image of an acceptable solution for a defined problem situation in its context. Trimming of partial solutions in the description of an acceptable solution. Difficulties in applying Classical TRIZ tools to the process of transformation of the Initial Problem Description into the description of an acceptable solution. The necessity of a universal

model for describing problem elements and solutions. Introduction to the "Element - Feature" and "Element – Feature Name – Feature Value" (ENV) models.

The basic aspects of the problem-solving process within the OTSM approaches include all the aspects of Classical TRIZ plus those revealed in the course of OTSM development.

1. The problem-solving process as a problem flow which includes both the problems present in the initial situation and the problems which appear while analyzing the problem situation and synthesizing an acceptable solution. The necessity of studying the process of the appearance of new problems and solutions to these problems in the course of the initial problem situation analysis and evaluation of the obtained partial solutions. The necessity of creating tools for developing practical skills of sequential thinking which would provide the analysis of a problem situation in the course of work on a problem. The necessity of studying the process which ensures the synthesis of an acceptable solution on the basis of the ideas obtained in the course of analysis and on the basis of partial solutions which follow from these ideas. The necessity of developing appropriate tools and mechanisms which ensure both the acceptable solution synthesis itself and the development of practical skills required for the performance of this synthesis. The necessity of further investigation of the process which activates parallel creative thinking in the course of synthesis by means of analytical and synthetic thinking operations.
   The process of problem situation solving as a flow of problems and solutions.

2. Problem solving as a fractal process which includes both the repetitive elements of sequential analytical thinking and the repetitive elements of parallel synthetic thinking which fit one inside the other in the same manner as matryoshka dolls do. The necessity of creating tools for support of the fractal process of thinking. These tools should fit one inside the other, as the need may be, for providing the performance of individual thinking operations, on the one hand. On the other hand, it is necessary to collect the information being accumulated in the course of the fractal process and combine it into an integrated system
   Problem solving as a fractal information process which ensures the analysis of all necessary details and sub-problems, collection of partial solutions and combining them into a system providing an effective synthesis of an acceptable solution.

3. Problem solving as a self-organizing process which is governed by the information obtained during the problem situation analysis and by the generated partial solutions. The necessity of tools for the realization of this process. The necessity of minimizing the set of tools which ensure the self-organizing fractal process. The necessity of avoiding the replacement of the trial-and-error method used with respect to solutions with the trial-and-error method used for tool search. The solution to this problem lies in minimizing the set of universal tools organized into a system. In this situation, some tools are designed for the analysis of a problem situation, synthesis of a solution and overcoming of psychological inertia, whereas other tools ensure the thinking process management, providing a purposeful construction of acceptable solution versions, evaluation of the obtained partial solutions and correction of the solving process.
   Problem solving as a self-organizing process governed by the flows of information obtained in the course of problem solving.

4. Problem solving as working with a sort of intellectual “Lego”: a set of relatively independent tools (bricks) which perform necessary functions plus a system of simple rules providing the

interaction between these bricks within the framework of a self-organizing thinking process based on the theoretical propositions of OTSM. The necessity of filtering the newly proposed tools and increasing their universality for providing the maximally necessary functionality with a minimal set of tools. The necessity of providing unlimited variety of all possible problems at the expense of a limited variety of specific tools. A system of general and, therefore, universal tools which ensure the obtaining of a specific problem in specific conditions. In this context, the system means a set of general tools and the rules of connecting these tools for obtaining specific solutions to a specific problem.

Problem solving as construction of a specific problem solving process by means of a set of general (universal) intellectual tools.

A set of requirements imposed on a practically effective but universal method.

Key problems solved while creating OTSM. The trial-and-error method – a universal but inefficient tool for solving creative non-standard problems. The task of transforming a problem description into the description of an acceptable solution. The task about the necessity of universal but practically useful tools for solving complicated non-standard problems and complex interdisciplinary problem situations. A motivating contradiction preventing the creation of universal tools independent of the problem subject area.

OTSM axioms. The main group of axioms: Axiom of Models (descriptions); Axiom of Process.

A group of axioms about thinking: Axiom of Impossibility - it is necessary to mentally admit the possibility of what seems impossible; Axiom of the Problem Source which directs thinking toward the detection of the deep roots of a problem situation; Axiom of Reflection (Axiom of independent observers), which ensures the viewing of the solving process from different points for self-control and self-organization of thinking.

A group of axioms about the picture of the world: Axiom of the world integrity; Axiom of the world diversity; Axiom of the connection between integrity and variety which solves the contradiction between the first two axioms of this group.

Direct use of Axioms in the everyday work on problems and for the development of new problem-solving tools.

Basic OTSM models

Models for describing problem situation elements: "Element - Feature Name - Feature Value" (ENV) model. The Powerful Thinking Scheme of Classical TRIZ presented within the framework of ENV model, subspaces of three basic dimensions of the classical scheme. Expanded Powerful Thinking Scheme of OTSM.

Models of a problem-solving process: Fractal model of a problem-solving process.

Basic OTSM-TRIZ[2] tools.

