The great is seen at a distance: ARIZ and TRIZ origins – on the 60th anniversary of the first article and the 55th anniversary of the first book by Genrikh Altshuller

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Abstracts

The educators and researchers can retrieve the new ideas of great importance from the origins of any science. This is correct regarding TRIZ also. Rediscovery of original concepts could sometimes encourage constructive changes in sciences to make them more effective in modern applications. The very origins of ARIZ and TRIZ can be rethought in new terms. Two great events as the 60th anniversary of the first article and the 55th anniversary of the first book by Genrikh Altshuller are considered in connection with modification of "classical" instruments of TRIZ for making more effective primary tools in education and inventing defined by author as Modern TRIZ (MTRIZ) direction.

Key words

TRIZ, ARIZ, Modern TRIZ (MTRIZ), Meta-Algorithm of Invention T-R-I-Z (MAI T-R-I-Z), SMART T-R-I-Z (Simplest Meta-Algorithm of Resourceful Thinking T-R-I-Z), contradiction, transformation model, extracting, reinventing, noosphere, creativity, creation, design thinking

Finding the new in the old – the lot of genius.

Jacob Perelman

I. Noospheres of creation. Civilization is built by engineers. It is to engineers that we owe absolutely everything for all that surrounds us, all that we enjoy. And all this had to be invented, designed, tested, built, and operated.

Civilization was invented, designed, and built by millions and millions of engineers. And new millions of engineers continue building the civilization.

I believe that everything that is built embodied three huge noospheres of knowledge and skills: professional – creative – psychological (fig. 1). Here, *noosphere*[1] should be understood as the sum of all knowledge, experience and skills in a certain space of activity, along with artifacts, realized as a result of this activity.

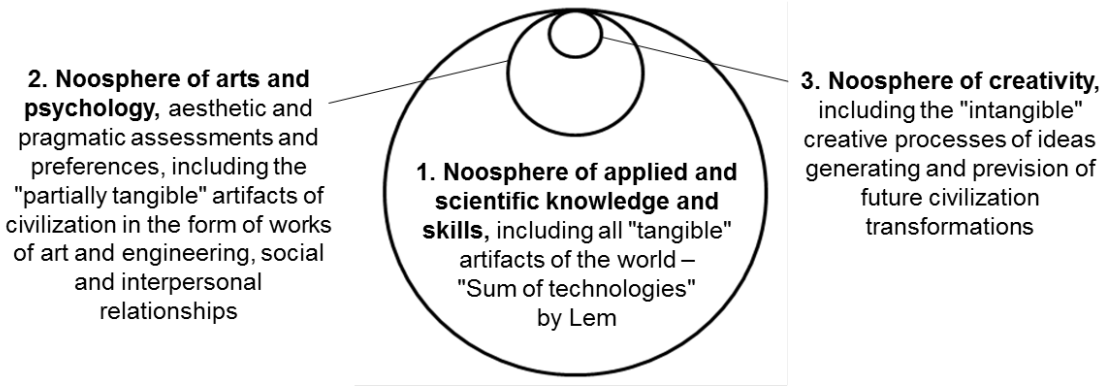


fig. 1. Noospheres of civilization

We can surely say that each artifact includes the results of influence and direct impact of all three noospheres.

Each artifact was invented at one time and then improved with the passing (and possibly not yet completed) of its life cycle as an object of a specific functional purpose, sometimes developing in many generations and for a long time. All artifacts have followed a certain trajectory of development, for example: of a few years – like drones (though they have a long history in the form of prototyping as aviation modeling); decades – as mobile communications, computers, solar and nuclear power, television; slightly less than or more than a century – as aviation, radio, rocket, car, electrical engineering; hundreds and thousands of years – as shipbuilding, construction of buildings and roads, agro-industry, medicine.

Implementation of each artifact requires *professional knowledge* (first noosphere), *motivation* to improve it and *the sense of beauty* of the idea created and of the "tangible" artifact (second noosphere), and, of course, one needs *an inventive creative thinking* (third noosphere).

It is important to pay attention to the relative size of each of the noospheres.

It is understood that the amount of knowledge of ***applied noosphere*** (1) exceeds the amount of all other knowledge (outer circle of the largest area).

The amount of knowledge of ***psychological noosphere*** (2) is also quite significant (middle circle), although much less than the sum of "applied" knowledge.

But what is fully clear: the ***creative noosphere*** (3) remains poorly studied (inside the smallest circle) and understood, as well as equipped with limited techniques and tools (models) for a meaningful – goal-oriented, managed and efficient – creation, mainly in design, engineering, art, and in the long term possibly in artistic sphere (?)

As a tangible metaphor, I demonstrate to students the difference between the applied and creative noospheres as an example of comprehension of paintings based on a "Magic Eye" technology. This simple example (fig. 2) allows them to understand that there is a "visible-and-tangible" space, but there is also an "invisible-and-intangible" space without the help of the teacher or the textbook to discover this space.

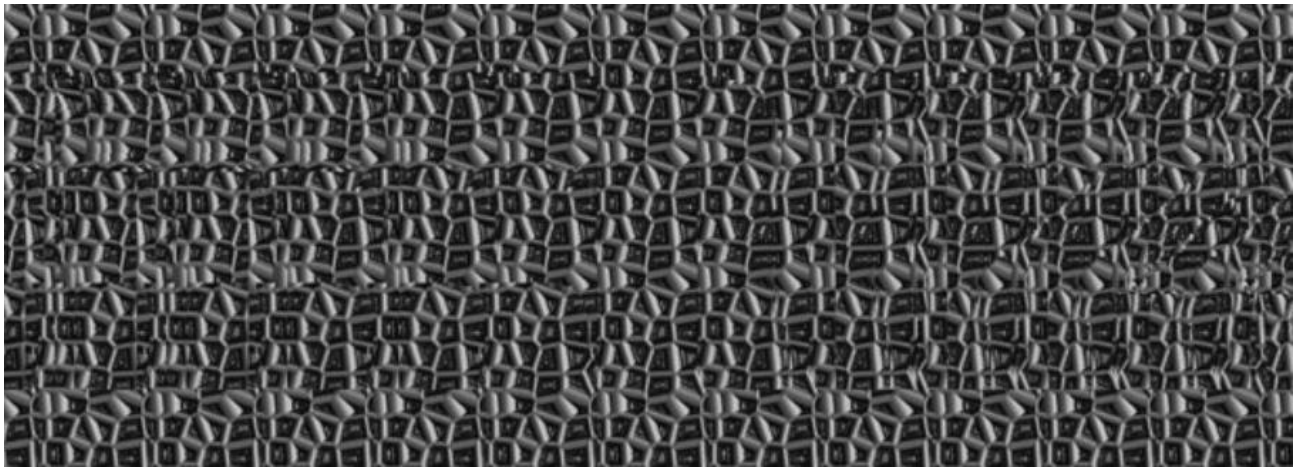


fig. 2. Comprehension of the depth

Applied noosphere is represented here by the "technique"-of-contemplating this picture: with abundant lighting, bring the sheet close to the face, until you lose focus and see a blurred image, then gradually move away from the image without looking at the surface of the sheet outside the image while maintaining an out-of-focus vision. As soon as you look at the sheet outside of the image, you *lose the chance to see something* that is in the depth of the visible image!

