

2. Toward the Modern TRIZ

The work is creative if its result is the creation of something new. The very same process of creating something new can be deeply conscious and systematic.

*The methodology of invention is not accidental godsend, but a natural stage in the development of technical creativity.*¹⁹

Genrikh Altshuller

2.1. TRIZ



TRIZ was founded in Russia, starting from the end of the 1940s, by the inventor, writer, and independent scientist Genrikh Saulowitsch Altshuller.

The first steps toward the development of what would later become TRIZ were made by him together with his ex-classmate Raphail Borisovich Shapiro.²⁰

Genrikh Saulowitsch Altshuller (1926-1998) – founder²¹ of TRIZ

The notion of the *"inventive problem"* in TRIZ was defined as a problem whose efficient (acceptable) solution still awaits because obvious solutions would be unsatisfying or because they do not exist and would be impossible to obtain using existing professional methods.

Definition of "Inventive Problem"	"Inventive Problem" (Inventive Assignment) – A problem containing a <i>contradiction</i> in the form of incompatible requirements and/or properties that appeared through an irregular development of (1) the parts of the system or of (2) the given system and its surroundings that cannot be solved by adequate methods and means.
Definition of "Invention"	Invention (inventive idea, inventive solution) – An idea that abolishes the contradiction and thereby the problem containing that contradiction.

¹⁹ From: G. S. Altshuller *How to Learn to Invent*. – Tambov, Tambov Book Publishers, 1961 (in Russian)
²⁰ *The Psychology of Inventive Creativity*. – **Journal "Questions of Psychology"**, No. 6, Moscow, 1956; coauthors: Genrikh Saulowitsch Altshuller (1926-1998) and Rafail Borisovich Shapiro (1926-1993)
²¹ Picture: magazine **Der Spiegel**, June 2005

The most fundamental concept introduced by TRIZ is that a new inventive problem can be solved on the basis of experience accumulated in inventions made earlier in various other areas!

To identify such experience, G. Altshuller and his followers analyzed dozens of thousands of inventions. As a result, they discovered "inventive techniques" (transformation models) most frequently encountered in real inventions. They also discovered two basic types of contradictions whose resolution engendered new inventions: *the technical ("standard" in MTRIZ) contradiction and the physical ("radical" in MTRIZ) contradiction.*

Definition of TRIZ	<i>Theory of Inventive Problem Solving (TRIZ) – TRIZ is a constructive methodology for generating ideas and solving problems, primarily when projecting engineering systems, on the basis of contradiction models, as well as the methods to solve them, which were extracted from previous known inventions.</i>
Constructive methodology – addition to definition of TRIZ	TRIZ is a <i>constructive methodology</i> that includes practically reproducible models and methods that allow the development of new inventions as well as the teaching of the process, the models, and the methods of creating inventions.

TRIZ rests on the foundation of the following basic provision:

System Platform	<i>Technical systems evolve in accordance with certain laws that can be cognized and applied to designing a new creative technology... thereby turning the development of technical systems into a precise science.²²</i>
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The structure of TRIZ is shown in fig.2.1.

In their first article, titled *The Psychology of Inventive Creativity*, G. Altshuller and R. Shapiro formulated **three fundamental premises** found in each creative solution of each new problem:

1. Formulation of the problem and determination of the contradiction that prevents resolution of the problem by applying the usual methods already familiar to engineers.
2. Elimination of the cause of the contradiction with a view to attain a new, i.e., higher technical effect.
3. Transforming the other system components to bring them into conformity with the modified component.

²² Altshuller, G. *To Find an Idea. Introduction to Theory of Inventive Problem Solving.* – Novosibirsk, Nauka (Science) Publishers, 1986 (there are also later editions).