The first generation of OTSM tools. The "New Problem" technology for formulating a problem that needs to be solved. The "Standard Problem" technology for solving standard (from OTSM-TRIZ viewpoint) problems and obtaining partial solutions used for building an acceptable solution. The "Contradiction" technology for working with relatively simple problems which are impossible to reduce to standard problems even from the TRIZ viewpoint. The Contradiction technology is based on ARIZ-85-B and includes additional parts, steps, recommendations and rules which facilitate the achievement of both the Goal (the main function) and Meta-Goal (the main production process) of Classical ARIZ. The "Problem Flow" technology is used for dealing with "multi-move" problems.

The second generation of OTSM tools. OTSM tools for dealing with interdisciplinary composite problems of a high degree of complexity.
1. OTSM Network of Problems/Solutions.
2. OTSM Network of Contradictions.
3. OTSM Network of Parameters.

Kinds of Parameter Networks for Knowledge Management: Specific network of parameters; Generalized network of parameters of a subject area; Universal network of parameters. Functions of various types of parameter networks.

The Problem Flow Networks is an approach which combines all the three types of networks into a single tool for dealing with complex interdisciplinary problems. The general application scheme of OTSM tools. Similarity and difference between ARIZ and Problem Flow Networks.

2. Some OTSM-TRIZ tools for everyday work on non-standard (creative, inventive) problems.

The "Tongs" model – a simplified analysis of a problem situation and building an image of an acceptable solution. Direct application of the OTSM Axiom of the Impossible. The "Golden Fish" method and its use for defining a problem and transforming the "impossible" into the "possible". Direct application of the OTSM Axiom of Problem Source in the problem-solving process. Exaggerating a situation by the DTC method as a tool for defining a problem and going beyond professional stereotypes.

The OTSM algorithm for determining the system functions (Goals of their existence). The notions of the "Main Useful Function" (System Goal) and the "Main Production Process" (Meta-Goal of a system). The OTSM interpretation of the classical law of technical system completeness, its use in the everyday problem-solving practice: "OTSM Express Analysis of a Problem Situation" for preparing for the first step of ARIZ-85-B and OTSM method "Negative System". Negative System application: search for an explanation of unclear phenomena and events; problem definition; analysis and elimination of negative effect causes. Introducing the building and using of networks of problems/solutions for revealing the

[2] OTSM-TRIZ means that many OTSM tools are interlaced with the Classical TRIZ tools: are based on them or use them as instruments.

situation specifics and problems to be solved in the first instance. The role of the problem/solution network in resolving a problem situation, constructing acceptable solutions and their implementation. Using the OTSM Network of Problems for evaluating the solutions being obtained. The OTSM Network of Problems/Solutions as a tool for self-organization of a problem-solving process: finding a system of goals and evaluation criteria of partial solutions being obtained; defining sub-problems and synthesizing partial solutions.

Some aspect of ARIZ-based thinking: basic methods, ideas and the general scheme of a process for dealing with a non-standard problem which cannot be reduced to a standard type. Practical recommendations.

Some aspects and principles important for the work of an OTSM instructor in problem solving in a temporary working group.

3. The Technology of Nonlinear Training in solving non-standard problems

The necessity of new training methods and technologies for mastering non-standard (creative, inventive) problem solving tools. Requirements imposed on the methods of training in solving Non-Standard problems. Linear and nonlinear training technologies. Nonlinear training as resolving of some contradictions characteristic of linear training technology. Advantages and disadvantages of nonlinear technology, teacher requirements. Nonlinear training technology as a means of maximal convergence of training problem solving and the work on real problems.

The “Tongs” model as a pedagogical tool for mastering other tools for developing ARIZ style thinking while dealing with a problem.

The “Yes-No” game and its use for mastering the OTSM-TRIZ-based tools. The three components of the method: Linear "Yes-No" games; Classification (multidimensional) "Yes-No" games; Situational "Yes-No" games. Creation of training problems for different classes of the game. The "Yes-No" game as a flexible tool for the training process management. Pedagogical techniques of using the game in the training process. The system of OTSM-TRIZ notions, skills and theoretical propositions students can master while playing the "Yes-No" game.

The fairy-tale technology of training in using the tools of non-standard problem solving. Construction of fairy-tale and fantasy story plots by using the TRIZ and OTSM tools. Building problem situations and resolving them in the process of constructing fairy-tale and fantasy story plots. Use of fairy-tale-based technology as a mechanism for overcoming mental inertia. The short history of the fairy-tale-based technology as a tool offered by G.S. Altshuller for the development of the Discovery Theory. Parallels between the discovery and building a solution to non-standard problems. The system of the OTSM-TRIZ notions and skills which students can master by means of the Fairy-Tale Technology.

4. Some aspects of the innovative process and the life strategy of a creative person.

The motivating contradiction of high-level Innovations: there is a need for a global novelty, yet it is necessary that somebody has already tested and implemented this novelty, and confirmed that the business is profitable. Other typical conflicts of the innovative process from the appearance of the idea to the introduction into the civilization culture. Eight stages of a successful innovative process according to John Kotter, who analyzed the history of real successful innovative processes.

The basics of the Theory of Creative Personality Development (TRTL). The notion of Worthy Goal (WG) and its role and evolution in the development of the Creative Personality (CP). The notion of the Creative Personality and six main qualities of the Creative Personality. Ideal strategy of the Creative Personality. Introduction to the Life Strategy of Creative Personality (LSCP) based on the analysis results of almost a thousand of CP biographies. LSCP as a collection of standard problems creative persons usually confront with in the course of innovative processes and the knowledge of which helps prepare in advance for solving such problems.

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