Psychological noosphere is revealed here in self-discipline (to follow the technique), and perseverance which is necessary sometimes so that our own brain can auto-***focus*** our vision on what is in the depths! We need to seek persistently this ***"self-tuning" of the brain and vision "to see the unseen"*** if it failed the first time.

Creative noosphere is appeared here in a ***sudden*** revealing ***(insight!)*** of an image in the depth of the sheet! This is the moment of comprehension of the "miracle". With a proper technique, the brain ***is autofocused*** at depth, and "miracle of insight" occurs! However, this skill of comprehension, the skill to see the "invisible-and-intangible" needs to be fostered and trained!

Indeed, not everyone is at once able to see what is in the depth of the picture. Similarly, we have learned to swim or ride a bike. However well the "theory" would have been explained to us, not all of us immediately went and swam. Many, if not most, immediately went into the water or fell with off a bicycle. So to summarize: the theory is an explanation of "how to act"; psychology is about mobilizing and organizing ourselves to achieve a goal; creation is to understand and implement.

II. ARIZ-1956. It is precisely in order to penetrate into the creative noosphere and to reveal its constructive content, structure, and laws at least for the engineering, the genius of Genrikh Altshuller was needed, as well as his friendship with Raphael Shapiro, their joint search, hypotheses, definitions and conviction that became the origins of the future TRIZ, and in the beginning the origins of the first ARIZ.

60 years ago, in 1956, G. Altshuller and R. Shapiro published an article [1], in which a new, constructive and methodical approach for the efficient generation of inventive ideas was offered to the world. The idea of methodical scheme, which later would be called ARIZ[2], was so clearly and precisely stated in this article, that it remains invariant concept in all versions of ARIZ in this century as well.

We will focus on the ARIZ and the TRIZ concepts as a whole in the following discussion. This area remains just as relevant today, as over the past 60 years, not only TRIZ has not been developed or implemented as it deserved to be, but what is even worse, some publications occasionally appear belittling the value of TRIZ or its primary tools and even cast a shadow on the persona of the TRIZ founder.

So for the first time in the history of civilization, a new *methodical scheme* and procedures for the effective solution of problems containing a *conflict* between *incompatible demands* was formulated in the article. It is such design problems, called by the creators of TRIZ *"inventive problems",* that have a special quality that we can define as *"complexity".*

Complexity is manifested in a situation where the problem solver (solution designer) cannot find and offer a solution in a reasonable time at acceptable levels of quality and efficiency.

In this case, you want to find (devise, invent) a creative idea, which can be further developed in the future solution suitable for practical implementation.

It is in that article, for the first in the world, the authors formulated the inalienable moments inherent in the process of solution creating in the engineering design:

"1. Separate parts of the machines, mechanisms, processes, are always in close interconnection.

2. The development of parts is uneven: some elements overtake others in their development.

3. The gradual development of the system (or machine, mechanism, process) is possible as long as the contradictions between the more advanced and the lagging (and/or worsen) elements does not arise.

4. This contradiction becomes a brake on the overall development of the whole system. Elimination of that contradiction is what we call invention.

5. A radical change of one part of the system needs a number of functionally driven changes in other parts."

A key aspect according to points 3 and 4 consists in pointing out the need to identify the *contradiction* which models and, in fact, defines the essence of a conflict problem. The authors show the example of such a conflict when they attempt to increase the *precision* of a technological operation, which leads at the same time to a decreasing *speed of operation*: *precision* vs. *speed*.

In itself, the recognition of the basic contradiction as the *main essence* of any conflict (including technical conflict) may well seem not new. There are many examples of understanding the role of contradiction in the resolution of conflicts – from the Greek philosophers to the founders of dialectical materialism. However, the contradiction, and in particular *technical contradiction*, first appears in the article using modern terminology as problem *modeling,* and as a *revelation and an explicit representation of the conflict structure*, while the *elimination of the contradiction as a necessary condition* for the successful solution of the problem.

Another pioneering achievement of the authors became a clear identification of the ability to discover, organize, and use of a set of *contradiction solution techniques* (*transformation models* – M.O.):

"In our opinion, the most rational system is the one in which the search for ways to eliminate the cause of the technical contradiction is conducted in the following sequence:

1. Examination of typical solution techniques (and existing samples/patterns as *prefigurations*):
a) use of natural prefigurations,
b) use of prefigurations from other areas of technology.

2. The search for new solution techniques by way of changes:
a) within the system,
b) in the external environment,
c) in adjacent systems.

The searches go in this sequence from the simple towards the complex to provide the right solutions with the minimum of effort and time. "

And most importantly, the authors hypothesized about the *possibility of a systematic and directed process of problem solving* supported by a certain methodical scheme. This scheme was later [4] named "Algorithm of Inventive Problem Solving", or ARIZ in abbreviated form. In my system, I designate this scheme as ARIZ-1956; below is its graphical version based on the original text of the authors (fig. 3).

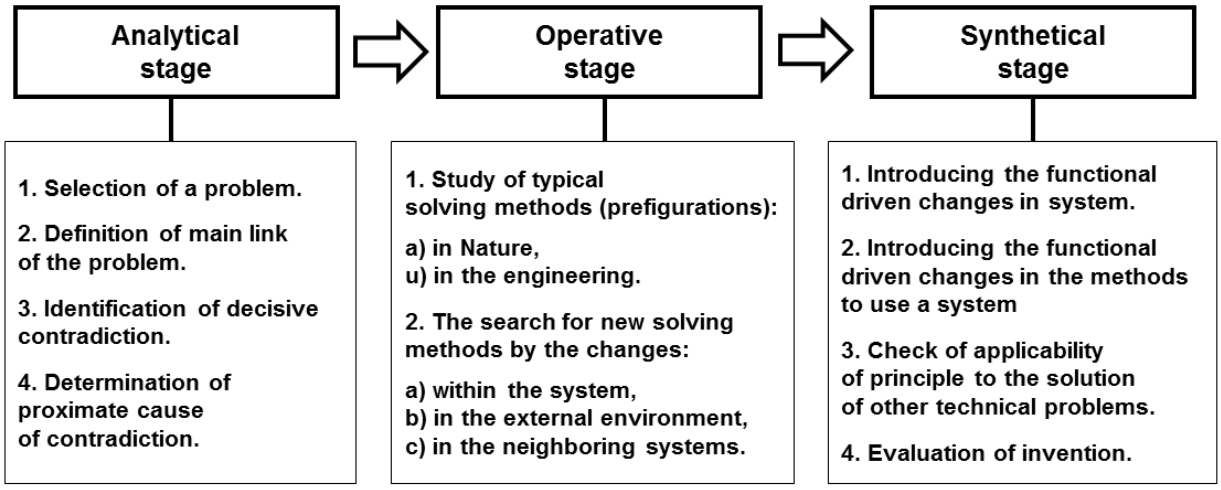


fig. 3. First Meta-Algorithm of Invention (ARIZ-1956)

The characterization of this scheme[3] by the authors themselves is fundamentally important:

"**Analytical stage** aims to analyze the development of a given machine, mechanism, or process (or in the broader case, the industry) and to identify the principal contradiction at this moment and to determine the direct (physical, chemical, etc.) reasons for that contradiction.