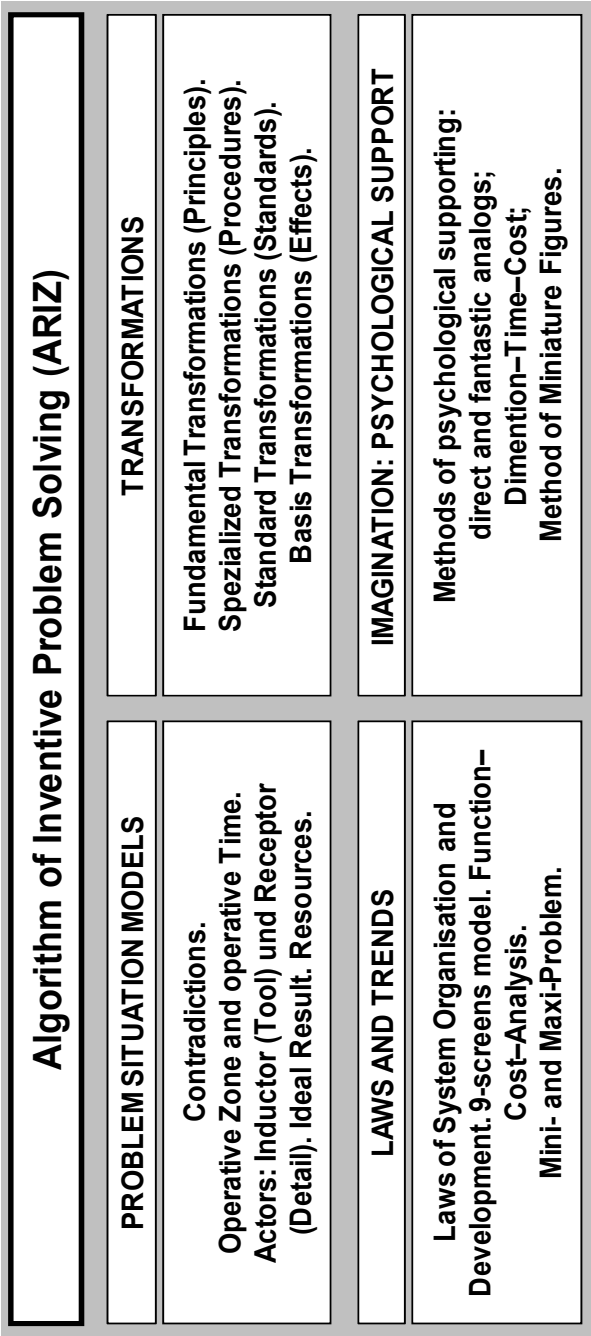


fig. 2.1. Structure of classical TRIZ

Subsequently G. Altshuller developed **three principles to resolve inventive problems**:

1. Identification and elimination of the systemic contradiction is the key to resolving the problem!
2. "There is an endless multitude of inventive problems, whereas the number of systemic contradiction types is relatively small. **There are typical systemic contradictions—and typical techniques used for their elimination.**"²³ Problem-resolution methods (techniques) can be identified by analyzing great inventions.
3. The strategy and tactics of directed problem resolution must rely on laws governing the evolution of technical systems.

The next point is critically important for understanding TRIZ fundamentals:

Psycho-logical Platform	<i>Invention methodology is based not only on the laws governing the overall progress of the engineering science and generalization of experiences accumulated by inventors. It also takes into consideration human psychology. It assumes that... each human being has certain talents. The methodology helps develop those talents and put them to good use.</i>²⁴ <i>Directed search does not exclude intuition. On the contrary, normalization of thinking processes creates a special "attitude" which is conducive to manifestation of intuition.</i>²⁵
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Rapid global expansion of TRIZ started in 1995 to 1996 when international business newspapers published stories about multi-million purchases by *Motorola* and *Mitsubishi* of thousands of licenses for the world's first sensational TRIZ-based software package called *Inventing Machine*. The package carried a defiant slogan: *Software That Invents*. Few people knew then that development of the package had started almost 10 years ago in Minsk in line with a conceptual framework designed by, and under the management of, V. M. Tsourikov, a brilliant TRIZ scholar and a specialist in artificial intelligence and expert systems.