Operative stage aims at a systematic, expedient, and goal oriented study of possible ways to remove the detected causes of the conflict.

Synthetic stage aims at entering additional changes arising from the ways found to resolve this technical contradiction into the rest of the system."

The fundamental discovery of the authors was the introduction of the concept of a "pivotal contradiction", followed by "the causes of contradiction," and finally, the *"technical contradiction".* Further long-term study of the concepts of the "pivotal contradiction" and the "causes of contradiction" has confirmed the discovery of ***two fundamental types of contradictions*** – *technical* (*standard* [4]) and *physical* (*radical*), as well as of various principles and inventive techniques to resolve them.

The past 60 years have fully confirmed the hypotheses proposed by the authors. The prominent role of contradictions (conflict models) and inventive techniques (transformation models) consists in that:

- the contradiction and transformation models do provide an opportunity to present and to accumulate experience in creating millions of inventions;

- the use of transformation models to solve contradictions makes it possible to deal effectively with a large number of mass problems encountered in daily design activities, as well as to test express solutions of the problems of elevated complexity.

If the authors stopped at only a general description and discussion of the three-step methodical scheme, including analytical, operational and synthetic phase, it still might have been a useful positive step, although such description would have been technically too close to the famous diagram showing the behavior of a problem solver in its most general form (fig. 4). By the early 1950s, many similar descriptions were offered (see below).

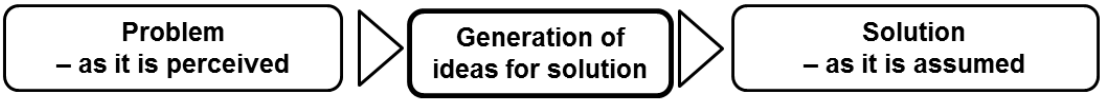


fig. 4. Behavioral diagram of problem solving

Yet the authors did not limit themselves to the discussion of the general scheme of creativity with new definitions and possibly empirical subtleties, but for the first time created a constructive methodological scheme, opening great perspectives in the following aspects:

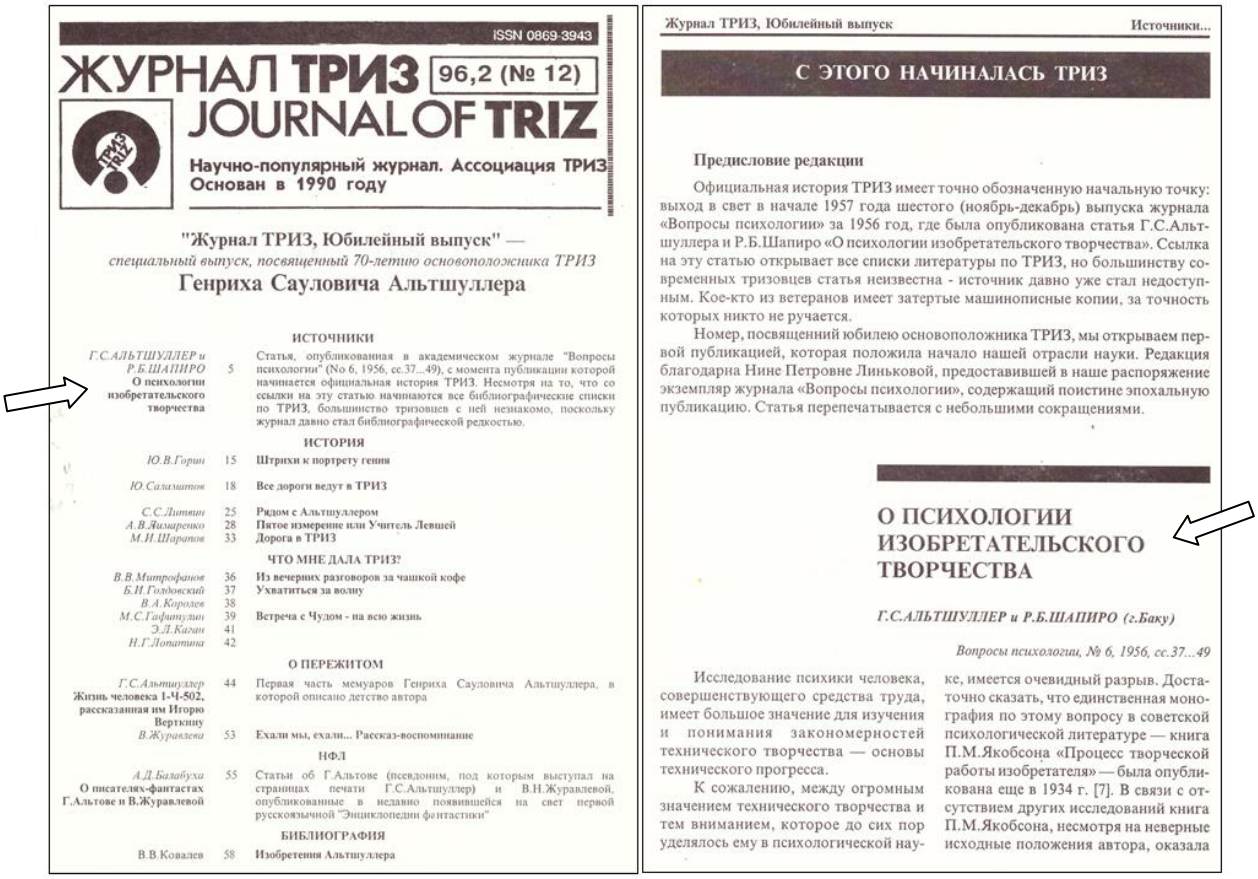
1) disclosure of the methods, the role and the prospects of accumulating creative experience in generating inventions,

2) discovery of the methods and the models to systematically directed solutions for problems of any complexity, especially in the crucial area of engineering;

3) opening of the possibility to transfer creative experience for new generations of creative professionals through systematic, structured training based on ARIZ;

4) creation of the prerequisites (not yet known at the time of the first article's by the authors) for future support of inventiveness with the help of software, and even automated search of analogs and scientific effects for use in new projects.

I believe that readers will be interested to see (fig. 5) a reproduction of the article [1] in the Russian "TRIZ Journal" in 1996 [2], dedicated to the 70th anniversary of G.Altshuller and, accordingly, to the 40th anniversary of the first article.