Today TRIZ has become a global phenomenon. TRIZ is turning into a precious asset that we are going to bequeath to our descendants from the 21st century and the 3rd millennium. And it continues to grow.

2.2. A-Studio of Modern TRIZ

The development of civilization took place on the basis of inventions. The invention of a new idea is not only to technical and technological evolution but also to social evolution. The main creative method was and still is brainstorming. Question: Does this thinking work in our current times?

²³ G.S. Altshuller *How to Learn to Invent*. – Tambov, Tambov Book Publishers, 1961 (in Russian)

²⁴ Defined by the author (M.O.) based on G. S. Altshuller *How to Learn to Invent*. – Tambov, Tambov Book Publishers, 1961 (in Russian)

²⁵ G.S. Altshuller *Invention Algorithm*. – Moscow, Moscow Worker Publishers, 1973 (in Russian)

The development of civilization in our time becomes more technocratic. Technical artifacts themselves are becoming more diverse and complex. The creation of new ideas for the development of technics and technologies requires more effective thinking. The new thinking must be even more intense. **However, most importantly, creative thinking should be more constructive.** A new creative technology of effective thinking is needed in order to link motivation with objective knowledge and talent with systematic management of the inventive process.

Modern TRIZ creates opportunities to overcome negative stereotypes of poorly organized thinking. In this case, MTRIZ does not negate intuition and talent, associative thinking, and conjecture. These creative components will remain at the heart of personal creativity, albeit in a new way, in conjunction with MTRIZ.

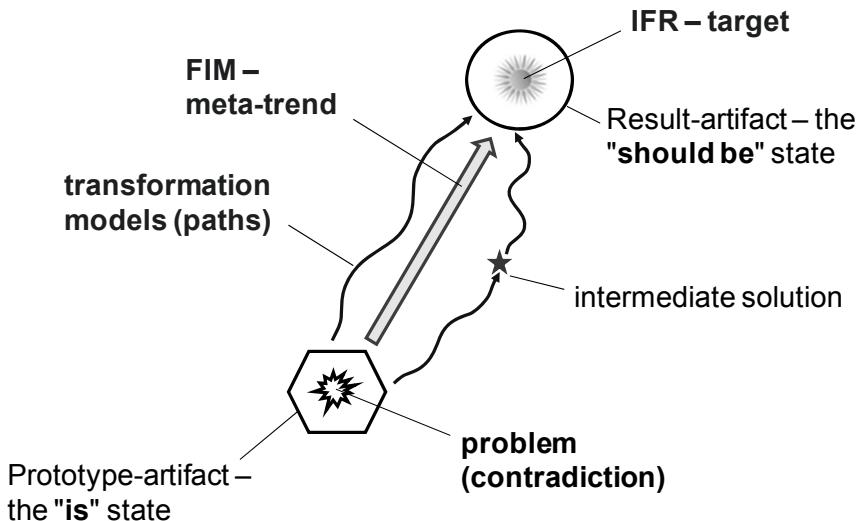
MTRIZ provides a systematic way of applying TRIZ by learning techniques and patterns for well-organized thinking.

According to TRIZ, invention is the path (fig. 2.2) from the available state of the artifact ("is" or "exists") to a future state ("should be" or "needs to be") with the help of transformation models acting as thinking navigators.



fig. 2.2. Invention as system transition from the state "is" to the state "should be"

The application of TRIZ can be illustrated as follows (fig. 2.3).



ATTENTION: You should know this scheme by heart!

fig. 2.3. Simplest scheme of resolving the problem according to TRIZ

A simplified method of constructing the ideas of solutions on TRIZ (fig. 2.3) is as follows:

1. The solution begins with the formulation of **contradiction(s)** as a **problem model**.
2. Then you set a **target** – an **ideal final result (IFR)**.
3. Then you formulate one or several **functional ideal models (FIMs)** setting the direction towards the IFR (**the "meta-trend"**).
4. It is necessary to choose the **transformation models**, i.e., specific **paths**, to the target. The number of test and **intermediate solutions** (indicated by an asterisk) is reduced multiple times by using TRIZ tools (catalogues, tables [matrices], etc.)!
5. Finally (and this is the most critical in importance and most creative moment!), you must go through this path to invent specific solutions that change the existing construction of the **prototype-artifact** for forming a new construction of the **result-artifact** that meets the required IFR.
6. Naturally, at the end of the solution-generation process, we must verify the idea(s) and check it for implementability and efficiency.