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ИСТОЧНИКИ

Г.С.АЛЬТШУЛЛЕР и Р.Б.ШАПИРО 5 **О психологии изобретательского творчества** — Статья, опубликованная в академическом журнале "Вопросы психологии" (No 6, 1956, сс.37...49), с момента публикации которой начинается официальная история ТРИЗ. Несмотря на то, что со ссылки на эту статью начинаются все библиографические списки по ТРИЗ, большинство тризовцев с ней незнакомо, поскольку журнал давно стал библиографической редкостью.

ИСТОРИЯ

Ю.В.Горин 15 **Штрихи к портрету гения**

Ю.Саламатов 18 **Все дороги ведут в ТРИЗ**

С.С.Литвин 25 **Рядом с Альтшуллером**
А.В.Жмаренко 28 **Пятое измерение или Учитель Левшей**
М.И.Шаранов 33 **Дорога в ТРИЗ**

ЧТО МНЕ ДАЛА ТРИЗ?

В.В.Митрофанов 36 **Из вечерних разговоров за чашкой кофе**
Б.И.Голдовский 37 **Ухватиться за волну**
В.А.Королев 38
М.С.Гафатулин 39 **Встреча с Чудом - на всю жизнь**
Э.Л.Каган 41
Н.Г.Лопатина 42

О ПЕРЕЖИТОМ

Г.С.Альтшуллер 44 **Жизнь человека 1-Ч-502, рассказанная им Игорю Верткину** — Первая часть мемуаров Генриха Сауловича Альтшуллера, в которой описано детство автора

В.Журавлева 53 **Ехали мы, ехали...** Рассказ-воспоминание

НФЛ

А.Д.Балабуха 55 **О писателях-фантастах Г.Альтове и В.Журавлевой** — Статьи об Г.Альтове (псевдоним, под которым выступал на страницах печати Г.С.Альтшуллер) и В.Н.Журавлевой, опубликованные в недавно появившейся на свет первой русскоязычной "Энциклопедии фантастики"

БИБЛИОГРАФИЯ

В.В.Ковалев 58 **Изобретения Альтшуллера**

Журнал ТРИЗ, Юбилейный выпуск — Источники...

С ЭТОГО НАЧИНАЛАСЬ ТРИЗ

Предисловие редакции

Официальная история ТРИЗ имеет точно обозначенную начальную точку: выход в свет в начале 1957 года шестого (ноябрь-декабрь) выпуска журнала «Вопросы психологии» за 1956 год, где была опубликована статья Г.С.Альтшуллера и Р.Б.Шапиро «О психологии изобретательского творчества». Ссылка на эту статью открывает все списки литературы по ТРИЗ, но большинству современных тризовцев статья неизвестна - источник давно уже стал недоступным. Кое-кто из ветеранов имеет затертые машинописные копии, за точность которых никто не ручается.

Номер, посвященный юбилею основоположника ТРИЗ, мы открываем первой публикацией, которая положила начало нашей отрасли науки. Редакция благодарна Нине Петровне Линьковой, предоставившей в наше распоряжение экземпляр журнала «Вопросы психологии», содержащий поистине эпохальную публикацию. Статья перепечатывается с небольшими сокращениями.

О ПСИХОЛОГИИ ИЗОБРЕТАТЕЛЬСКОГО ТВОРЧЕСТВА

Г.С.АЛЬТШУЛЛЕР и Р.Б.ШАПИРО (г.Баку)

Вопросы психологии, № 6, 1956, сс.37...49

Исследование психики человека, совершенствующего средства труда, имеет большое значение для изучения и понимания закономерностей технического творчества — основы технического прогресса.

К сожалению, между огромным значением технического творчества и тем вниманием, которое до сих пор уделялось ему в психологической науке, имеется очевидный разрыв. Достаточно сказать, что единственная монография по этому вопросу в советской психологической литературе — книга П.М.Якобсона «Процесс творческой работы изобретателя» — была опубликована еще в 1934 г. [7]. В связи с отсутствием других исследований книга П.М.Якобсона, несмотря на неверные исходные положения автора, оказала

fig. 5. Reproduction of the first TRIZ-article in 1996 (scan-copy of the heads)

III. ARIZ-1961. The world's first book in this field was published in 1961 [3], 5 years after the first article. This book (fig. 6) became a prologue to the future TRIZ.

fig. 6. First TRIZ-book *"How to learn to invent"* (G.Altshuller, 1961)

This first book contains examples of modeling a number of inventions including inventions by G.Altshuller using ARIZ-1956. Some stages of ARIZ-1956, particularly the operational stage, were refined and developed further. Therefore, we can speak about the emergence of ARIZ-1961.

The operational step of ARIZ-1956 was endowed in this book with the first transformation models that were still reminiscent of the famous lists for brainstorming.

However, shortly after, the use of these basic, primary models led to the development and the accelerated proliferation of TRIZ and ARIZ (mostly by enthusiasts of the new technique).

I keep notes from my first experience with ARIZ-1956 and as per its description in [3], for a solution in 1965 to a problem of cutting the gold wire from the contact pad of an integrated circuit after welding (in [5] this example is described with the necessary criticism based on the modern level of TRIZ knowledge).

The first transformation models have been developed in the course of a few years into a very effective modeling "toolbox" including A-catalogs and A-matrix (see particularly in the [7-9] modifications suggested at an early stage of the Modern TRIZ development). This initial "algorithmic" concept – ARIZ-1956 – became the invariant core of all future versions of ARIZ and the whole ideology of the future TRIZ. This is the trailblazing role that the first article played for the concept and the principles of a new methodological scheme of inventive idea generation.

We can also consider the article [1] and the book [3] as a source of the idea about the possibility to accumulate experiences of creating inventions. Today, we know that to achieve this goal a long way was needed [7] to create effective methods to describe, store, transfer and apply, including for educational purposes [8], the transformation models [9]. And this way is not completed yet.

III. ARIZ-1956 and ARIZ-1961 in format MAI T-R-I-Z. ARIZ-1956 has undergone great development, and within 30 years (by 1985) had become a "classic" scheme, the description of which, however, required about two dozens of pages, e.g. see in [5]. Study of the ARIZ-1985 by beginners had become practically impossible, and the application of the TRIZ tools by beginners without mastering ARIZ had become an obstacle for a practical use of TRIZ. To the same extent, this also applies to later versions of the "classical" ARIZs, up until now, that is in 2016.

Therefore, approximately 20 years ago, I went on a "reverse track" – I began to structure the existing TRIZ materials to enhance the effectiveness of teaching the TRIZ fundamentals. I came to the idea of learning through reconstruction by each trainee of the research and the methods of G.Altshuller and R.Shapiro during formation of the transformation models, models of problems as contradictions, and representation of the process of creating inventive ideas in a compact format similar to the algorithmic scheme ARIZ-1956.

Meta-Algorithm of Inventing T-R-I-Z (MAI T-R-I-Z) has become such scheme (fig. 7). This scheme reverted to the very first ARIZ, namely, ARIZ-1956 in order to facilitate learning for beginners, and improve the efficiency of use of the TRIZ tools at/from the very first steps of learning.

This scheme is called a *meta-algorithm*, which is a *generalized algorithm*, because it does not contain detailed procedures for modeling and solving the contradictions or other related problems. However, this relates fully to the scheme ARIZ-1956 shown in fig. 3. Therefore, ARIZ-1956 is also a meta-algorithm by definition – *the first meta-algorithm of TRIZ*.

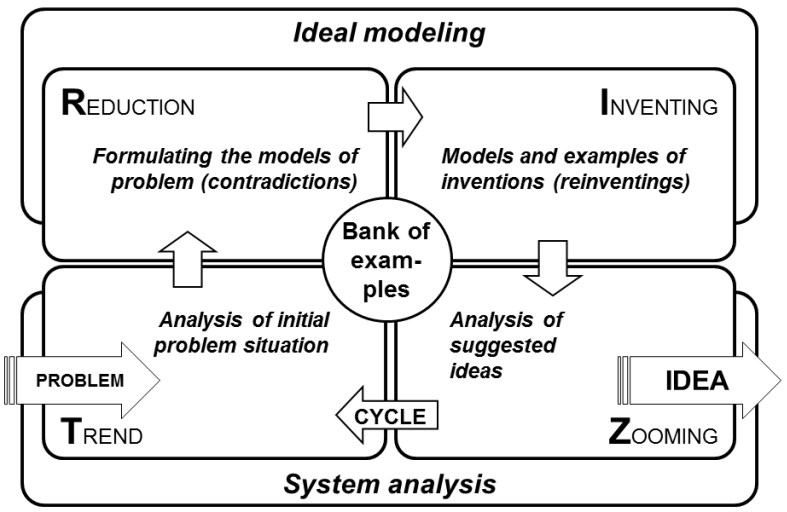

fig. 7. Meta-Algorithm of Inventing T-R-I-Z (mid-1990s)

So the return to the first ARIZ schemes, starting with ARIZ-1956, but at a new level of understanding and application of TRIZ and ARIZ, led to the formation of MAI T-R-I-Z. At the same time, this return, was an improvement since it was found that MAI T-R-I-Z is quite sufficient and effective not only for training but also for a wide practical use.

Moreover, a structured representation of inventing process in the form of MAI T-R-I-Z revealed great efficiency in building a system to store and transfer of inventive experience for mass education on the basis of standardized definitions and standardized training procedures.

Development of MAI T-R-I-Z can be considered as a *reduction* (*convolution, compression, generalization*) of the later versions of ARIZ, starting with ARIZ-1971. The names were given to MAI stages as ***T, R, I*** and ***Z***, so that, on the one hand, they indicate correctly their contents, and on the other hand, provide easy memorization of each stage of MAI T-R-I-Z in the right sequence.

Very briefly, we note that the stage ***Trend (Targeting)*** is designed to studying the source of the problem situation, setting goals and direction (trend) of system improvement and development.

Stage ***Reduction*** is intended to determine the Operative Zone (comprising a source of conflict), simplify the original description of the problem by formulating the contradiction (or several contradictions), formulate the Ideal Final Result, and analyze the resources.

Stage ***Invention*** aims to find an effective idea through the use of TRIZ tools (models of transformation). This stage integrates to the highest degree the logical TRIZ models with creative abilities of the problem solver. It is clear that any tools work best in the hands of an experienced and talented craftsman. This stage is crucial in all senses.

Stage ***Zooming*** is designed to evaluate the effectiveness and the properties of the proposed ideas. The term "zooming", denoting a scaling operation in the digital video and photographic technique, is used for naming this stage. Here, it emphasizes the need to consider the idea on a different scale, e.g. at the Operative Zone level, at the system, the subsystem, and the component levels, and in the opposite direction – at the super-system, and other systems in the vicinity and in the hierarchy.

IV. Contradictions and ARIZ – fundamental invariants of TRIZ. Attempts to explain the process of idea generating have been made repeatedly. The results of several crucial definitions and their joint evolution [8] may be represented as a graphical diagram (fig. 8).

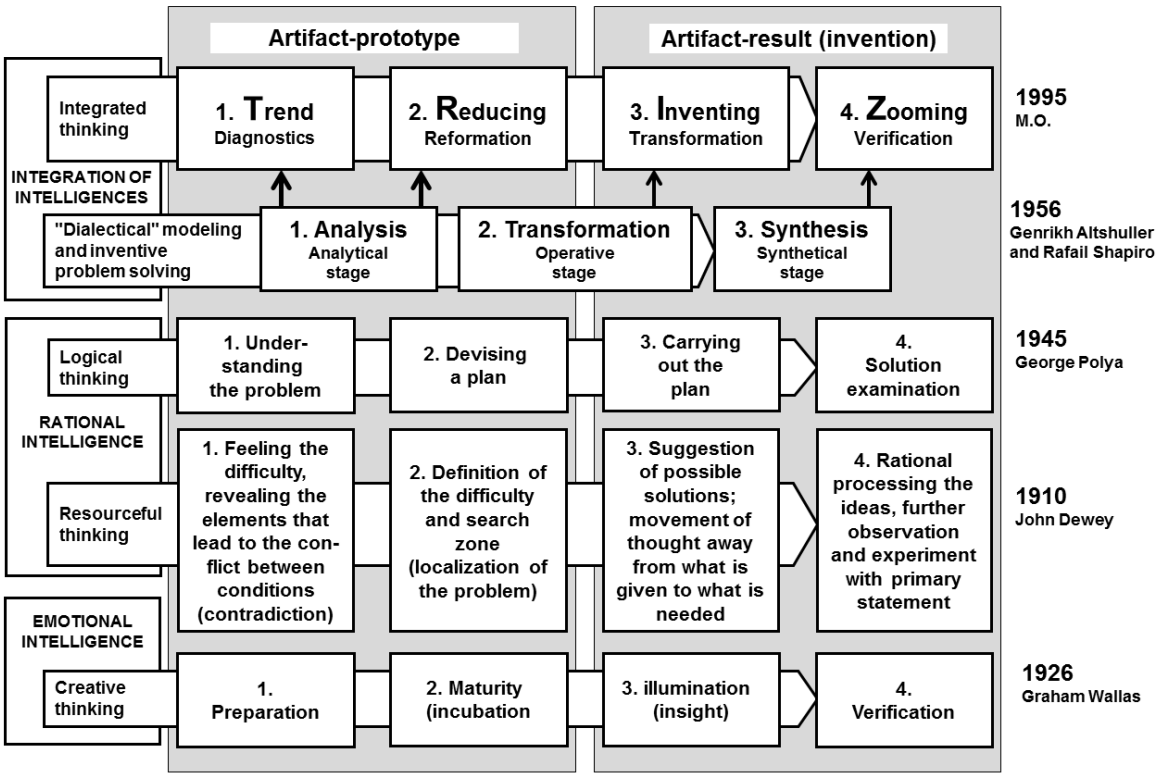

fig. 8. Evolution of the meta-algorithms of invention

Here, there are two polar opposite strategies: a meta-algorithm by Wallace is a "classic" brainstorming, and a meta-algorithm by Polya – a "classical" engineering approach.