Now we will study the child's solution for Problem P5 to compare it with the TRIZ approach! It will help introduce us to TRIZ modeling and problem solving step-by-step.

Example 2.1. First child's solution²⁶ to Problem P5.

And then there was a girl who solved the problem. At first she acted all too commonly (my brainstorming! the usual *modus operandi*): She grabbed a rope but could not reach to the other and then threw the rope, grabbed another... but here she become thoughtful. She stopped hustling and started thinking!

"I pull this rope," she said to the educatress, "and you give me that rope, please."

The educatress said that she and the gentleman (Genrich Altshuller) could not interfere with the game. The girl went on thinking.

Looking around the playroom, she was looking for something.

Then she went to the window sill, rummaged among the toys, and pulled out a tattered doll. A second "person" was needed who could give her the rope! And the girl has found this "person" in the form of a doll!

She tied the rope to the doll (fig. 2.4) and swung the resulting "pendulum," ran to the second rope and grabbed it, then came back and caught the swinging doll.

So, a very big candy "Gulliver" has been honestly earned for the creation of a genuine miracle!

²⁶ G. S. Altshuller *To Find an Idea: Introduction to the Theory of Inventive Problem Solving*. – Novosibirsk, Science Publishers, 1986 (in Russian, later editions exist).

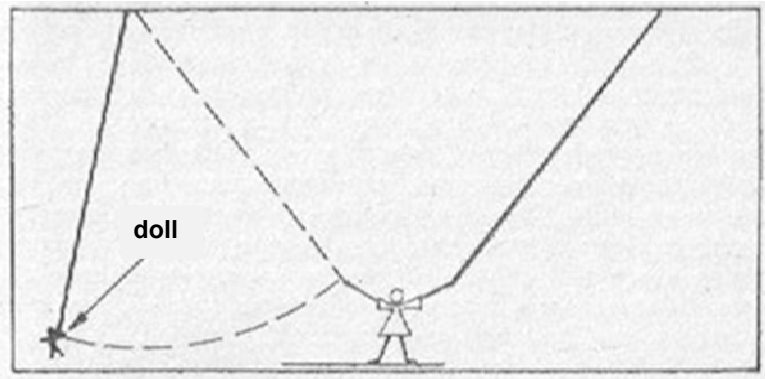
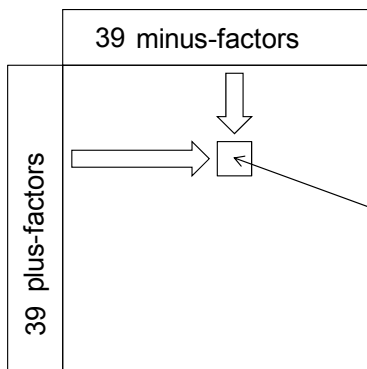


fig. 2.4. First child's solution to Problem P5

Example 2.2. First TRIZ's solution to Problem P5.

Now let us start the "magic" problem-solving process according to TRIZ. We will solve (model) Problem P5 together with the kids from kindergarten!

And now imagine that you are already well aware of TRIZ, at least from the volume ABC-TRIZ!



Purpose: increase rope swing range. To do that, we must increase swing time. *Main deficiency of the "system":* the rope quickly loses momentum because it is thin and too light. Air resistance quickly stops its swinging.

cluster of
models

Now let us go to our "magic" adviser (fig. 2.5) – *Altshuller's matrix*, or *A-matrix*²⁷.

fig. 2.5. Structure of A-matrix

First we must give our "adviser" a brief presentation of the problem in the form of a *formal contradiction*: "We want this—our purpose or *plus-factor*, but we cannot do it because of that—the obstacle or *minus-factor*". The "classical" A-matrix (fig. 2.5) contains 39 *plus-factors* (*lines*) and 39 *minus-factors* (*columns*).