Of particular interest to TRIZ historians is the Dewey's scheme, which I built in the mid-1990s to visualize logical steps for examples of his famous book in the form of algorithmic structures. The analysis of these examples and the text in the next few pages[5] allowed me to formulate the logical structure of search for solutions according to Dewey.

I drew attention to the similarity of this scheme to the foundation of the TRIZ logic, namely, in the structure and the components of the deployment of the solution finding process. Which in terms of the modern TRIZ is: structuring the problem situation, defining the conflicting factors (identification of contradiction); localization of the problem source (Operative Zone); inventing an idea as a transition from the "is" state to the "must be" or "should be" state as required; evaluation and development of ideas.

It should be noted that the concept of "contradiction" deserves a separate article. Contradictions become invariant basis for the methodology and the practical application of TRIZ. Here, we emphasize that this fundamental concept of the future of TRIZ was first introduced in [1] and the book [3].

After practical experiences with different ARIZs for the previous 30 years, building and studying Dewey's scheme had become for me motivating moments for a final decision to compress a long "classical" ARIZ into a compact generalized scheme at the "top" level (meta-model) that could be disclosed and deployed for different creative approaches after being filled with adequate models of transformation.

Thus, this approach is actively used by us for demonstrating the TRIZ instruments and for structured teaching in the format of so called PentaCORE system [7, 8] including five creative "studio-cores" of Modern TRIZ (we show a very brief description here):

A – *Algorithmic*, or *Altshuller*, Studio: basic primary instruments of TRIZ;

B – *Brainstorming*, or de *Bono*, Studio: universal brainstorming models;

C – *Challenge* Studio: substance-field modeling and effects database;

D – *Dominant* Studio: role and other stimulating models;

E – *Evolution*, and also *Ecology*, Studio: models of system development and patterns of Nature.

Thus, PentaCORE offers an integrated approach (integration of alternative systems) to generate creative ideas. The simplest instrumental algorithm [8, 9] SMART T-R-I-Z (Simplest Meta-Algorithm of Resourceful Thinking T-R-I-Z) is shown in fig. 9 as a basis of training in the A-Studio.

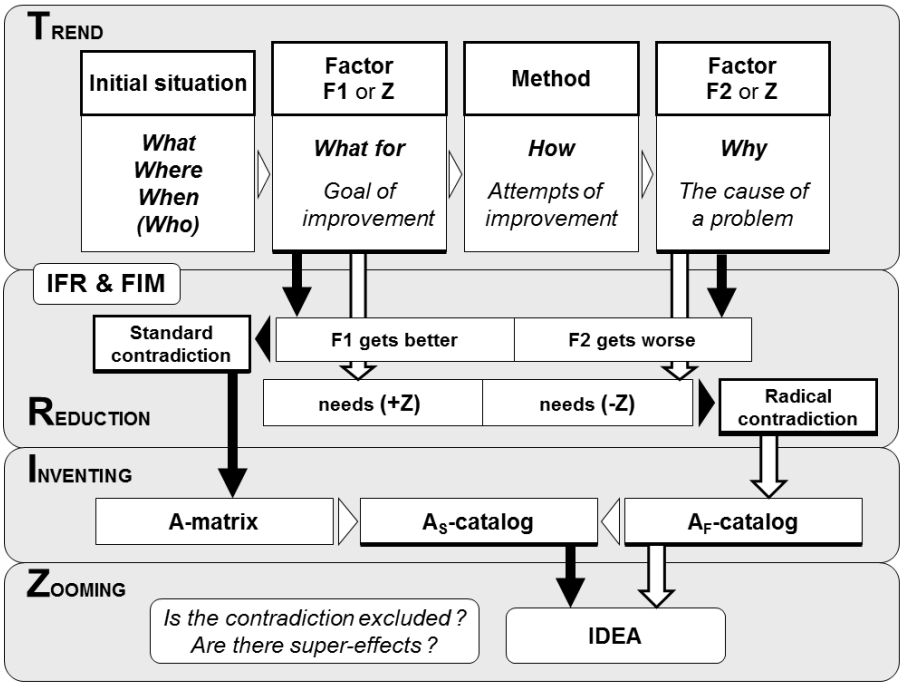

fig. 9. A-Studio: SMART T-R-I-Z – the simplest ARIZ

Here, the black solid arrows indicate the route of the idea generating for solving a standard contradiction, and the white arrows indicate the route of solving a radical contradiction.

Instrumental arsenals of all PentaCORE studios have the same structure in the form of SMART T-R-I-Z with the invariants in each studio in the form of *technical (standard)* and *physical (radical)* contradictions, but use specific models of transformation.

MAI T-R-I-Z in the version SMART T-R-I-Z has become the de-facto standard in modern TRIZ. This has ensured a standard representation of any and all examples in MTRIZ knowledge databases, in lectures, in software, in training, and practical applications. The speed of training increased manyfold, and the quality of learning and the adoption of the base material became convincing and durable.

V. Future of TRIZ – in expanding the practical application and the development of the theory.
Structuring the first ARIZ in the format of MAI T-R-I-Z helped develop a deeper understanding of the process of idea generation in TRIZ (fig. 10-12). Students can easily understand and remember these highly important schemes.