If we select one plus-factor and one minus-factor, they will point (see arrows) to an A-matrix cell that contains "advice," i.e., problem-solving models, and we are talking here about *any problem* where contradictions can be described by the selected pair of factors.

²⁷ see S21.2 Table of A-matrix

To be more exact, the cell contains model numbers, while the actual descriptions are placed in a special catalog, the As-catalog,²⁸ which features 40 such models. These 40 problem-solving *models* (*navigators*, *specialized transformations*) constitute the "magic" toolbox complete with examples! There are such models as "inverse action," "dynamization," "copying," "segmentation," etc. All you have to do is select the requisite number using its number in the A-matrix cell, look at recommendations, and examine examples to see how it works.

Naturally, like in any magic story, you must understand what exactly this model tells you to do with respect to your specific problem situation! You must interpret the prompts provided by the model so that you can come up with an idea for a solution to your problem!

The model is a magic metaphor that you need to "figure out" (just like in a fairy tale!) and then use your talent and imagination to transform it into a change of the situation or object resulting in removal of the problem. Now let us look at how we can tell our "adviser, i.e., the A-matrix, about the contradictions that exist in the situation at hand.

How about this: *The rope must swing for a long time, but it rapidly loses the energy we transfer to it.* This informal description of just one of the possible contradictions can be matched to the following A-matrix inputs: plus-factor 23 *Functional time of the moveable object* and minus-factor 39 *Loss of energy*. The A-matrix "advises" us to apply models 01 *Change in the aggregate state of the object*, 02 *Preliminary action*, and 18 *Mediator*.

Let us try to figure out what those models "advise" us to do. The "composite sketch" of a possible solution looks like this:

01 Change in the aggregate state of the object: b) changes in concentration or consistency, degree of flexibility, temperature, etc. Alright, let us assume that we need to **increase the weight** of the rope;

02 Preliminary action: a) previous necessary (partial or complete) change of an object; b) prepare objects in advance so that they can be put to work from the best position and are available without loss of time. Aha! We need to change the weight of the rope **in advance**;

18 Mediator: a) use another object to transfer or transmit an action; b) temporarily connect an object with another (easily separable) object. Well, it keeps getting better and better! We need to **connect** some relatively **heavy object** to the rope!

...I hope you remember that the playroom had a lot of toys!

This is where inventing thinking kicks in: You can take an adequately heavy toy, say, a large doll, tie it to one of the ropes in advance, and swing that rope as a pendulum! Then you should run and grab the second rope, get back to the central position, and catch the first rope.

That's it! The "mediator" has worked!

So, in looking for a solution, we passed through the following four phases: *problem*, *problem model (contradiction)*, *solution model (method)*, and *solution*! This is a simplified "classical" TRIZ cycle, which is illustrated in many books by the following chart (fig. 2.6).

²⁸ see As-Catalogue (sections S22.2, or S22.3, or S35)

Of course, in reality it is much more complicated than that. Still, TRIZ is based on contradictions and methods (models) of their resolution. The purpose of this book is to help you study those models and acquire initial skills of their correct application.

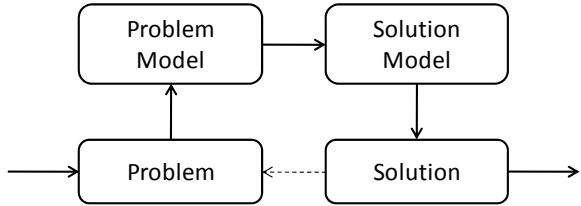


fig. 2.6. Simplified problem-solving scheme according to classical TRIZ

That is why it is called the "ABC" of TRIZ.

The primary TRIZ toolset includes contradiction models and contradiction-resolution models based on various A-catalogs as well as the A-matrix used to select models in one of the catalogs. The author called this primary toolset the "A-studio"²⁹ in honor of G. S. Altshuller.