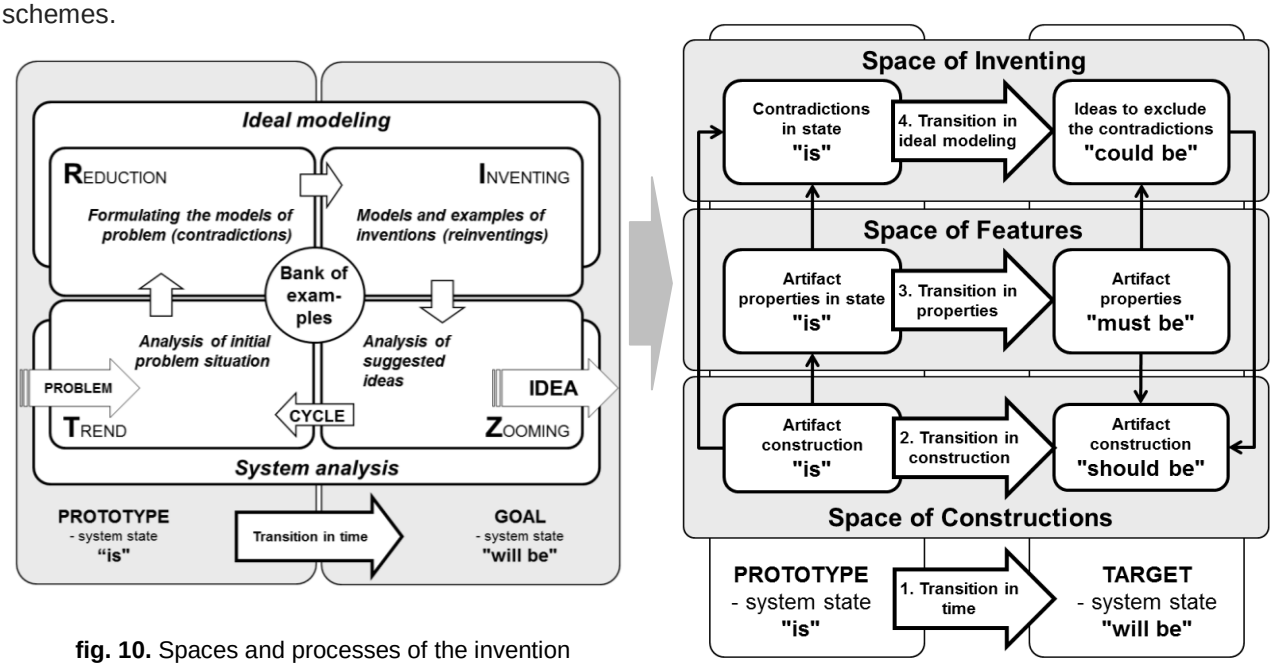

fig. 10. Spaces and processes of the invention

A crucial point in teaching TRIZ is the explanation to the students of the modeling space related to: a) the prototype – *the contradictions are present only in the prototype* and are considered only at the stages of *Trend* and *Reduction*, and b) the future result (goal) – *the transformation models are only used to create an artifact-result* at stages *Inventing* and *Zooming*. This explanation allows trainees to quickly master the concepts of contradictions and the transformation models, and to know exactly to which objects and temporal stages they belong.

The methods ***Extracting*** and ***Reinventing*** were developed for a quick and appropriate training.

Extracting is constructed (fig. 11) on the basis of comparison of a known artifact with its prototype (the closest possible) to identify creative TRIZ models (known or new) that are *objectively* present in a new artifact-result and led to its creation in comparison with the prototype (refer to: C – contradiction, IFR – Ideal Final Result).

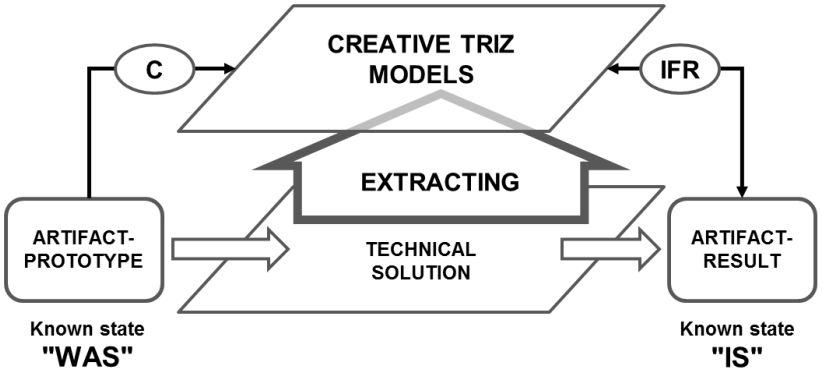

fig. 11. The process of Extracting

As a result of *Extracting*, creative models are revealed (extracted) from the known effective solutions, and generalized. Further, they may be classified and complement known catalogs of models, and/or serve as a basis for creating new catalogs.

Reinventing is based on the MAI T-R-I-Z, and is a simulation of the overall process of the artifact-result invention on the assumption that the extracted transformation models could lead to the invention, if the designers knew TRIZ before creating the artifact-result. Hundreds of Reinventing examples for a detailed training are presented in [7-9]. A set of examples for introductory purposes can be found also on our websites [10, 11].

It should be noted that the methods of Extracting and Reinventing were, in fact, used by G.Altshuller [3] to identify and accumulate models of conflicts (the contradictions) and transformation models, that is, for the

empirical study of both the field of technical inventions and the inventions of Nature. Numerous examples of studying inventions in books [3, 4] are in fact reinventions. The definition of these fundamental research methods in TRIZ and the explicit specification of their procedures have been proposed in [7, 8] that made the initial descriptions [3, 4] effective TRIZ instruments for constructive research, teaching and solving tools.

Therefore, methods of Extracting and Reinventing go back to the origins of ARIZ and TRIZ introduced in the world's first article and the first book about the future ARIZ and TRIZ. These two methods support historical continuity and create a direct link to the fundamental ideas of the TRIZ founders.

Description of the invention stage (*Inventing*) according to TRIZ (on any ARIZ, and of course, MAI T-R-I-Z) can be represented as in fig. 12.

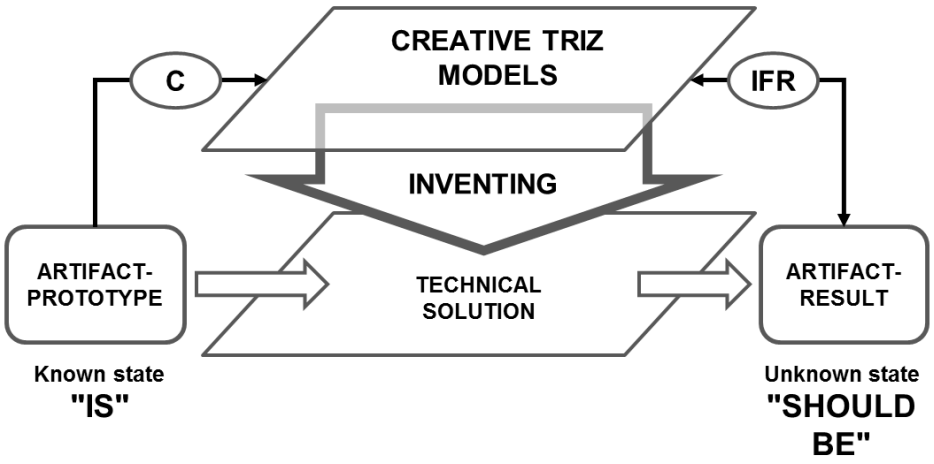

fig. 12. Inventing with applying the transformation models to eliminate the contradictions

When *Inventing* with TRIZ, creative models direct the formation of technical solutions.

Work on the development and the application of ARIZ in the format MAI T-R-I-Z is based primarily on connection and continuity of MAI T-R-I-Z with respect to any of ARIZ, but especially to the first versions, beginning with ARIZ-1956. And this work is far from complete. In my opinion, TRIZ (and, as one of its directions – Modern TRIZ) needs further standardization and "algorithmization", the development of modern systems of transformation models, the improvement of teaching methods, and the development of more effective methods (new tools and perhaps specialized versions of ARIZ) to solve problems at differentiated complexity levels. I believe that attempts of "unification" and "standardization" of information in the format of MAI T-R-I-Z, together with the methods and the procedures of Extracting and Reinventing, will yield results in the development of both our research and the readers' activities.

VI. "The great is seen in time and at a distance." This poetic line[6] reflects our understanding of the content and the significance of the TRIZ origins when we return back 60 years later.

G.Altshuller and R.Shapiro became in the first article [1] the pioneers in opening *the direction of scientific structuring and empirical research* of an extremely important activity of the noosphere – *the noosphere of creation*, starting from the *inventive creation in engineering*. We can surely say that the ideas and the results of TRIZ can be summarized and distributed to many, if not all, spheres of creative activity. This field needs new researchers today to continue development of TRIZ, who would be comparable, at least collectively, to the genius of G.Altshuller.

G.Altshuller and R.Shapiro also gave us an example of personal courage and resilience, faith in oneself and in the prevalence of good, and not evil, in humans. After years of suffering endured in Stalin's camps, being convicted in unthinkably unfair circumstances, they had the courage to reveal to us the source of the future TRIZ. Remember that in 1956, they were just 30 years old! And they were freed from prison only 2 years before that. And it is impossible to forget that they were sentenced to 25 years of labor camps ... so that they only were expected to return to a regular life at the age of 48 years. TRIZ would have hardly existed today...

G.Altshuller left no memoirs. But he created another book [6] of tremendous value, a which also contained a tremendous emotional stress. His intellect of a genius investigated the fate of thousands of other devotees to creation, and his heart understood and accepted their aspirations and sufferings, mistakes and personal victories. I think that that book by G.Altshuller expressed also his own sufferings endured in the camp, and the moral and mental suffering of the thousands of people who suffered the same fate. He saw, knew, and understood these people.

Returning to TRIZ, I believe that we can fully think and say about the destiny and the life path [9] of G.Altshuller in the words of the same ascetic of mind and kindness, talent and selflessness – Jacob Perelman [9]: *To be able to find the new in the old is the sign of a genius*. Indeed, hundreds of thousands of

inventors and thousands of researchers, scientists, have observed the millions of engineering transformations, hundreds of thousands of patents, and they had seen only the technical ideas and solutions. That is, they saw only what was still "on the surface", what was consistent with the engineering education and design-technological practice. In contrast, TRIZ reveals what is "in the depth" of any technical solution – *creative content, deep invariant structures and processes of creative thinking, of creative design and synthesis.*

I think that TRIZ is the source of the future structure for the entire noosphere of creation. Such is the way of any science – from the ingenious idea, the first concept, through further experimental confirmation, towards advanced penetration into other areas of activities.

There is also a development of TRIZ as a *Theory of Invention* – hard, uneven, with ups and downs, but ever deeper, more precise and wider. That may be, and I believe will be a function of another, wider science – the *Theory of Creation*, necessarily including TRIZ, and I am sure based on TRIZ.

However, following the famous saying of G.Altshuller about TRIZ, we can also say that *science does not substitute talent but supports the talent*.

All of the methodological constructions are consistent with one other fundamental idea – *a clear differentiation of creative and applied spaces, and the corresponding noospheres.* The source of this idea lies directly in ARIZ and TRIZ. "Pure" design-theoretical, projecting, applied space overlaps, of course, with the creative space. But if we do not perceive the creative space as a separate essence and the phenomenon of the highest value, we will continue to stay in the syncretic error, which is represented by the "classical" brainstorming[7].

Thus it is possible to repeat that the concept and the ideas of TRIZ – Theory of Invention by G.Altshuller – are the source of an absolutely different level of thinking, knowledge and skills throughout the entire noosphere of creation for the continuous development of civilization. Further study of the empirical field of inventions, as well as of the wider creative practice, should lead to new discoveries in the TRIZ methodology and instruments, and hence to the wider application of TRIZ in various fields of creative noosphere as a whole.

Returning to the metaphor of the "Magic Eye", it can be said that the function and the value of TRIZ is the "tuning" of the mind to "see the unseen", to see and "to understand the incomprehensible."

TRIZ "focuses" the mind in a very different space! TRIZ creates a structured model from initial blurred "problem situation" (see fig. 2), for which there are effective tools of inventive improvement and development. Therefore, TRIZ educates and develops the "autofocusing" for our rational and emotional intelligences both on the structure and on the beauty of creation, leads us to creativity, to fruitful discoveries and creation[8]. Of course, this requires considerable persistence (here it is – a psychological noosphere!) in order to achieve excellence in TRIZ! But this is the only way to grasp a skill in any other sphere of activity.

At the end of this article, it feel it is my duty to note with the utmost respect that this year is also 90th anniversary of the birth of G.Altshuller and R.Shapiro, and to this event, along with the 60-year anniversary of the first article and the 55th anniversary of the first book introducing the future TRIZ, I dedicate my humble work.

Endnotes

[1] The term was coined by *Édouard Le Roy* and *Pierre Teilhard de Chardin* on the basis of lectures by *Vladimir Vernadsky*; the author believes that these names are known to the reader, but if they are not, then there are many opportunities to find the necessary information, such as the Internet;

[2] The earliest use of the term "theory of invention" (p. 3) and "algorithm" (p. 8) can be traced to 1964 [4]; G.Altshuller repeatedly gives [4] the definition of the purpose and the content of ARIZ (without the well known and popular abbreviation) as the "algorithm of inventive problem solving", but this name is given in full for the first time only at the end of the book on p. 236;

[3] Changes made by me in the structure and the font of section – M.O.

[4] The names *standard contradiction* and *radical contradiction* were introduced by me 15 years ago to expand the fields of application of the contradiction concept, for example, to social systems, processes, problems and conflicts – M.O.

[5] My translation and interpretation of the text and the examples from pages 68-78 (Part II: Logical Consideration. Chapter VI. The Analysis of a Complete Act of Thought) from Dewey, John *How we think.* – Heath & Co., 1910. – 242 pp.

[6] This is a version from Sergei Yesenin, popular and well-known Russian lyric poet; a little bit long my translation but in keeping with the length and the rhythm of a known poetic line – M.O.

[7] In itself, brainstorming is not bad, as brainstorming has driven the development of civilization to date. What is, bad is that advocates and fans of brainstorming do not go further without knowing TRIZ and understanding that the *integration of alternative systems* (TRIZ term!), namely *Brainstorming-and-TRIZ*, certainly will bring a lot more together than the mere use of brainstorming without TRIZ. Thus, Modern TRIZ pays tribute to brainstorming as a method for generating ideas (as "natural" and "classical" in the historical and psychological sense), while brainstorming stubbornly avoids the use of TRIZ, e.g. in a certain direction "Design Thinking". By the way, the same applies, in fact, to all the "trendy" and "fashionable" areas of application of the so-called "management methods", such as 5S, Kaizen, Lean, 6 Sigma, DfSS, which are actively promoted around the world, but strangely make little use of TRIZ (we welcome, but we do not discuss here some publications with proposals to incorporate TRIZ in management techniques and strategies). Brainstorming without TRIZ today is clearly depleted, and is a much less effective tool in comparing with TRIZ. With TRIZ, brainstorming will always be a modern tool, yet without TRIZ – although "classical", but outdated and inferior.

[8] For the application of the metaphors "focus" and "autofocusing" for thinking with the help of TRIZ, I owe it to my wife Valentina, the executive director of our companies for almost 25 years. I am earnestly and very much grateful to her for that – for the wonderful metaphors and for a lot of productive work!

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