The basic A-studio models constitute the "ABC" of TRIZ.

Naturally, this book is not as simple as a primer you would use to learn to read letters, syllables, and words. However, the problems you will learn to solve are much more complex than the kindergarten experimental study. And you are probably more than three times (!) older than the kids in the kindergarten where that experiment was staged. So you have completely different tasks in store for you.

Based on many years of TRIZ-teaching experience, the author hopes that this book will prove to be not only useful—but also interesting and even funny—and fascinating in a way that any exploration, including self-exploration, and quest for magic powers can be deemed fascinating.

2.3. MTRIZ-herbie!

I address this section to my young readers to tell them that to be successful in achieving what one desires requires perseverance and will; indeed, much of the training is very hard work, not amusement.

The book you hold in your hands gives you the standard initial minimum knowledge to qualify for MTRIZ Junior and Practitioner certification under the EASyTRIZ™ program (www.modern-triz-academy.com).

However, that alone is not enough: You also need training and character to master and use that knowledge and keep going despite possible failures.

In conclusion of this preface, I would like to tell you a story³⁰ that not only confirms the importance of standard training and vigorous practice but also reminds us that in anything we do our success depends to a large extent on our motivation, perseverance, and will to pursue and attain our goals.

²⁹ M. Orloff *Inventive Thinking through TRIZ*, part "A-studio: Algorithmic Navigation of Thinking"

³⁰ The author started this book concurrently with his book *Modern TRIZ*. He deemed it possible to recount this story in both books as he believes it to be very significant.

Herb Brooks³¹ was appointed to coach the US national ice hockey team for the 1980 Winter Olympics in Lake Placid, USA.

He started off by saying to his boys:

***You think you will win with only your talent...
Gentlemen, you don't have enough talent to win on talent alone.***

Just think about it—he said THAT to *outstanding American players* hand-picked to become one team, one fraternity, one family!

To boost the starting speed and increase the endurance of his players, he invented and implemented a method which was later dubbed *herbie* based on the diminutive version of his first name. The method basically boiled down to this³²: During each training session, the players had to start from their goal line (fig. 2.7), sprint for the blue line on their half of the playing field, stop dead in their tracks as soon as they reached it, and skate back to the goal line; then stop, turn around, and immediately run for the middle red line and back to their goal line; then stop, turn around, and immediately run for the blue line on the other half of the playing field and back to their goal line; and finally, stop, turn around, and immediately run for the other team's goal line across the entire playing field—and then back to their goal line! And they had to do it hundreds of times!

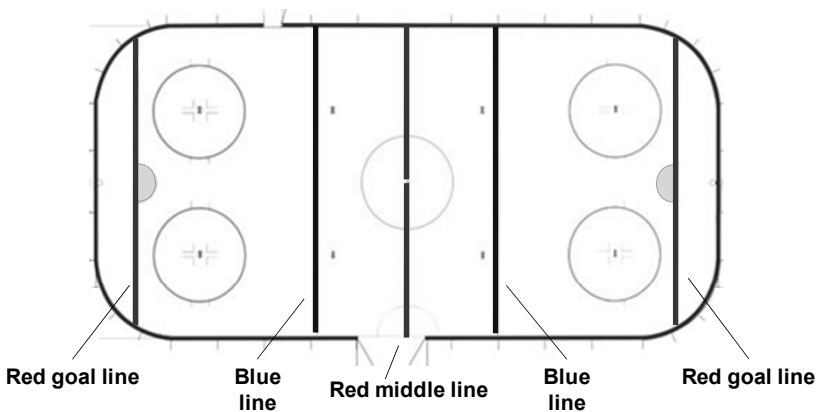


fig. 2.7. The ice-hockey rink is 30 meters wide and 60 meters long!

Just ask yourselves, would you be able to withstand such a drill?!

If the answer is *no*, then maybe this book is not for you, and you need to find something else to do with your time, maybe something simpler.

If the answer is *yes*, then rest assured that the *EASyTRIZ™* program is not all that difficult for those who are able and willing to work hard.

³¹ Herbert Brooks (1937-2003) – outstanding US ice hockey coach.

³² Herb Brooks quote: *Red line, back. Blue line, back. Far blue line, back. Far red line, back. And you have 45 seconds to do it. Get used to this drill. You'll be doing it "a lot." Why? Because the legs feed the wolf, gentlemen. I can't promise you we'll be the best team at Lake Placid next February. But we will be the best conditioned. That I can promise you.*

Prior to his appointment, Herb Brooks said to the members of the US Olympic Committee: *The Americans have to change their style of playing and adopt the hybrid style of the Canadians and the Russians!*

In the semifinal match with the invincible (!) USSR team, his boys scored a 4:3 victory. Many remember that match as if it were the final because it was more memorable, even though the US–Finland final (4:2) was equally dramatic. The US national ice hockey team became the 1980 Olympic champion.

Herb Brooks wrote in his memoirs³³: ***We were a fast, creative team that played extremely disciplined without the puck.***

Thus the victory was made *before the game!*

And only then was it made *during the game!*

The match (popularly known as the "*Miracle on Ice*") became an outstanding sporting event because it showed what could be achieved by individual mastery and teamwork based on a *well-designed intensive practice regimen* multiplied by single-mindedness and purposefulness.

I remember that match...

Individuals and teams that understand and skillfully apply Modern TRIZ are capable of similarly great achievements.

The *EASyTRIZ™* training program can become a catalyst of success for anyone who is willing to succeed and is prepared to go through *MTRIZ-herbie* to train to be successful.

I sincerely wish you luck!

Michael Orloff

Berlin, January 2011 – October 2015

P.S. I have just remembered another Herbert Brooks maxim—one that is particularly important for me—*Give the Game Back to the Players.*

This brings to mind another dream of mine. I want basic TRIZ training to start as early as possible but in any event not later than during senior school years, better still before children go to school.

I want children to perceive training as an exciting game, a joyful and fascinating examination of the surrounding world. I want that joy and fascination to persist throughout their adult lives.

TRIZ must do more for children: It must come to schools, kindergartens, and families.

At the beginning of this post scriptum, I quoted the words spoken by Herbert Brooks after he had led his team to its victory in the Olympics. He wanted to give the game back to the kids, to revive the joy of the game, to prevent the game from being destroyed by thoughtless commercialism and equally thoughtless "fanism."

³³ www.herbbrooksfoundation.com

I would like to finish by another Brooks quote; just pretend that this is said not about ice hockey but about TRIZ:

the courage to be unusual, without compromise, innovative, highly prepared, maximally successful through hard work and persistence, to have the courage to dream, to be unafraid of failures, to respect others, both students and teachers... unrelenting, insubmissive, contradictory and hard working and all of this with a great love for all humans, both the players and volunteers.

2.4. WORKSHOP FOR CHAPTER 2

Answer these questions yourself with (or better without) a book:

1. When was first the TRIZ article published?
2. What is an inventive problem?
3. What is an inventive idea?
4. What is the most fundamental concept of TRIZ?
5. What is the definition of TRIZ?
6. Why is TRIZ a constructive methodology?
7. What is the system platform in TRIZ to obtain new inventions?
8. What are three fundamental premises to solve any problem?
9. What are three principles to resolve inventive problems?
10. What is the psychological platform in TRIZ to obtain new inventions?
11. Is an invention, what should be the system transition from the state "is" to the state "should be"?
12. Can you draw and explain the simplest scheme of resolving a problem according to TRIZ?
13. Can you tell your friends the story about an inventive little kindergarten girl who solved the "problem with two ropes"?
14. Can you demonstrate to your friends the solution of the "problem with two ropes" using the A-matrix and the transformation models from the As-catalogue?
15. What is a simplified problem-solving scheme according to classical TRIZ?
16. What is *MTRIZ-herbie*, and what do you think about it?

ABC-TRIZ

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TRIZ Modeling

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